Exploring factors associated with workers' safety rule violations in the Chinese construction industry: A multimethod investigation

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Thesis submitted to the University of Nottingham

for the degree of Doctor of Philosophy

July, 2013

Abstract

The Chinese construction industry is China's third biggest industrial killer. Accidents causation analysis revealed that more than 80% of accidents are caused by unsafe human behaviour. The current research was focused on exploring and examining the factors affecting safety rule violations among Chinese construction workers through four main studies in which a combination of qualitative and quantitative methodologies were used. In the first study, on-site observation and organisational document analysis were conducted in fourteen construction companies to familiarise the author with the research settings and to obtain triangulation evidence for the following studies. It was followed by the second study in which interviews and focus groups were conducted among 97 managers, safety officers and workers in order to explore the factors associated with workers' rule violation. Thematic analysis revealed four main categories of factors, i.e., individual factors, managerial factors, sectoral and labour market factors, and national and cultural factors. The qualitative study was followed by questionnaire surveys (n = 700) to test in a larger management sample the qualitative study's results. Survey results complemented the qualitative study's findings. Based on the obtained results, a fourth study using the Delphi method and the modified G1 method was conducted among 17 experts in order to calculate the importance levels of each factor in influencing workers' rule violation. Although managerial factor was ranked as the most influential factor compared with other categories, some extra-organisational factors and situations were ranked at high positions amongst 24 specific factors. The results suggested that workers' behaviour need to be scrutinised not only within the context of organisational safety management, but also from the particular background and characteristics of Chinese migrant workers, Chinese construction sector, as well as the society and the culture.

Resultant published conference paper:

Wang, D. D. & Griffiths, A. (2011). Modelling the factors influencing unsafe behaviour at work in China's construction industry. In G. Fu (Ed.), *Proceedings of the 1st International Symposium on Behavior-based Safety and Safety Management, Beijing, 23-26 September 2011* (pp. 161-165). Irvine, CA: Scientific Research Publishing.

Resultant journal articles currently under construction:

Chapter 4 is currently being utilised to produce a submission for the journal *Safety Science.* This paper is entitled: 'Factors associated with rule violations among Chinese construction workers'.

Chapter 6 is currently being utilised to produce a submission for the journal *Risk Analysis: An International Journal*. This paper is entitled: 'Evaluation of factors associated with safety rule violations among Chinese construction workers based on Delphi method and G1 method'.

Acknowledgements

This thesis would not have been possible without great support from managers and safety officers of all participant construction companies, as well as all the practitioners and scientific researchers who have shared their experiences and knowledge. I would like to thank in particular (last names in alphabetic order) Ming Jing, Su Qing Li, De Dong Ma, Rui Shi, Pei Wang, Gang Wen, Chun Shui Zhang, Jian Zhang, and Jian Hui Zhang for introducing me to numerous senior managers in construction companies and looking after me while I was collecting data in their cities. I would also like to thank Dr. Jian Liu for devoting to me many evenings and weekends to explain different research methods and for giving me mental support.

I would also like to thank my supervisors, Professor Amanda Griffiths and Professor Tom Cox, for their great support, encouragement, and invaluable commentary throughout my research process. I also thank all my friends and colleagues for patiently listening to my frustrations and for their unconditional support. In particular I would like to thank Henri van Hoeve, Jie Li, and Georg Penner.

Big thanks to my parents, my aunt and my partner David. My parents have always trusted in me and provided me the strength to continue my thesis; my aunt was always able to comfort me with her delicious cooking; and David has been extremely patient and understanding with me and provided great help in correcting my English.

Table of content

Index of tables

Index of figures

Preface

In China, the construction industry is one of the fastest growing and largest sectors (Pan, Lu & Zhang, 2012). In 2010, the housing construction alone in China has 70.06 billion square meters under construction. Meanwhile, more than 40.43 million jobs were created by this industry, which accounted for about 5% of the total number of employment in the society (National Bureau of Statistics, 2010). Construction industry is one of the most important industries in China's economy. Unfortunately, because of the unique features of construction activities, such as long periods of work, complicated processes, poor working environment, financial intensity, and dynamic organisation structures, the Chinese construction industry is subjected to much higher safety risks compared to many other industries. It is the third biggest industrial killer in the country after transport and mining, with a conservative estimate of more than 2,000 fatal accidents every year (National Bureau of Statistics of China, 2010).

As a result of the political and economic system reform from 1978 onwards, with the gradual loosening of administrative restrictions on labour mobility to urban areas, millions of rural surplus labourers in China flushed into cities to seek job opportunities and their fortune. One characteristic of migrant workers is their low educational attainment. A survey carried out in Beijing, Chongqing, Shenzhen, and Shanghai on 39 construction sites in 2011 showed that 52.1% of migrant workers had up to nine years of education and 24.8% had up to 6 years of education (Daily Economy News, 2011). Their low educational attainment indicates that migrant workers enter the labour market as unskilled manual workers in need of training. Because of the huge demand for construction workers to meet the requirements of the booming construction industrial market, and the relatively lower employment

standards, migrant workers account for a large proportion of the workforce in the Chinese construction industry. According to statistics, in 2006, 80% of all jobs in the construction industry in China were filled by migrant workers (Research Office Project Team, State Council, 2006, p.7). Previous research has demonstrated that lower-educated workers were less compliant with safety procedures and recorded higher accident involvement rate (Gyekye & Salminen, 2009; Swaen et al., 2003). Another characteristic of migrant workers is their young age. The survey that was carried out on 39 construction sites in Beijing, Chongqing, Shenzhen, and Shanghai in 2011 showed that 32.2% of participate construction workers were below the age of 30 (Daily Economy News, 2011). Although previous research did not find direct positive relationships between age and accident rate at workplace, researchers and practitioners argued that because of the lack of occupational training and work experiences, young workers are at high risks of fatal accidents (Bureau of Labor Statistics, 2012; Statistics New Zealand, 2012). In addition, the survey that was conducted in 2011 showed that some 93.5% of participate construction workers were male (Daily Economy News, 2011). Accident analyses around world have demonstrated that male workers are more likely to experience work-related accidents than female workers. For example, in Australia, some 55.6% of work-related injuries and illness were reported by male workers between 2009 and 2010 (Australian Bureau of Statistics, 2010); injury statistics in New Zealand revealed that men made up 71 percent of all claims of work-related injuries in 2011 (Statistics New Zealand, 2012). Meanwhile, migrant workers are a vulnerable group in the general population. Because of China's household registration system, rural migrant workers are often discriminated in urban society. They work long hours on jobs that are often refused by the urban workforce, receive minimal wages, live in crowded dormitories which normally lack basic sanitation

facilities, and are mostly not covered by occupational injury insurance nor medical insurance (Research Office Project Team, State Council, 2006). A survey published in a Chinese authoritative newspaper reported migrant workers felt lonely, anxious and pessimistic, and demonstrated high levels of alcohol consumption and cigarette smoking (*Nanfang Weekend,* 3rd April 2008). Research has demonstrated that negative emotions have a significant relationship with occupational injuries (Iverson & Erwin, 1997). The characteristics of the Chinese migrant workers place them at a vulnerable position towards occupational injuries and accidents. Thus, it is extremely important to improve the safety management levels in the Chinese construction industry.

With China's rapid development and the advancement of society, the Chinese government has placed increasing attention on improving human values and health and safety management in the workplaces. At The Seventeenth National Congress of China's Communist Party in 2007, "people-oriented, scientific sustainable development policy" was added into the Party Constitution and became one of the guiding ideologies of the Communist Party (CCP). A series of legislation and regulation have also been issued in the past decade to regulate safe production and safety management in hazardous industries, including the construction industry. In addition, in order to develop and maintain a so-called "harmonious society" the government has made great efforts to improve social and economic environment for migrant workers to ensure that they have equal access to public services in urban areas. With the government's efforts, continuous reductions in annual accident rates have been reported in recent years (Ministry of Housing and Urban-Rural Development, 2011). However, the current fatal accidents rate demonstrates the importance and challenge of further efforts.

Safety management has a long history. One of the fist accident causation models, accident proneness model, dated back as early as 1910s (Hale & Glendon, 1987). The model assumes that there are some people who are more prone to accidents than others. However, research studies that have attempted to find the individual traits of accident proneness failed to identify individual characteristics that are predictive of accidents (Hale & Glendon, 1987; Heinrich, Petersen & Roos, 1980). The Chernobyl disaster brought the attention of researchers and practitioners on the importance of safety rule violations in industrial safety. The analysis of this unusual accident revealed that five out of 7 human actions that led directly to the accident were deliberate deviations from written rules and instructions rather than human errors in the form of slips, lapses and mistakes (Reason, 1987). The important role of unsafe human behaviour in accident causation had been reported long before the disastrous accident. In reviewing 75,000 accident files, Heinrich (1950) demonstrated that a large number of accidents were a function of workers' unsafe acts. He further concluded that 88% of all industrial accidents were caused primarily by unsafe human acts; 10% by unsafe conditions; and 2% by acts of God. The notion that the vast majority of accidents are caused by unsafe behaviour has been supported by many researchers. For example, Williamson and Feyer (1990) illustrated in their study of all occupational fatalities that occurred in Australia during the period of 1982 and 1984 that 91 percent of the fatalities were the function of unsafe behaviour; Free (1994) affirmed this notion through an examination of railway accidents in Britain between 1989 and 1992 revealing that unsafe behaviour, safety rule violation in particular, play a considerable role in accident occurrence.

Violations are defined as unsafe work behaviours that involve deliberate deviations from the rules, procedures, instructions and regulations (Lawton,

1998). According to Reason (1990), unsafe behaviour can also occur as human errors in the forms of, for example, slips, lapses, and mistakes. All humans are fallible. While unintentional human errors are caused by forgetfulness or inattention, and are unpredictable, virtually all deliberate safety rule violations have a causal history, and are thus predictable (Bust, Gibb & Pink, 2008). Heinrich's (1931) domino theory is one of the most widely quoted accident causation model so far. The theory asserts that any injury (5th domino) is the result of an accident (4th domino) which in turn is caused by unsafe human behaviour and/or unsafe conditions (3rd domino) that are preceded by fault of person (2nd domino) and ancestry and social environment (1st domino). Heinrich (1950) advocated that removal of the 3rd domino is the easiest and most effective way to stop the sequence leading to an injury. Thus, in order to improve the safety levels and to reduce accident rates in the Chinese construction industry, an effective control of workers' violation behaviour should be the focus of safety management.

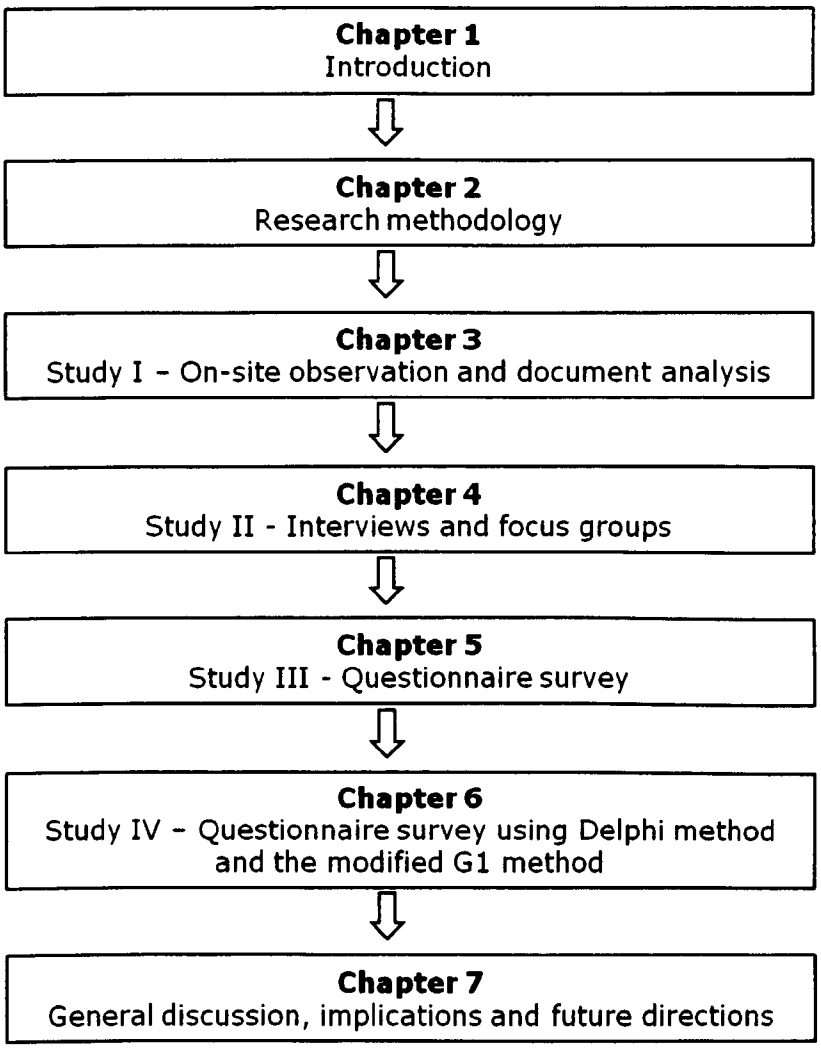
Controlling workers' safety rule violations remains one of the biggest challenges for construction company managers (Choudhry & Fang, 2008). Empirical studies in the west have demonstrated that the factors associated with safety rule violations in industry are complex and dynamic (e.g., Beatty & Beatty, 2004; Beilock, 1995; Hobbs & Williamson, 2002; Laurence, 2005; Lawton, 1998). In addition, the findings from the systematic literature review conducted by Alper and Karsh (2009) suggest that violation in industry needs to be examined independently from violations in other settings such as recreational driving and general precautions, and violation within particular industrial sector are affected partially by specific factors that need to be explored with independent focus. In China, there is still a limited amount of research literature that investigates safety rule violations and their causes, especially in the construction industry. Thus, in order to further reduce

accident rates on construction sites, and to protect the health and safety of people working in the Chinese construction industry, as a first step it is necessary to understand workers' safety rule violations, the associated factors, and how these factors affect workers' behaviours. This is what the current research aims to achieve.

The main body of the thesis is divided into seven chapters. The first chapter briefly introduces the research background in relation to the development path of the Chinese construction industry and its current status. It also introduces the characteristics of migrant workers, including Chinese construction workers. The background information illustrates the importance of focusing on health and safety management research among Chinese construction workers (Section 1.2). The introduction of the theoretical background to the current research explains accident causation, the role of human factors in accidents, especially the role of rule violations, and the theoretical framework of the predictors of violations (Section 1.3). The literature review in Section 1.4 demonstrates the gap in the existing body of literature explaining the influential factors of rule violations in the Chinese construction industry. It leads to the development of the aims and objectives of the research towards the end of the first chapter (Section 1.5). The second chapter of the thesis begins with an introduction of the research plan, which is followed by a discussion of the appropriate methodologies chosen for meeting the requirements of each stage in the research plan. From the third chapter to the sixth chapter, the thesis explains the whole process of the research and the procedures of reaching the research aims and objectives. Chapter three introduces in detail the design, ethical considerations, the procedure, and the results of the first study of the research – on-site observation and document analysis. Conclusions and discussion on the particular stage of the research are drawn at the end of the chapter. Chapter

four introduces in detail how the interviews and focus groups study was conducted following the principles of thematic analysis with sections explained thoroughly in terms of study design, participants, ethical considerations, study procedures, data analysis methods, and study results. The chapter then concludes by discussing the direct and indirect effects of the emerged factors on workers' rule violation. A summary of the study findings is presented at the end of the chapter. Chapter five provides a systematic introduction of the questionnaire survey study. The chapter begins with descriptions of the questionnaire's initial design process followed by a detailed introduction of how pre-pilot discussions and the pilot study were conducted together with explanations of the participants' feedback on the questionnaire as well as respective amendments. The final part of the chapter introduces the questionnaire survey itself. The chapter then concludes by discussing the factor structure extracted from exploratory factor analysis and the results obtained from descriptive analysis. Chapter six introduces the fourth and last study of the research. The study method, including questionnaire design, participants, ethical considerations, study procedure, and data analysis procedure, is explained in detail in the chapter. The study results are demonstrated hereafter. Discussion and conclusions of the findings are presented towards the end of the chapter. The last chapter, Chapter seven, starts with a summary of the research findings. The implications of the research results for theory, method, practice, and policies, as well as the limitations of the research are discussed. The chapter concludes by highlighting the contributions that the thesis has made to the knowledge of influential factors of safety rule violations and presents future research directions at theoretical, methodological and practical levels. The structure of the thesis is illustrated in Figure 1.

Figure 1. Thesis structure



1. Introduction

1.1 Chapter overview

This chapter begins with an introduction on the Chinese fast-developing construction industry and the alarmingly high rates of accident within the industry (Section 1.2.1). The chapter then highlights the significant importance of examining the management of health and safety in this hazardous industry with a particular focus on the unique working group that is migrant workers (Section 1.2.2). It presents the background to the problem and context for the thesis. An evaluation of the theoretical explanations on accident causation reveals that human unsafe behaviour, safety rule violation in particular, is the major cause of accidents. Theoretical concepts on rule violation are thus addressed hereafter (Section 1.3). Having acknowledged both the research as well as the theoretical background to the thesis, the chapter identifies the research gap in practical and theoretical literature on the basis of a literature review (Section 1.4). It leads to the next section of the chapter which introduces the aims and objectives of the current research (Section 1.5). The chapter then concludes by summarising the contributions of the thesis and discussing the importance of the present work (Section 1.6).

1.2 Research background to the study

1.2.1 The Chinese construction industry

The construction industry is one of the most important industries in an economy. It has complex links to most of the industries of each nation's economy. It has always been acknowledged, particularly in developing countries, that the construction industry contributes a great amount to the national gross domestic product (GDP) as well as to a nation's development

(Horvath, 1999). In China, the construction industry is one of the fastest growing and largest sectors. It maintained an average annual gross output value increase of 22.5% between 2001 and 2010 (National Bureau of Statistics, 2010). In the past 30 years, China has become the "construction site of the world" (Pan, Lu & Zhang, 2012). The scale of newly constructed housing areas in China each year is nearly half of the total amount of the world (Gu, 2009). According to the National Bureau of Statistics (2010) the gross output value of the Chinese construction industry rose from RMB5.7 billion (£528m) in 1952 to RMB9.5 trillion (£948bn) in 2010 and realised value-added of RMB2.65 trillion (£264bn) in 2010, accounting for 6.6% of China's GDP, which places the construction industry in the fourth position among all of the industries in China in terms of contribution to GDP.

Unfortunately, because of the unique features of construction activities, such as long periods of work, complicated processes, poor working environment, financial intensity, and dynamic organisation structures, the construction industry is subjected to much higher safety risks compared to many other industries (Akintoye & MacLeod, 1997; Smith, 2003). During the past two decades, China's Central Government, as well as the Chinese Ministry of Construction that takes overall responsibility of overseeing the construction industry, have paid increasing attention to the protection of labour from occupational diseases and accidents on construction sites. They have issued several pieces of legislation and regulation on construction safety management, such as Construction Law (1997, 2011), Standard for Construction Safety Inspection (2011), Regulation on Construction Site Management (1991), and Construction Safety Production Management Regulations (2004). In addition, China's Central Government advocated in 2003 the 'people oriented' policy that posits people's interests as the starting point and the ultimate goal of all work. Chairman Hu pronounced on March 10,

2004, during his speech at a central government forum on work, population resources, and the environment, that "human life is most precious. China is a socialist country. Our development cannot be at the expense of spiritual civilisation, the cost of sacrificing the ecological environment, and especially the sacrifice of human life. Serious accidents caused significant damage to people's lives and property. We must learn from our lesson of blood, and effectively increase the intensity of the work of production safety management, and resolutely curb the momentum of frequently happening extraordinarily serious safety accidents." However, despite the numerous pieces of legislation and regulation implemented by the Central Government, the number of accidents and injuries within the Chinese construction industry remains alarmingly high. The construction industry is the third biggest industrial killer in the country after transport and mining, with a conservative estimate of more than 2,000 fatal accidents every year (National Bureau of Statistics of China, 2010).

1.2.2 Chinese construction workers

Significant political reform in China resulted in its 'opening up' in the early 1980s. Since then it has witnessed a major economic boom that has impacted on the world of work in many ways. Not least, a new and unique group of workers has emerged; a surplus rural labour force that migrates from the countryside to urban areas in search of work and better lives in what has been called "the world's largest ever peacetime migration" (Tuñón, 2006, p.5). In China this group is usually called the *liu dong ren kou* (floating population). In the west, they are known as *migrant workers*. The term migrant worker has different official meanings and connotations in different parts of the world. In China, migrant workers usually refers to those workers who hold rural household registration but migrate to cities or towns to be

employed in non-agricultural work and rely on wages as their main income source. China now has more than 252 million migrant workers (China News, 2011). It is expected to grow even more, with some estimating the figure could reach 300 million by 2015 (Ping & Pieke, 2003). Data revealed that 17.7% of migrant workers are construction workers (National Bureau of Statistics of China, 2011). What follows are general characteristics of Chinese migrant construction workers, which demonstrate the vulnerability of this particular group in society. More importantly, empirical studies on human safety have illustrated that many of the characteristics of Chinese construction workers are directly or indirectly associated with occupational accident and injuries.

Mainly relatively young males with low educational level. Migrant construction workers in China are made up of a relatively young and less-educated labour force. Between April and November 2011, a group of volunteers from the Beijing Cultural Development Centre and universities in Beijing, Chongqing, and Shanghai, carried out a survey on 39 construction sites in Beijing, Chongqing, Shenzhen, and Shanghai (Daily Economy News, 2011). A total of 1,194 questionnaires were distributed and 1,064 valid questionnaires were collected. The survey results showed that 32.2% of construction workers were below the age of 30, 25.3 % were between age 31 and 40, 29.9% were aged between 41 and 50, and 12.5% were over 50 years old. Some 93.5% of construction workers are male. The survey also showed that 52.1% of construction workers had up to nine years of education and 24.8% had up to six years of education. Previous research suggests that younger workers, because of their lack of job experience and maturation, are more susceptible to accidents than are older workers (Frone, 1998; Laflamme, Menckel & Lundholm, 1996; Rhodes, 1983; Saha, Kumar & Vasudevan, 2008; Swaen et al., 2003). Likewise, males were found to be

prone to more accidents than females possibly due to their typically higher exposure to risky activities (Frone, 1998; Leigh, 1986; Waldon, 1988). Ferguson, McNally, and Both (1984), Gyekye and Salminen (2009), as well as Swaen and his colleagues (2003) found a positive association between education and safety perception: lower-educated workers were less compliant with safety procedures and recorded higher accident involvement rate.

Difficult work with low payment and benefits. Chinese migrant construction workers' jobs are described in China as *zang* (dirty), *lie* (physically demanding), *ku* (bitter) and *xian* (dangerous). They are required to work very long hours; they work on average 11 hours a day, 26 days a month (Amnesty International Report, 2007). National statistics revealed that although migrants worked 50% longer than urban workers, they earned about 30% of urban workers' average salary (Che, 2011). High exposure to physical hazards and excessive workloads were found to be significant predictors of work injuries among young workers (Frone, 1998). Dembe and his colleagues (2005) reported through an analysis of a nationally representative sample of working adults from the United States that overtime and extended working hours were associated with a 61% higher injury hazard rate compared to jobs without overtime. Swaen and his colleagues (2003) found that fatigued workers were more likely to be involved in occupational accident and injuries. Fatigue may decrease the ability of the worker to process important visual and perceptive information about a hazardous situation, and it may decrease the ability to adequately respond to a hazardous situation. Swaen and his colleagues (2003) also reported that workers with jobs that involve the use of tools or machinery had much higher risk for being injured in an occupational accident.

Poor living conditions. Migrant workers tend to spend as little as possible on daily necessities. A survey carried out by the State Council in 2006 revealed that on average migrant workers spend between RMB200 and RMB300 (between £18 and £27) each month (Research Office Project Team, State Council, 2006). Migrant workers stay in the cheapest and most congested accommodation. According to the State Council survey (Research Office Project Team, State Council, 2006), in Shanghai, migrant workers occupied an average of less than seven square metres per person (five square metres for workers living in a dormitory and, in extreme cases, only two square metres), half of the size of local workers' accommodation. Poor housing conditions were found to increase the likelihood of accident proneness (Kirschenbaum, Oigenblick & Goldberg, 2000).

Social marginalisation. As a result of Chinese rural household registration regulations, once migrant workers leave their registered place of residence, they lose their basic benefits and become 'second class' citizens, with no access to the rights afforded to urban residents. With a lower social status than urban residents, migrant workers suffer from daily exploitation and policy discrimination in household registration, identity, employment, social security, and children's enrolment into school. Their lawful rights and interests cannot be secured. For example, they are frequently portrayed negatively in the media and blamed by local residents for overcrowded public transportation and increasing crime rates; public schools charge extra fees beyond tuition to enrol migrant workers' children who stay with their parents in the cities (Wong, Li & Song, 2006).

At higher risks of mental illness. The harsh working and living conditions and social discrimination, as well as the effort-reward imbalance, put migrant workers at higher risk of mental illnesses. A survey published in

an authoritative Chinese newspaper reported that migrant workers in urban society often get baffled and frustrated in work and life. These tend to induce their identification and psychological crises; they feel lonely, anxious and pessimistic, and demonstrated high levels of alcohol consumption and cigarette smoking. More than 50% felt their life to be 'meaningless', while 17% had thought about suicide (*Nanfang Weekend*, April 3 2008). An alarming tragedy – with 10 suicides and two unsuccessful suicide attempts resulting in severe injuries occurring between January and May 2010 in a factory in Shenzhen – has demonstrated the worryingly poor mental health of this group of workers even though it is only a very small number of the hundreds of millions of Chinese migrant workers. Poor mental health and negative emotions were found to have a significant association with occupational injury. For example, Iverson and Erwin (1997) examined the impact of positive and negative affectivity on occupational injury among 362 blue-collar manufacturing employees. Their study illustrated that negative affectivity had a significant positive impact on occupational injury. Frone (1998) reported similar results. In addition, anxiety, tension, and depression were found to be associated with accidents (Hansen, 1989; Sutherland & Cooper, 1991). High levels of alcohol intake and smoking were also found to be associated with accident at workplace (Dawson, 1994; Frone, 1998; Saha, Kumar & Vasudevan, 2008; Wells & Macdonald, 1999). The association was found to be stronger among unskilled workers who engaged in repeated strenuous physical activity at work (Dawson, 1994).

It is clear from the research to date that the Chinese construction industry is one of the most hazardous industries with high accident and injury rates. The migrant workers who work in this particular industry are in especially vulnerable position to occupational injuries because of their unique set of characteristics. However, only a limited research has been conducted in

China to examine the safety management system and accident intervention measures within this particularly hazardous industry. Thus, special attention is deserved from multidisciplinary researchers and practitioners to improve health and safety in the Chinese construction industry and to protect people who work in this industry from occupational accident and injuries.

1.3 Theoretical background to the study

The previous section of the thesis demonstrates the alarmingly high rates of accident and injury in the Chinese construction industry. It also explains why Chinese construction workers are especially vulnerable to accidents based on previous research findings. This section focuses on presenting the theoretical explanations to accident causation and the theoretical concepts on human unsafe behaviour as well as safety rule violation in industry which has been concluded as a major cause of occupational accident.

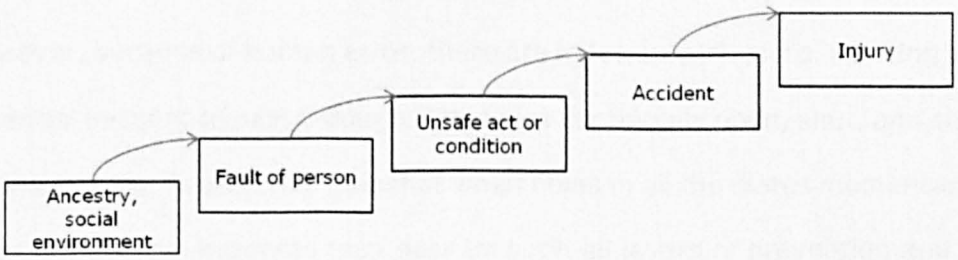
This theoretical overview of accident causation and human unsafe behaviour is not intended to provide a comprehensive account of all theories and developments in these research areas. Rather, the most prominent and widely disseminated accident causation models and unsafe behaviour theories that are of primary interest to this thesis are summarised and critiqued. Evaluations of accident causation theories provide theoretical evidence of the role of unsafe human behaviour in accidents. Theoretical concept on human unsafe behaviour describes the nature of unsafe acts, including both human error and violations, which justifies the focus of the current research on safety rule violation. Theoretical framework of rule violations in industry illustrates the potential predictors of violation. This theoretical overview provides a conceptual basis for the derivation of the aims and objectives of the current research.

1.3.1 Accident causation theories

Over the years, several theories of accident causation have evolved that attempt to explain why accidents occur. Models based on these theories are used to predict and prevent accidents.

The domino theory. Traditionally accident causation models explain accident as the result of a chain of discrete events that occur in a particular temporal order. Heinrich's (1931) domino theory is one of the most widely quoted sequential accident causation model so far. After studying the 75,000 industrial accidents reports, Heinrich concluded that 88% of industrial accidents are caused by unsafe acts committed by workers, 10% are caused by unsafe conditions, and another 2% are unavoidable (Heinrich, 1950). Heinrich's study laid the foundation for the development of his theory of accident causation, which came to known as the domino theory (see Figure 2). The theory asserts that any injury (5th domino) is the result of an accident (4th domino) which in turn is caused by unsafe human behaviour and/or unsafe conditions (3rd domino) that are preceded by fault of person (2nd domino) which are either inherited or acquired from ancestry and social environment (1st domino). Heinrich (1950) advocated that removal of the 3rd domino is the easiest and most effective way to stop the sequence leading to an injury.

Figure 2. The domino theory (Heinrich, 1931, 1950)



Some of Heinrich's view were criticised for oversimplifying the control of human behaviour in causing accidents (Zeller, 1986). In addition, some researchers argued that in the contemporary industrial systems, the domino theory and other sequential accident causation models are limited in their capability to explain comprehensively accident causations. Nevertheless, a number of main messages that the domino theory emphasises provided the foundation for future researchers and were important for understanding the causes and control of accidents. These main messages are: 1) an accident can occur only as the result of an unsafe act by a person and/or a physical or mechanical hazard, 2) most accidents are the result of unsafe behaviour by people, 3) holding the power and authority, management should assume responsibility for safety, and 4) the acknowledgment of the reasons behind people's unsafe acts can help with selecting corrective actions.

The Swiss cheese model. On the basis of the traditional sequential models, a number of researchers adopted a multi-causality approach in order to explain accident causations more comprehensively. This approach regards events leading to accidents as the result of a combination of random factors, some manifest and some latent, that happen to exist together in space and time (Hollnagel, 2004). One of the most well-known models that took this approach is Reason's (1990) Swiss cheese model. Reason argues that most safety systems have a number of layers, or plates. Each of these plates serves the function of preventing potential incidents passing through. However, because of human error, there are holes on each plate, allowing the potential incident to pass through. The holes continually open, shut, and shift their locations. Reason explains that when holes in all the plates momentarily line up, potential incidents may pass through all layers of prevention and permit a trajectory of accident opportunity. According to Reason, the holes in the defence plates arise for two reasons; active failures and latent conditions.

Almost all accidents are caused by a combination of these two factors. Active failures are unsafe behaviours or acts committed by people who are in direct contact with the system. They occur in the form of, for example, slips, lapses, mistakes, and procedural violations (Reason, 1990). All humans are fallible. While some unsafe acts are caused by forgetfulness or inattention, and are unpredictable, some behaviours are reasoned, and thus predictable (Bust, Gibb & Pink, 2008; Dong, et al., 2009; Tam & Fung, 2011). In fact, virtually all such behaviours have a causal history extending back to various levels of system (Reason, 2000). Latent conditions are considered by Reason as the "resident pathogens" within the system. These conditions are developed from decisions made by different parties within the system, for example, management, clients, designers, and workers. Latent conditions, according to Reason, have two kinds of adverse effect. They can translate into more apparent errors provoking incidents in the workplace, for example, inadequate equipment, lack of training, and work pressure. They can also create long-lasting and more hidden hazards, for example, unworkable procedures and inactive alarm systems. Unlike active failures, whose occurrences are often difficult to foresee, latent conditions can be identified and remedied before an adverse event happens. The notion of latent factors advanced the traditional models in the acknowledgement of accident causation beyond the proximate causes. However, it was argued that the multi-causality approach still follow the principles of sequential models (Hollnagel, 2004) as they focus on failure events in static engineering designs and linear notions of causality. These models do not adequately capture the dynamic complexity and non-linear interactions that characterise accidents in complex systems. Nevertheless, the multi-causality approach demonstrates explicitly the importance of understanding the causation of latent conditions, learning to identify the conditions, and taking proactive actions by top

management to remedy them in order to create solid defence plates with fewer holes in safety systems.

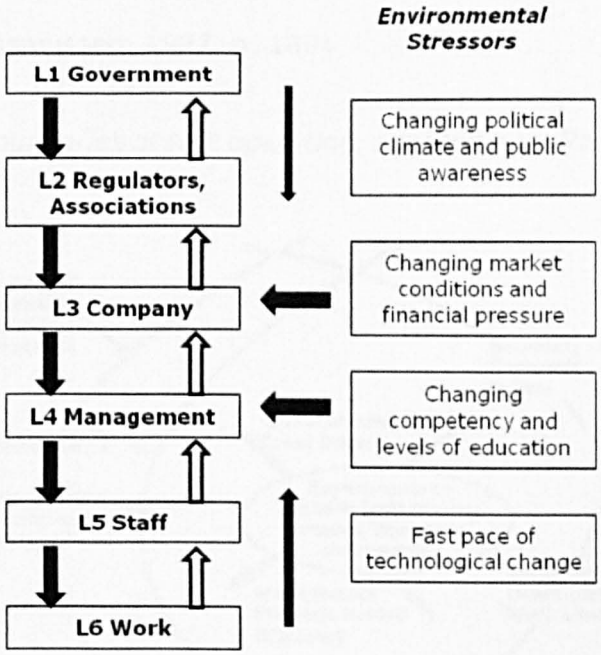
The social-technical framework. More recently, a new approach to accident modelling emerged. This new approach adopts a systemic view which considers the performance of the system as a whole. A complex system is composed of many components that interact with each other in linear and complex manners (Qureshi, 2007). Linear interactions exist in production or maintenance sequences and are quite visible even if unplanned, while complex interactions occur in the manner of unfamiliar and unexpected sequences that are either not visible or not immediate comprehensible (Perrow, 1984). To handle this more comprehensive view of accidents, a number of models based on control theoretic concepts emerged in the literature. One of these models is Rasmussen's (1997) social-technical framework. It models the organisational, management, and operational structures that create the preconditions for accident. Kirwan (2001) advocated that Rasmussen's framework can be used to trace back to the accident's real root-causes.

Rasmussen's framework comprises two parts: structural hierarchy and system dynamics. These two parts are discussed separately in the following.

1) *Structural hierarchy.* Rasmussen (1997) argued that the socio-technical system for safety management includes several hierarchical levels ranging from legislators, organisation and operation management, to system operators. As shown in the Figure 3 below, the top level L1 describes the activities of government who controls the practices of safety in society through legislation. The level below L2 describes the activities of regulators, industrial associations and unions that are responsible for the implementation of the legislation in their respective sectors. Level L3

describes the activities of a particular company for safety management and level L4 describes the activities of the management board in the particular company that initiate, plan, control, and manage the work of their staff. Level L5 describes the activities of the individual staff members in the company who have direct interactions with technology or the process of work. The bottom level L6 describes the application of engineering disciplines involved in the design of potentially hazardous equipment and operating procedures for process control. The structural hierarchy illustrates an important point that is very often overlooked by researchers who focus on one particular horizontal level, that is, there is a need for vertical examination across the levels as accidents can be caused by decisions and actions of the involved persons at all levels. As shown in Figure 3, the government decision on safety legislation and public awareness of safety transmit down the hierarchy and the information about the safety management and work process propagate up the hierarchy. There is a closed loop feedback system in this vertical information flow. The Figure 3 also demonstrates that there are external disruptive forces affect the various layers of complex socio-technical systems. These environmental stressors are imperative to the efforts of safety management and improvement within a level.

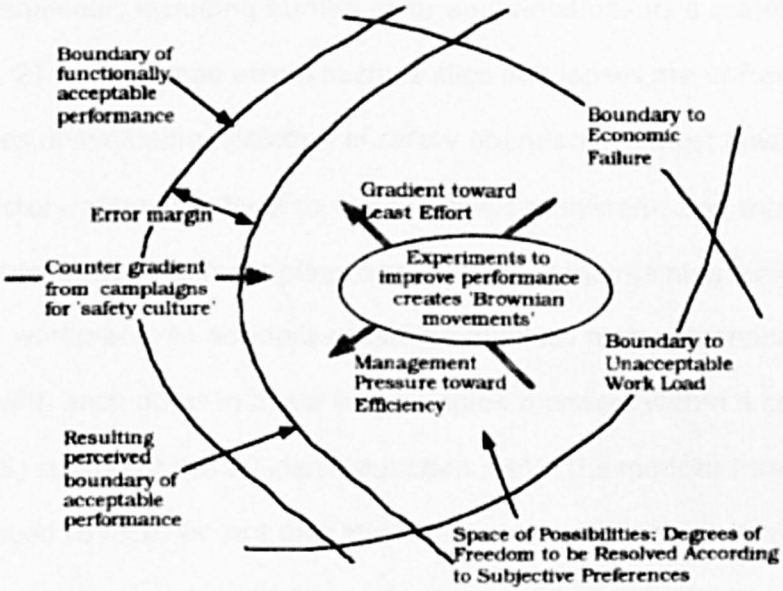
Figure 3. Hierarchical model of socio-technical system, adapted from Rasmussen (1997)



2) *System dynamics.* Rasmussen (1997) believed that the behaviour of operators is context dependent and is shaped by the dynamic conditions in the work environment. Thus, according to Rasmussen, to handle human errors and violations, an approach that focuses on the mechanisms generating behaviour in the actual, dynamic work context is necessary. Rasmussen (1997) argues that human behaviour in any work system is shaped by objectives and constraints. Decision making and human activities are required to remain within the bounds defined by administrative, functional and safety constraints. Accidents may occur when safety-related constraints on the development, design, and operation of the system fail to control external disturbances, component failures, or dysfunctional interactions. Rasmussen (1997) advocated that the safe space of performance within which actors can navigate freely is contained within three boundaries: individual unacceptable workload; financial and economic constraints; and the safety regulations and procedures (see Figure 4). In this

situation, the boundary of safe behaviour of one particular actor depends on the possible violation of defences by other actors in the system, and these attempts of adapting to environmental stressors are "preparing the stage for an accident" (Rasmussen, 1997, p. 189)

Figure 4. Boundaries of safe operation, adapted from Rasmussen (1997)



In systemic accident models, systems are viewed as interrelated components that are continually adapting to and reacting to the changes in themselves and their environment. Safety is management by a control structure embedded in this adaptive socio-technical system. Thus, accident is not caused by one particular actor of performance, but an ineffective control structure. Consequently, the systemic accident causation approach emphasises that the study of the modern complex systems requires an understanding of the interactions and interrelationships between the technical, human, organisational, and social aspects of the system. Rasmussen (1997) argued that without exhaustive modelling or test, the combined interactions of linear and complex interactions could not be comprehended or controlled.

Evaluation of accident causation theories. Examining the evolution of accident causation models over time, it seems that there is a shift from searching for a single immediate cause as a result of a sequence of events to the recognition of multiple causes existing in the whole system. An evaluation of the different explanatory approaches of accident causation demonstrates a number of key points in understanding the causality of accident: 1) human unsafe behaviour, including human error and violations, is a major cause of accident, 2) while human errors such as slips and lapses are unforeseen and sometimes unavoidable, violation of safety boundaries almost always have a causal history extending back to various levels of system, and thus controllable, 3) management plays a crucial role in maintaining a high level of safety at workplace, 4) accident causation involves many components that interact with each other in linear and complex manners within a complex system, 5) studies of the accident causation within the modern complex work system need to focus on not only the horizontal level but also the vertical effects across the levels, and 6) safety management and accident control in the modern dynamic work settings need to take a systemic approach, considering the interactions and interrelationships among all the components within the system. Because violation of safety boundaries is a major cause of accident and it is the type of unsafe behaviour that can be managed and controlled, the current research focuses on examining safety rule violations.

1.3.2 The nature of violation

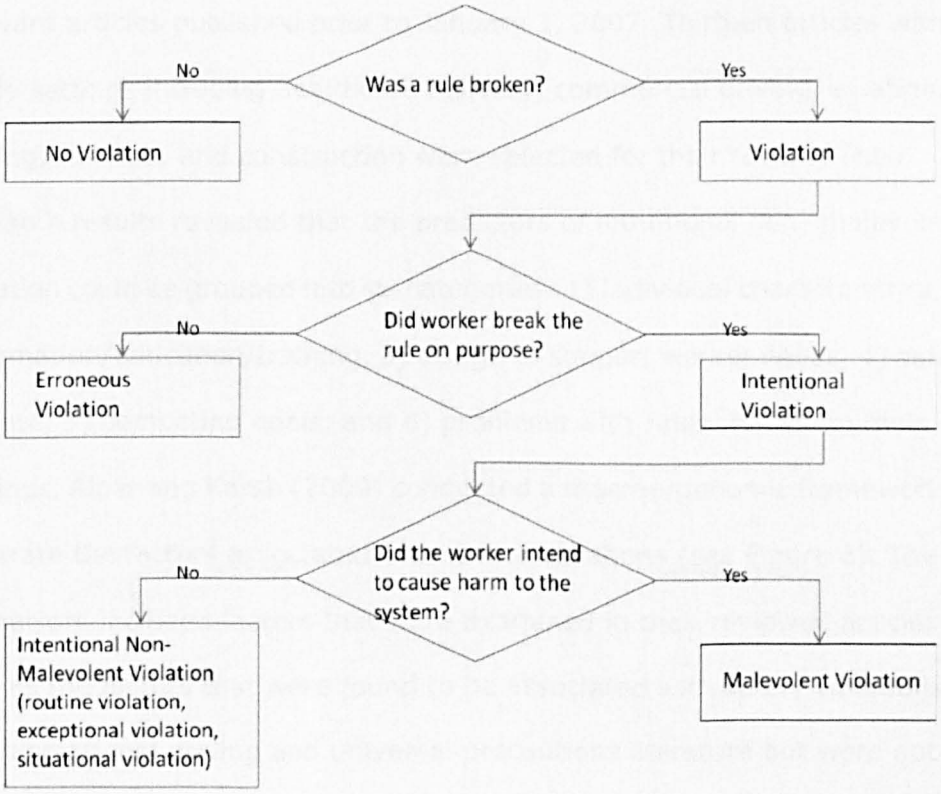
The previous section explains the reasons behind focusing on rule violation in the current research based on an evaluation of accident causation theories. This section introduces the nature of violation, including the definition of violation, its distinction from human error, and its categorisation.

Definition of violation and its distinction from human error. As mentioned earlier, violation is one type of human unsafe acts. It is normally defined as deviations from procedures, standards or rules that describe the safe or approved method of performing a particular task or job (Lawton, 1998; Reason, 1990). Violation differs from other types of unsafe acts such as human errors that take place in the form of slips and lapses. While violation is generally associated with individual motivation and attitudes, human errors arise primarily from cognitive failure that is largely unaffected by the attitudes, beliefs, and values of an individual (Lawton, 1998). In addition, violation occurs in a regulated social context and its control requires remedies on various causal issues extending back in time and up in a system. Human errors, in contrast, can be explained by cognitive process in the mind of an individual. The reduction of human errors can be achieved by improving the quality and delivery of the necessary information to the individuals (Reason, 2005). The distinction between violation and human errors was supported by a study of aberrant driving behaviour conducted by Reason and his colleagues (1990) where differing behavioural types were categorised into three factors through factor analysis: violation, dangerous human errors, and slips and lapses that are unlikely to cause danger to others.

Categorisation of violation. Reason (1990) classified violations based on intentionality and outcome. On one end, the "malevolent violation", the act is to intentionally cause a bad outcome, for example, terrorist action. At the other end, the violation act is unintended and so is the bad outcome, which Reason named as the "erroneous" or "unintentional violation". It can occur because of human error or simply because the individual is not aware of the rule governing the actions (in this case, workplace health and safety policies and practices), does not understand it, or it appears to them to be irrelevant. In addition, there is the "intentional non-malevolent violation",

which is divided further by Reason (1990) and Lawton (1998) into three categories, namely "routine violation", "exceptional violation" and "situational violation" (See Figure 5). Routine violation is habitual behaviours that happen so regularly that they become automatic, unconscious behaviours, and the way people do things. Exceptional violation is rare and occurs in unusual circumstances such as an emergency or system failure. It can be the result of conscious decision-making or instinctive reactions. Situational violation occurs when resources (e.g. equipment, staffing) are scarce and employees find it difficult or impossible to comply with the rule. In most cases, people undertaking violations do not hold the intention to cause harm, damage, or adverse outcome (Mason, 1997). Thus, the current research focuses on intentional and unintentional non-malevolent violations.

Figure 5. Categorisation of violations based on Reason's (1990) work, in Apler & Karsh (2009)



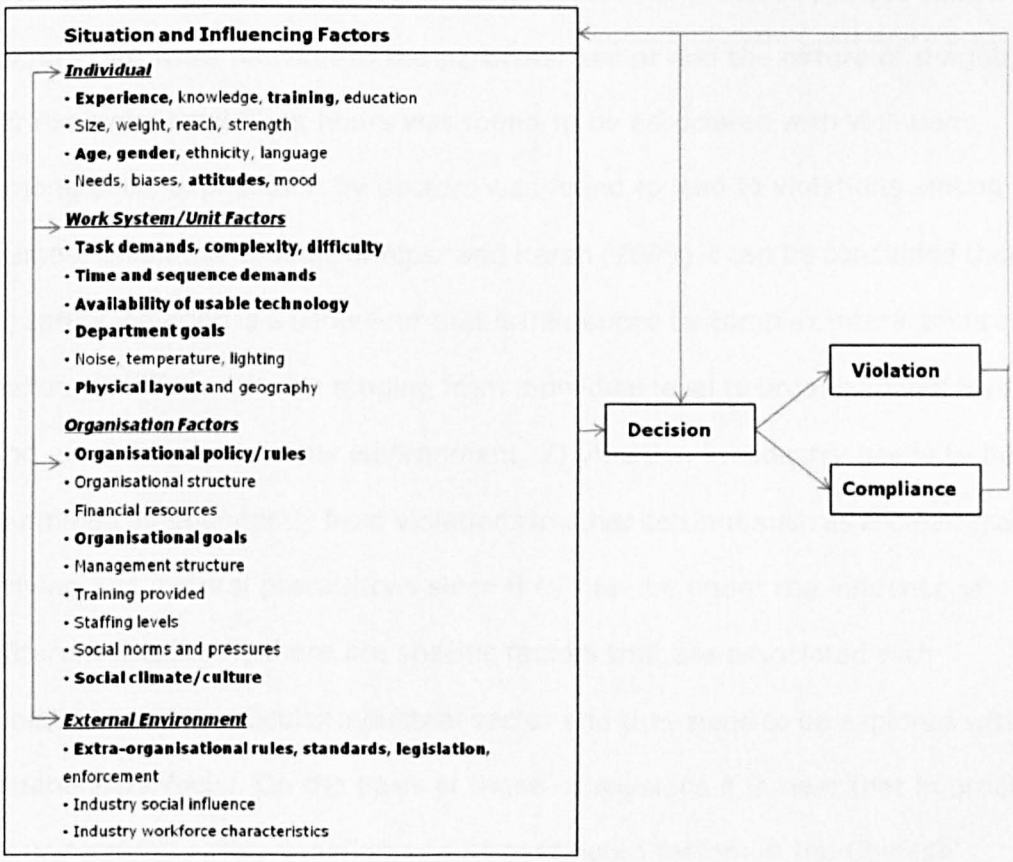
1.3.3 Predictors of violation

Industrial records documented the existence of safety rule violation. For example, Patterson and his colleagues (2006) as well as McKeon, Fogarty, and Hegney (2006) reported safety violations in healthcare; Hobbs and Williamson (2002), as well as Wenner and Drury (2000) documented violations in aviation maintenance. In addition, Laurence (2005) reported violation in the mining industry, and Lawton (1998) recorded violations in railroad. It is widely accepted to date that violation forms one of the major causes of accidents in industry (Reason, 1990). The examination of Chernobyl accident revealed that of the seven human actions that led directly to the accident, five were deliberate violation of written rules and instructions rather than human error such as slips, lapses or mistakes (Reason, 1987).

Alper and Karsh (2009) conducted a systematic review of the factors associated with intentional non- malevolent safety violations in industry on relevant articles published prior to January 1, 2007. Thirteen articles with study settings including healthcare delivery, commercial driving, aviation, mining, railroad, and construction were selected for their review. Their research results revealed that the predictors of intentional non- malevolent violation could be grouped into six categories: 1) individual characteristics, 2) information/education/training, 3) design to support worker needs, 4) safety climate, 5) competing goals, and 6) problems with rules. Based on their findings, Alper and Karsh (2009) conducted a macroergonomic framework to illustrate the factors associated with safety violations (see Figure 6). The framework included factors that were examined in their reviewed articles as well as the factors that were found to be associated with safety violations in the recreational driving and universal precautions literature but were not examined for the industrial safety violations. The factors are classified into

four levels: 1) individual, 2) work system/unit factors, 3) organisation factors, and 4) external environment. According to Alper and Karsh (2009), the causes of violation can exist at any level of the work system. The framework shows a closed feedback circle of violation behaviour and the work system. When an individual with certain personal background encounters a situation in the work system, he or she makes a decision on violation or compliance of safety rules, and then acts on that decision. Once the action is taken, the outcomes of that action feed back in to the work system and influence future decisions and actions.

Figure 6 . Macroergonomic framework of safety violations. Adapted from Alper and Karsh (2009). Bold variables are those identified in their systematic review.



The long list of the factors associated with industrial violations included in the macroergonomic framework illustrated that safety violation is a behaviour that is influenced by complex interactions between different factors at various levels. The macroergonomic framework suggests the need of recognising the multilevel nature of the context in which violation behaviour is generated.

Many of the findings reported by Alper and Karsh (2009) on the basis of their reviewed literature were consistent across studies, for example, poor management, time pressure, and workload. However, some of the factors that were examined in the systematic review had different relationships with violations in industry as in recreational driving and universal precautions literature, for example, gender, experience, and worker level of knowledge. The research studies included in the systematic review also reported specific factors that were relevant to the particular sector and the nature of the job, for example, total flight hours was found to be associated with violations among pilot, expectation by doctors was found to lead to violations among nurses. Given the findings of Alper and Karsh (2009) it can be concluded that 1) safety violation is a behaviour that is influenced by complex interactions of factors at different levels ranging from individual level to organisational level and extending to external environment, 2) violation in industry needs to be examined independently from violations in other settings such as recreational driving and general precautions since they may be under the influence of different factors, 3) there are specific factors that are associated with violation within particular industrial sector and they need to be explored with independent focus. On the basis of these conclusions it is clear that in order to understand safety violation and its associated factors in the Chinese construction industry, systematic studies that focus on this particular topic are needed.

An evaluation of the accident causation theories introduced in the previous section and the rule violation theories explained in this section reveals that examining the causes of violation is important and necessary for controlling violations and consequently reducing accidents. In addition, although not all violations may result in unwanted outcomes, it is believed that safety violations may put a work system into a more vulnerable state (Reason, Parker & Lawton, 1995, 1998). Thus, understanding violation and effectively controlling such behaviour may improve the whole work system and decrease the risk of unwanted outcome. Having examined the analysis approaches for both accident causation and safety rule violation it seems that there is a trend of focusing on the work system as a whole and recognising the multilevel nature of the dynamic work system that comprises not only individuals and organisations, but also the external environment in which the work system is shaped. Thus, it is necessary to recognise the multilevel nature of the system and to explore the factors and their effects not only horizontally at one particular level but also vertically across the levels.

1.4 Literature review

The previous section concludes that in order to understand safety violation and its associated factors in the Chinese construction industry, systematic studies that focus on this particular topic are needed. Thus, the purpose of literature review was to obtain an overview of the research studies related to rule violation among Chinese construction workers that have been carried out so far. This was done in order to ascertain how current research might contribute to both academic and practical fields. General words were used as key terms for the searching of literature. Research papers examining any particular aspects or theories in the field of safety management and safety behaviour, for example, safety culture, safety climate, and safety

attitudes were excluded from the review. The literature review was conducted between March and May 2010. Table 1 below demonstrates the search terms both in English and Chinese and the results from Google Scholar and a Chinese equivalent search engine Baidu.

Table 1. Literature review search results

Search engine/electronic database	Search terms	Search results	Selected articles
Google Scholar	China, safety, construction, industry, rule violation, behaviour, factors	about 19,000 hits	Choudhry, R. M. & Fang, D. P. (2007) Why operatives engage in unsafe work behavior: investigating factors on construction sites, *Safety Science, 46* (4), 566-584.
	China, safety, construction, industry, unsafe behaviour, factors	about 13,400 hits	
	中国，安全，建筑行业，违反安全规定，行为，因素	about 3,260 hits	
	中国，安全，建筑行业，不安全行为，因素	about 15,100 hits	Liu, Y. S. (2005) The discuss of unsafe behavior in safety management (安全管理中人的不安全行为的探讨), *West-China Exploration Engineering*, *109* (6), 226-228.
Baidu	中国，安全，建筑行业，违反安全规定，行为，因素	about 9,187 hits	
	中国，安全，建筑行业，不安全行为，因素	about 160,778 hits	

As the table above highlights, although a large number of hits were derived from the search, after browsing through the titles of the first 200 articles and in some cases, when the titles appeared to meet the selecting criteria, reading article abstracts, only two articles met the selecting criteria. The criteria were, as the search terms suggested, scientific research papers that explored the factors influencing rule violation or unsafe behaviour in the Chinese construction industry. There was no timeframe restriction to the publications.

The results from the literature review showed that there were no systematic research studies to date extensively exploring all the factors and their effects on workers' rule violations in the Chinese construction industry, both horizontally at one particular level as well as vertically across the levels

within the system. The study carried out by Choudhry and Fang (2008) investigated factors on construction sites in order to explain why operatives engage in unsafe work behaviour. They conducted semi-structured interviews with seven operatives who had been experienced occupational accident. Their study revealed eleven factors that were associated with operatives' unsafe behaviour: 1) management's support, involvement, and commitment in safety, 2) safety procedures, 3) workers' psychological feature, 4) economic feature, 5) self-esteem, 6) experience, 7) performance pressure, 8) perceived risk, 9) working environment, 10) job security and education, and 11) safety orientation and training. However, the study was carried out in Hong Kong with both Chinese and non-Chinese operatives. Given the differences in historical background, cultural background, social issues, and economic development between Hong Kong and mainland China, the results from the study cannot be considered as being representative for the Chinese construction industry. In addition, the study focused on factors at management level and how these factors affect safety performance on sites. Such approach lacks the recognition of the multilevel nature of the work system as well as the influential effects of factors in the external environment proposed by the systemic accident causation models (e.g. Rasmussen, 1997) and macroergonomic framework of safety violations (Alper and Karsh, 2009). The paper published in Chinese - Liu (2005) - listed factors that may affect workers' unsafe behaviour on Chinese construction sites, for example, management factor, training factor, psychological factor, and social factor. However, the paper was written in a descriptive style and no systematic studies or results were included. Results from empirical studies are needed to justify the conclusions.

The search results from the literature review confirmed that occupational health and safety management systems in the Chinese

construction industry, as well as the factors underlying the existence and operation of such systems, are under-researched fields. It is therefore necessary to conduct a piece of research examining the influential issues both horizontally and vertically, exploring not only factors at management level but also other deep embedded factors in the external environment, in order to understand how these factors affect each other, and how they together influence workers' rule violations on construction sites in China.

1.5 Research aims and objectives

The previous sections introduce the importance and necessity of conducting a systematic study to explore and examine a whole range of factors that affect workers' rule violations in order to control violation and subsequently to reduce accident rates in the Chinese construction industry. It provides the foundation for developing the aims and objectives of the current research.

Given the exploratory nature of the current research, there are no predetermined hypotheses or narrowly focused research questions. As China's occupational health and safety management systems, as well as underlying factors, are largely under-researched areas, framing research questions around an exploratory approach would enable the discovery of the salient aspects of the research topic. Thus, the research question and associated aims and objectives are formulated as follows:

Research question: What are the factors affecting workers' safety rule violations in the Chinese construction industry and how do these factors affect such behaviour among the workers?

Aim 1: To explore the factors that have direct and indirect effects on safety rule violations among Chinese construction workers

Objectives:

- To find out the factors which directly lead to Chinese construction workers' safety rule violation
- To find out the issues which underlie the direct influential factors and exert indirect effects on workers' behaviour
- To explore the influential effects among the factors

Aim 2: To determine factors which have a strong influence on workers' rule violation and are suitable for interventions

Objectives:

- To evaluate factors' influential power on workers' violation behaviour
- To rank factors in order on the basis of their influential power
- To propose actionable intervention measures for restraining the negative effects of strong influential factors on workers' rule violations

In order to meet the aims and objectives, the current research project comprised four main studies in which a combination of qualitative and quantitative methods was used. The initial on-site observation and document analysis conducted on 14 Chinese construction sites enable the author to be familiarised with the Chinese construction industry, to obtain first-hand data on workers' rule violation as well as safety management policies and their implementations, and to acknowledge the problem of workers' rule violation on construction sites. The findings of the first study also provide alternative triangulation for some of the findings of the following studies.

Having acknowledged the problem, a qualitative study, using semi-structured interviews and focus groups with 97 managers, foremen, safety officers, and workers who work on construction sites, addressed the first research aim with an exploratory approach. Thematic analysis was selected for study design and data analysis. The inductive nature of qualitative study made it possible to obtain a breadth of information regarding interviewees' experience of working on construction sites, their opinions on factors that have effects on workers' rule violations, as well as in-depth and detailed explanations in relation to how different factors affect one another and how these factors, as a result, lead to violations of safety rules.

Following the acknowledgement of factors and their effects associated with workers' rule violation, a questionnaire survey study was conducted among 700 participants whose job roles were closely related to safety management in the Chinese construction industry. These participants included managers, foremen, safety officers, engineers, finance officers, and administrators who worked within construction companies, as well as people who worked outside construction companies such as third-party inspectors and project investors. Exploratory factor analysis and descriptive analysis were used to analyse the survey data in order to provide a complementary source of information to the previous qualitative study. These two studies together draw a reliable picture of the situation, and address fully the first aim of the current research.

The second aim of the research was achieved by the last study of the research which took all information obtained through the research into account, and used a combination of the Delphi method and the modified G1 method to calculate differing factors' importance of influence on workers'

violation behaviour and present each factors' influential power with numerical values. An evaluation of the ranking order of factors' influential power, together with the understanding of the influential effects of differing factors, enabled the author to propose actionable intervention measures for restraining the negative effects of strong influential factors on workers' rule violation.

The current research provides an important theoretical contribution to the research literature on health and safety rule violations in the construction industry in China and worldwide. It highlights the importance of recognising the multilevel nature of the work system as well as the influential effects of factors in the wider contextual environment when examining safety management and safety rule violations. It introduces, for the first time, a ranking order of a comprehensive list of factors associated with rule violation according to their influential power. It raises awareness among employers, health and safety professionals, and policy-makers in developing countries about the advantages of employing a holistic, multi-level approach to understanding and improving workplace health and safety in what is currently a hazardous industry.

1.6 Chapter summary and conclusions

In this chapter, the background of the research was contextualised. It sets the scene for the current research. An evaluation of current theoretical understanding of accident causation as well as safety rule violation has provided a conceptual framework for the development of research questions. A literature review identified a gap in the research up-to-date. This introductory chapter has justified the need for the present work and described the scope of the research, including the research aims and objectives. The next chapter introduces the research design and

methodological strategy used to investigate the aims and objectives of the research.

2. Research methodology

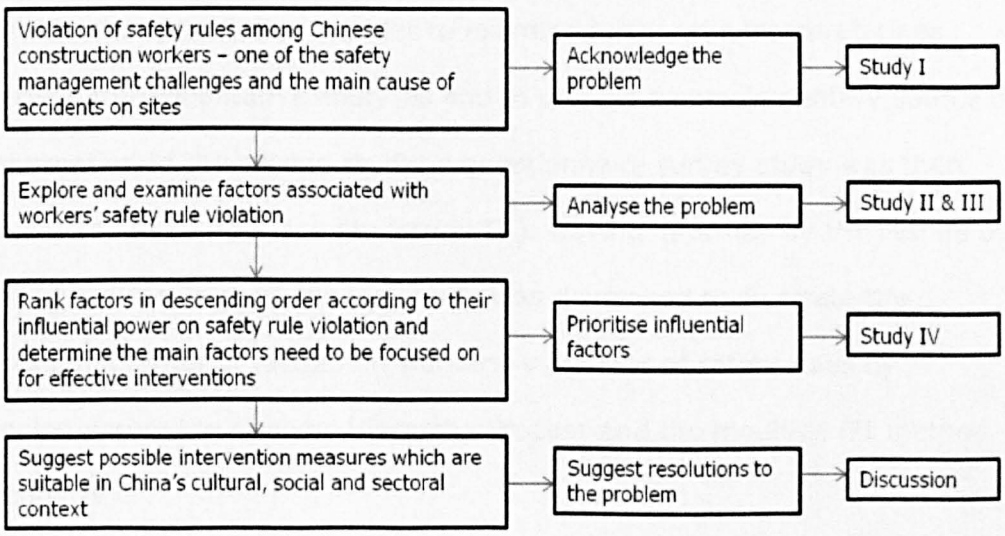
2.1 Chapter overview

This chapter focuses on the research plan and methodological strategy used to meet the research aims and objectives described in the previous chapter. The first part of the chapter presents the research plan (Section 2.2). It is followed by introducing the particular methods implemented to meet the requirements of each stage in the research plan. Discussion on the rationales behind the choices made for each method and the important practical issues associated with differing methods is also included in this section (Section 2.3).

2.2 Research plan

Reflecting the aims and objectives of the current research that are explained in the previous chapter, the structure of the research plan is illustrated in the Figure 7 below.

Figure 7. The structure of the research plan



Previous literature has recognised that safety violation is one of the main causes of accident (Abdelhamid & Everett, 2000; Heinrich, 1959; Parker et al., 1995; Reason et al., 1990). In the Chinese construction industry, safety violation is considered as one of the biggest challenges for company managers (Choudhry & Fang, 2008). Both empirical research findings and theoretical concepts suggest that the causes of safety violation are manifold, involving factors at various levels of work system (Alper & Karsh, 2009). Unfortunately, very limited research up to date has explored and examined the issues associated with safety violation in the Chinese construction industry. Thus, the current research took a grounded approach to obtain in-depth and comprehensive information on this specific topic. The current research project was designed first to acknowledge the prevalence of safety violations among Chinese construction workers by observing activities and environment on the participant Chinese construction sites (study I). It was followed by interviews and focus groups among people working in the Chinese construction industry to delve into their experiences in order to extract the factors influencing safety rule violations among Chinese construction workers and to explain the influential effects of these factors on one another (study II). In order to examine further the interpretations derived from qualitative analyses and to provide a complementary source of information to the second study, a questionnaire survey study was then conducted in a larger sample (study III). Having informed by the results of the first three studies, the last study was developed to illustrate the influential power of factors on workers' violations of safety rules by implementing the Analytic Hierarchy Process and the modified G1 method (study IV).

2.3 Research methods

Having explained the sequences of stage in the research in the previous section, this section explains the methods chosen to meet the requirements of each stage in the research and the practical issues associated with each method.

In the case of the current research, the nature of the problem and the supporting questions have driven the choice of the methodology and, subsequently, the research method used to collect and analyse the data. It was decided to combine qualitative and quantitative methods in the current research project in order to compensate for their mutual and overlapping weaknesses. By doing so, the researcher can obtain the varying degrees of participants' interpretation regarding the research topic, and explore not only the depth but at the same time the width of participants' experiential knowledge. The findings of the studies using qualitative and quantitative methods can also triangulate with one another and consequently build in reliability of the results. Thus, the current research strives not only to maximise the strengths and minimise the weaknesses of both qualitative and quantitative approaches, but also to strengthen research results and contribute to theory and knowledge development.

2.3.1 Observation and document analysis

Observation. Observations of behaviour are generally considered to be more objective than self-reports of behaviour (Sandelowski, 2000). Direct observation can be partially useful in the study of a) verbally deficient or unsophisticated individuals, such as young children; b) behaviours that most people cannot accurately describe, such as interaction rates; c) events that subjects may be motivated to distort or omit in reporting. The latter two occasions are relevant to the behaviours and events being observed in the current research. One of the biggest advantages of well-conducted

observation is that it helps the researchers to acknowledge what is happening "out there", as opposed to what people think is the case. Observation may provide direct information on the issue under scrutiny. It allows the researcher to discover rather than simply test the research question, thereby reasoning by induction rather than deduction. When it is used with other research methods, information obtained through observation may provide a means for triangulation against other research findings, for example, published research, and interview results (Reeves, Kuper & Hodges, 2008). This type of triangulation is very useful, as sometimes what people say about their actions can be very different from their actual behaviour (Strong, 1977). When observation is conducted at workplace, it could result not only in increased site-specific knowledge, but also in hard data on various aspects of work (Mintzberg, 1973).

Scan sampling method (Altmann, 1974) was used for sampling selection in the current observational study. Scan sampling, also called spot observation and point sampling, has been used as a standard technique in studies of animal behaviour (Altmann, 1974), and, more recently, has been adopted by anthropologists and cross-cultural psychologists for collecting quantifiable records of everyday behaviour in small-scale societies (Rogoff, 1981; Betzig & Turke, 1985). The technique of scan sampling varies in some detail among researchers but generally consists of sequences of observations of a random or stratified sample of the population under scrutiny, with the observer noting the pertinent features of subject behaviour or activity at the moment the subject is first observed (Hawkes, et al., 1987). Scan sampling is one of the four main within-episode selection strategies: a) actors, as in focal-animal and sociometric matrix sampling; b) actions, as in event sampling and scan sampling; c) settings, as in spatial grid sampling; or d) occasions, as in time-sampling. The applicability of any of these

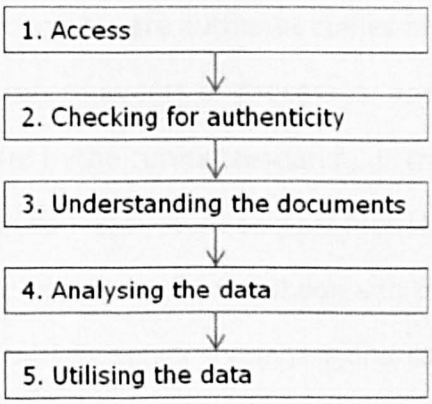
within-episode strategies depends not only on the nature of the episode – i.e. the number of actors, the rate and duration of behaviours, and the structure of the setting – but also on the purpose of the investigation, since each strategy tends to yield a somewhat different estimate of frequency and duration parameters (Altmann, 1974; Slater, 1978; Murphy & Goodall, 1980). Observation in the current research focuses on actions, workers' violation behaviour in particular, thus scan sampling is the most suitable method comparing with the other sampling selection strategies. One criticism of scan sampling is that when subjects are not continuously observed, a bias may appear in the observational data because of the specific time period (Hawkes, et al., 1987). In order to address the potential bias in the collected data, on-site observation in the current research was conducted three times a day with one hour duration in each session to cover all workers who work on three shifts. Detailed description of the data collection procedure can be found in the next chapter (Section 3.4).

Behaviour variables approach (Kendon, 1982) was chosen for collecting behavioural data in the observational study. This approach is especially characteristic of applied research, where the interest may be largely confined to the frequency of certain behaviour (McCall, 1984). The important parameters of the behaviour, based on practical or theoretical grounds, are selected in advance. Observers most often watch for and note the occurrence of pre-selected behaviours or events, their frequency, and duration on a checklist or tally sheet (Hinde, 1973). The behaviour variable approach is one of the three fundamental approaches for systematic observation (Kendon, 1982). Compared with the other two approaches, namely, the behaviour element approach (Medley & Mitzel, 1963), and the constructivist approach (Weick, 1968), the behaviour variable approach was the most fitting for the purpose of the current study. Behaviour element approach is particularly

congenial to the ethnologist's notion of genetically and physiologically "fixed action patterns" as its objective is to discern the synchronic and diachronic structure of a stream of behaviour by statistically analysing these data (Kendon, 1982). The constructivist approach focuses on analysing how the actions of multiple participants are jointly organise to produce or to manage some socially recognisable episode or event (Kendon, 1982). Given the purpose of observing workers' violation behaviour as recording the frequency of violation, behaviour variable approach was chosen to collect behavioural data for the current study.

Document analysis. In addition to the observational study, organisational document analysis was another triangulation method used in the current research to verify and enhance the data collected from the interviews and questionnaire surveys. Generally speaking, organisational documentation comes in many forms including both text and visual data. These documents are normally considered as a useful source of evidence (Bowen, 2009). Forster (1994) introduced five practical stages for using, accessing, and utilising company documents. These five stages are illustrated below in Figure 8.

Figure 8. Stages in accessing and analysing company documents (adapted from Forster 1994)



According to Forster (1994), the first stage, access, deals with issues such as why is it needed to access company documents, what documents to be required, where these data to be obtained, and from whom to obtain the documents. Pershing (2002) advocated that the choice of documents is determined by the research questions and objectives. The employment of organisational document analysis in the current research was to serve the purpose of familiarising the researcher with organisational structure, managerial roles, accident rates, and safety management strategies. Thus, safety management handbook which contained descriptions of safety management standards, requirements of relevant legislation and regulations, and safety management systems within the company was requested from the 'Champion' of all participant companies. In addition, descriptions of the project related information such as the nature of the project, the potential hazards on site, and accidents records of the construction projects were sought from the 'Champion' of participant companies. The obtainment of these documents may facilitate the researcher with developing interview schedules for the following study in the research in addition to providing another means of triangulating data.

The second stage of Forster's five practical stages, checking for authenticity, is to evaluate the trustworthiness of the obtained documents. It involves checking whether the documents are from a primary or secondary source, whether the documents are authentic copies of originals, whether the documents accurately record events or processes, and whether the authors of documents believable. In the current research, all the obtained documents were from primary sources – they were original files stored in the participant companies. Both safety management handbook and project descriptions were produced by companies' senior managers and safety officers. Their authorship was confirmed during interviews later in the research process.

Because the documents obtained in the current research were mainly neutral descriptions of the project under construction as well as safety management procedures and requirements, the trustworthiness of the written document itself was less likely to be distorted. However, actual events and processes in the work settings may not be a full reflection of what stated in the written documents. Thus, the obtained documents in the current research were carefully checked and critically interpreted.

The third stage of Forster's five practical stages, understanding the documents, involves deciding on how the documents to be understood and how the obtained information to be triangulated with other sources of information. In the current research, the focus of the document analysis was on the existing safety management policies issued by participant companies. Content analysis method was used to understand and analyse the issued policies. Content analysis was chosen because it allows the researcher to compress large volumes of information into fewer content categories based on explicit rules of coding. Content analysis is also useful for examining trends and patterns in documents (Stemler, 2001). Content analysis can be used to analyse either qualitative or quantitative data in an inductive or deductive way (Elo & Kyngäs, 2008). The choice of the approaches is determined by the purpose of the study (Elo & Kyngäs, 2008). Given the objective of document analysis in the current research as to acknowledge what the existing safety management policies are in the participant companies and to obtain an overview of the management structure and the project under construction, inductive approach was chosen for analysing data. Elo and Kyngäs (2008) advocated that the process of inductive content analysis includes open coding, creating categories, and abstraction. Open coding involves writing notes and headings in the text while reading. It is followed by categorising the codings under higher order headings.

Abstraction means formulating a general description for each category. In order to become immersed in the data, the written material needs to be read through several times (Burnard, 1991; Polit & Beck, 2004). In the current research the obtained documents contain either specific information such as accident rates, organisational structure, or information that is already written under well organised headings and subheadings, for example, safety management policies. Thus, the analysis of the obtained information in the current research followed the original document structure. The information on safety management policies was used to triangulate with other data obtained from observation, interviews, focus groups, and questionnaire survey in order to examine the actual implementations of the written policies and regulations. Other information obtained from document analysis was considered as background knowledge for the researcher to proceed with the research.

According to Forster, the fourth stage in accessing and analysing company documents is analysing the data. At this stage, the understanding of the obtained data moves from a literal level to an interpretative level. It is the stage when the researcher to make sense of the implications of the findings. In the current research, this was only fully achieved after comparing the findings of document analysis with some of the findings of the other studies in the current research.

The last stage in accessing and analysing company documents is utilising the data. According to Forster, this stage is about feeding back the analysis results to the collaborating companies as well as potential publications of the findings. In the current research, document analysis was one of the studies that were conducted to meet the research objectives. Thus,

the findings of the document analysis were analysed and reported together with the findings of the other studies in the research.

2.3.2 Interviews and focus groups with thematic analysis

Qualitative research is well known for its ability to capture the meanings people attach to certain phenomena and to provide researchers with the opportunity for a comprehensive understanding of the experiential and interpretive elements of a particular research topic (Connolly, 1998). The emphasis of qualitative research is upon "discovery, description and meaning" (Osborne, 1994, p. 168). The biggest advantage of qualitative research lies in the fact that it allows for flexibility and the attainment of a deep, valid understanding of the subject. One of the main objectives of the current research is to capture personal knowledge and experience of people who work in the Chinese construction industry in order to obtain a comprehensive understanding of the complex environment in which interactions of various factors take place and workers' rule violations are generated. Given that the current research topic is complex and previously underexplored, implementing qualitative methods as the initial approach to uncover the experiential elements of the research topic serves this study perfectly.

Qualitative approaches are incredibly diverse, complex and nuanced (Holloway & Todres, 2003). Smith and Firth (2011) divided qualitative analytic methods into three main categories on the basis of their utilities. The first category of the analytic methods is implemented to explore the use and meaning of language, for example, discourse and conversation analysis. The second category focuses on developing theory and is typified by grounded theory. The third category is conducted to describe and interpret participants' views, for example, content and thematic analysis. Having acknowledged the differences amongst diversified qualitative research methods, given the

purpose of the research in exploring the factors associated with violations of safety rules among Chinese construction workers, thematic analysis was chosen for the current study since it is suitable for the research question under consideration, and suitable for the objectives of the current research.

There have been criticisms on the validity of thematic analysis as a method in its own right (Boyatzis, 1998; Ryan & Bernard, 2000) because "thematizing meanings" should be seen as one of a few shared generic skills across qualitative analysis (Holloway & Todres, 2003; p. 347). Thus, thematic analysis has often been seen to be carried out by someone without adequate knowledge or skills to perform a supposedly more sophisticated form of analysis such as interpretative phenomenological analysis (IPA) or grounded theory (Braun & Clarke, 2006). However, numerous researchers have argued that thematic analysis, when carried out rigorously, may provide rich and detailed information that answers particular research questions, and thematic analysis should be considered as an independent method in its own right (e.g., Aronson, 1994; Braun & Clarke, 2006).

Having decided on thematic analysis as the research analytic method for the current study, there are a number of other choices that need to be made before the data analysis in order to ensure the rigorousness of the research process (Taylor & Ussher, 2001). The first decision is to determine what counts as a theme. A theme is normally considered as abstract and difficult to define (DeSantis & Ugarriza, 2000). Based on a content analysis of interdisciplinary definitions, qualitative research texts, and seminal articles, DeSantis and Ugarriza (2000) defined a theme as "an abstract entity that brings meaning and identity to a recurrent experience and its variant manifestations. As such, a theme captures and unifies the nature or basis of the experience into a meaningful whole." While some researchers considered

a theme as a "recurring regularity" (e.g., Polit & Hungler, 1997, p. 470), Braun and Clarke (2006, p.82) advocated that the 'keyness' of a theme is neither dependent on its prevalence in terms of space within each data item, nor its prevalence across the entire data set; it is dependent on "whether it captures something important in relation to the overall research question". Since the primary objective of the current research is to capture the experiences and interpretations of people who work on Chinese construction sites, in terms of workers' violations of safety rules, the prevalence of themes is not crucial to the analysis, but the 'keyness' of themes. Another issue related to the definition of theme is the terms used for levels of theme identification, since theme may exert its unifying and explanatory functions at multiple levels. In research literature, the terms used to distinguish the differing levels of themes are inconsistent (Aamodt, 1991; Leininger, 1985). In order to make it clear for the readers, the terms of code, sub-category, and category are used to describe different levels of themes in this thesis. Code is used to describe the lowest level of data analysis from which units of text relevant to the research question are grouped together. Sub-category is used to describe the secondary level of data analysis that clusters the codes together according to conceptual similarities. Category is the overall classification of similar sub-categories.

The second decision is to decide theme identification. There are two primary ways to identify themes or patterns in thematic analysis, namely, an inductive or 'bottom up' way (e.g., Frith & Gleeson, 2004), and a deductive or 'top down' way (e.g., Hayes, 1997; Boyatzis, 1998). An inductive approach means the purpose of the data collection process is not to fit into a pre-existing coding frame, or the researchers' preconceptions (Braun & Clarke, 2006). In contrast, a deductive approach is more explicitly analyst-driven, and the data collection process revolves around a specific

research question or a specific theoretical framework (Braun & Clarke, 2006). The choice between these two ways of theme identification depends on the purpose of the research, and determines how data is collected. Because the purpose of the qualitative study in the current research is to explore all potential factors perceived by participants that are associated with safety rule violations among Chinese construction workers, it was decided not to draw any pre-assumptions before or during data collection in order to capture all valuable information relevant to the research question. Thus, the thematic analysis in the current research takes the inductive approach.

The third decision needing to be made in terms of thematic analysis is the 'level' of themes identification, either at a semantic or explicit level, or at a latent or interpretative level (Boyatzis, 1998). A semantic approach identifies themes within the surface meanings of the data, which means the analysis remains explicitly at the level of what a participant has said or written (Braun & Clarke, 2006). The analytic process involves organisation of patterns or themes in semantic content, and to theorise the significance of the patterns and their broader meanings and implications (Patton, 1990), often in relation to previous literature (Frith & Gleeson, 2004). In contrast, the interpretative approach examines the underlying ideas, assumptions, and conceptualisations that shape or inform the semantic content of the data (Braun & Clarke, 2006). Given the purpose of the thematic analysis in the current research, and because the research topic can be considered by some participants as sensitive so that the analysis in the surface meanings of the semantic data is insufficient, it was decided that the interpretative approach was suitable for the thematic analysis in the current research.

In order to ensure a piece of good quality research, the question of the reliability and the validity of the research must be considered (Patton, 1990).

The traditional criteria for reliability and validity stem from a positivist tradition (Winter, 2000). When judging qualitative work, given the differences in paradigmatic positions of qualitative versus quantitative research methodologies, positivists often hold sceptical opinions on the reliability and the validity of interpretivist research (Shenton, 2004). Meanwhile, some interpretivists questioned the appropriateness of applying the principles of validity and reliability to evaluate the quality in qualitative research. For example, Stenbacka (2001, p. 552) argued that "if a qualitative study is discussed with reliability as a criterion, the consequence is rather that the study is no good". Some other qualitative researchers believe that the quality of a study in each paradigm should be judged by its own paradigm's terms (Healy & Perry, 2000). Guba and Lincoln are two notable researchers who hold such a belief. They proposed four criteria to address similar issues as reliability and validity in pursuit of trustworthy qualitative research (Guba, 1981; Lincoln & Guba, 1985): 1) credibility (in preference to internal validity); 2) transferability (in preference to external validity/generalisability); 3) dependability (in preference to reliability); 4) confirmability (in preference to objectivity). Although these constructs are still emerging and being defined (Lincoln, 1995), they have been well accepted by many (Shenton, 2004). Shenton (2004) suggested a number of possible ways to ensure meeting the four criteria in pursuit of qualitative research. Table 2 below lists the tactics that were implemented in the current research. All four criteria and their relevant tactics are explained individually in the following.

Table 2. Tactics used in the current research to address Guba and Lincoln's four criteria for trustworthiness of qualitative research (adapted from Shenton, 2004)

Qality criteria	Tactics impletented in the current research
Credibility	Adoption of appropriate, well recognised research methods
	Development of early familiarity with culture of participating organisations
	Stratified random sampling of individuals serving as participants
	Triangulation via use of different methods, different types of informants and different sites
	Tactics to help ensure honesty in informants
	Iterative questioning in data collection dialogues
	Debriefing sessions between researcher and supervisors as well as other researchers and practitioners
	Peer scrutiny of project
	Description of background, qualifications and experience of the researcher
	Member checks of data collected and interpreations/theories formed
	Thick description of phenomenon under scrutiny
	Examination of previous resarch to frame findings
Transferability	Provision of background data to establish context of study and detailed description of pheneomenon in question to allow comparisons to be made
Dependability	Employment of "overlapping methods"
	In-depth methodological description to allow study to be repeated
Confirmability	Triangulation to reduce effect of investigator bias
	Admission of researcher's beliefs and assumptions
	Recognition of shortcomings in study's methods and their potential effects
	In-depth methodological description to allow integrity of research results to be scrutinised

1) Credibility. Credibility was considered as one of the most important factors in establishing trustworthiness of qualitative research (Lincoln & Guba, 1985). It deals with the question, "How congruent are the findings with reality?" (Merriam, 1998). The following tactics were used in the current research to address this issue.

The adoption of research methods well established in pursuit of data collection and data analysis. As mentioned earlier, the current research was conducted with semi-structured interviews and focus groups, following

research guidelines (Adams & Cox, 2008) to obtain qualitative data. Semi-structured interviews and focus groups are two commonly used methods for qualitative research (Silverman, 2000). In terms of data analysis, thematic analysis was conducted strictly following the analysis procedures that were successful utilised in previous research (Braun & Clarke, 2006).

The development of an early familiarity with the culture of participant organisations before commence of data collection. It involved consultation of organisational documentations, on-site observations, and meetings with steering groups. It was a process for the author to gain adequate understanding of the participant organisations and to establish a relationship of trust with the members of participant organisations.

Stratified random sampling of individuals to serve as research participants. People working on construction sites were first divided into different subgroups according to their job titles. Then simple random sampling was applied within each stratum. Stratification allows subgroups to be studied in greater detail (Marshall, 1996) and ensures the voice of all subgroups within the research population to be heard. Random sampling provides the greatest assurance that those selected are a representative sample of the larger group (Bouma & Atkinson, 1995). It also helps with ensuring an even distribution of any "unknown influences" within the sample (Preece, 1994). Thus, it was particularly appropriate to the nature of the investigation.

Triangulation in the current research involved the use of different methods: consultation of a range of relevant documentations both from organisations and media, on-site observations, one-to-one interviews, and focus groups. In addition, a wide range of participants from numerous different organisations located around China were included in the research. It

helped the author to obtain a rich picture of the opinions of people who work in the Chinese construction industry, and reduced the effect on the study of particular local factors peculiar to one organisation.

Tactics to help ensure honesty in participants when collecting data. Participants were encouraged to be honest from the beginning of the conversation. They were assured that all information they shared would remain confidential. The author's independent status as a PhD student pursuing scientific research was emphasised. Participants were also informed that they had the right to withdraw from the study at any time without an explanation.

Iterative questioning. In the current research, interview schedules were designed carefully, with the purpose of eliciting detailed information in relation to safety management within organisations as well as workers' rule violations, before fieldwork took place. The obtainment of detailed information is helpful for uncovering deliberate lies (Shenton, 2004). In case of doubt in reported information, a rephrased question on the same issue was raised later in the conversation.

Frequent debriefing sessions between the author and research supervisors as well as other researchers and practitioners in the research field were conducted before and during the qualitative research. In addition, opportunities for *peer scrutiny of the research project* were often sought during the research process. Discussions with other researchers and practitioners, and their feedback, provided the author with great opportunities to widen her vision and knowledge in research methods and the research topic. They also brought other people's fresh perspectives on the issue under scrutiny and helped the author recognise her own biases in terms of data interpretation.

Description of background, qualifications and experience of the researcher is considered important in qualitative research (Alkin, Daillak & White, 1979). Thus, the author always introduced herself in terms of her background and qualifications, as well as her research interests and research experience to people who were involved in the current research. It helped to build a relationship of trust with the people the author encountered. Alkin and his colleagues (1979) advocated that participants' trust in the researcher was of equal importance to the adequacy of the research procedures in assuring the trustworthiness of the research.

Member check is believed to be the single most important method to enhance a study's credibility (Guba & Lincoln, 1985). It involves confirmation with interview participants on whether the researcher's interpretations of participants' words reflect the actual meaning. Member check may take place during the conversation as well as at the end of the interview. Another tactic suggested by researchers for member check involves verification of emerging patterns and theories as they were formed through researcher's analysis during the interviews (Brewer & Hunter, 1989; Miles & Huberman, 1994). Both methods for member check were used in the current study.

Thick description of the phenomenon under scrutiny. It was suggested that detailed description of the research findings could be important for promoting credibility of qualitative research as it conveys the actual situations that have been investigated as well as the contexts that surround them, and helps the reader to determine the extent to which the findings truly embrace the actual situations (Shenton, 2004). Thus, detailed descriptions of the research context as well as the findings are provided in the relevant chapters in this thesis.

Examination of previous research findings may provide researchers with the opportunities to assess the degree to which the analysis results are congruent with those of past studies. The ability of the researchers to relate their findings to an existing body of knowledge is considered as a key criterion for evaluating the quality of qualitative research (Silverman, 2000). In the current research, the findings of the current research were always related to those of previous studies.

2) Transferability. It is difficult to directly address transferability in qualitative research, since the qualitative findings are specific to a small number of participants within a particular environment or context (Erlandson et al., 1993). Some researchers argued that the transferability of qualitative research should be judged by the readers based on the context of their research projects, and the researcher's responsibility is to provide sufficient contextual information about the research in order for readers to have a proper understanding of the research, to compare with their own research situations, and to make their own judgment (Lincoln & Guba, 1985; Firestone, 1993). In recent years, such a stance has earned increasing recognition among qualitative researchers (Shenton, 2004). However, Firestone (1993) noted that such tactic could risk the possibility of not including certain information that was unimportant in the researcher's eyes, but crucial from a reader's perspective. Cole and Gardner (1979) as well as Marchionini and Teague (1987) emphasised the importance of reporting the boundaries of the study to the readers. They suggested the following information should be provided in research report:

- The number of organisations taking part in the study and their locations
- Any restrictions in selecting participants

- The number of participants involved in the research
- The data collection methods that were employed
- The number and length of the data collection sessions
- The time period over which the data was collected

Some other researchers argued that it is important to recognise that understanding of a phenomenon is a process of accumulation of findings and information from different settings and sources, and inconsistent results from different research projects do not necessarily imply untrustworthiness of the research, as long as the reasons behind the variations are acknowledged (Borgman, 1986; Cole & Gardner, 1979). The current research took all the above-mentioned issues into account. With no intention to produce truly transferable results with this single study, the author enclosed as much detailed information as possible in the qualitative research chapter in this thesis, including the information of the study boundaries listed above, with the purpose of enabling the readers to related the study with their research, and contributing valuable information to the understanding of rule violations in the Chinese construction industry.

3) Dependability. Lincoln and Guba (1985) emphasised the close ties between credibility and dependability, and argued that qualitative research demonstrating the former (credibility) is sufficient to establish the latter (dependability). To address the issue directly, Shenton (2004) suggested the use of "*overlapping methods*", such as the use of individual interviews and focus groups, and the *provision of in-depth detailed descriptions of the study process* for a future research to repeat the work. Both tactics were implemented in the current research, as explained earlier.

4) Confirmability. The concept of confirmability is associated with objectivity in science (Guba, 1981). Patton (1990) argued that real

objectivity is almost impossible to achieve, especially in social sciences, since a researcher's biases were inevitable throughout the research process, from the research design to the interpretations of research findings. Nevertheless, it is important to take effective measures to try to ensure as much as possible that the research findings were a true reflection of participants' experiences and perceptions, rather than the preferences and expectations of the researcher. The first step to address confirmability is the researcher's recognition and acknowledgement of their personal beliefs and assumptions, as well as the shortcomings in a study's methods and their potential effects (Shenton, 2004). Only with such recognition and admission can other measures be taken with high levels of caution, and in turn, be effective. Throughout the current research process, the concept of confirmability was addressed to minimise any possible misinterpretation or bias. The use of *triangulation* and the *provision of detailed descriptions of research process* helped with reducing the researcher's bias effect. Other tactics that were used to promote the other three criteria for trustworthiness of qualitative research also played important roles in ensuring confirmability. Together, these tactics helped to enhance the trustworthiness of the current qualitative research and ensure the current qualitative research was a piece of quality research.

2.3.3 Questionnaire survey

Questionnaire survey is a structured way of collecting data from a population or a sample of a population (Lewin, 2005). The aim of quantitative methods is to test pre-determined hypotheses using a deductive process of knowledge and to produce generalisable results (Marshall, 1996). The purpose of conducting a questionnaire survey following interviews and focus groups in the current research was to examine further the interpretations

obtained from thematic analysis in a larger sample through factor analysis and descriptive analysis in order to obtain a reliable picture of the researched situation as well as to draw a full conclusion regarding the factors associated with safety rule violations among Chinese construction workers.

Although the questionnaire survey has many advantages compared with other qualitative research methods, for example, lower cost and the collection of a larger data set within a short time, researchers may also face obstacles in conducting questionnaire surveys, for example, low response rates (Matz, 1999; Sax, Gilmartin & Bryant, 2003), and non-response bias (Couper, 2000; Dey, 1997). Some researchers have reported specific issues in the case of conducting questionnaire surveys in China (Alon, 2006; Manion, 1994; Peng & Nunes, 2008). One of the serious obstacles to survey research in China is sampling (Manion, 1994). For most researchers, obtaining a nation-wide probability sample of the Chinese population or even just a specific group of population, such as in the case of the current research, is impossible and impractical. In addition, given China's current political situation and its cultural traditions, survey research that involves institutions and their officials is almost always subject to the approval of Communist authorities within the institutions. Furthermore, Chinese tend to place a high level of trust on recommendations from closely related people. It may provide good opportunities for researchers to gain access to large samples through networking. However, it bears the risks of obtaining access to only the organisations or samples that other people consider as suitable for the research. Another issue related to sampling that is specifically relevant to the current research is that because of workers' low educational level, only the ones with adequate reading and comprehensive levels may complete the questionnaire.

In addition to the sampling issues, a number of obstacles may also be generated during the process of questionnaire design, especially in a country where democratic survey is considered to be of less value and is unfamiliar among the population. Extra attention needs be placed on the sensitivity of question items and the wording. Also, the complexity of the measure and the time taken for administration need to be considered to guide the design of the number of question items and formats of the Likert-response, especially when there is a very limited time and monetary budget.

Having been aware of the issues related to conducting survey research in China, the author strived to seek the balance of all considerations with the principle of not losing crucial information relevant to the research question during the pursuit of the questionnaire survey. Detailed descriptions of the methods used for the survey research in terms of questionnaire design, pilot studies, sampling, ethical considerations, and study procedures are introduced in Chapter 5.

The descriptive analyses of the survey results are based on the percentage of participants who agreed or disagreed with the statements. The judgment of the conformity of participants in relation to the Likert-scaled statements enlisted in the questionnaire is based on the majority rule. The majority rule is popular across the full spectrum of human groups as a decision rule in groups (Boehm, 1996; Mueller, 1989; Wilson, 1994). In the modern age, the majority rule is frequently adopted to make formal social choices in elections, legislatures, and committees (Hastie & Kameda, 2005). In the case of election, according to the majority rule, candidate x is chosen if, for all other candidates y in the feasible set, more voters prefer x to y than y to x (Dasgupta & Maskin, 2008). Because the current research mainly concerns the percentage of participants who agree with the statement (hypothesis)

enlisted in the questionnaire, x, in this case, is the response of basically agree/agree/totally agree, and y implies the responses of basically disagree/disagree/totally disagree as well as neutral. If more participants choose x to y, in other words, if there is a higher percentage of participants basically agree/agree/totally agree with a statement than the percentage of participants who choose other options, the statement (hypothesis) is considered to be confirmed. It is worth mentioning that the majority rule itself has a number of flaws in practice. One of them which is directly related to the context of the current research is the neglect of "minority will" (Spaeth & Segal, 1999). The author is aware of the value of the minority's opinions, and believes that there is invaluable information behind each individual's voice. The fact that some participants had very different opinions from others affirmed that there is the need for further research in safety management and rule violations in the Chinese construction industry. At an exploratory level, the current research is focused on the majority's opinions to capture the bigger picture of what has been happening in the Chinese construction industry, what has been done in terms of safety management and controlling of rule violations, and how different factors interact with one another as well as draw effects on workers' behaviour.

Judgement on the question item that asks participants to select the biggest safety management problem in the Chinese construction industry was based on the simple plurality approach, which is also named as first-past-the-post. In a similar way to the majority rule, simple plurality procedure is a method commonly used for voting in elections (Ching, 1996). The principle is that each voter gets one vote and the candidate who gets the most votes is the winner. In relation to the judgement of the responses for the question item in the questionnaire, the problem that received the most votes was considered as the biggest safety management problem.

2.3.4 The Delphi technique and the modified G1 method

The Delphi technique. Häder and Häder (1995, p.12) defined the Delphi method as a "relatively strongly structured group communication process, in which matters, on which naturally unsure and incomplete knowledge is available, are judged upon by experts". Originally developed in the 1950s by the RAND Corporation in Santa Monica, California, the Delphi method has been considered to make better use of group interaction with the questionnaire as the medium (Martino, 1983; Rowe, Wright & Bolger, 1991). The Delphi method can be considered as a name given to a collection of Delphi techniques whose applications are diverse (Woudenberg, 1991). However, it has been agreed that the standard Delphi method has the following characteristics; firstly, based on an expert survey in two or more rounds where experts are anonymous among each other; secondly, the results of the previous rounds of survey are given as feedback in the second and later rounds; thirdly, after each survey round, each expert gives their judgments again on the same issue under the influence of other experts' opinions. Thus, the Delphi method enables individual experts to express their distinctly different opinions as compared to the group perspective, without having to compromise or shift their judgements because of peer pressure or fear of losing face, a phenomenon that commonly exists during face-to-face group discussions (Myers & Lamm, 1976; Stasser, Kerr & Davis, 1989). In the current research, the Delphi method is an efficient approach in achieving group consensus of judgements without losing the input of valuable individuals.

The modified G1 method. The modified G1 method stems from the analytic hierarchy process (AHP). AHP was first introduced by Saaty (1977) and is a theory of measurement (Golden, Wasil & Harker, 1989; Saaty &

Alexander, 1989). When applied in decision-making, it aids decision makers to rank or sort information based on a number of criteria. In multiple criteria decision making, the criteria are usually classified as being two kinds: 1) quantitative criteria that can be easily defined and measured by number, for example, time and cost, 2) qualitative criteria that are not easily specified or directly measured and determined by subjective judgement. The AHP is the popular tool for the subjective judgement of the qualitative data (Ishizaka & Labib, 2009; Yuen, 2009). It is one of the advantages of AHP compared with methods such as factor analysis that evaluate relative weights of criteria based on eigenvalues assigned to factors. Another important advantage of AHP is that the decision makers or the experts on the topic under examination make direct decisions on the importance of criteria. In contrast, with factor analysis, the researcher is the one who infers and interprets, using her/his theoretical convictions and knowledge, about the existence and the meaning of factors. Accordingly, the ultimate results of factor analytical research partially depends on the decisions and interpretations of the researcher and different researchers may reach different conclusions using similar factorial methods (Cervone & Pervin, 2008). Given that the influential factors being examined in the current study are qualitative criteria, and it is important to receive experts' direct input on the importance of criteria, AHP was chosen as the method to analyse the relative importance of differing factors associated with workers' safety violation.

In the AHP, factors that are important for a particular decision are first selected and then arranged in a hierarchic structure descending from an overall goal to attributes (or criteria, issues), subattributes (or subcriteria, subissues) and alternatives in successive levels (Beynon, 2002). Each level of attributes may represent a different cut at the problem; the attributes at the higher levels of the hierarchy may have global characters, and the attributes

at the lower levels of hierarchy may explain the particular attribute at higher level in greater depth and details. The basic principle of the AHP is to provide a fundamental scale of relative values of a set of attributes expressed in dominance units to represent judgements in the form of paired comparisons (Saaty, 1990). A ratio scale of relative values is then derived from each set of comparisons. A ranking of the alternatives emerges through the synthesisation of the overall ratio scale of attributes. Saaty (1977) introduced a rating scale to measure the intensity of importance (Table 3). Although after Saaty's verbal rating scale, many different scales, including numerical, verbal, and graphical, have been proposed by numerous researchers (e.g. Harker & Vargas, 1987; Lootsma, 1989; Salo & Hämäläinen, 1997), the linear scale with the integers one to nine and their reciprocals has been by far the most often used in applications (Ishizaka & Labib, 2011). Saaty (1980, 1989) advocates it as the best scale to represent weight ratios.

Table 3. Saaty's rating scale (Coyle, 2004)

Intensity of importance	Definition	Explanation
1	Equal importance	Two factors contribute equally to the objective
3	Somewhat more important	Experience and judgement slightly favour one over the other
5	Much more important	Experience and judgement strongly favour one over the other
7	Very much more important	Experiece and judgement very strongly favour one over the other. Its importance is demonstrated in practice
9	Absolutely more important	The evidence favouring one over the other is of the highest possible validity
2,4,6,8	Intermediate values	When compromise is needed

According to Saaty (1977) the pair-wise comparisons are based on one basic assumption; if attribute A is absolutely more important than attribute B, and is rated at 9, then B must be absolutely less important than A and is valued at 1/9. By means of pair-wise comparisons, reciprocal matrices for all attributes can be formulated. In order to measure the level of consistency of

a reciprocal matrix, Saaty (1977) proposed a Consistency Index (CI). According to Saaty, the higher the value of CI, the more inconsistent the reciprocal matrix will be.

AHP is a well-known and frequently used method for measuring or choosing decision alternatives that are judged by a number of different criteria (Frei & Harker, 1999). However, AHP also has its flaws. One of the most criticised issues is related to the consistency of people's judgments (Belton & Stewart, 2002; Tung & Tang, 1998). Saaty (1977) proposed a standard for consistency level called consistency ratio (CR) that measures how consistent the judgments have been relative to large samples of purely random judgments. CR needs to be smaller than 0.1, otherwise the judgements are considered as untrustworthy, and the judgement process need to be repeated. However, some researchers question whether the criterion of consistency level is rational because it allows contradictory judgements in matrices (Kwiesielewicz & van Uden, 2004) or rejects reasonable matrices (Karapetrovic & Rosenbloom, 1999). In addition, there is a limit to the number of comparisons to which people can provide trustworthy judgements. Miller (1956) demonstrated by applying the concept of limited capacity to sensory judgments and memory span, that there is a span of absolute judgment that can distinguish a few categories or facts, seven plus or minus two. Thus, Saaty (1977) suggested that pair-wise comparisons for all factors should not normally be more than seven otherwise people would become confused and could not handle the information. However, there are very often more than seven attributes (plus or minus two) for people to consider. This is the case in the current study.

Guo (2006) proposed a G1 method to avoid the shortcomings of the AHP. According to Guo (2006), the G1 method means it is not necessary to

construct matrix in the course of determining the weights of each index and there is no need for the consistency check as in the AHP. The main content of the G1 method is presented as follows:

Definition 1: If index X_i is more (or not less) important than X_j with respect to an assessment criterion (or goal), it can be defined as $X_i \geq X_j$

Definition 2: If indices $X_1, X_2, \ldots, X_m$ have the following formula with respect to an assessment criterion (or goal): $X_i \geq X_j \geq \ldots \geq X_k$, while $i, j, \ldots, k=1, 2, \ldots, m$, it can be concluded that the sequence relation among indices is established according to "≥".

For an assessment of index set $X=\{x_1, x_2, \ldots, x_m\}$, the sequence relation can be established according to the following three steps:

a) Determining the order relation: supposing an expert selects an attribute from an evaluation index set $\{x_1, x_2, \ldots, x_m\}$, which is considered as the most important one and is recorded as X_i . Then supposing the expert selects another attribute from the remaining m-1 indices, which is again considered as the most important one and is recorded as X_j. Similarly, supposing the expert selects another attribute from the remaining (m-(k-1)) indices; this is still considered as the most important only one and is recorded as X_k. The procedure repeats until there is only one attribute remaining unselected in the index set and is recorded as X_m.

b) Determining the ratio of the importance between two neighbouring indices X_{k-1} and X_k: supposing the expert gives reasonable judgments of the ratio of the importance r_k between the indices X_{k-1} and X_k based on a certain criteria (or goal), therefore

$$r_k=\omega_{k-1}/\omega_k, \quad k = m, m-1, m-2, \ldots, 3, 2, \qquad (1)$$

where ω_k is the weight of the index X_k, the value of r_k is shown in Table 4. In this way, the relatively important degree of all indices can be calculated according to the above steps. Consequently there is the following formula:

$$r_{k-1} \geq r_k,\ k = m, m-1, m-2, \ldots, 3, 2$$

c) *Calculating the value of the weight ω_k:*

$$\omega_k = \left(1+\sum_{k=2}^{m}\prod_{i=k}^{m} r_i\right)^{-1},\ \omega_{k-1}=r_k\omega_k,\ k = m, m-1, \ldots, 3, 2 \quad (2)$$

where ω_k is the weight of the k-th index.

Table 4. The relatively important degree between neighbouring indices for the G1 method (Xie et al., n.d.)

r_k	**Explanation**
1	Index X_{k-1} have the same importance as index X_k.
1.1	Between little more importance and same importance
1.2	Index X_{k-1} is little more important than index X_k.
1.3	Between more importance and little more importance
1.4	Index X_{k-1} is more important than index X_k.
1.5	Between much more importance and more importance
1.6	Index X_{k-1} is much more important than index X_k.
1.7	Between extremely more importance and much more importance
1.8	Index X_{k-1} is extremely more important than index X_k.

Liu (2007) argued that in real applications, there are very often many assessment indices. As a result, the ratios between the weights of indices are greater than nine, which makes the G1 method invalid. Liu (2007) suggested an improved method of G1 method, which is named in this thesis as the modified G1 method. The main aim of the improvement is to reduce the ratios between weights of indices to less than nine using different mathematic calculation techniques, while the method for deciding the preceding

relationship between indices remains the same as the G1 method. Thus, the first two steps of the method are:

(1) Decision of the preceding relationship between indices according to the G1 method.

(2) Establishment of the relatively important degree between two neighbouring indices.

The relatively important degree between X_{k-1} and X_k can be represented with the following formula:

$$r_k=\omega_{k-1}/\omega_k,\ k = m, m-1, m-2, \ldots,3, 2,$$

where the value of r_k ,according to Liu (2007), can refer to Table 5. In Table 5, A is a variable with the initial value of natural constant e. The final value of A will be decided in Step 3.

Table 5. The relatively important degree between neighbouring indices in the modified G1

r_k	Explanation
A^0	Index X_{k-1} have the same importance as index X_k.
A^1	The important degree between indices X_{k-1} and X_k is within the same and lightly more importance.
A^2	Index X_{k-1} is lightly more important than index X_k.
A^3	The important degree between indices X_{k-1} and X_k is within lightly and normally more importance.
A^4	Index X_{k-1} is more important than index X_k.
A^5	The important degree between indices X_{k-1} and X_k is within normally and notably more importance.
A^6	Index X_{k-1} is notably more important than index X_k.
A^7	The important degree between indices X_{k-1} and X_k is within notably and extremely more importance.
A^8	Index X_{k-1} is extremely more important than index X_k.

(3) Adjustment of value of A

Firstly, according to the relatively important degree between two neighbouring indices, Liu (2007) suggested that there should be a calculation of the ratio of the most important index to the least one to see whether the value of the ratio is more than nine. If the value is not more than nine, the value of *A*, the natural constant *e*, is acceptable. Otherwise, the value of *A* needs to be adjusted as follows:

The value of *A* can be computed according to $\prod_{i=k}^{m} r_i \leq 9$, and the value of r_k is obtained. It is then inputted into Formula 1. The ratio between two neighbouring indices is recalculated respectively.

(4) Calculation of weight ω_m according to Formula 2.

For the purpose of the current research, the modified G1 method (Liu, 2007) was conducted to prioritise and assign the important weightings for the factors that emerged from qualitative and quantitative studies. Detailed descriptions of the Delphi method and the modified G1 method used for the fourth study in the research in terms of questionnaire design, pilot studies, sampling, ethical considerations, and study procedures are introduced in Chapter 6.

2.4 Chapter summary

This chapter has presented the research plan and the research methodology used in the current research in order to address the research aims and objectives. A large proportion of the chapter was given over to an argument for the methodologies chosen and an explanation of the practical issues in conducting the research. The next chapter proceeds to introduce the first study of the research – on-site observation and document analysis.

3. Study I – On-site observation and document analysis

3.1 Chapter overview

This chapter is focused on explaining comprehensively the first study of the current research – on-site observation and organisational document analysis. The chapter first introduces the aims of conducting the study (Section 3.2), which is followed by the descriptions of ethical implications of the study (Section 3.3). Section 3.4 focuses on explaining the procedure carried out under the guidance of both objectives and ethical considerations. The chapter proceeds by presenting the findings obtained from observation and document analysis (Section 3.5). Discussion and conclusions in relation to the study findings are presented at the end of the chapter in Section 3.6.

3.2 Introduction to the study

The objectives of conducting on-site observation and organisational document analysis were for the author to be familiar with each participant construction site, to gain site-specific knowledge and general experiential information in the context of construction sites, and to obtain first-hand information on the prevalence of workers' rule violation. This study was part of the first stage of the research plan (Section 2.2, Figure 7) as to acknowledge the problem of worker's rule violation. The information obtained from this study was used as triangulation evidence for the development and analyses of the subsequent studies in this research.

3.3 Ethical considerations

Observations were only made when permission was obtained from senior management and foremen. Individual workers were not identified during observations. The author received the standard safety and security

training for all site visitors from the participant organisations prior to entry on to the construction sites. The study received full ethical approval from the relevant ethics committee.

3.4 Procedure

Fourteen construction companies – 13 state-owned and one privately owned – situated at seven different locations in mainland China (Tanchang village in Gansu province, Chongqing, Beijing, Tianjin, Guangzhou, Xiamen, Wuhan), participated in the study. The locations of these companies represented the current situation in China in terms of economic growth and living conditions. The procedures of data collection were the same at all participant companies.

One of the senior managers (the organisation's 'champion') in each participant construction company was contacted directly through phone calls by the author prior to arrival at the construction site. The aim and the scope of the study, and the necessary support needed from the management board, were explained to each 'champion'. A steering group, including senior managers, safety officers, and human resource management staff, was formed in each construction company in order to facilitate the author in conducting the study.

Upon arrival at the construction site, a group meeting with the steering group was held, at which the aims and the design of the research project as well as the author's background were introduced. Requested organisational documents, including information on the construction project, organisational structure, safety records, training materials, and the safety management system, were received at the meeting. Standard safety and security training for all site visitors was delivered to the author by one of the safety officers

after the group meeting. Once the training had been completed, observations were carried out on the construction sites and the living areas. Ten out of the 14 participant companies granted permission to carry out on-site observation. The four companies that refused were engaged in tunnel construction and it was against the companies' regulation to have a female on site.

All participant construction sites operated 24 hours a day and workers worked three shifts, i.e. 7am–3pm, 3pm–11pm, and 11pm–7am. Having been aware of the potential bias in observations using scan sampling, in order to conduct observations on all working groups, and to capture behaviours at different times of day, observations on rule violations and the communications between management and workers were carried out three times a day for three days on each construction site. Each day, the observation began one hour later than the previous day, starting with the first hour of each shift. Each session lasted an average of one hour. The author strived to observe each individual or a group of workers when they were working closely together for the same period of time, about three minutes on average.

Important parameters of behaviour were selected in advance and a checklist was made (see Appendix I for the English version and Appendix II for the Chinese version). The checklist was a simplified version of the standard inspection checklist used by official inspectors. The rule violations to be observed were chosen by consultation with two safety officers from the first construction company visited. Given the large size of the construction sites, and the large number of workers on site, the violation behaviours to be observed were the ones that were the most common and could be easily and quickly distinguished. The checklist was approved by safety officers each time before visiting a new construction site. Situations of work at height and

mechanical lifting for mobile cranes were chosen as they were suggested by safety officers as the two situations where violations occur most often. In addition to the rule violation checklist, a short list of closed questions in relation to physical environment in which workers live and work, as well as training procedure and communication styles, was designed in advance in order for the author to be familiar with the context and physical environment. In order to evaluate the observed factors, a scoring rank ranging from 1-9 (1=very bad and 9 = very good) was designed (see Table 6).

Table 6. Scoring ranks for observed factors' evaluations

1	2	3	4	5	6	7	8	9
Very bad	Bad	Relatively bad	Between relatively bad and neutral	Neutral	Between neutral and relatively good	Relatively good	Good	Very good

Both rule violation checklist and short questions were printed on A4 sized paper and carried with the author on site during observation in two-ring hard binder folder for the ease of notetaking. Notes were taken during observations on the checklist. Once the violation behaviour from one particular individual worker was noted, it was counted as one time occurrence; there was no double count of the same behaviour from the same worker during one observation session. Observations on working and living conditions were made on the first day of observation.

In order to observe the most natural behaviour of the construction workers and to ensure the author's personal safety, observations were carried out accompanied by experienced workers who were arranged by foremen. The focuses of observations were on workers' safety rule violations, workers' living conditions, working environment on sites, training procedure, stringency of onsite inspections, and communication between management

and workers. In order to avoid the Hawthorne effect – the tendency of some people to change their behaviour because of their awareness of being in a study (French, 1950) – special care was taken during observation. The author ensured that she was only to be seen on construction sites with designated experienced workers accompanying her for safety reasons, but not with safety officers or any management members; the author wore a safety helmet with a colour indicating the role of a worker rather than an employee of the main contractor or inspectors; the author made no pointing gesture directing worker(s) on sites and kept the maximum possible distance from the workers without compromising the ability to see their behaviours and hear their conversations; no recording devices such as camera, video camera, and recorder was carried on sites. Summarised notes on focused issues were taken soon after observation.

3.5 Results

3.5.1 Document analysis results

All 14 participant companies provided their safety management handbook which contained descriptions of safety management standards, requirements of relevant legislation and regulations, and safety management systems within the company, including comprehensive safety management policies, risk assessments and control plans, responsible persons' job descriptions and responsibilities, accident report and documentation requirements, intervention measures, safety training requirements, safety management evaluation methods, and so on. In addition, the author was provided from all companies with a short description of the project under construction, a full list of potential hazards on site, organisational structure of the company as well as the work team, and accidents records of the construction projects. Table 7 below lists the general information about the

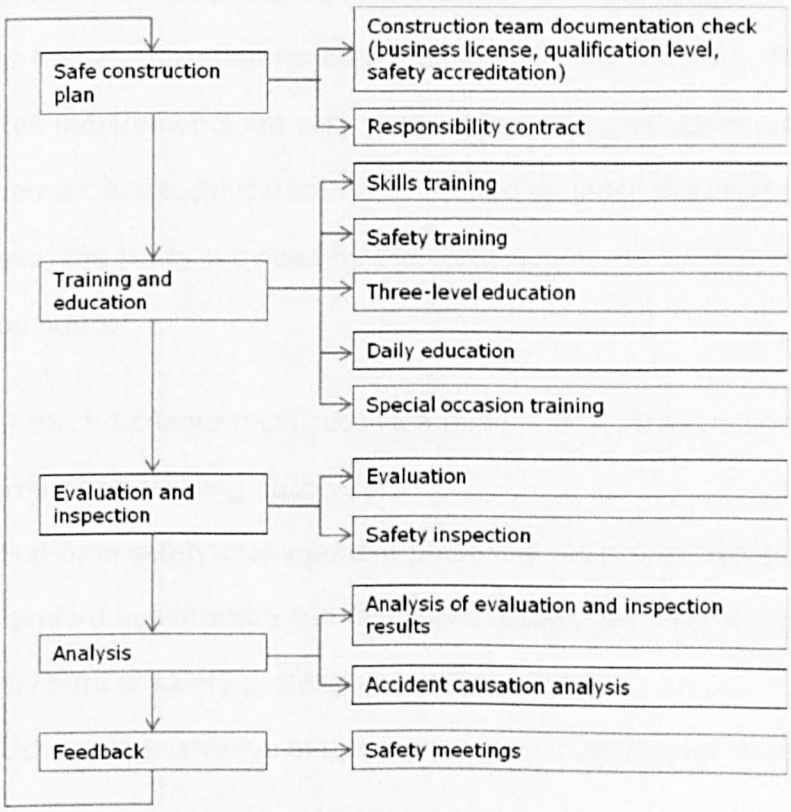
participant construction sites, their projects, the number of workers and safety officers working on site at the time of the research, and the number of reported major and minor accident since the beginning of the project.

Table 7. General information about the participant construction sites, their projects, the number of workers and safety officers, and the number of reported major and minor accident

The location of the construction site	Construction project	The starting year of the project	The duration of the project	No. of people working on site at the time of the research	No. of safety officers	No. of major accident since the beginning of the project	No. of minor accident since the beginning of the project
Guangzhou	Statium	2009	3 years	about 800	6	0	3 cases of hammers hitting on workers' fingers
Beijing site 1	Underground	2009	3 years	about 650	5	0	0
Beijing site 2	Residential compound	2010	2 years	about 600	5	0	0
Tianjin	City cultural centre	2010	3 years	about 900	6	0	2 cases of workers being cut by sharp objects
Lanzhou site 1	Residential compound	2009	2 years	about 600	6	0	1 case of a worker stepping on a sharp object and injured
Lanzhou site 2	Residential compound	2009	3 years	about 500	4	0	0
Tanchang site 1	Tunnel	2009	3 years	about 700	5	0	1 case of a worker stepping on a sharp object and injured
Tanchang site 2	Tunnel	2009	3 years	about 700	6	0	0
Wuhan site 1	High way	2010	4 years	about 650	6	0	0
Wuhan site 2	Bridge	2009	3 years	about 600	5	0	0
Xiamen site 1	Bridge	2009	3 years	about 750	6	0	0
Xiamen site 2	Tunnel	2010	4 years	about 800	5	0	0
Chongqing site 1	High way	2009	4 years	about 800	6	0	4 cases of hammers hitting on workers' fingers
Chongqing site 2	Tunnel	2008	4 years	about 900	6	0	0

The organisational document analysis in the current research focused on the safety management policy documents (later named as the policies) provided by the participant companies because they cover the fundamental safety management components regulated by each company. The quality of the policies preparation may be considered as an indicator of the management attitude towards safety. The policies provided by the participant companies are very similar in terms of their content and structure. The analysis of the policies revealed the following five key points that communicate the safety management issues associated with workers' safety behaviour and safety maintenance: 1) safe construction plan, 2) training and education, 3) evaluation and inspection, 4) analysis, and 5) feedback (see Figure 9). These five key points are introduced in the following.

Figure 9. Key points revealed from document analysis that communicate the safety management issues associated with workers' safety behaviour and safety maintenance



Safe construction plan. The policies include detailed requirements on ensuring that the construction teams and the team members (the workers) have the adequate construction license and qualifications before commencing their work on sites. These requirements are legal requirements that are listed in the 'Construction Law' (1997) under the clause 12, 13, and 14. It is also required in the policies that all team leaders to sign safety management responsibility contract prior work starting. Safety responsibilities for all levels of management, safety officers, foremen, engineers, and workers are enlisted in the policies. Construction companies are legally required to implement the safety management responsibility system to strengthen the management of safety on construction sites. The 'Construction Law' (1997) clause 44 clearly states that the legal representatives of the construction companies are responsible for overall safe production of their correspondent company.

Training and education. All participant companies provided documentation that comprises detailed requirements on safety and skills training as well as education for both management and workers. The documented requirements are very similar among all participant companies. All management and technical staff are required to undertake safety training. For example, the policy provided by the construction site located in Guangzhou states:

- "Project manager must receive a minimum of 30 hours of safety production training each year"
- "Full-time safety management personnel must hold national standard qualification certificate and receive annually a minimum of 40 hours of safety professional skills training"
- "Other administrative and technical staff must receive annually a

minimum of 20 hours of safe production training"

Although all policies require trainings for management and technical staff, the number of training hours is various. For example, the policy provided by the construction site located in Guansu requires that all management members and engineers to receive a minimum of 24 hours of safety training each year instead of 30 hours as required by the construction site located in Guangzhou. The common requirement among all policies is that all training participants must pass the relevant examination before work starting.

For workers, the skills and safety trainings are required to be designed and delivered regularly in accordance to the ever changing characteristics of the construction environment, season, construction techniques, and construction workers. Workers who are engaged in excavation support, scaffolding, formwork engineering, construction electricity, tower cranes, material hoist, lifting of large objects, and explosion must receive job-role targeted training.

In relation to safety education, the policies list four types of required education: 1) three-level education, 2) changing job role education, 3) special job role education, and 4) frequent safety education. The three-level education includes education provided at main contractor level, subcontractor level, and labour group level. It is stated in the policies that newly hired workers must receive three-level education and pass relevant examinations before starting to work. The content of the three-level education at each level is also well explained in the documents: education received from the main contractor level focuses mainly on the general information about the construction project and its associated safety issues on the particular construction site, for example, fire-control, anti-poison

knowledge; education from the subcontractor and labour group level focuses on more specific safety issues related to the undertaking jobs, for example, specific machinery handling, safety policies for workers working at height. In cases of workers changing their job roles, it is required in the policies that a minimum of four hours of education needs to be provided to the relevant workers on the new job and its associated safety issues. Workers must pass the examination before taking the job. Special job role education requires that workers with special tasks such as electrical, welding, vehicle driving must undergo special security operation training, pass relevant examination, and receive qualification certificate before assigning to posts. Frequent safety education is considered as an extension of the three-level education. Frequent safety education can take place in different forms, for example, before and after daily work meeting, safety promotion events, safety knowledge competition, and safety meetings. Detailed policies on daily safety meeting before and after work are included in the policies provided by all participant companies, and the policies are very similar among all companies. The policies on daily safety meeting are summarised as below:

- "Organise safety technical operation training on newly introduced production process, technology, equipment or special construction location"
- "The daily safety meeting will be examined and evaluated irregularly by safety officers"
- "Conduct safety check on mechanical equipment, construction facilities, safety supplies, and surrounding environment. Construction work can only be carried out after full confirmation of security check"
- "Every morning, site manager must organise safety meeting with foremen, summarise the safe production condition of the previous day, and emphasise the safety issues related to the tasks of that day.

Foremen must disseminate production and safety information to their responsible working group immediately after their morning meeting with site managers"

- "Safety reminders and warnings, safety precautions, dos and don'ts and other relevant safety rules and regulations should be issued to workers"
- "Site managers and foremen need to praise the good deeds and promote the advanced safety technology as well as the lessons need to be learned"
- "Site managers and foremen need to record in detail daily safety meetings"

In terms of monthly and annually safety meetings, the policies all require that project manager must organise at least once safety meeting each month with all management members, foremen, and safety officers. Every year project manager must organise once annual safety meeting with all management members, safety officers, engineers, and foremen.

Evaluation and inspection. According to the policies, evaluation on trainings relies mainly on examinations. It is stated in the policies that all training participants must sign training attendance and pass relevant examination before start working. Examinations for all types of trainings can only be retaken once. It is also clearly stated in the polices that workers who fail the examination twice cannot be hired. The evaluation of safety management and safety behaviour, according to the policies, uses assessment scoring system. The scoring method is various across different policies: while some construction sites use number scores, other construction sites use five-level Likert scale including excellent, good, pass, fail, and suspension and rectification. The evaluation is required to be conducted every three months by the person directly superior to the person being evaluated.

The policies on safety inspection emphasise cross-level inspections. For example, it is stated in the policy provided by one of the construction sites located in Beijing:

- "The construction company is responsible for regular inspection on safety management with a focus on most hazardous jobs and locations"
- "Each month, project manager and safety officers conduct systematic safety inspection"
- "Every two weeks, site managers organise regional managers, subcontractors, foremen, and specialised engineers to conduct safety inspection within the responsible regions"
- "Foremen must conduct daily safety inspection on responsible equipments, workers, and environment"
- "Safety officers supervise and inspect the activities of the above-mentioned persons"
- "Subcontractors must set up their own security inspection system. In addition to the participation of the inspections organised by the main contractor, subcontractors must adhere to self-inspection, discover, correct, and rectify any violations and safety hazards within the responsible area. Follow-up inspections need to be conducted on potential hazards and hazardous area in order to prevent accident"
- "Labour groups need to ensure self-check before, during, and after daily work, with a special focus on the working environment security check"
- "Every worker needs to ensure no hazards around and no safety violation at all time"

According to the policies, where safety hazards found during inspections, the principle of "four confirm" must be followed: 1) confirm the responsible

person for required rectification, 2) confirm corrective measures, 3) confirm rectification completion time, and 4) confirm the acceptance person. The responsible safety inspector issues the rectification notice, implements the rectification, ensures the rectification process, and reviews the rectification results. Rectification on major hazards must be fully completed within the prescribed period. Where major hazards that may result in accidents or damage to equipments are found, safety inspectors have the authority to order immediate suspension. Construction activities can only be continued after the rectification results are accepted by safety inspectors. Any form of violation and hazards once discovered must be corrected immediately. The person(s) who refuse to rectify will be punished in accordance with the relevant provisions of legislation, and will be responsible for any accident that arises from the mis-rectification.

Analysis. All policies state that the evaluation and inspection results need to be carefully analysed. Safety officers summarise the lessons need to be learnt from pervious mistakes or the things need to be re-emphasised or pay extra attention to. In cases of accident of any scale, the causation of the accident needs to be carefully analysed and reported in detail. When an accident happened on other construction sites, safety officers need to analyse and study the accident causation analysis report, and learn from others' failures.

Feedback. The policies set specific requirements on feeding back all kinds of evaluation and analysis results to the people working on construction sites. As mentioned earlier, daily, monthly, and annually safety meetings need to be conducted by different levels of management to emphasise any emerging hazardous issues and key points that deserve extra attention in safety management. The policies also include requirements on immediate

alteration on existing safety management policies and strategies based on the evaluation and analysis results in order to improve safety management levels.

In addition to the detailed requirements associated with safety behaviour and safety attitude among workers and managers, the policies also include precise requirements on other issues closely related to safety maintenance on construction sites, which are as well part of safety management system. These requirements mainly cover the management of construction machinery and equipment, civilised construction, the safety issues in the living area, and emergency preparedness. These requirements are introduced briefly in the following:

The management of machinery and equipment. The policies clearly state the safety rules ranging from the purchases to repair and maintenance of machinery and equipment. The policies emphasise the usage of good quality and secure machinery and equipment, and strictly forbid purchasing and/or renting machinery and equipment that do not comply with the national mandatory standards, of poor quality, rudimentary structure, and are lack of security guarantee. It is also written in the policies that any machinery or equipment being discovered with potential hazards must stop immediately their usage and be repaired; all machinery and equipments must receive maintenance services regularly in accordance with relevant maintenance regulations. The policies also state the requirements for people who operate machinery and equipment. For example, it is required that only the workers with appropriate qualification have the authority to operate the special or large- and medium-sized machinery and equipment; strictly follow "one worker one machine" policy, i.e. one worker is responsible for one particular piece of machine, no other people is allowed to operate it.

Civilised construction. The policies require that by all means to reduce construction noise, to reduce the negative effect on environment and vegetation. All the construction waste must be kept at the designated location. Construction area or dangerous area must signal with clear warning signs and protected by appropriate safety protection equipment. All the roads on construction sites must be kept clear and smooth with no sharp material or large area of stored water.

Living area management. According to the policies, all visitors must register at the security office their valid identity card number and contact number. No visitor is allowed between 12:00am and 6am. Some other requirements include, for example:

- "Kitchen doors, windows, and locks must remain stable and secure; the keys must be kept securely by the responsible person"
- "Food left over night, drinking water machine and cups must be locked in secure and hygiene location; the keys must be kept securely by the responsible person"
- "Kitchen staff must undergo health check each year and keep good personal hygiene; must wear white uniform and hat; must not topless, bare feet, or split on the floor"
- "It is strictly forbidden to use fire, electric furnace, gas cooker, and electric blanket in the dormitory"
- "Do not hang clothes on electric wire or use more than 60 watts bulb"

Emergency preparedness. The policies clearly state the responsibilities of the member of emergency committee and each individual working on construction site. The direct contact numbers for all external emergency providers nearest to the project site and all internal emergency providers, as well as the construction site and office layout map including fire

exits, evacuation routes, the flammable and explosive locations, as well as fire equipment set positions are required to be illustrated clearly on site. Safety officers are required to scientifically assess the potential accidents and their influential degree. In addition, safety officers are required to establish the best emergency plan on the basis of security evaluation criteria and methods, the actual site surrounding situation, the characteristics of the construction project, and the construction requirements. The policies also include requirements on emergency preparedness training and drills. For example, it is required that drills need to be carried out frequently; every half a year the project manager must organise once emergency preparedness training to every person on site; every new workers must undergo emergency training before work starting; emergency training must clarify to all training participants "what to do, how to do, and who is responsible for what" in cases of emergency. The policies provided by all participant companies include similar requirements in relation to emergency training. It includes, for example:

- The use of fire-fighting equipment and fire-fighting procedure training
- The use of safety devices and personal protective measures
- Identification of the apparent characteristics of potential hazards
- Accident alarming and various basic rescue skills
- Team working mentality during emergency rescuing

3.5.2 Observational study results

Observations on construction sites demonstrated one common character held by all participant companies; slogans written in large red characters reminding workers of the importance of safety were displayed at many different locations on sites and some smaller warning posters were displayed just a few metres apart. However, workers' behaviour while

working, the cleanliness and tidiness of the physical environment of the working areas and living areas, as well as the communication styles among managers and workers, were very different amongst the construction sites being observed. Regarding workers' rule violations, the two construction sites in Beijing and the one in Xiamen had the least frequencies of the violation behaviours included on the observation checklist; the construction site in Chongqing had the highest frequencies. Table 8 below demonstrates the frequency of observed workers' safety rule violations on each construction site being observed. The construction sites in Beijing and Xiamen also had the highest score on the cleanliness and tidiness of the physical environment of working and living areas, inspections on site, as well as communication styles among managers, safety officers, foremen, and workers; the construction site in Chongqing had the lowest score on these factors. Regarding safety training, the construction site in Xiamen, and one construction site in Wuhan, earned the two highest scores because of their well-designed training materials and better evaluation methods comparing with other construction sites. For example, the safety officers on the construction site in Wuhan designed training materials using not only paper handouts, but also PPT, pictures and videos; the safety officers on the construction site in Xiamen had organised contests among workers to evaluate their obtainment of safety knowledge through safety training, instead of relying solely on multiple choice tests which can be easily cheated. The construction site in Chongqing had the lowest score because of their poorly-designed training materials and apparent faulty attendance signature lists. Table 9 shows the scores obtained by each construction site on different factors.

Table 8. Frequencies of observed workers' safety rule violations on each construction site being observed

Safey rule violations being observed	**Frequency of safety rule violations on each construction site**									
	Guangzhou	Beijing site 1	Beijing site 2	Tianjin	Gansu site 1	Gansu site 2	Wuhan site 1	Wuhan site 2	Xiamen	Chongqing
Workers don't wear safety helmet with chin strap	14	11	18	51	38	23	38	42	13	80
Workers don't wear anti-slipery shoes	0	2	1	1	0	19	2	5	0	0
Workers smoke on site	0	0	0	3	6	2	0	2	0	1
Workers don't wear proper safety clothes, including life jacket	0	0	0	0	0	0	0	0	0	0
Workers don't wear safety harness during erection/alteration/ dismantle of scaffolds	4	0	0	19	13	5	3	2	0	24
Safety harness of workers is not attached to independent lifeline OR proper anchor point	4	0	1	2	5	12	0	0	0	0
Workers stack materials near the edge of working platform	0	0	0	6	7	5	0	2	0	2
Workers do not maintain a clear passageway on the working platform in placing construction materials and equipment	0	0	0	8	2	0	3	7	0	2
Load/unload material without clearance of traffic, pedestrians, overhead cables, or other obstructions	0	0	0	1	5	6	2	0	0	1
Workers stay at the bottom of lifting or moving load when lifting operation is carried out overhead	0	0	2	1	4	2	0	0	0	0
Operate the lifting appliance while its moving parts not properly guarded	0	0	0	0	1	0	0	0	0	1
Do not rig the material properly before lifting operation	0	0	0	0	0	0	0	0	0	0
Total	***22***	***13***	***22***	***92***	***81***	***74***	***48***	***60***	***13***	***111***
Total number of workers being observed during three days	***378***	***351***	***405***	***414***	***369***	***351***	***378***	***315***	***306***	***360***
Safety rule violation behaviour rates (%)	***5.82***	***3.70***	***5.43***	***22.22***	***21.95***	***21.08***	***12.70***	***19.05***	***4.25***	***30.83***

Table 9. Scores obtained by construction sites on different evaluating factors

	Scores obtained by construction sites on different factors					
	Guang zhou	**Beijing site 1**	**Beijing site 2**	**Tianjin**	**Gansu site 1**	**Gansu site 2**
Living condition	***35***	***43***	***39***	***25***	***36***	***32***
Are there properly built toilets for both male and female staff? (Relatively clean with flushing water)	7	8	8	4	6	6
Are there properly built showers with hot water?	4	8	4	3	4	2
Are there properly built dormitories? (With windows, fire-proof material)	9	9	9	8	9	8
Are the surroundings of the dormitories clean and tidy?	8	9	9	2	8	8
Is there a properly built kitchen for workers?	7	9	9	8	9	8
Are domitories crowded?	8	7	7	7	8	8
Clean and tidiness of site	***18***	***17***	***17***	***9***	***16***	***14***
Is the construction site tidy?	9	8	8	5	8	6
Are there any obvious hazards on site? (e.g. big gaps or holes with no coverage or warning signs, nails on ground, icy surface)	9	9	9	4	8	8
Inspection	***34***	***36***	***33***	***27***	***28***	***27***
Are there safety officers on site?	9	9	9	8	8	7
Was inspection stringently conducted?	8	9	8	7	6	7
Was warning given to workers or foremen?	9	9	8	6	7	7
Was correction made immediately after warning?	8	9	8	6	7	6
Safety training	***24***	***29***	***27***	***23***	***24***	***24***
Was training provided before workers start working on site?	9	9	9	7	9	8
Was there good quality training material (the use of easy and simple words and sentences, the use of pictures or videos)?	6	9	8	6	6	6
Was there any kind of effective training evaluations afterwards?	2	2	2	2	2	2
Was there an attendence check?	7	9	8	8	7	8
Communication	***8***	***8***	***7***	***8***	***6***	***6***
Was there any reprimand from managers/foremen/safety officers to workers?	8	8	7	8	6	6
Total Score	***119***	***133***	***123***	***92***	***110***	***103***

Table 9 (continue). Scores obtained by construction sites on different evaluating factors

	Scores obtained by construction sites on different factors			
	Wuhan site 1	**Wuhan site 2**	**Xiamen**	**Chongqing**
Living condition	***36***	***34***	***41***	***14***
Are there properly built toilets for both male and female staff? (Relatively clean with flushing water)	8	7	9	2
Are there properly built showers with hot water?	3	3	5	1
Are there properly built dormitories? (With windows, fire-proof material)	9	9	9	2
Are the surroundings of the dormitories clean and tidy?	8	6	9	2
Is there a properly built kitchen for workers?	8	9	9	7
Are domitories crowded?	8	8	6	8
Clean and tidiness of site	***17***	***15***	***17***	***8***
Is the construction site tidy?	8	8	8	5
Are there any obvious hazards on site? (e.g. big gaps or holes with no coverage or warning signs, nails on ground, icy surface)	9	7	9	3
Inspection	***29***	***31***	***36***	***14***
Are there safety officers on site?	7	9	9	7
Was inspection stringently conducted?	8	7	9	3
Was warning given to workers or foremen?	7	8	9	2
Was correction made immediately after warning?	7	7	9	2
Safety training	***29***	***31***	***32***	***8***
Was training provided before workers start working on site?	9	9	9	2
Was there good quality training material (the use of easy and simple words and sentences, the use of pictures or videos)?	7	9	9	2
Was there any kind of effective training evaluation afterwards?	4	4	5	2
Was there an attendence check?	9	9	9	2
Communication	***7***	***9***	***8***	***4***
Was there any reprimand from managers/foremen/safety officers to workers?	7	9	8	4
Total Score	***118***	***120***	***134***	***48***

3.6 Discussion and conclusions

As the first study of the research, the on-site observation and organisational documentation analysis were conducted on 14 construction sites in eight cities and a town across China for the author to be familiarised with the environment of construction sites, to gain basic knowledge of safety management policies and regulations, and to obtain first-hand information on workers' violation behaviour.

Based on the documentation the author was provided with, it can be concluded firstly, that all projects under construction by the 14 companies were large-scale challenging projects with at least 500 workers working at the same time; secondly, all companies had well-documented safety management relevant policies, standards, strategies, and measures that are very similar in their content; thirdly, apart from four companies that had records of minor accidents such as hammers hitting fingers and workers being cut by sharp objects, all companies showed zero accident in their records. The detailed documentations on safety management and intervention provided by the participant companies demonstrate to some extent that managers on construction sites are aware of the importance of safety management.

The on-site observation provided the author with first-hand information on the prevalence of selected workers' rule violation behaviour and some aspects of the actual implementation of safety management policies in different participant companies. The findings demonstrate firstly, that safety violations exist on the Chinese construction sites, and the prevalence varies across different types of violations and different construction sites; secondly, although all participant construction companies provided very similar safety management policies, the actual implementations of the written rules and

policies on some construction sites were poor, and the safety management performance varied across different construction sites; thirdly, the results demonstrate a pattern that when the physical environment of working and living areas is tidy and clean, inspections are stringently conducted, corrections are made immediately after warnings, safety training are well prepared and delivered, and there is good communication style on construction sites, workers are less likely to violate safety rules during their work; fourthly, the scores obtained from construction sites on different factors show a trend that the construction sites scoring high on any one of the factors tend to score high on all other factors as well. The factors being evaluated at this stage represent different aspects of safety management. Thus, it can be concluded from the observation findings that the companies that perform well on one aspect of safety management are very likely to hold high quality of safety management in general, and the quality of safety management is associated with the frequency of workers' violation behaviour. These findings are in alignment with previous research which has demonstrated a strong association between organisational factors and safety behaviours (e.g., Mullen, 2004; Mason, 1997).

One limitation of the observation studies is that the author was the only observer. Having two or more observers would increase the reliability of the results. However, in order to obtain the most natural results it was believed that not involving workers and management members was most appropriate. In addition, as the behaviours and other elements to be observed were straightforward, very little ambiguity was anticipated.

3.7 Chapter summary

This chapter has introduced the first study of the research – on-site observation and document analysis. The study reveals that all the participant

companies have well-documented safety management policies and regulations. However, in reality, the implementation of the policies and regulations vary across different companies and workers' rule violation is common on some construction sites. Having acknowledged the existence of safety violations among the workers and the organisational information of the participant companies, interviews and focus groups were conducted to explore the factors and their effects that are associated with workers' violation. This is the second study of the research and is introduced in the following chapter.

4. Study II – Interviews and focus groups

4.1 Chapter overview

This chapter introduces the second study of the current research, namely, the interviews and focus groups study. The conceptual background and rationale for the study is explained in the beginning of the chapter (Section 4.2). It is followed by a detailed introduction of the study method which includes descriptions of participants, ethical considerations of the study and the procedure that took place to ensure obtainment of accurate and comprehensive information from participants without ethical offence. Data analysis techniques are presented at the end of the section (Section 4.3). The chapter then proceeds to present the findings of the study in four separate sub-sections. Each sub-section focuses on one main category of the themes that emerged from thematic analysis (Section 4.4). The chapter concludes by discussing the effects of the emerged factors on one another and their combined effects on workers' safety violation (Section 4.5). The last two sections of the chapter (Section 4.6 and 4.7) summarise the findings of the study and the content of the chapter respectively.

4.2 Introduction to the study

The review of organisational documents in the previous study demonstrated that all participant companies had well-documented safety management policies and measures. Warning signs were also displayed at different locations on all participant construction sites. However, the observation on workers' rule violation revealed that at least on some participant construction sites, safety violations were still with high frequency. It raised the question of why workers still bend the rules. It is the question

that the current study strives to answer. This study is part of the second stage of the research plan – analyse the problem (Section 2.2, Figure 7).

The aim of the interviews and focus groups study was to obtain a breadth of information regarding interviewees' experience of working on construction sites, their opinions on factors that have effects on workers' rule violations, as well as in-depth and detailed explanations in relation to how different factors affect one another and how these factors, as a result, lead to violations of safety rules. This study was conducted to serve the first aim of the research - to explore the factors that have direct and indirect effects on safety rule violations among Chinese construction workers.

The accident causation models (Heinrich, 1950; Reason, 1990, 1997; Rasmussen, 1997) and the macroergonomic framework of safety violations (Alper & Karsh, 2009) mentioned previously in Section 1.3 suggest that management plays a crucial role in maintaining high level of safety at workplace and in controlling safety violations. The observational study results from the previous study support the theoretical position. In addition to the management factors, the macroergonomic framework illustrates various other factors at four different levels, namely individual, work system/unit factors, organisation factors, and external environment (Alper & Karsh, 2009). Choudhry and Fang's (2008) research findings also demonstrated eleven individual, management, and organisation factors associated with operatives' unsafe behaviour in the construction industry, which were explained in the section of the literature review (Section 1.4) of the thesis. Their research findings as well as the macroergonomic framework (Alper & Karsh, 2009), along with the document analysis results obtained from the previous document analysis study provided the conceptual guidance for the design of the interview schedule for the current study.

4.3 Method

4.3.1 Participants

All 14 companies described previously in Section 3.4 participated in this study. A total of 97 people (two females, 95 males) were interviewed, among whom 19 people were from top management levels, 26 were safety officers, 21 were foremen, and 31 were construction workers.

4.3.2 Ethical considerations

The present study was initially approved by the relevant ethics committee. When approaching participants individually, each individual was provided with an interview consent form in Chinese (see Appendix V for English version and Appendix VI for Chinese version), which carefully explained the research purposes and interview procedure. The consent form was only signed after participants confirmed that they had read and fully understood their rights to withdraw from the interview and to anonymity of all collected data for the current research. No data was collected until a completed consent form had been received. Participants were numbered based on the company they were in, their work position, and the sequence of interviews. Permission for interview audio recordings was sought directly from each participant and no recording was made without participants' permission.

4.3.3 Procedure

Because of the exploratory nature of the current study, it was decided to use an inductive approach for the study. In order to ensure accuracy and comprehensiveness of the author's interpretation of participants' responses, interviews and data analysis (initial coding) were carried out simultaneously.

It also facilitated the development of new interview questions in addition to the original interview schedule to probe interesting and important areas that had arisen during interview conversations. The interview process ended when the main categories and their linked sub-categories were saturated during coding. Various measures were implemented during the process to ensure the trustworthiness of the research (see Section 2.3.2 for explanations).

Semi-structured interviews and focus groups were conducted soon after the completion of the on-site observation and document analysis study in each company. A total of 55 one-to-one semi-structured interviews and 12 focus groups with three-five people in each group were carried out to obtain data. Interviews with managers were conducted at an appointed date and time. Interviews with workers were carried out during their break time. Focus groups were conducted when interview schedules were tight. It was ensured before each focus group session that the participants had the same level of job positions, for example, all participants worked as safety officers, or all of them worked as foremen. Interviews and focus groups took place either in a quiet room on construction sites or in a meeting room at project headquarters. Standard verbal introductions of the research project and the purpose of the interviews were prepared in advance for organisations' champions, managers/foremen and workers (see Appendix III for English version and Appendix IV for Chinese version). The actual interviews lasted, on average, 30 minutes (minimum: 15 minutes; maximum: 70 minutes).

Two sets of interview questions were designed separately for management and workers based on their different educational levels and the nature of their jobs. The interview protocol was designed to encourage and stimulate participants to describe their own experiences in relation to risk

behaviour at work, their perceptions of the safety management on sites, and their opinions about factors which may influence workers' rule violation behaviour. All questions were first written in English and discussed in depth with supervisors. Amendments were made whenever necessary. The questions were then translated into Chinese. The Chinese version was then back translated by three native Chinese speakers, who are also fluent in English, and have work experience within the Chinese construction industry. Suggestions for improvements of the interview protocol design with a focus on the usage of industry-specific language were sought from supervisors, colleagues with similar research interests, and experienced Chinese managers and workers in the construction industry. Necessary amendments on both Chinese and English versions were made afterwards (see Appendix VII and VIII for the English version of the interview schedule for managers and foremen as well as workers respectively. The Chinese versions of both interview schedules refer to Appendix IX and X).

Participants from each company were selected in such a way as to include senior managers, foremen, safety officers, and workers. The decision on the inclusion of new participants to any one group of job position depended on whether there was any newly emerged code from the last two participants of that particular job position group. The selection of participants within each job position group was random.

Each interview started with general questions related to current and past work experiences as well as experiences with accidents at work. Participants were then asked about their understanding of the causes of accidents at work, and ways of intervention. It was followed by questions that focused on the current existing safety management systems within the organisations which were informed by the previous document analysis; for

example, safety communication, safety inspections, and safety training. Questions on factors associated with safety rule violations and intervention methods were the focus of each interview. Information on working and living conditions was collected during each interview in order to understand how other factors, such as work-related stress and living conditions, affect participants' attitudes towards safety and safety behaviour. As mentioned earlier, the prepared questions for interviews should be used as the basis to keep conversations rolling; the actual interview questions were guided and directed by the interviewees' responses.

Throughout the interview, special care was taken to avoid directive questions and participants were always encouraged to provide meanings or reasons for their experiences. The accuracy of the researcher's understanding of participants' responses was checked several times during the interview. Before the interview session was finished, it was verified that participants had no further information or questions, and they were assured again that the conversation was highly confidential. With permission from participants, notes were taken during interviews. Notes were made in such a way that the author processed the information obtained simultaneously as the interview proceeded and key words which related to the factors that influence workers' violation behaviour, as well as links between factors, were noted on paper as codes and memos.

The author tried to use the words of respondents to label the factors whenever it was possible. Alternatively, the author named the factor based on the meaning that the responses evoked, with accuracy confirmed with interviewee. In cases of interview audio recordings being refused by participants, the author noted their responses in detail with pen and paper

during the interview. This had been permitted by each participant before the interview started. The codes and memos were also simultaneously noted.

At the end of each day of interviews, codes were read through and categorised or re-categorised into categories and sub-categories based on the links between words or phenomena. Having the summarised coding bared in mind, questions on emerged codes were added into the further interviews whenever it was necessary. For example, it was mentioned by interviewees that the rapidly developing economy in China, the huge demand in the labour market for migrant workers, the improvement in general living conditions, changes in people's attitudes towards money and being rich, migrant workers' educational level, and lack of being precise as well as lack of having the habit of following rules in the Chinese culture and so on, may all directly or indirectly affect workers' attitudes towards safety and their violation behaviour. Questions on these topics were added to the semi-structured interview protocol in order to receive diversified opinions from other interviewees on the effects of these factors. Newly-obtained interview results were always compared against the emerged coding. Memos on the links between codes were made during the process. The procedure was carried out repeatedly.

The primary aim of thematic analysis is to describe in detail the experiences and perceptions of the research participants (Guest, MacQueen & Namey, 2012). Thus, given the potential geographical and cultural differences among companies, participants from each company were considered as one particular group, and comprehensive analyses were conducted on their interview data. It facilitated the understanding of participants' experiences and perceptions within the particular context. With the comprehensive understanding of each participant, responses from all

participants were examined altogether for the research purposes. Thus, separate coding was firstly generated for each particular group of participants. It was followed by comparisons among one another, and synchronisations of separate coding into one summary of codes that comprises data from all completed interviews. Interviews within each company ended whenever there were no more additional codes emerging from the last couple of interview sessions to the summarised list of codes.

4.3.4 Data analyses

The interview recordings were transcribed in Chinese. The transcriptions, along with memos and coding that were noted during the interview process, were then imported into NViVo 9.0 (a computerised data management package, designed for the storage and analysis of narrative data) and analysed using thematic analysis. Table 10 below summarised the thematic analysis procedure carried out in this study. The analysis procedure followed the guidelines proposed by Braun and Clarke (2006), and is explained in detail in the following.

Table 10. Summary of thematic analysis procedure carried out in this study

Process of analysis	Level of analysis	Description of analysis
Familiarisation/ gaining insight	Reading transcriptions	Reading and re-reading transcribed interviews with the interviews played in MP3 mode to gain an appreciation of the whole story and recall the interviews in both a cognitive and affective sense, thereby becoming 'intimate' with the account (Senior et al., 2002). Memos were captured as reflective notes on the issues identified (Patton, 1990). Interesting or significant notes or comments were recorded.
Coding	Generating initial codes	Coding interesting features of the data in a systematic fashion across the entire data set. Grouping units of text relevant to the research question into codes. Each code was given an initial descriptive label to describe the conceptual nature of the text.
Association/ pattern recognition	Developing sub-categories	With the first two steps completed for all interview transcriptions, continuous comparisons amongst the emerged codes were conducted to identify and explain similarities and differences, thereby to cluster the codes together into different sub-categories according to conceptual similarities. Each sub-category was given a descriptive label which conveys the conceptual nature of the sub-category. Drawing associations amongst codes and sub-categories. Amendments on the emerged themes were made whenever it was necessary in order to make sense of the associations and to avoid repeated themes.
Further association/ pattern recognition	Developing categories	The step 2 and 3 were conducted repeatedly until the author was satisfied with the emerged themes and convinced that what the participants had actually said was covered. Further comparisons amongst the emerged sub-categories were conducted to identify and explain similariest and differences, thereby to cluster the sub-categories together into different categories according to conceptural similaries. Each category was given a descriptive label which conveys the conceptual nature of the category.
Reviewing themes	Checking themes at different levels	Checking themes at all levels until the author was satisfied with the final result and the overall story the analysis tells. Generating a thematic 'map' of the analysis to illustrate the associations amongst the themes at different levels.
Explanation and abstraction	Enfolding literature	Starting at an early stage of data analysis, the theory building process of "enfolding literature" was conducted. This involved an iterative and comparative process of tacking back and forth between existing theory and the data (Yanow, 2004), whilst remaining sensitive to the unique situated experiences of the participants.
Obtaining others' perspectives	Discussing themes and research topic with others	Recognising the potential personal bias in interpreting data, continuous discussions with supervisors, other researchers within the same research field, and practitioners were carried out throughout the analysis process to obtain other people's perspectives on the research topic and the emerged themes. Review the emerged themes and the thematic 'map' repeatedly, while taking other people's perspectives into account, and remaining sensitive the the original reports of the participants. Amendments to the themes and the thematic 'map' were made whenever it was necessary.
Credibility and confirmability check	Having others to read the transcriptions and to code themes	Once all the steps listed above were completed and the author was fully satisfied with the final result, one researcher and one practitioner were invited to read the transcriptions against the developed coding at their own time. Both of them have rich experiences within the Chinese construction industry. No new code emerged.
Writing up	Producing the report	Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

Firstly, each transcription was read through with the interviews played in MP3 mode by Media Player and coded with sentence analysis method; each sentence was analysed against the existing codes. Reading through the transcriptions with respective audio recording firstly enabled the author to double check the accuracy of the transcriptions, and secondly facilitated the

author in understanding the sentences with a vivid memory of the interview scenes and interviewees' emotions. This is a more systematic and rigorous analytical process compared to the coding process undertaken during interviews. Whenever there was a new code that emerged from the interview transcription, it was added to the original coding. An additional memo was written for transcriptions whenever it was necessary. This process was repeated three times in order to ensure the comprehensiveness of the coding list. It was followed by grouping different codes into bigger more abstract sub-categories according to their properties, which was repeated four times by the researcher to ensure the relatedness as well as differentiations between each sub-category were clear, and its codes were the best fit. The process stopped when all sub-categories were saturated, i.e. there was no new information emerging during coding. Once the whole process was completed, and the author was satisfied with the emerged themes, further analyses and comparisons were conducted among the emerged sub-categories of themes in order to cluster together different sub-categories into bigger categories according to their conceptual similarities. Memos made during interviews and previous analysis processes were used to facilitate the understanding and exploration of the relationships between categories and sub-categories. The emerged themes were checked numerous times, with time intervals ranging from days up to two weeks to allow fresh views on the analysis results. Meanwhile, discussions with other researchers and practitioners were undertaken to obtain different perspectives on the research topic and the emerged themes. In addition, a literature review was conducted throughout the analysis process to compare the existing theories with the obtained data. Once the author was fully satisfied with the analysis results, and the overall story that the analysis told, a thematic 'map' was

conducted to illustrate the associations among the emerged themes at different levels.

As the analysis progressed, it was noted that some participants, especially the ones with relatively good educational background, or holding management positions (senior managers and safety officers), provided the richest information and their interview information covered all existing codes. In order to discuss the coding system efficiently with other researchers and practitioners, and for consensual validation of the findings, transcriptions of interviews and focus groups with these participants (33 transcriptions in total) were given to two Chinese persons, one who is an applied psychology researcher, and the other a well-experienced former manager of a state-owned construction company. Both read them separately against the developed coding. No new code emerged.

4.4 Results

Interviews and focus groups data analyses revealed that there were four main categories of factors that had a direct or indirect influence on workers' rule violation behaviour. The four main categories were 1) individual factors, 2) managerial factors, 3) sector and labour market factors, and 4) national and cultural factors. The factors are summarised and listed below in Table 11:

Table 11. A summary of the themes emerged from the interview analyses

1. Individual factors	**2. Managerial factors**
a. Workers' past experiences	***a. Management attitudes & commitment towards safety***
i.Workers' educational experience	i. Financial investment on safety management and protection equipment
ii. Experience of working on farms before working on construction sites	ii. Immediate rectification and reform once hazards are discovered
iii. Experience of working unsafely on construction sites	iii. Repeated emphasis on the importance of safety
iv. Direct and indirect experience of accidents on construction sites	iv. Strict following of safe construction procedures and regulations under the pressure of tight working schedule
b. Workers' personal gains by violating safety rules	v. Reward system
i. Convenience and physical comfort	vi. Exemplary safety behaviour
ii. Reduced working time	vii. Genuine concern about workers' general well-being
	b. Safety training for workers
	i. The frequency of safety training
	ii. The materials used for safety training
	iii. The style of safety training
	c. Safety management policies on sites
	i. Designated responsibilities for safety on site
	ii. Inspections and immediate follow-up actions
	iii. Communication and report system
	iv. Materials and equipment management
	v. Physical environment management
3. Sectoral and labour market factors	**4. National and cultural factors**
a. Shortage of high quality workers and managers	***a. China's extremely rapid development***
i. Shortage of construction workers, especially experienced and skilled workers	i. Demand for fast completion of large scale infrastructure construction
ii. Shortage of experienced and competent managers at all levels	ii. Development of the belief of 'time is money'
b. Unregulated labour market	***b. Improved living conditions and quality of life***
i. Few workers have labour contracts	i. Improved living conditions in rural areas
ii. Labour service companies do not fulfil their responsibilities	ii. Improved quality of life and changed attitudes
c. National and sectoral health and safety management legislation and regulations as well as their implementation	***c. The Central government attitudes and commitment towards safety and 'people oriented' policy***
i. National constitutional law	i. 'Safety first' policy
ii. Sectoral health and safety management regulations	ii. 'People oriented' policy
iii. Implementation as formality	***d. Raised status of migrant workers and protection of them***
d. Hidden business 'rules'	i. The Central Government demands for raising the status of migrant workers in the society
i. Different 'cooperation styles'	ii. The Central Government-issued legislation and policies to protect migrant workers
ii. Unwritten rules for successful bid	***e. "Qing (情) Li (理) Fa (法)" (Emotion Reason Law)***
iii. Default payment	i. *Guanxi*
	ii. Lack the elements of being precise and obeying rules

4.4.1 Category I: Individual factors

Individual factors, according to the interviewees, were those having direct effects on workers' safety attitudes and rule violation behaviour. This category of factors comprised two main sub-categories; workers' own past experiences and personal gains by violating safety rules.

Workers' past experiences

All interviewees at management levels and safety officer positions reported that workers' past experiences had effects on their safety awareness and their attitudes towards rule violation behaviour which were directly associated with safety rule violation behaviour. Past experiences, summarised from interviewees' reports, comprise workers' educational experiences, workers' experiences of working as farmers in their hometown before working in cities, workers' experiences of working unsafely without proper training on other construction sites – in most cases construction sites in small towns and cities – and workers' direct, as well as indirect, experiences of accidents on construction sites.

Workers' educational experiences

Interviewees repeatedly mentioned that one of the main reasons for workers' lack of safety awareness is their low educational levels. Interviewees explained that general education provides a person not only knowledge but also improves his or her overall quality as well as his or her understanding of the surrounding situations. Interviewees believe that low educational level limits workers' abilities in judging hazardous levels while they are working, hinders them from learning training materials, and restrains their understanding of the importance of safety rule compliance while working. As one project manager (participant 24) reported:

"Right now my biggest challenge at work is workers' training. They just don't understand. Some of them can't even write their names."

Experiences of working on farms before working on construction sites

Interviewees reported that because of their past experiences working on farms, and lack of work experience on construction sites, some new workers had little safety awareness which could have affected their attitude towards safety.

A project manager (participant 13) mentioned:

"Many new workers had no knowledge of the construction industry before coming to work and they have no basic required skills for working on construction ... they were holding a hoe working on farms yesterday and today they are construction workers working on construction sites. How could these people have safety awareness?"

In addition, interviewees explained that working on farms cultivated workers' lack of discipline and rule compliance awareness. It could cause difficulties for workers to comply with safety rules on sites, and could also generate negative attitudes from them towards safety rules, which in turn could affect their attitudes towards rule violation behaviour.

Another project manager (participant 24) reported:

"Most of the construction workers have worked since they were kids on farms but very little on construction sites ... these workers are used to doing whatever they feel like doing. They are not used to being disciplined."

Experiences of working unsafely on construction sites

Most managers and safety officers stated during the interview process that some workers violate safety rules on sites because they had previously worked unsafely for a long time and nothing had happened to them. It made workers believe that there would not be any accident even if they continued working the same way. As a safety manager (participant 2) mentioned:

"They [some workers] have low safety awareness and self protection awareness ... Some old workers think they have worked that way for so many years without an accident, nothing will happen. It seems to me that some workers really hold themselves as supermen with no fear at all."

In addition, many interviewees believed that because some workers worked unsafely for a long time without being told how dangerous it was, the unsafe behaviour became part of their work habits. For example, a site manager (participant 53) mentioned:

"Previously, people on construction sites paid less attention on safety and the enforcement of safety regulations was less stringent. Some workers who have worked for a long time on construction sites have developed their bad habits."

Direct and indirect experiences of accidents on construction sites

Interviewees reported that direct and indirect experiences of accidents on construction sites could affect workers' safety awareness and, in turn, their behaviour. It was believed by interviewees that direct personal experience, for example, having personal injury or witnessing a fatal accident of closely related colleagues, was most effective in raising safety awareness and changing attitudes towards rule violation behaviour. For example, a worker (participant 59) who witnessed a fatal accident of his colleague stated:

"I have experienced [accident] before. Things fell off the tower crane while they were being lifted and dropped on a worker. The worker died instantly ... I was very scared. That worker was also from my hometown. Since then I have always been very careful."

Indirect experiences, such as being told about accidents by other colleagues, or by safety officers at training, on the other hand, were considered by interviewees less effective, especially in the long run. For example, a site manager (participant 10) mentioned:

"We often show workers case study videos. The case studies we choose are the ones with a similar work environment as our site ... It can strike an alert bell to the workers ... Workers obey safety rules for a few days afterwards. However, the effects don't last long."

Personal gains by violating safety rules

Interviewees reported that one of the direct causes for workers' violation behaviour was their immediate personal benefits by carrying out such behaviour. These benefits, summarised from interviews, include convenience while working, workers' physical comfort, and reduced working time.

Convenience and physical comfort

It was widely perceived by managers and safety officers that workers very often violated safety rules (e.g. not wearing safety helmet or safety belt) because they found it easier and more comfortable to work without them. For example, a project deputy manager (participant 23) mentioned:

"Some workers don't wear safety belts when they work at height ... because it is inconvenient for them to work with a safety belt."

Another project deputy manager (participant 87) mentioned:

"In summer it is very hot here. Very often you see workers on site doing their work without safety helmets or safety jackets."

Reduced working time

It was also repeatedly mentioned by managers and safety officers that reducing working time was another motivation for workers to take shortcuts and violate safety rules. For example, a safety manager (participant 76) reported:

"They [the workers] just want to finish their work earlier and faster. It is clearly written on the crane that the maximum loading allowance is 40 tons but he loads 60 tons so that he can reduce the number of times of lifting, and in doing so finish his work earlier."

4.4.2 Category II: Managerial factors

Apart from individual factors, interviewees also reported several managerial factors within organisations that had a direct effect on workers' safety attitudes and, in turn, their violation behaviour.

Management attitudes and commitment to safety

It was widely thought among the interviewees that managers' attitudes towards safety had a great influence on how managers made decisions about safety management, how workers under their management valued safety, and in turn, how they behaved at work. According to interviewees, management attitudes and commitment towards safety is reflected from various aspects of safety management in daily work settings. These specific aspects are explained below.

Financial investment on safety management and protection equipment

Safety management costs money. According to the interviewees, some managers are not willing to invest in safety because the outcome is less

obvious than investment on construction quality. Interviewees repeatedly mentioned that management attitudes and commitment towards safety determined the amount of financial investment on safety management and protective equipment. A project deputy manager (participant 87) mentioned:

"I think the main issue is management attitudes towards safety. If they really consider safety as the top issue, they will naturally invest money on it."

Interviewees stated that the amount of safety management budget was required by the official Construction Projects Safety Management Regulations to be a fixed percentage of the total project budget, normally 1-3.5%. It is designated money for the purpose of safety management only. This rule applies to all construction projects. However, some other interviewees provided another side of the story. According to these interviewees, although there are detailed regulations on safety management budget for construction projects, the implementation of those regulations depends on management attitude and commitment towards safety. For example, a third party inspector (participant 5) reported:

"According to the regulations the money is for safety management purpose only. It is implemented well in big cities, but not in remote cities and towns. There is always a way to save the money or use it for other purposes if one wants. It all depends on the project manager's quality and attitudes."

Having said that, it was also explained by a third party inspector (participant 5), along with a number of other interviewees, that construction companies, especially private companies, now gain little profit and this causes difficulties for them in investing money in safety. As the inspector (participant 5) explained:

"... it's all because the profit is too low. Their unwillingness to invest is one thing; they [managers] also have no money to invest ..."

A site manager (participant 22) mentioned:

"... how do construction companies invest [in safety management] under situations of deficit?"

Interviewees commented that a lack of financial investment on safety equipment may lead to, for example, poor quality safety helmets and safety nets, little or poor safety training, and a lack of designated people responsible for safety. Interviewees believed that with poor safety management workers can hardly perform safely during their work. As one project manager (participant 24) mentioned:

"On some construction sites there is not even one safety officer, let alone good quality safety equipment and safety training. All of these need investment ... How do you expect workers on these construction sites to behave safely while working?"

Immediate rectification and reform once hazards are discovered

One criterion repeatedly mentioned by interviewees when they were asked to further explain how they judge if managers pay great attention on safety or are committed to safety management was managers' immediate action once hazards were discovered. As a foreman (participant 21) explained:

"Management is very strict on this construction site ... Whenever there is a problem discovered, immediate rectification and reformation take place. Otherwise, managers stop construction completely until they find a solution.

That is why there is no accident on this site, and very few workers disobey safety rules."

Repeated emphasis on the importance of safety

Another aspect mentioned by workers and managers to describe managers' safety attitudes and commitment was management's repeated emphasis on the importance of safety. As a worker (participant 6) mentioned:

"Managers here pay great attention to safety ... there are meetings every day reminding us to pay attention to safety issues on site. Managers remind us the importance of safety at all possible occasions."

Managers and safety officers believed that repeatedly reminding workers of safety issues was a very efficient method to keep workers alert and to reduce safety rule violations and accidents. As a safety manager (participant 38) reported:

"... [managers] must repeat again and again the safety issues to workers, reminding them how important safety is ... only with this method can safety be controlled well."

Strict following of safety procedures and regulations under the pressure of tight working schedule

Interviewees reported that management attitudes and commitment towards safety could be reflected by how managers treat safety procedures and regulations under the pressure of tight working schedules. All managers, including senior managers and foremen, mentioned that there were very tight working schedules and high production pressure. Meanwhile, they all agreed that if managers genuinely placed safety as the top priority, they

would never compromise safety for fast completion of projects. As one project manager (participant 13) mentioned:

"No matter under what circumstances, safety always comes first. We emphasise construction under the premise of guaranteeing safety. I always remind our managers that they should never rush blindly to complete projects."

Reward system

A reward system encouraging safe production was another issue relevant to management attitudes and commitment towards safety mentioned by interviewees. Interviewees believed that it showed managers' orientation in the conflict between safety management and production. As a safety officer (participant 42) explained:

"We have a reward system especially for rewarding workers and teams who behave continuously safely ... Managers set up this reward system because we want to encourage workers to work safely, but not only quickly."

Exemplary safety behaviour

Interviewees believed that managers who paid great attention to safety and were committed to safety management were the ones who themselves followed strict safety rules and set themselves as examples for workers to follow. As a worker (participant 8) mentioned:

"Managers on this site pay great attention on safety. They don't only tell us to obey safety rules. They also follow the rules very strictly. They set us a good example."

Genuine concern about workers' general well-being

Interviewees said management attitudes and commitment towards safety could be shown as management genuine concern about workers' general well-being. To show their concerns about workers' general well-being, some managers strived to provide workers comfortable living conditions, while some other managers demonstrated their concerns about workers' general health by providing workers with drinks and watermelons to prevent heatstroke in summer as well as reminding workers the importance of maintaining their health and safety. Interviewees reported that management genuine concern about workers' general well-being could improve workers' safety behaviour. For example, a project manager (participant 13) mentioned:

"If you care about them, workers can feel it and they would also care about themselves. Consequently, workers will work safely and happily on site. Being happy and stress-free is also an important factor of ensuring safety on site."

According to the interviewees, management genuine concern about workers may not only ensure workers' safe behaviour, but also attract workers to join the company and reduce workers' high turnover rate. For example, when a worker (participant 15) was asked why he decided to quit his previous job and join the present company, he answered:

"My friend told me that the managers in this company are very nice and working for them is safe. My friend also told me the managers here really care about workers' well-being."

Safety training for workers

Safety training for workers is another sub-category of managerial factors. Managers and safety officers believed safety training was an

important way to raise workers' safety awareness and change their attitudes towards safety. As a foreman (participant 61) explained:

"We need to frequently give them [the workers] training, and frequently tell them the severe consequences of disobeying safety rules. Only when they really understand the logic and the severe consequences can they actively follow safety rules."

However the effectiveness of training on workers' safety attitudes, according to interviewees, depended on the frequency of the training, the materials used, and the style of training.

The frequency of safety training

Interviewees reported that safety trainings need to be provided with high frequency in order to maintain their educational effects. For example, a safety officer (participant 1) explained:

"[We need to] strengthen our education, every day repeatedly explain to the workers the importance of safety ... if we don't remind them for a day or two they forget."

However, although frequent reminders of safety and safety training are believed to be effective in raising workers' safety awareness, some interviewees mentioned that frequent safety training could also generate antipathy among a small number of workers towards safety management and safety training. As a safety officer (participant 56) stated:

"Our job is to talk every day, every month [about safety issues] ... Sometimes workers get annoyed by us. Some told us that they did not have time to listen to us."

Materials used for safety training

Given workers' limited educational level, in order to attract workers' attention and make them understand the training content, interviewees believed that the materials used for safety training was important. For example, a project deputy manager (participant 23) mentioned:

"Workers' educational level is limited. In order for them to understand and accept training, the method you use is very important ... One can use pictures, or show them videos of real scenarios or accidents. These will shock the workers. Once they are shocked they will pay attention."

The style of safety training

In addition to the materials used for safety training, the style of safety training was also believed to be essential for workers' understanding and acceptance of safety education. Interviewees at management levels reported that simply preaching to workers about the importance of maintaining safety had little effect on changing workers' attitude towards safety. Instead, safety trainings need to be delivered using the language that workers understand and targeting at workers' concerns. For example, a foreman (participant 53) explained:

"When we talk to them about safety issues we tell them things they could understand. I ask workers to imagine the picture of their parents, wife, and kids waiting for them outside their houses. I explain to them if they had accident they would never have chance of earning money, sending their kids to universities, and seeing them get married ... Workers understand when I tell them these kinds of things. If you tell them about company's reputation or industrial legislation and regulations, they would not understand."

Safety management policies on sites

Another managerial factor reported by interviewees was safety management policies on sites. Interviewees, especially managers and safety officers, repeatedly mentioned the importance of safety management policies in shaping workers' attitudes towards safety and regulating their behaviour on sites. Safety management policies reported by interviewees covered several aspects of management, including the management of people and communication, the management of materials and equipment, and the management of physical environment.

Designated responsibilities for safety on site

The majority of interviewees believed that every person who worked on a construction site had responsibilities to keep themselves, as well as others, safe. In order to ensure that every person understood their individual responsibilities, managers mentioned that it was important to designate unambiguous responsibilities and explain to each individual what these responsibilities were in a clear way. In addition, some interviewees explained that clearly designating safety management responsibilities also entails empowering each individual, including workers, to fulfil their responsibilities and to refuse rule violation demands from the superiors. Interviewees believed that with these kinds of policies workers can learn to take their own responsibilities in protecting themselves. For example, a project manager (participant 13) stated:

"Because everybody has clear responsibilities, including workers, and workers have the rights to refuse to work unsafely, workers pay more attention to their own safety, and are less likely to disobey safety rules."

Inspections and immediate follow-up actions

Stringent inspections and immediate follow-up actions have been considered by all interviewees as one of the most effective methods of ensuring high safety levels on site. When they are carried out appropriately and comprehensively, according to interviewees, inspections and follow-up actions could raise workers' safety awareness and effectively control workers' rule violation behaviour. As a safety manager (participant 55) stated:

"Inspection is very important ... Our safety management policy is that safety officers stay on site 24 hours a day conducting inspections. Once safety officers spot any rule violation behaviour they take a picture. They will give first a warning. If workers continue their behaviour there will be a financial penalty. And if it still does not change anything, the worker will be fired ... Workers are afraid of us, but it makes them remain alert and afraid of performing any rule violation behaviour."

However, there were also a number of interviewees who reported that in the current situation, where there was a big shortage of workers in the labour market and a huge demand for construction workers on construction sites, penalties or any other punishment methods were less effective than they were previously. According to interviewees, workers may immediately quit their jobs once safety officers execute penalties on rule violations. As one site manager (participant 22) explained:

"When we ask the worker to pay the penalty the worker immediately asks to quit his job. He leaves our construction site at this moment and across the road he will get another job straight away ... So a penalty is not always that effective anymore."

<u>Communication and report system</u>

Interviewees mentioned that having open communication and reporting channels among workers, managers, and safety officers could enable the discovery of hazards at an early stage. It could also enable managers to acknowledge workers' concerns, and to encourage workers to take their responsibilities as well as active roles in self-protection.

A safety manager (participant 57) stated:

"We pay great attention on communication with workers. We listen to their concerns and suggestions ... we encourage workers to report immediately any hazard once it has been discovered to any manager or safety officer, regardless of their positions. In this way, workers really feel that they have the power to be in charge of their own safety, and they also pay more attention to their own safety."

Materials and equipment management

Materials and equipment management, according to the managers and safety officers, is another important element in safety management. It is exceptionally important in China, as reported by interviewees, because of the large number of low quality and fake commodities.

A senior manager (participant 39) mentioned:

"In relation to materials and equipment, our headquarters sets its own standards, all of our daughter companies, as well as subcontractors, have to purchase things that meet our specific standards. Nowadays there are many low quality fake commodities on the market; there are safety helmets that cost over 100 RMB each and there are safety helmets look almost the same but cost 3 RMB each."

In addition to the management of purchases of materials and equipment, interviewees also mentioned the importance of the safety management policies in relation to the use of equipment. For example, a site manager (participant 32) mentioned:

"It is required by the company that each crane is used by designated workers only. No other workers are allowed to touch the machine."

Physical environment management

Interviewees reported that physical environment management is also important in eliminating potential hazards and in keeping safety levels on construction sites. Interviewees explained that although these requirements do not directly target rule violation behaviour, management attitudes and commitment towards safety can be well observed through management of the physical environment. For example, a safety manager (participant 38) mentioned:

"We require workers to tidy up their surroundings every time after their work and to ensure there is no potential hazard. Workers can only leave the site after their foremen has checked ... it is all part of safety management, we need to pay attention to all aspects. Workers can also see how much we value safety and how much effort we put in."

In addition to the physical environment on site, interviewees reported that the management of the physical environment within living areas are equally important. For example, a safety officer (participant 11) reported:

"Our company now uses central heating in all of our accommodations. No one is allowed to use personal electric heating or electric blanket."

4.4.3 Category III: Sectoral and labour market factors

Sectoral and labour market factors, according to interviewees, cover issues that have more direct effects on managerial factors and consequently an indirect effect on workers' safety attitudes and rule violation behaviour. There are four factors included in this specific category and they are introduced separately below.

Shortage of high quality workers and managers

One of the sector and labour market factors reported by the majority of interviewees was the shortage of high quality workers and managers. The construction industry has grown extremely fast in China during the last decade, and it is still increasing. With the fast development of the Chinese construction industry, the shortage of people to carry out the work was considered by interviewees as one of the biggest problems. For example, one project manager (participant 13) stated:

"Construction in China is building fast and on a large scale. There are, however, not enough people to do the work. This is a very big problem."

Shortage of construction workers, especially experienced and skilled workers

It was widely reported by the interviewees at management levels that there has been a big shortage of workers in the Chinese construction industry. For example, a project manager (participant 71) stated:

"Fast development demands a huge number of construction workers. Since 2005 there has been a big shortage of construction workers, especially experienced and skilled workers."

According to interviewees, a shortage of construction workers has generated various human resource management difficulties for construction

companies. All interviewees at management positions, with no exception, mentioned that it was extremely difficult to manage workers nowadays. The shortage of workers leaves employers no opportunity to select appropriate skilled workers for the job. As a foreman (participant 90) described:

"There aren't enough workers so we can only hire whoever comes to us."

Interviewees at management levels explained that because of the shortage of workers construction companies had to lower their recruitment criteria in order to meet the high demand for workers in the industry. In addition, the high demand for workers to carry out the jobs within a short period of time leaves companies little time for systematic training for workers. As a result, workers lack of adequate safety and skills training before they start their jobs on site. For example, a site manager (participant 93) mentioned:

"Because anyone can come and work on construction sites, the overall quality of personnel on construction sites is low ... and there is no time for systematic training; workers can only learn while they work. That's why sometimes workers just don't know the potential danger that may be caused by their behaviour."

Shortage of experienced and competent managers at all levels

In addition to the shortage of construction workers, interviewees reported that there is a shortage of experienced and competent managers at all levels in the industry. A project manager (participant 36) reported:

"It is required by legal regulations that managers at different levels need to have appropriate certificates in order to be at that position. But in reality,

many people do not have those certificates. We just don't have enough people to do the job. Things are developing too fast."

Similar to construction workers, because of the high demand for managers in the industry, interviewees reported that there is little time to provide systematic trainings to managers at all levels. A project deputy manager (participant 12) mentioned:

"... very often foremen are workers who have a few years of experience. They haven't had a good education or systematic training."

Interviewees explained that managers' lack of trainings and incapability may have a negative effect on the quality of trainings that are delivered by managers to workers. For example, a project manager (participant 36) mentioned something similar:

"Some people who give training to workers are not well-trained themselves. I sometimes wonder how much they know about safety protection"

Unregulated labour market

An unregulated labour market in the construction industry was mentioned repeatedly by managers during interviews. It was considered as one of the root causes for workers' lack of training, high turnover rates, and management difficulties faced by construction companies.

Few workers have labour contracts

Many managers stated during interviews that most workers do not have labour contracts and that is how they have earned their name 'temporary labour'. It was considered by interviewees as one of the aspects of

unregulated labour market. As one project manager (participant 83) explained:

"Workers almost always left their hometowns with one leader who was normally the foreman. Workers and foremen have no legitimate labour contracts. They just have an oral agreement on how much the worker gets paid each working day before coming to cities."

When managers were asked why they did not force workers to sign contracts, managers explained it was because of the limited restrictive power of labour contracts. According to the interviewees, there are three main factors that cause the limited power of labour contracts: 1) companies have little time to sue each worker who violate labour contract, 2) there are limited number of legal officials dealing with the cases of workers violating labour contracts, 3) the Central Government places a great attention on protecting the vulnerable group of labour force – workers, but provides limited legal support to employers. For example, a focus group of managers (participant 83, 84, 85, 86) expressed:

Participant 83: *"It is impossible to apply labour contracts on workers ... No company has the time to sue each worker who violates the contract."*

Participant 85: *"There aren't enough legal officers to deal with all these cases anyway."*

Participant 86: *"The new labour law is in favour of workers ... if the worker violated his contract, no company would sue him and the company had to pay the worker straight away once he quits to avoid further complications."*

One direct effect of little legitimate power to restrain on employment relationships, as explained by managers during interviews, is high turnover rate of workers. As one project manager (participant 2) mentioned:

"Workers now come and leave whenever they want ... workers nowadays have no problem getting another job on different construction sites."

According to the managers, workers' high turnover rates generate potential hazards on construction sites because new workers have limited experience in the new working environment, as a safety manager (participant 13) mentioned:

"... most accidents happen on the first few days after the workers started to work, because they are not experienced on the new construction site. Every site is different."

High turnover rates also generate difficulties for training provision, as one manager (participant 53) explained:

"... we need to provide training for each new worker, but almost every day there are workers leaving and new workers coming. It is very time consuming."

Having little management control over workers makes it difficult for managers to require workers to strictly follow safety rules and regulations. Interviewees mentioned that when some workers are annoyed by strict regulations they may quit their jobs. Given the shortage of workers on construction sites and the tight working schedules, workers leaving their jobs may cause severe problems for construction companies in proceeding construction work smoothly to meet the deadlines. As one safety manager (participant 41) mentioned:

"... if the workers are not happy with our regulations they just take their money and leave, and when they leave they leave in a group ... it is very difficult nowadays to manage workers ... you can't require them to do anything, you just have to talk to them very nicely again and again, even then, if they get annoyed by your talks, they leave."

Although all managers mentioned the difficulties in managing workers, when they were asked how general these cases were, managers confirmed that only a small number of workers cause trouble. However, managers also mentioned that even though it was a small number, it caused enough trouble for managers in their daily work life and had very negative effects on other workers.

Labour service companies do not fulfil their responsibilities

Interviewees reported that one of the reasons for the unregulated labour market was the poor services given by labour service companies. A project manager (participant 36) reported:

"... if the labour service companies have fulfilled their responsibilities the labour market would not be such a mess."

National and sectoral health and safety management legislation and regulations and their implementation

National constitutional law

Managers and safety officers repeatedly mentioned during the interviews that the newly-amended national constitutional law in relation to the sanction of responsible persons for severe accidents at workplace has altered their attitude towards safety management and accident. For example, one project deputy manager (participant 23) stated:

"The government has recently issued new legislation which clearly states that the responsible persons for severe accidents will face imprisonment. This is very effective ... nowadays what we are most afraid of is an accident."

Sectoral health and safety management regulations

In addition to national constitutional law, managers and safety officers reported that there were comprehensive sectoral health and safety management regulations to regulate health and safety management decisions and activities on construction sites. As one safety manager (participant 5) reported:

"There are now all kinds of very detailed legislation and regulations in relation to health and safety management in the construction industry."

Implementation of legislation and regulations as formality

Although there is comprehensive sectoral health and safety legislation and regulations, managers and safety officers reported that the implementation of such legislation and regulations is problematic. Interviewees believed that workers' unsafe behaviour could be a result of poor implementation of legislation and regulations by construction companies. For example, it was considered that on some construction sites, training and inspections were a 'mere formality'. As one project deputy manager (participant 12) reported:

"It is an official requirement that all workers, before they begin their work, need to receive 'three level' training, but very often it is mere formality in order to have the documents ready for government inspections. I know companies where workers are given answers for their training evaluation

tests. Some workers can't write, they just ask people to copy the answers for them. At the end of the day, the managers did what it is required and if anything happens, it's not their responsibility. It's all just a show."

Meanwhile, some interviewees explained the difficulties in fully implementing the existing legislation and regulations given the reality of workers' low educational level. For example, a safety manager (participant 2) explained the difficulties of delivering and evaluating training:

"... sometimes it is quite difficult to make the workers do those tests. They can't even write their names, how can they do the test? This is just the reality."

Some interviewees believed that poor implementation was a result of unrealistic standards. According to interviewees, some of the existing safety management regulations and standards adopted from developed countries are not suitable for the reality of the Chinese construction industry. Therefore, in reality, the implementation of different regulations becomes flexible, and much work is being done for show in order to appear as having met the targets or standards. For example, a project manager (participant 84) commented:

"Government institutions set all kinds of regulations and standards just like the ones in western countries. But these management concepts very often are not suitable for Chinese companies, and the standards are way too high for the reality of Chinese industries. Some standards are simply impossible to meet."

Poor implementation of relevant legislation and regulations happens not only in construction companies. Inspections by official inspectors were also

reported by the interviewees as being "sometimes just for show", especially in small cities and rural areas. One site manager (participant 5) mentioned:

"To be honest, inspections on some construction sites in small cities and rural areas are just for show. Inspectors inform construction sites' managers of their visits before going there. Then inspectors come and walk around. People take some pictures. Then all the important people have a meeting over lunch or dinner banquet. That is the procedure of inspections."

Some interviewees explained that conducting inspections for show could help construction project managers to avoid punishment and it is a way for inspectors to shift their responsibilities. One safety manager (participant 2) reported:

"... in small cities and rural areas, very often, you find the construction project manager has close connections with local authorities, and inspections on those sites are just for show ... actually it is just a method for shifting responsibilities. He [the inspector] carried out inspections, and executed fines. If there is an accident, it would not be his responsibility."

Hidden business 'rules'

Almost all interviewees in a management position mentioned there were "hidden rules" in the Chinese construction industry, which generate various problems in the industry and "give construction companies a hard time".

Different 'co-operation styles'

One of the hidden rules mentioned by interviewees was different 'co-operation styles'. The 'co-operation' could be at organisational level as well as between organisation and individuals. One example of the 'co-operation' was that construction companies or labour groups that do not

have adequate qualifications pay other companies or individuals solely to use their names. As a project manager (participant 36) reported:

"The construction industry is in a mess ... There are those anchored companies and labour groups that do not have adequate qualifications themselves. They pay a certain amount of money to a bigger company that has those qualifications and work with that company's name. Some companies do not have enough qualified engineers and as a result are not able to receive certain qualifications. They pay engineers outside their companies just to use their names."

Another example of the 'co-operation' reported by interviewees was multi-level sub-contract by different construction companies or labour groups. Such 'co-operation' cause not only difficulties in maintaining high management standards on site, but also exploitation each time the work is passed down the chain. As a result, the construction companies or labour groups have little financial resources to invest in safety management. As a site manager (participant 22) explained:

"Construction projects in China are contracted to one company and then sub-contracted and sub-sub-contracted to different companies or labour groups. Each time the work is passed down the chain, the contractor exploits the sub-contractor ... So when the work comes to the final sub-sub contractors, there is almost no profit for them."

Unwritten rules for successful bid

Unwritten rules for a successful bid were another scenarios very often mentioned by the interviewees. Interviewees reported that illegal bidding exist in different forms, for example, surround-bidding, forging bids and accompanying-bidding. Through the illegal bidding process, corruption is

severe. One direct consequence of illegal bidding, according to the interviewees, is that projects' payments are much lower than they should be and consequently, construction companies have little money for safety management. A project deputy manager (participant 12) reported:

"They [investors] all say that they want good quality construction companies to do their projects, but in fact, we all know they almost always choose the company with the lowest price. It forces us to endlessly lower our price. It becomes vicious competition. And after the company wins the bid, it has to cut all kinds of costs as much as possible in order to make a tiny bit of profit. That is why many companies have no money to invest in safety. In some small cities or remote areas, bidding is just a show. The decision was already made before the bid. Corruption is severe."

Default payment

Managers reported that default payment is one of the biggest problems of doing business in China; and the problem is even more severe in the Chinese construction industry as a result of many social and industrial issues. As a general problem in the Chinese business world, default payment exists in a vicious circle. According to interviewees, construction workers are the victims at the end of the default payment chain and it affects workers' emotions to a great extent. As reported by one safety manager (participant 89):

"It is normal to wait for a couple of years for the payment from the client. But very often the client is also waiting for money from someone who owes them money. It is a vicious circle ... in the end, workers don't get paid on time ... these things also affect workers' emotions, which cause difficulties for us to manage them."

4.4.4 Category IV: National and cultural factors

National and cultural factors were reported by interviewees as the fundamental explanation for the existence of many issues in safety management on construction sites and the labour market as well as in the construction industry. Some of the factors, according to interviewees, had direct effects on workers' safety attitudes and self-protection awareness.

Extremely rapid economic development

When interviewees were asked to give their opinions about the root cause of difficulties in safety management, China's extremely rapid economic development was often their answer. Rapid economic development, according to interviewees, could affect the size and speed of construction as well as some people's perception and judgement of achievement and success.

Demand for large scale infrastructure construction

One direct outcome of rapid economic growth in a huge country like China, according to interviewees, was the huge demand for large-scale infrastructure construction. For example, a project manager (participant 13) mentioned:

"Now the scale of underground construction is extremely big and construction projects are carried out more or less at the same time. Take Beijing as an example, it was planned to complete 516km underground construction by 2015 and 1,050km by 2020 ... Meanwhile, there are supporting facilities such as the underground passage and underground highway that need to be completed in order to reduce the traffic in Beijing ... And there are highways, railways, bridges, tunnels, residential buildings,

schools, hospitals, economic development zone, science and technology development zones, and so on."

Demand for fast completion

According to interviewees, extremely rapid economic development demands not only large-scale infrastructure constructions, but also rapid completion of these constructions. Such demand places a huge pressure on managers of construction companies. For example, a project manager (participant 86) mentioned:

"The project we are working on, in western countries, would take eight-10 years, but we have to finish it within three years. Now, hundreds of new cars are going on to the road in this city every day ... The city just can't wait for eight years ... We want to take our time, but we can't. China is now developing so fast. So we all need to be fast."

Development of the belief of 'time is money'

Extremely fast economic development, according to interviewees, also affects people's general value of life. Many people aim blindly for 'fast'. For example, a site manager (participant 31) mentioned:

"China is now developing very fast in many aspects. Many people aim blindly for 'fast'. Thus, everything is about doing things quickly in China now. It's not just the construction industry, but in every industry, even in everyone's daily life. The country wants fast development, the whole society wants fast advancement, companies want quickly enlargement, everyone wants to get rich quick."

Interviewees reported that with the fast economic development in the past twenty years, 'time is money' has become a commonality in the Chinese

society. In some cases, people are willing to take risks at high potential cost driven by the desire of being rich in the shortest time possible. As a site manager (participant 31) mentioned:

"Fast means reduced time, which means money! Time is money! Some people changed from penniless paupers to millionaires in a few years. It makes some not yet rich people strive to become rich in the shortest time possible and at any cost ... They are willing to gamble in the face of high financial rewards."

Improved living conditions and quality of life

Interviewees believed that China's rapid economic development improved living conditions and the quality of life for the population across China, including rural areas. Such improvements, explained by interviewees, had direct effects on the labour market in the Chinese construction industry as well as on people's attitudes towards health and safety.

Improved living conditions in rural areas

Many interviewees mentioned that in addition to the huge demand for labour in the construction industry across China, improved living conditions and quality of life in rural areas was another reason for the shortage of migrant workers in the labour market. Interviewees explained that because the Central Government had been striving to reduce the disparities between cities and rural areas, people in rural areas could make a good living in their hometowns and there is less need for them to migrate to cities for job opportunities. As a safety manager (participant 2) explained:

"In recent years, with the economic development, people's living conditions have improved dramatically across China. In most rural areas,

people can have a good quality of life ... Now people can find jobs in their local areas ... Many workers don't want to work in big cities anymore."

In addition, interviewees explained that as a result of improved living conditions the new generation of migrant workers are unwilling to take on difficult jobs on construction sites. It is also a reason for the shortage of workers in the Chinese construction industry. As a project deputy manager (participant 23) mentioned:

"The younger generation has much better living conditions comparing to the older generation ...You don't see that many young workers on construction sites. Young workers often find work on construction sites too tiring and bitter."

Improved quality of life and changed attitudes

Most interviewees said that the overall life quality in China had improved dramatically in the past 20 years and it had changed people's attitudes towards life and their values of life. As one project deputy manager (participant 23) mentioned:

"The overall life quality in China has improved so much in the past few years. It is not about making money to survive anymore, but to improve life quality even more. With improved overall life quality, people now value their lives much more than before."

The Central Government attitudes and commitment towards safety and 'people oriented' policy

Interviewees repeatedly mentioned that the Central Government has now changed its attitudes towards safety; new policies all emphasise the importance of safety and the protection of people. Interviewees believed that

with the government's shifted attention from "mass production" to "scientific development concept" and "people oriented policy", government officers, managers in all industries, as well as people in general, begin to change their attitudes towards safety, their management methods, and their personal behaviour.

'Safety first' policy

Interviewees reported that the Central Government now repeatedly emphasises "safety first" and has made it the policy of safety management in China. It shows the Central Government attitudes towards safety which is very different from decades ago when the focus was on mass production at any cost. For example, a project manager (participant 24) stated:

"Nowadays the Central Government attitudes towards safety are different than before. Decades ago it was all about mass production, ignoring costs ... Now the whole society has moved forward. The Central Government has also realised the importance of safety. Thus, it is repeatedly emphasised by the Central Government and other relevant institutions that, no matter what, safety is the top priority."

'People oriented' policy

In addition to the 'safety first' policy, interviewees reported that unlike the old days when people's mission was to protect nation's property, the current government emphasises 'people oriented' policy and considers people's health and safety as the most important issue. The alteration of the Central Government's policies is the result of the society advancement, and it demonstrates the shift of people's attitudes towards health and safety. As a project manager (participant 24) mentioned:

"In the old days, if there was a fire in a factory, instead of running out to escape, people would run in to save nation's property. Now the belief has totally changed ... Now the government says no matter what you do, you must follow the 'people oriented' policy; people's lives are much more important than anything else."

Raised status of migrant workers and protection of them

Another national factor associated with workers' attitudes towards health and safety mentioned by interviewees was the raised status of migrant workers in the society and government's emphasis on the protection of them.

The Central Government demands for raising the status of migrant workers in the society

In addition to the improved life quality, interviewees also mentioned that the changed social attitudes towards workers have effects on workers' attitudes towards their own health and safety. As one project manager (participant 13) mentioned

"... the Prime Minster repeatedly emphasised in public that the whole society needs to protect 'migrant workers' ... people in cities now pay much more respect to workers ... it helps workers to respect themselves and their own safety."

The Central Government-issued legislation and policies to protect migrant workers

In addition to the demands for raising status of migrant workers in the society, many interviewees reported that the Central Government had also issued several pieces of legislation and policy in the past few years to protect migrant workers in order to achieve a harmonious society and eliminate

unfair treatment of migrant workers both at workplace and in the society. A site manager (participant 22) mentioned:

"The Central Government has issued several policies to ensure the protection of migrant workers and to improve their quality of life ... this is also for the purpose of creating a harmonious society and ensuring the stability of the society."

Qing (情) Li (理) Fa (法) (Emotion Reason Law)

One safety manager (participant 38) cited the phrase "Qing Li Fa" (Emotion Reason Law) during his interview. He believed that this phrase was a highly abstract but accurate summary of the deep elements of Chinese culture and was embedded in Chinese people's daily life as well as in business and management activities. This manager, along with several other interviewees, explained with their individual perspectives the influence of "Qing Li Fa" in the Chinese construction industry.

Guanxi

Guanxi is an important cultural element in the Chinese society. It literally means 'relationships'. It is the relationship or the network of relationships among each individual, as well as among various parties that co-operate together and support one another. Interviewees explained that *guanxi* is very much associated with the concept of Qing Li Fa. Interviewees reported that because Chinese people place Qing (Emotion) at the first position prior to Fa (Law) as a method of dealing problems, people tend to seek *guanxi* instead of seeking formal procedures whenever there is a problem. The use of *guanxi* is very common in the daily life in the Chinese society. In the construction industry, having a good *guanxi* with local authorities and investors may help construction companies win biddings on

construction projects, and avoid being punished in cases of violations of safety regulations. Thus, *guanxi* is associated closely with many aspects of safety management in the Chinese construction industry and indirectly links to workers' violation. A senior manager (participant 39) mentioned:

"I think the problem of "Qing Li Fa" is the root cause of many current social issues in China ... Chinese are very emotional and have low awareness of legality. Whenever there is a problem, the first thing people think about is to seek guanxi instead of seeking formal procedures."

Lack the elements of being precise and obeying rules

Interviewees reported that because Fa (Law) is placed at the end of the sequence of Qing Li Fa, there is a lack of being precise in the Chinese culture. For example, a project manager (participant 85) reported:

"Chinese mentality is that as long as something is usable or able to get by it is all right; there is a lack of the spirit 'striving for precision and perfection'. This is a common mentality and is related to many other traditional concepts."

In addition, interviewees believed that because Fa (Law) has lower importance in the Chinese mentality, Chinese people are reluctant to obey rules. For example, a project manager (participant 84) mentioned:

"Deep down, Chinese are reluctant to follow rules or regulations. You ask them to do something they may do it once as you told them, but, almost certainly, from the second time they start to think of ways for shortcuts. Chinese care more about practicality. Rule compliance is just not in the Chinese culture."

A large number of interviewees believed that the lack of being precise and obeying rules has direct negative effects on workers' as well as management safety attitude and safety behaviour. For example, a project manager (participant 85) reported:

"... workers think it is good enough if they just have their helmets on their heads without the strap appropriately fastened or they think it is all right if they use a crane with 100kg weight limit to lift 150kg bundled bars. Similarly, managers might think it is good enough as long as the training is delivered and workers have signed the attendance or they might think it is not a big deal if the protection net has a hole in it."

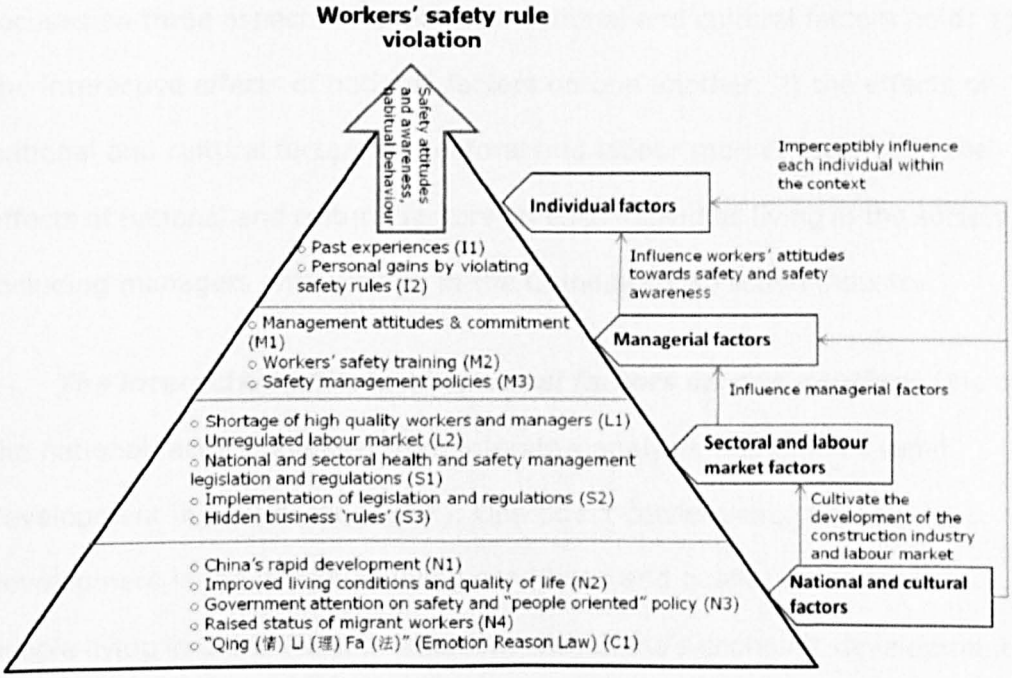
4.5 Discussion

This study was conducted to serve the first aim of the research, namely, to explore the factors and their influential effects that are associated with safety rule violations among Chinese construction workers. A summary of interview analysis results is illustrated in Figure 10 below. Each sub-category factor is given a code comprising a letter and a number for clearer presentation of the discussion.

Factors reported by interviewees are categorised into four main categories: individual factors, managerial factors, sectoral and labour market factors, and national and cultural factors. According to interviewees, national and cultural factors cultivate the context that stimulates the development of the construction industry and labour market. National and cultural factors also imperceptibly influence the attitudes, beliefs, and perceptions of each individual who lives within the context. Sectoral and labour market factors, according to interviewees, have influential effects on managerial factors. For example, the shortage of experienced and competent managers at all levels

affects the quality of the safety training on-site, workers' high turnover rates affect the effectiveness and the efficiency of safety trainings to workers, national and sectoral health and safety legislation and regulations affect management's attitudes and commitment towards safety as well as on-site safety management policies. The majority of interviewees believed that managerial factors played the most crucial role in raising workers' safety awareness, altering workers' attitudes towards safety, and regulating workers' rule violation behaviour, while workers' past experiences and their personal gains by violating safety rules offer explanations for the occurrence of workers' violation acts. The factors and their effects are discussed in detail in the following.

Figure 10. Graphical summary of interview analysis results



4.5.1 The effects of national and cultural factors

As mentioned previously (Section 1.3.1), Heinrich (1931) described the accident sequence as a series of five factors. He named ancestry and social environment as the first factor. Similarly, in his hierarchical model of

socio-technical system, Rasmussen (1997) named the government as the first level of hierarchy in the socio-technical system and is under the influence of changing political climate and public awareness. The interview analysis results support the theoretical positions. Interviewees believed the root causes of not only what is happening in the construction industry, but also many other existing phenomena in the Chinese society, are what the author labelled as national and cultural factors. These factors are the evolutionary outcomes of history, politics, religions, and many more. Interview analyses revealed that there were five sub-categories of national and cultural factors: 1) China's rapid development (N1), 2) improved living conditions and quality of life (N2), 3) government attention on safety and 'people oriented' policy (N3), 4) raised status of migrant workers (N4), and 5) Qing Li Fa (Emotion Reason Law) (C1). On the basis of interview analyses the following discussion focuses on three aspects of effect that national and cultural factors hold: 1) the interactive effects of national factors on one another, 2) the effects of national and cultural factors on sectoral and labour market factors, 3) the effects of national and cultural factors on each individual living in the society, including managers and workers in the Chinese construction industry.

The interactive effects of national factors on one another. One of the national factors revealed from interview analysis was China's rapid development in past decades (N1). One direct consequence of such development is the improved living conditions and quality of life for the people living in China (N2). In addition, with China's economic development, the whole society moved forward. As a result, the Central Government has changed its attitudes towards human values, as well as the issues of people's health and safety (N3). The current government advocates a 'people oriented' scientific concept of development. It differs from the traditional development concepts which paid too much attention on accumulating wealth, and

neglected human values in dealing with the relationship between humans and nature, merely for the pursuit of growth of GDP (Zhang, 2004). The 'people oriented' scientific concept of development emphasises the importance of humans; human status, values, dignity, and significance. It claims that meeting the needs of human existence and development is the internal motivation to human development, as well as the starting point of social development. According to the concept, social development comprises the overall development of material, spirit, and policy. Meanwhile, in order to realise the promise of "allowing every Chinese to live with dignity", the Central Government demanded that the status of migrant workers in society should be raised and has issued legislation and polices to protect migrant workers (N4).

The effects of national and cultural factors on sectoral and labour market factors. The effects of national and cultural factors on sectoral and labour market factors are complex. The following discussion focuses first on the effects of national factors on sectoral and labour factors.

Since China's reformatory opening-up and economic transformation in the late 1980s, the traditional central governmental control system has gradually converted to a market-driven system. The once state-owned organisations have been privatised and a large number of private companies in all industries emerged in the market. In order to stay 'fit' in the competition, companies, big or small, strive to be the first to catch the opportunities in the huge market. Also, as part of the trend of fast economic development, government officials strive to make remarkable contributions to earn personal merits. They often initiate the so-called 'political achievement projects' or 'earning-face projects' (*zheng ji gong cheng* or *mian zi gong cheng*). These projects are always huge landmark projects. Some of them are

projects deemed to be extremely challenging given their scale and the costs involved. Government officials are normally selected every four years. In order to achieve personal political merits, these projects need to be completed within four years. Such time-restricted projects accelerate the development of the Chinese construction industry. In addition, fast economic development has resulted in infrastructure being in desperate need of improvement; railways, highways, bridges, undergrounds, residential buildings, schools, and hospitals are being built across China. Thus, under the trend of China's rapid development (N1), the Chinese construction industry has witnessed an unprecedented boom in the recent history. According to the interviewees in this study, the demand for fast completion of large-scale construction projects because of national development, as well as political reasons, generates a huge demand for construction workers across China. Meanwhile, economic development (N1) also generates more job opportunities in other industries both in cities as well as in rural areas. With improved living conditions and quality of life in rural areas (N2), there is less willingness or need for workers to migrate to big cities far away from their hometowns to work in what is a hazardous construction industry, especially amongst the new generation who were born after the early 80s under the 'one child policy'. On one hand there is a high demand for construction workers, while on the other hand is the reduced labour supply. Such an imbalanced demand and supply relationship causes a large shortage of construction workers in the labour market (L1). Meanwhile, the huge number of large-scale projects under construction has also generated a big shortage of competent managers at all levels in construction companies (L1).

In addition to the national factors, interview analyses revealed that cultural factor has also direct influential effect on certain issues in the Chinese construction industry. *Guanxi* is one of the main factors reported by the

interviewees that makes it possible for some people in administrative institutions and in construction companies to escape punishment for their behaviour, especially in small cities or remote areas. In the business world, having the right *guanxi* with suppliers, banks, and local government officials can help organisations in minimising risks, frustrations, and disappointments when doing business (Yan, 1996). While analysing the effect of *guanxi* on modern Chinese society, Yang (1994) regarded *guanxi* as a key factor in driving the Chinese government to operate. *Guanxi* is usually used to control others and distort the laws (Lin, 2011). *Guanxi* (C1) strongly affects the stringent implementation of legal regulations (S2). The lack of stringent inspection and enforcement enables some illegal phenomena (S3), for example, corruption and default payments for projects as well as companies paying individuals merely for their names in order to have the required number of qualified safety officers or senior engineers. These illegal operations have become well-accepted industrial business norms and ubiquitous in the Chinese construction industry (Qi, 2011). In addition, the problems of surround-bidding, forging bids as well as accompanying-bidding are extremely severe amid a bidding process, i.e. inviting companies for bids, choosing the main contractor and selecting sub-contractors (Zhou, 2005; He, 2005). One direct consequence of illegal bidding is that projects' payments are much lower than they should be. With the exploitation through each level of sub-contract, and default payment for projects, the money for the end-contractor is rarely enough to carry out up-to-standard work. Thus, it may generate further policy violation acts (S2). For example, managers reported during interviews the difficulties in investing in safety management with little financial resources. Little financial resources very often also caused arrears of workers' salaries (Qi, 2011).

The effects of national and cultural factors on managers and workers in the Chinese construction industry. With China's rapid economic development (N1), the concept of "time is money, efficiency is life" proposed by Geng Yuan, the founder of China's first industrial park in 1984, has become a commonality in the society. Under the influence of such concept, along with the huge urgent demand for an infrastructure that is compatible with rapid development, managers and workers in the construction industry inevitably feel under constant pressure to work at high speed in order to finish projects on time, as advocated by the interview participants. Such pressure may weaken management commitment towards safety management (M1).

While the race against time at national and local level facilitates the whole nation's fast development, it also affects each individual in the society in terms of lifestyle and beliefs. The traditional value of egalitarianism and being reluctant to pursue wealth was broken up with the emergence of an affluent business class. In this way, the pursuit of riches is no longer openly condemned as a shameful activity, but rather encouraged and considered to be glorious. As explained by participants during interviews, achieving a high level of health and safety management requires comprehensive legislation and regulations as well as stringent inspections, but more importantly, it depends on management attitudes and commitment towards safety. Under the conflict between the pressure of fast production as well as gaining higher profits, and health and safety management being time consuming and costly, the concept of 'worshiping money' may negatively affect management commitment towards safety management (M1). According to the interviewees, the belief of 'time is money' and the mentality of worshiping money are also associated with workers' attitudes towards safety and their daily behaviour in the workplace. In particular, workers are willing to violate

safety rules and take risks in order to reduce working hours and earn extra money (I2). As explained in Rasmussen's (1997) socio-technical model, financial pressure is an environmental stress that can influence companies in the socio-technical system. The current study reveals that financial pressure and the desire of higher financial profit can influence not only the companies and management, but also the attitudes towards safety and the safety behaviour of every person who is involved in the system.

Because Chinese very often use first emotion and *guanxi* to deal with things, there is a lack of being precise and obeying rules in Chinese culture (C1). Chu (2010, p.29, p36) advocated that "the Chinese way of thinking is a kind of emotional thinking or image thinking. It is not about the pursuit of deep thinking and accurate analysis of things, but about drawing conclusions based on past experiences and general superficial descriptions ... therefore Chinese pay great attention on things at the superficial level, but ignore the essence ... which generates the formality and the content being two completely different things." Chinese can very often be heard saying "as long as it looks fine it is OK." This kind of mentality causes some managers and construction workers to only focus on the formality of their work, but not the implementation process of safety rules and regulations (M1, M2, and M3). In addition, because people tend to deal with things with emotion, and less by following standardised regulations or law (C1), the occurrence of many things in life are deemed to be by chance. This may explain why some managers and construction workers are willing to take chances or gamble in order to make more benefits, or just to make their work easier (M1, I2).

The interview analysis results of the current study demonstrate the influential effects of national and cultural factors on the existing issues within the Chinese construction industry, as well as the safety attitudes and

behaviours of individuals within the industry. Rasmussen (1997) did not include the effects of cultural element on socio-technical system, neither did Alper and Karsh (2009) in their macroergonomic framework of safety violations (see Section 1.3.1). The current study demonstrates that the effects of national and cultural factors on safety management and safety behaviour should not be overlooked. These factors should be included in theoretical models that explain accident causation and safety violations in industry.

4.5.2 The effects of sectoral and labour market factors

Sectoral and labour market factors are the ones that exist in the context of the Chinese construction industry. Interview analyses revealed that there are five sub-categories of these factors: 1) shortage of high quality workers and managers (L1), 2) unregulated labour market (L2), 3) national and sectoral health and safety management legislation and regulations (S1), 4) implementation of legislation and regulations (S2), 5) hidden business 'rules' (S3). As discussed earlier, these factors are under direct influence of the national and cultural factors. In other words, national and cultural factors cultivate the development of the construction industry and the issues existing in the labour market. In alignment with Rasmussen's (1997) hierarchical socio-technical model and the macroergonomic framework of safety violations proposed by Alper and Karsh (2009), interviewees in the current study reported that sectoral and labour market factors have influential effects on managers' safety attitude and commitment as well as the practices of safety management on construction sites. The following discussion focuses on the influential effects of sectoral and labour market factors on these two particular aspects.

The effects on management attitude and commitment towards safety. Having introduced the basic development concept, 'people oriented' policy, the Central Government issued "safety first, intervention first" as the basic safety management policy for all industries, including construction industry. In addition, it also issued several pieces of legislation and regulation in relation to safety management and inspections of safe production (S1).

The Regulations on Accidents Report, Investigation, and Penalty Measures issued in 2007 by the State Council (State Administration of Work Safety, 2007) clearly states the classification of industrial accidents and respective penalty measures for the company and the accident's responsible person(s) (Table 12).

Table 12. Classification of industrial accidents and respective penalty measures for the company and the accident's responsible person(s)

Accident grade	Demarcation	Penalty for construction company	Penalty for responsible person(s)
I. Exceptional severe accidents	Over 30 fatalities; or over 100 severe injuries; or over RMB1 billion in direct economic losses	RMB2-5 million	80% of previous year salary
II. Severe accidents	10-29 fatalities; or 50-99 severe injuries; or RMB50 million-1 billion in direct economic losses	RMB0.5-2 million	60% of previous year salary
III. Relatively severe accidents	3-9 fatalities; or 10-49 severe injuries; or RMB10-50 million (excluding 50 million) in direct economic losses	RMB0.2-0.5 million	40% of previous year salary
IV. Normal accidents	Less than 3 fatalities; or less than 10 severe injuries; or less than RMB10 million in direct economic losses	RMB0.1-0.2 million	30% of previous year salary

The Regulations on Accidents Report, Investigation, and Penalty Measures (2007) also states clearly the amount of financial penalty for the main responsible person(s) of the company, people responsible for safety management and control, such as safety officers, foremen, and third party inspectors, as well as the company, local government, safe production

inspection institutions in cases of delayed rescue actions, delayed or faulty report of accident, absence from duty during accident investigations and handling, falsified or intentional destruction to the scene of an accident and to the relevant evidence and information, refusing to accept investigation or refusing to provide relevant information, and escaping and hiding after an accident. In addition to financial penalties, the relevant business license of the construction company that is responsible for the accident shall be suspended or revoked; the career qualifications and job certificates of the responsible person(s) shall be suspended or revoked, and in severe cases, the responsible person(s) may face criminal punishment or demotion; within five years after the completion of criminal punishment or disposition, the person(s) shall not act as the main person in charge of any production and business units.

Because of the severity of punishment to the responsible person(s) of the construction companies as well as accidents, local governors, industrial municipal leaders, as well as company managers, started to pay more attention on safety at workplace and in daily life (M1). Interviewees at management levels revealed their fear for accidents, especially fatal accidents, during interviews.

The effects on the practices of safety management on construction sites. Although the majority of relevant government officials as well as company managers pay high attention on safety management, the issue of poor implementation of legislation on inspections in reality (S2), especially in remote areas, as reported by interviewees, encouraged some construction company managers to continue to ignore safety management regulations and legislation and take chances to maximise profit (M1, M2, M3).

One of the reasons for the poor implementation of legislation and regulations relevant to inspections is the uneven quality of professional inspectors in the construction industry (Hao, 2009). Since 1989, China has begun adopting the 'Construction Inspection Scheme'. One of the project-inspector's responsibilities is to monitor construction safety. Since the issuance of the Regulation on Construction Project Inspection in 1996, the Construction Inspection Scheme has been extensively practiced in China. According to the system, the role of the inspectors is to enhance construction inspection and supervision by introducing checks and controls at various construction stages on behalf of the clients. Under clause 32 of the current Construction Law issued in 2011, the inspectors' duties are to ensure construction works in compliance with the construction regulations, to supervise the execution of the work, to monitor construction safety, to prepare inspection plans, and to notify the government in the case of any violation of the relevant statutory legislation. On one hand, construction project supervisors are given such crucial responsibilities in overseeing projects' quality and safety controls; on the other hand, however, the whole market of construction inspection is irregular, inspectors' training remains a mere formality, there is not a strict inspector qualification examination system, and, as a result, inspectors are of varied quality and the quality of inspections on construction sites cannot be guaranteed (Liu, 2010).

Another reason reported by the interviewees was that some of the rules and standards were simply impossible to implement or meet given the current situation of the Chinese construction industry, for example, the low educational level among general construction workers, shortage of construction workers, and extremely low budget for construction projects. In addition, Cao (2011) argued that poor implementation of regulations in the Chinese construction industry was because regulations were not practical and

the whole legal system is imperfect. Some pieces of legislation and regulation repeat or cross over one another. It causes difficulties for implementation in reality.

Having explained the reasons for the poor implementation of existing legislation and regulations in the construction industry, the following paragraph is focused on illustrating a management perspective on the issue of implementation of legislation and regulations revealed by interviewees at management levels in the current research. Taking the problem of arrears of workers' salary as an example, in more recent years, with the introduction of Inspection Regulations of Labour Protection (2004) and Interim Management Measures for Migrant Workers' Salary Payment in Construction Industry (2004) which clearly forbid arrears of workers' salaries, and the introduction of amended Labour Law in 2008 which added punishment measures for arrears of workers' salary to the previous version, such phenomena have been reduced to a great extent (Wang, 2011). Meanwhile, since China's Prime Minister Wen personally helped one construction worker chase his salary in 2003, the issues of controlling arrears of workers' salaries as well as improving migrant workers' quality of life and social status have become a focus of work for the government. Interviewees at management level reported that although they supported the government initiatives in protecting migrant workers, under exploitation within the industry, they felt they were in a vulnerable position. In addition, participants at management levels also revealed their feelings of frustration and helplessness towards the current reality in the industry and the difficulties in their daily management activities on construction sites through their tones, facial expressions, and body language during interviews. Often, when they were asked about why certain issues exist in the industry, such as hidden rules for bid, default payment, or inspections from some official institutions as formality and show,

some managers answered simply "this is the reality". Although most managers were aware that the current situation is part of the development process in a massive developing country like China, and showed appreciation for the huge improvement in the past decades and an optimistic view about the future, they expressed the huge pressure they were experiencing. Several project managers and safety managers reported that they kept their mobile phone available 24 hours a day and even took their mobile phone with them when they were in shower. Some managers reported that they had problems sleeping because of the high pressure of tight deadlines, limited budget, safety issues on sites, workers' demands, as well as making profits. In one extreme case, a project manager reported that the previous project manager of that project, his colleague, had to take sick leave because of a nervous breakdown. Managers are seemingly facing great challenges as on one hand, they need to lower their budget in order to win a project bid, and in some cases they even need to invest with their own money in advance because of default payments from clients and for investment in *guanxi* development and maintenance; on the other hand, labour costs increased dramatically because of the shortage of workers and safety management requires financial investment. In addition, it is important that the construction project is completed within the deadline to avoid penalties, regardless how tight the deadline is. And, on top of all this, a company needs to make profits in order to survive in the business world. The management perspective on the issues related to implementation of legislation and regulations revealed another side of the story. With increasing attention on the protection of migrant workers, as well as safety management from the Central Government, managers of construction companies are facing great challenges in the current sectoral situation. In order to overcome these challenges, and to ensure high safety levels on construction sites,

management attitudes and commitment towards safety as well as their capabilities are inevitably crucial. At a sectoral level, it is important to recognise that the protection of migrant workers and safety management on construction sites are not solely the responsibilities of managers; executing punishment on managers alone is insufficient for tackling the existing issues.

Almost all interviewees at managerial level reported that there was a shortage of workers, especially experienced skilled workers (L1). As mentioned earlier, this phenomenon is generated by the imbalance between huge demand from construction companies and a reduced number of people who are willing to work on construction sites. The problem of the shortage of workers in the construction industry had led to issues which have been reported repeatedly by the interviewees in managerial positions, namely increased labour costs, high turnover rates of workers, difficulties in managing workers, and difficulties in recruiting experienced and skilled workers. These issues have had further effects on other aspects of management, for example, increased labour costs leave the construction companies which have already very little profit under even more financial pressure; high turnover rates make the outcome of safety and skills training less satisfactory (M2). The management of workers and the quality of training for workers are even more problematic with afore mentioned problems of the shortage of competent and qualified managers at all levels (L1).

In addition to the shortage of workers and competent managers, the unregulated labour market within the construction industry (L2) was considered by interviewees as another cause of workers' high turnover rates and lack of professional training. One aspect of the unregulated labour market reported by interviewees was the lack of legitimate labour contracts

between workers and employers or labour agencies. In fact, interviewees reported that workers attached more trust in verbal promises from close family or friends than paper contracts. Another aspect of the unregulated labour market in the construction industry, according to the interviewees, is the incapability of labour agencies. The establishment and development of the labour agency in the construction industry started in 2005. It is a very new industry. There are a number of management issues within the labour agency industry (Deng, 2011). Firstly, because it is the beginning of the labour agency industry, the requirements for such an agency to be registered are low. As a result, most labour agencies have very little financial foundation and a very small number of employees who have little managerial competence and specialised skills. These agencies are not able to provide workers any professional training or safety education. Secondly, many labour agencies do not sign labour contracts with workers' group leaders or with workers in order to reduce their responsibilities and workload. Thirdly, the labour agency industry is becoming competitive. Like the construction industry and many other industries in China, there is unfair and vicious competition within the industry. Thus, many agencies focus more on survival instead of providing adequate services. A third aspect of the unregulated labour market in the construction industry, according to the interviewees, is the restricted power of labour contracts on construction workers. Such a phenomenon is associated with many issues, such as the incapability of labour agencies, lack of specialised legal representatives in both construction companies and relevant government institutions dealing with migrant workers breaching labour contracts, China's residence registration system, and the large population of migrant workers. It is a complex issue which deserves great attention from relevant government officials and practitioners because it may generate a butterfly effect on many aspects in society. The

long-term effects of workers working without labour contracts are beyond the scope of the current research. However, interviewees reported that it was associated with workers' high turnover rates that have a direct negative effect on project management and efficiency of training for workers (M2).

Alper and Karsh (2009) classified the enforcement on extra-organisational rules and legislation, industry social influence, and industry workforce characteristics into the external environment level of their macroergonomic framework of safety violations. However, these factors were not examined in their systematic review. The findings of the current study provide empirical evidence to their theoretical concepts. In particular, the interview analysis results of the current study demonstrate that the enforcement on rules and legislation relevant to safety management as well as the characteristics of labour market in the Chinese construction industry can influence management attitudes and commitment towards safety, the implementation of rules and legislation, as well as the quality of safety management practices.

4.5.3 The effects of managerial factors

Interview analyses in the current research revealed three sub-categories of managerial factors: 1) management attitudes and commitment, 2) workers' safety training, 3) safety management policies. The effects of these factors on safety management within organisations and employees' safety attitudes as well as safety behaviour have been clearly documented in the literature (Clarke, 2006; Hofmann & Stetzer, 1996; Seo, 2005; Varonen & Mattila, 2000). These factors were also included in the organisational factors within the macroergonomic framework of safety violations proposed by Alper and Karsh (2009). The following discussion focuses on explaining the effects of the three sub-categories of managerial

factors revealed in the current study on safety management and workers' violation behaviour with the support of previous research results and theoretical concepts.

The effects of management attitudes & commitment towards safety. One of the managerial factors extracted from interview analysis was management attitudes and commitment towards safety (M1). Zohar (1980, p. 10) noted that management commitment to safety "is a major factor affecting the success of safety programmes in industry". Clarke (1999) advocated that perceptions of senior managers' attitudes and behaviour regarding to safety form the basis for safety behaviour of workers, and consequently the safety performance of the organisation. Garcia, Boix and Canosa (2004) explored the relationship between workers' perceptions regarding management attitudes towards occupational safety and health and workers' behaviour at work among 734 production workers within the pottery industry in Spain. They found that workers' perception of organisational factors related to occupational health and safety, for example, management commitment to risk prevention or priorities of safety versus production, was strongly associated with workers' attitudes towards safety at work. Perceptual data obtained in the UK construction industry suggested the impact of managerial commitment to safety could exert an impact of approximately 51% on a Behavioural Safety process (Marsh, et al., 1998). Management commitment and attitudes towards safety can affect workers' perception of the sincerity of safety management motivation. In alignment with other empirical data (e.g., Bloom, 1999; Pfeffer, 1998), interviewees in the current research revealed that if managers paid great attention to safety, provided frequent and appropriate training, showed genuine concern about workers' well-being, together with the reward system encourages workers to behave safely, workers would place a great importance on safety, develop a

sense of trust and affective commitment towards the company, and consequently there would be less safety rule violation acts and lower turnover rates.

The effects of safety training for workers. Neal and her colleagues (2000) reported that safety behaviour is determined by safety knowledge and skills necessary for particular behaviours and by the motivation of individuals to perform the behaviours. Thus, they suggested that interventions such as providing training and emphasising the importance of safety could be effective when they are carried out within the context of a positive safety climate. Safety training and repeatedly emphasise the importance of safety (M2) were also considered by current research participants as crucial factors influencing workers' safety awareness, safety attitudes towards safety, and rule violation behaviour.

However, interviewees also mentioned that simply preaching to workers on safety issues was not sufficient to improve workers' safety attitudes and their safety working behaviour. Interviewees in the current research explained that one of the factors negatively affecting the efficiency of workers' safety training was workers' lack of awareness of the importance of safety training and their lack of interest in obtaining safety training. Cooper and Phillips (2004) demonstrated with their research study among 374 manufacturing employees that the perceptions of the importance of safety training were predictive to actual levels of safety behaviour. Interviewees at management levels in the current research repeatedly explained the importance of utilising different training materials, such as videos and pictures, to illustrate actual case studies and safety behaviour. They also emphasised the importance of implementing training styles that are suitable for workers' comprehension levels. According to the protection motivation

theory (PMT, Rogers, 1975), protection motivation is high when the information about the magnitude of noxious consequences, the probability of the occurrence, and the efficacy of the coping strategies is adequate. Thus, in order to stimulate workers' self-protection motivation, it is important to make them acknowledge the severe negative consequences of accidents and the likelihood of accident occurrence. The perception and understanding of negative consequences can be individually different given people's positions, for example, people at management levels who do not work on the front-line may be more concerned about the loss of their jobs, termination of the construction project, and ruining the company's reputation; workers, on the other hand, are more likely to be concerned about their own personal injuries or accidents, the burden they may bring to their families and their inability to continue working. Thus, as interviewees at management levels explained, it is more effective in stimulating workers' self-protection motivation and controlling rule violation behaviour if workers are told about the negative consequences that are closer to their concerns.

Safety management policies on sites and their effects. Another important managerial factor extracted from interview analysis was safety management policies (M3). Hadjimanolis and Boustras (2013) advocated that clear safety policies and safety procedures may improve work attitudes, increase workers' motivation and safety commitment, and have a positive impact on safety performance. Thompson and his colleagues (1998) presented a model that linked management supports, organisational climate, and self-reported safety outcomes. They concluded from their study that the influence of management commitments on safety attitudes was mediated by safety management systems and procedures. The previous on-site observation study in the current research also revealed that when the written safety management policies were well implemented, for example, on the

participant construction sites in Xiamen and Beijing, the frequency of workers' rule violation was low.

One aspect emphasised by interviewees relating to safety management policies was workers' involvement in safety management. Workers' involvement in safety management may provide workers with feelings of empowerment and being in control of events happening around them. Interviewees at management levels explained the positive effects of implementing safety management policies that encouraged workers to take their own responsibilities in self-protection and protecting others on reducing workers' violation behaviour. Interviewees also emphasised the importance of encouraging workers to report any violation decisions made by managers at any level in reducing workers' violation act. The importance of workers' involvement in safety management in the workplaces has been emphasised by scholars and practitioners regardless of which approach they take for safety management, whether it is a behaviour-based approach or a culture-change approach (DeJoy, 2005). Workers' autonomous capacity to take initiatives in safety management has been shown to be a determining factor in controlling accident rates and maintaining safety levels in the workplaces (Simard & Marchand, 1994). In addition, studies have shown that safety management level and workers' involvement have reciprocal effects on each other. For example, Rundmo, Hestad, and Ulleberg's (1998) study results obtained from their longitudinal research among Norwegian offshore oil installation workers in 1990 and 1994 demonstrated that poor safety management and management practices in general can reduce employees' interest in being involved in safety management and in proposing efforts to improve safety. It consequently forms a vicious circle.

In addition to workers' involvement in safety management, interviewees in the current research also revealed rewards for good safe production practices and punishment for safety rule violations were effective in controlling workers' behaviour and it reflects management attitudes towards safety management. Previous research on safety management programmes has also shown that both carrot and stick motivational techniques are common and effective measures (Howell et al., 2002). Interviewees in the current research reported the effectiveness of strict inspections by safety officers on sites and financial punishment in controlling workers' violation behaviour, although the effectiveness is less satisfactory with the increased demand of workers in the construction industry. The association between financial punishment and workers' violation behaviour has not been found in previous research or in literature by the time of writing the thesis. It might be because financial punishment for individual workers is not a commonly implemented method on construction sites in controlling violation behaviour outside China. According to interviewees, rewards for good safe production practices are implemented less in reality for various reasons such as the complication of implementation and requirements of extra financial investment.

The effects of financial punishment on controlling rule violation behaviour can be understood with the behavioural economics theory (McKenzie & Tullock, 1975). As the behavioural economics theory advocates, the exact behaviour a person takes depends on the available resources and the person's assessment of the efficiency of substitutional processes (Battmann & Klumb, 1993). In addition, behavioural economists argued that the achievement of optimal substitution can only be achieved through immediate and detailed feedback. Thus, when a worker assesses his immediate cost and benefit of safety rule compliance with the immediate cost

and benefit of rule violation, very likely the worker would assess his immediate physical comfort generated by, for example, not wearing safety helmet, or the immediate convenience produced by not wearing safety belt with the possible financial punishment. Because the immediate benefits of not complying with safety rules are very certain, only if the immediate and detailed feedback on rule violation is also available each time the behaviour occurs, in other words, being caught by safety officers and being punished financially, can the worker learn that rule compliance behaviour is the optimal behaviour given that no worker is willing to pay penalties. Thus, as managers explained during interviews, it is necessary to keep at least two safety officers on sites 24/7 observing workers. However, in reality it is impossible to keep eyes on each worker on site without a break. As a result, although strict inspection and immediate financial punishment are effective in controlling workers' rule violation, interviewees at management levels reported that it is certainly not the optimal measure in eliminating such behaviour and keeping safety on sites. The best management measure should be the one that stimulates workers' self-protection motivation, raises their safety awareness, and ensures workers voluntarily comply with safety rules. People usually do what they do because of the consequences they expect to get for doing it. As Skinner's (1974) radical behaviourism holds, behaviour is a function of environmental histories of reinforcing consequences and reinforcement is the central mechanism in shaping and controlling behaviour. However, very often, negative reinforcement is mistakenly conceived as a synonym of punishment by scholars and practitioners (Matson & Taras, 1989). In fact, while positive reinforcement is the strengthening of behaviour by the application of some event, for example, praise or give material reward after certain behaviour occurs, negative reinforcement is the strengthening of behaviour by the removal or avoidance

of some aversive event, for example, avoid the payment method that encourages rushing work behaviour.

4.5.4 The effects of individual factors

Interview analyses in the current research revealed two sub-categories of individual factors: 1) workers' past experiences, 2) personal gains by violating safety rules. These factors were also included in the individual factors as well as external environment factors within the macroergonomic framework of safety violations proposed by Alper and Karsh (2009). The following discussion focuses on explaining the effects of the two sub-categories of individual factors revealed in the current study on workers' violation behaviour with the support of previous research results and theoretical concepts.

Workers' past experiences and their effects. As explained in the Section 1.1.2, the characteristics of Chinese construction workers have been developed along with the evolutionary changes in society, politics, and economy within China in the past decades. Unlike most construction workers in western countries, or Chinese construction workers in the 1960s or 1970s who received proper training for being a construction worker and considered construction worker as their occupation, current Chinese construction workers are normally farmers or have been working almost their whole life on farms before leaving their hometowns for cities in search of job opportunities. Some of the construction workers still spend a few months each year working on their land in their hometowns. Thus, this group of workers are also named as 'farmer worker' (*Nong Min Gong*) in China. As interviewees explained, their long experience of working on farms generates low safety awareness and a lack of discipline among the workers because a large proportion of work on farms in China is still carried out by human labour. Interviewees believed

that these are the reasons why construction workers are likely to violate rules and regulations. Safety knowledge was considered as one of the important factors determining safety behaviour (Neal et al., 2000). Zhou, Fang, and Wang (2008) suggested that safety knowledge can be influenced by personal education experience. Through their analyses, Zhou and his colleagues found that when education experience changed from low to high the probability of good safety behaviour increased slightly. Alper and Karsh (2009) included workers' education and industry workforce characteristics in their macroergonomic framework of safety violations. But they did not examine these two factors in their systematic review. The current study confirmed the effects of these two factors on workers' safety violations.

Workers' bad working habits that are generated by working long time unsafely on construction sites were also considered by interviewees as one direct cause for their rule violation. In addition, because no accident happened after repeated trials of risky behaviour, workers tend to develop a sense of 'blind' confidence in their own skills and neglect safety rules (Kouabenan, 2009). Consequently, workers do not consider that their violation behaviour will lead to any negative outcome and may even perceive safety training as unnecessary and time wasting. Such attitudes towards rule violation and safety training, according to interviewees, exist among some construction workers and lead workers to repeatedly violate safety rules while working.

Interviewees reported that workers' experience of accidents on construction sites could improve workers' safety awareness, change their attitudes towards safety, and in turn, generate safe behaviour. Such positive correlations between personal accident experience and safety behaviour were also found in other research studies (e.g. Laugery & Vaubel, 1989;

Kouabenan, 2002). However, interviewees also mentioned that the effects of accident experience on safety behaviour are short-term. This might be associated with Kouabenan's (1998) study about beliefs and perceptions of risk related to accidents, where he found no connection between prior accident experience and perceptions of risk related to accidents. In addition, it has been argued that the relation between personal accidents experience and (un)safe behaviour is mediated by causal attributions of accidents (Gonçalves et al., 2008). Depending on the position of the person, either victim or witness, explanations of accident causation can be different. While victims tend to attribute accidents to external factors that are beyond their control, witnesses are more likely to relate accidents to victims' own causal responsibilities (Kouabenan et al., 2001). In addition to the biased explanations of accidents, people also tend to have illusory beliefs when it comes to self-judgement. In psychology literature (e.g., Harris & Middleton, 1994; Weinstein, 1980, 1982) these illusory beliefs are described as unrealistically positive self-evaluations (tendency to see oneself as better than average others); the illusion of control (exaggerated belief in one's control over events); unrealistic optimism (tendency to believe positive evens are more likely to happen and negative evens are less likely to happen than they are in reality); and the illusion of invulnerability (tendency to believe harmful consequences of negative events are less likely to happen to themselves). In other words, these illusory beliefs can be translated into one common belief: It won't happen to me. It explains why workers are willing to take risks in the first place and how they develop "blind" confidence as mentioned earlier, or in other words, strong illusions of invulnerability, after repeating trials of violating safety rules without accidents. Research has shown that these illusory beliefs can create ignorance to safety procedures and can account for greater exposure to accidents (Colvin, Block & Funder,

1995; McKenna, 1993). These illusory beliefs may also affect workers' attitudes towards safety training, and consequently decrease safety training's effectiveness or even generate workers' antipathy against safety training and safety management. Thus, in alignment with the PMT discussed earlier, it is important to emphasise the likelihood of accident occurrence, to find ways to reduce workers' biases or illusory perception of risks, as well as their capabilities and invulnerability in order to convince workers the importance of complying with safety rules on construction sites.

Workers' personal gains by violating safety rules. Interviewees reported that workers often violate safety rules because it was more convenient or physically more comfortable. In addition, taking shortcuts could sometimes reduce working time. Grant, Christianson, and Price (2007) also reported that employees were reluctant in using personal safety equipment because it reduced their comfort and convenience. Workers' personal gains by violating safety rules were the immediate benefits perceived by workers. These may have a direct effect on workers' attitudes towards rule violation, and consequently their behaviour. As mentioned earlier, only with strict inspections and controlling strategies can these immediate beneficial effects be removed.

4.6 Conclusions

The current study serves the first aim of the research by exploring the factors and their effects associated with workers' rule violations using interviews and focus groups. The analysis results showed clearly that despite the importance of an individual's beliefs and attitudes in contributing to violations and unwanted outcomes, individual factors were not perceived as the sole determinant of rule violation behaviours. Violation is an act influenced by complex interrelations among differing factors. These emerged

factors, according to their nature of existence and effects, were categorised as individual factors, managerial factors, sectoral and labour market factors, as well as national and cultural factors. Thus, in order to understand rule violation behaviour amongst Chinese construction workers, it is important to consider individual characteristics and motivations, as well as all the other factors in a wider context in which behaviour is regulated. In other words, their acts need to be examined in a system as a whole. The analysis results support the systemic accident causation approach (Rasmussen, 1997) as well as the macroergonomic framework of safety violation proposed by Alper and Karsh (2009), and provide empirical evidence for the influential effects of factors that Alper and Karsh (2009) proposed but did not identify through their review, namely, workers' education, financial resources, training provided, extra-organisational enforcement, industry social influence, and industry workforce characteristics. In addition to the factors already listed in the macroergonomic framework, the current study revealed the effects of some newly found factors, namely, national and cultural factors. These factors, according to interviewees, cultivate the existence of other factors at sectoral and labour market level, and have direct influence on the attitudes and behaviours of every individual in the society, including managers and workers who work in the construction industry. The findings of the current study demonstrate the importance of recognising not only the influential factors at individual and managerial levels, but also the factors at the external environment level such as sectoral and labour market factors as well as national and cultural factors.

4.7 Chapter summary

This chapter has presented the second study of the research – interviews and focus groups. Having obtained substantial input on factors

associated with workers' rule violation from 97 participants including senior managers, foremen, safety officers, and construction workers, the next step is to establish an instrument examining the perceptions of an important group of people, who determines safety management policies and practices, on factors influencing workers' violation. This group comprises people whose job roles are related to management issues in construction companies. It includes senior managers, foremen, quality control officers, finance officers, and safety officers. This group also includes people who work outside construction companies but are closely related to construction activities and management, for example, third-party inspectors, and government officials. The following chapter presents the third study of the research – questionnaire survey among a large number of participants whose job roles match the descriptions of the target group. The findings of the third study complement the analysis results of the second study.

5. Study III – Questionnaire survey

5.1 Chapter overview

This chapter introduces the third study of the research – the questionnaire survey. The rationale of the study and its functions in meeting the research objectives are explained in the beginning of the chapter (Section 5.2). The following four sections of the chapter correspond to the four stages of the questionnaire survey study. The first stage of the study is the initial design of the questionnaire (Section 5.3). Upon completion of the initial design, a group of participants were consulted on the design (Section 5.4). The amended questionnaire was then tested through a pilot study (Section 5.5). As there was no further correction required for the questionnaire, at the last stage of the study, the actual survey was conducted (Section 5.6). The four complete stages are discussed in great detail. Data analysis techniques and study findings are presented towards the end of the Section 5.6. The chapter ends with some interpretations of the results in light of the study's research objective and theoretical framework.

5.2 Introduction to the study

The previous study has demonstrated the factors and their effects associated with workers' rule violation through a qualitative approach. The qualitative methods enabled the author to capture participants' in-depth personal knowledge and experience relevant to the research question. On the basis of the findings of the previous study, the present study proceeds to examine further the influential factors and their effects associated with workers' rule violation through a large-scaled questionnaire survey. With a different methodological approach as the previous study, the present study provides a complementary source of information and triangulation data for

the previous qualitative analysis results. Together with the previous interviews and focus groups study, the current study serves the first aim of the research - to explore the factors that have direct and indirect effects on safety rule violations among Chinese construction workers.

5.3 Stage I – Questionnaire initial design

The procedure of the questionnaire development is shown below as Figure 11 and Figure 12. Figure 11 demonstrates the procedure of the design of questionnaire in English. The initial questionnaire in English provided the basis for the further development of the questionnaire in Chinese. Figure 12 illustrates the developmental procedures of the questionnaire from the initial English version to the final version. The procedure is discussed in detail from Section 5.3 to 5.5.

Figure 11. The development process of the initial questionnaire in English (adapted from Churchill and Iacobucci, 2002)

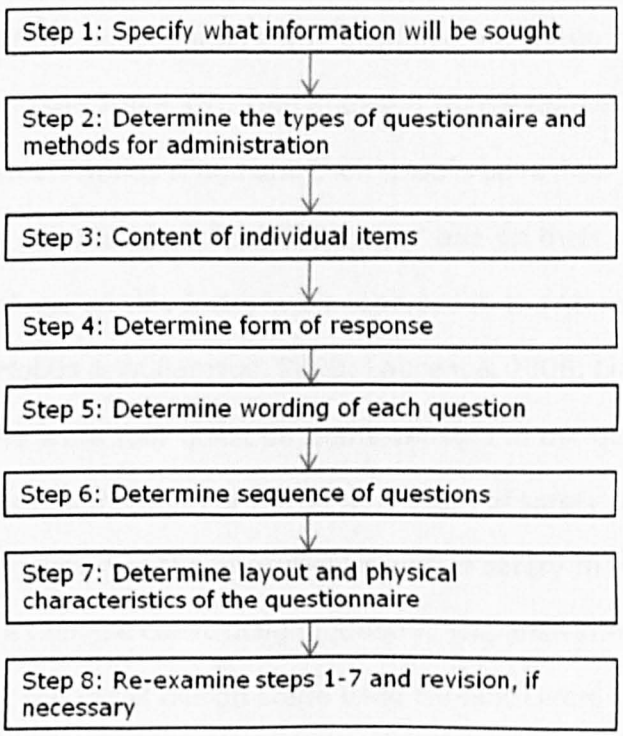
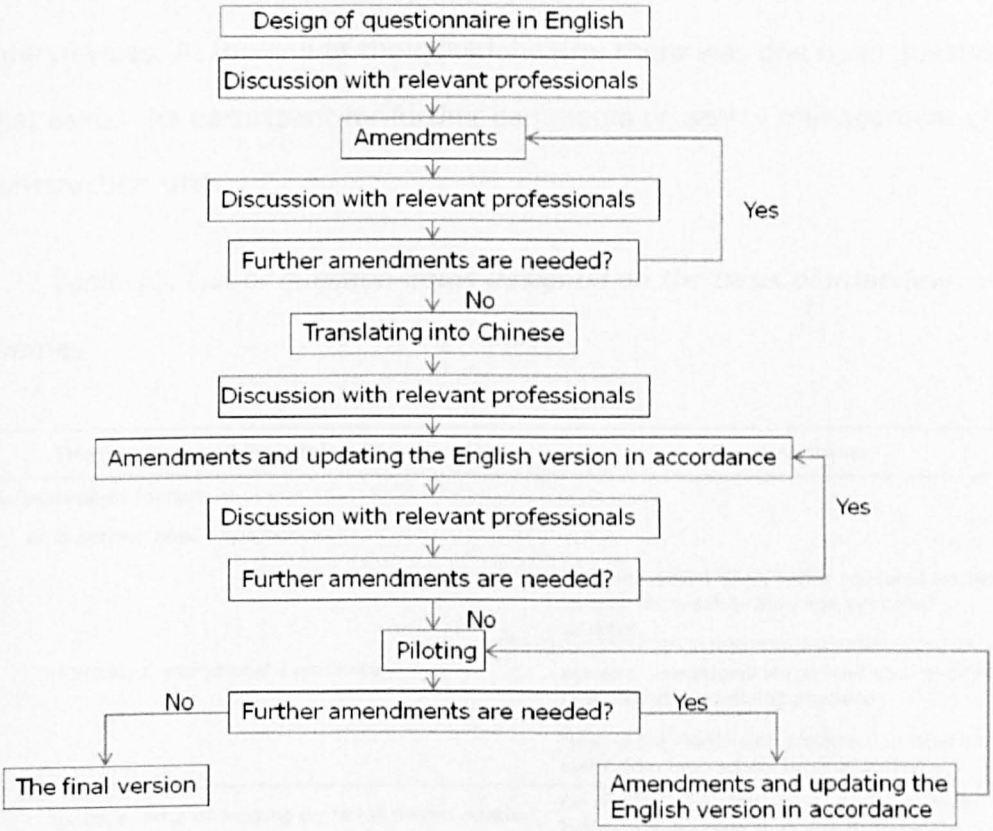


Figure 12. The developmental procedures of the questionnaire from the initial English version to the final version



The draft of the questionnaire was designed mainly on the basis of interview results (see Table 13). One question item examining the association between workers' age and their unsafe behaviour was included in the questionnaire to test the effect of workers' age on their behaviour since inconsistent findings on this factor were reported in the literature (e.g. Beilock, 1995; Hobbs & Williamson, 2002; Laurence, 2005; Li & Baker, 1995). In addition, there were four question items enlisted in the questionnaire to examine managers' perception of the general state of safety management as well as the stringency and the implementations of safety management legislation in the Chinese construction industry. The answering format of the questionnaire at the initial design stage used 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. There was also one question item

adopted a different answering format as 5-point Likert scale as it asked managers to select the biggest safety management problem in the Chinese construction industry among eight issues that had been reported by interviewees. At the end of the questionnaire, there was one open question that asked the participant for further comments on safety management on construction sites.

Table 13. List of question items designed on the basis of interview themes

Themes emerged from interview analysis	Question items
1. Individual factors	
a. Workers' past experiences	
i.Workers' educational experience	On construction sites, better educated workers behave more safely than less educated workers
	workers' educational levels limit their ability to understand the training provided
	Most of the workers on construction sites have lower than high school level education
ii. Experience of working on farms before working on construction sites	On construction sites, experienced workers behave more safely than less experienced workers
iii. Experience of working unsafely on construction sites	Workers violate rules or take risks while working because they are in the habit of working unsafely
	Workers violate rules or take risks while working because they are careless
iv. Direct and indirect experience of accidents on construction sites	workers violate rules or take risks while working because they are not aware of the serious consequences of their behaviour
	They don't think their unsafe behaviour can cause an accident
b. Workers' personal gains by violating safety rules	
i. Convenience and physical comfort	It is inconvenient or more difficult to work while complying with safety rules
ii. Reduced working time	Working safely is more time consuming

(Continued)

Themes emerged from interview analysis	Question items
2. Managerial factors	
a. Management attitudes & commitment towards safety	Senior managerial commitment and attitudes towards safety are crucial factors in keeping construction sites safe Foremen play an extremely important role in shaping workers' attitudes towards safety and ensuring that workers act in a safe manner
i. Financial investment on safety management and protection equipment	It is very often the case that rule violation behaviour and accidents are due to insufficient investment in safety
ii. Immediate rectification and reform once hazards are discovered	If corrective action is always taken as soon as managers discover unsafe practices, workers are less likely to violate rules or taking risks while working
iii. Repeated emphasis on the importance of safety	If it is clear that the managers are genuinely concerned about workers' safety, workers are more likely to pay attention to health and safety
iv. Strict following of safe construction procedures and regulations under the pressure of tight working schedule	The safety rules do not always describe the safest way of working. Sometimes it is safer not to comply with the safety rules at work It is impossible to complete jobs on time while following all safety rules
v. Reward system	Incentives or reward systems are/would be more effective than severe disciplinary actions in reducing unsafe behaviour workers rush to finish their work early because the payment system encourages them to do so
vi. Exemplary safety behaviour	If managers always comply with safety rules, workers are more likely to do the same
vii. Genuine concern about workers' general well-being	If it is clear that the managers are genuinely concerned about workers' safety, workers are more likely to pay attention to health and safety A caring and considerate management style helps prevent workers' unsafe behaviour

(Continued)

Themes emerged from interview analysis	Question items
b. Safety training for workers	
i. The frequency of safety training	More training is needed for both managers and workers in order to improve safety at construction sites
ii. The materials used for safety training	The health and safety training provided on most construction sites is not designed at the appropriate level for most workers
iii. The style of safety training	A caring and considerate management style helps prevent workers' unsafe behaviour
c. Safety management policies on sites	
i. Designated responsibilities for safety on site	Poor management and design of policies are the root causes of preventable accidents at work
ii. Inspections and immediate follow-up actions	Safety officers are very important for keeping construction sites safe; without them accidents would happen more frequently
	Severe disciplinary action for safety rule violations is needed to achieve sustainable improvement in the safe behaviour of both managers and workers
	workers would not comply with safety rules and operational regulations if there weren't safety officers on site on the lookout for safety rule violations
iii. Communication and report system	workers can offer valuable suggestions on how to improve health and safety. Taking their advice can help reduce accidents on sites
	Frequent communication between managers and workers on safety issues can reduce workers' unsafe behaviour
iv. Materials and equipment management	The provision of modern, good quality equipment improves workers' attitude towards safety and their safety behaviour
v. Physical environment management	Untidy and dirty working sites are associated with workers' unsafe behaviour
	The sheer size and geographical spread of contemporary construction projects causes difficulties for project and human resources management

(Continued)

Themes emerged from interview analysis	Question items
3. Sectoral and labour market factors	
a. Shortage of high quality workers and managers	
i. Shortage of construction workers, especially experienced and skilled workers	The shortage of skilled workers means construction companies are not in a position to select workers. Thus, they have to employ whoever is available
ii. Shortage of experienced and competent managers at all levels	The high demand for workers on construction sites increases turnover rates (because workers can easily get jobs elsewhere)
b. Unregulated labour market	
i. Few workers have labour contracts	Because the restriction of labour contract on workers is limited the majority of employers don't sign labour contract with workers
	workers can come and go as they wish because there are no penalties for workers who break their contracts
	High turnover rates make it very easy to lose track of workers unless there are systematic management procedures
ii. Labour service companies do not fulfil their responsibilities	The large number and high turnover rates of workers make it difficult for managers to get to know each operator well and to allocate work based on their preferences and skill set; this can affect workers' safety behaviour
	Moving frequently from site to site and repeatedly receiving safety training cause workers to pay less attention to safety training
c. National and sectoral health and safety management legislation and regulations as well as their implementation	
i. National constitutional law	The most important reason why managers care about safety at work is because they don't want to lose their jobs and go to prison
ii. Sectoral health and safety management regulations	Many standards and regulations about safety training in the construction sector are taken from developed countries, but are not suitable for the reality of Chinese society and the Chinese construction sector, and are difficult to implement properly
iii. Implementation as formality	Managers of small construction companies have the resources to invest in safety management. They don't do so because they only want to maximise their profit
	Because the investment in safety management is long term and the effect is not obvious sometimes, many construction companies are reluctant to invest in safety management
	Many constructions use the budget money for safety environment and equipment on other purposes
	There is less media attention and rigorous inspection from responsible institutions of projects carried out by small construction companies because the projects are normally small and in remote areas. Therefore smaller companies are more likely to take risks and violate rules
d. Hidden business 'rules'	
i. Different 'cooperation styles'	Having a good 'Guanxi' with the local authority and responsible institutions can help companies avoid being discovered and punished for safety rule violations. It affects the stringent implementation of legal regulations, especially in remote areas
ii. Unwritten rules for successful bid	It is very difficult for small construction companies to make a profit from their projects. This leaves them very little money to invest in safety management
iii. Default payment	

(Continued)

Themes emerged from interview analysis	Question items
4. National and cultural factors	
a. China's extremely rapid development	
i. Demand for fast completion of large scale infrastructure construction	There is constant pressure to work at a high speed in order to finish projects on time
ii. Development of the belief of 'time is money'	People want to achieve things quickly. This reflects on daily behaviour in workplaces in China
	"Worshiping money" is a common phenomenon in the modern society. It threatens the values of "integrity", "striving for excellent quality", "taking social responsibility" among some people
b. Improved living conditions and quality of life	
i. Improved living conditions in rural areas	The increase of workers' salary and the general living condition in the society improves workers' self protection awareness
ii. Improved quality of life and changed attitudes	
c. The Central government attitudes and commitment towards safety and 'people oriented' policy	
i. 'Safety first' policy	Nowadays, managers at all levels are more interested in safety than production
ii. 'People oriented' policy	
d. Raised status of migrant workers and protection of them	
i. The Central Government demands for raising the status of migrant workers in the society	The increase of workers' salary and the general living condition in the society improves workers' self protection awareness
ii. The Central Government-issued legislation and policies to protect migrant workers	
e. "Qing (情) Li (理) Fa (法)" (Emotion Reason Law)	
i. *Guanxi*	Having a good 'Guanxi' with the local authority and responsible institutions can help companies avoid being discovered and punished for safety rule violations. It affects the stringent implementation of legal regulations, especially in remote areas
ii. Lack the elements of being precise and obeying rules	Being 'good enough is fine' is a culture. This is reflected in daily behaviour at work by both managers and workers
	Most people I know believe accidents are a matter of fate; they are predetermined and nothing can stop them from happening
	People are happy to take risks because they assume bad things will not happen to them

As the study aimed to explore participants' opinions about the effects of different factors on workers' violation behaviour, the majority of the questions were worded in the form of explanatory statements revealing the

associations amongst different factors and their effects on workers' safe or unsafe behaviours. Another reason for adopting the form of explanatory statements was that although the author was confident with the honesty in interviews and focus groups participants, comparing their reports on the frequency of workers' rule violations on site with the author's counting during on-site observations, there were certain degrees of discrepancies. It was believed that using rule violation as a measure in the questionnaire could affect the validity of the research. Vredenburgh (2002) also designed some of the question items in the same form for the survey study on the effective management practices for reducing employee injury rates in a hospital setting. For example, in terms of rewards, a question item states "to what extent do you think that work-related injuries are due to a lack of rewards for reporting hazards?"; in terms of management commitment, a question item states "to what extent do you think that work-related injuries are due to a lack of management support in correcting employee safety hazards?". Vredenburgh (2002) used extent scales ranging from 1=no extent to 5=a great extent as the answering format for the questions. It is similar to the 5-point Likert scale answering format adopted for the questionnaire in the current study.

The questionnaire was translated with an approach named decentering translation (Calson, 2000). This approach assumes that the instrument developed in the original language is not finalised until the translation to the target language is completed. Thus, modifications can be made to the instrument in the original language when problems are revealed in the process of translation. Both versions of the instrument should be compared and revised repetitively until the conceptual equivalence is achieved. This approach, according to Calson (2000), may reduce the potential problems generated by translation and is considered as the optimal method in

translating instruments. By drawing on the principle of the decentering approach, the questionnaire was developed and translated through the following rigorous process:

Step 1: The draft questionnaire was first developed in English based on the information obtained through interview analysis and literature review.

Step 2: The initial questionnaire draft was discussed in-depth with the author's supervisors and other colleagues who were in their middle or final stages of PhD. The discussion was mainly focused on the content, format, layout, and structure of the questionnaire. Amendments were made whenever necessary.

Step 3: Once the English version of the questionnaire draft was completed, the author translated it into Chinese with the help of Chinese articles to identify the proper Chinese terms and phrasings for accurate translations of English text.

Step 4: The Chinese version of the questionnaire draft was discussed in-depth with 14 Chinese managers at different levels of management in construction companies and experts in health and safety management. The focus of the discussion was similar to the one at the step 2 mentioned above. In addition, particular attention was given to the wording of questions. Amendments were made whenever necessary. (See Section 5.4 for detailed explanations)

Step 5: Changes were made to the English version of questionnaires according to the updated Chinese version. Both the English version and the Chinese version of the questionnaire were reviewed and revised repetitively with discussion and consultation from the author's supervisors, colleagues and Chinese academics as well as practitioners until it was assured that both

versions were conceptually equivalent and accurately expressed the intended meanings of questions.

5.4 Stage II – Pre-pilot discussion

5.4.1 Design

The ultimate purpose of pre-pilot discussions was to receive feedback from senior managers of construction companies as well as health and safety management experts on the questionnaire draft in order to eliminate poor design features of the questionnaire. Twenty-one preselected managers at different levels of management positions in construction companies and experts in health and safety management were to be contacted. The interview process would stop whenever there was no new information revealed through the interviews.

5.4.2 Participants

Fourteen participants from 10 different organisations participated in the study. Among the participants, four were senior managers of construction companies in Beijing, Shenzhen, and Dongguan, four were safety managers and safety officers in Beijing, three were inspectors in Beijing and Dongguan, two were academics teaching and doing research on the topic of health and safety management in hazardous industries in two prestigious Universities in Beijing and Tianjin, and one was a legal advisor in a construction company in Shenzhen. Participants were aged between 31 and 59, and have worked in the construction industry for at least six years. See Table 14 below for participants' demographic information.

Table 14. Demographic information of questionnaire pre-pilot discussion participants

Participant	Age	Years of working in the construction industry	Job title	Location
1	36	12	Inspector	Beijing
2	40	18	Safety manager	Beijing
3	42	19	Senior manager	Beijing
4	58	36	Senior manager	Beijing
5	59	39	Inspector	Beijing
6	52	30	Senior manager	Shenzhen
7	38	14	Safety manager	Dongguan
8	31	6	Safety officer	Beijing
9	43	17	Academic researcher	Beijing
10	40	14	Academic researcher	Tianjin
11	31	9	Safety officer	Beijing
12	36	14	Inspector	Dongguan
13	50	19	Legal advisor	Shenzhen
14	53	21	Senior manager	Dongguan

5.4.3 Ethical considerations

The current study aimed to collect feedback from interviewees on the design of the questionnaire, including the appropriateness of the questions and language, as well as whether more questions were required to be included in the questionnaire. No personal experience or sensitive topics were discussed during the interview. The questionnaire was first sent to each participant via email for review after receiving participants' consent for doing so over the telephone. An appointment was then made via telephone in advance with each interviewee. The purposes of the research project and the discussion were explained clearly on the phone before sending questionnaire to the interviewees. Discussions only took place when the interviewees were agreed to participate and share their opinions.

5.4.4 Procedure

All interviewees were carefully selected from the pool of candidates that encompassed senior managers and foremen that participated in the interviews in the previous year, and new contacts gathered during the preparation period for the questionnaire survey. The aim of the selection was to include senior managers, inspectors, and safety officers who have worked in the construction industry in China for at least five years, academics who have great knowledge in the theories of health and safety management and in research methods, and legal advisors who are specialised in legislation and regulations in relation to health and safety management in the Chinese construction industry and labour protection.

Twenty-one potential participants were first selected from the pool of candidates. The author personally contacted all 21 participants via telephone during the first week of August 2011. The purpose of the research project and the current discussion was explained clearly on the phone. Nine contacts agreed to participate at the end of the first round of telephone conversations. Three contacts' telephones were switched off and the remaining nine contacts were on business trips and needed to be contacted again within a week. The questionnaire was sent to all nine participants via email for review. Participants were also informed, and agreed during the telephone conversations, that a follow-up meeting either on the phone or face-to-face would take place in three to seven days to discuss their comments on the questionnaire. The time schedule for each follow-up meeting was arranged during the telephone conversation.

A second round of telephone contacts to the remaining 12 potential participants was made one week after the first round. Five participants agreed to participate in the study. In the same way as the previous procedure, the questionnaire was sent by email to each participant for review and a

follow-up telephone or face-to-face meeting for discussion was arranged to take place in three to seven days.

Among the 14 participants, eight participated in face-to-face meetings in their offices at a time of their convenience, and six shared their opinions through telephone meetings. All participants made changes and comments on the original questionnaire and sent the questionnaire back to the author before the arranged meeting session. During the meetings, participants were asked about their overall impression of the questionnaire and the reasons for the changes they made. Detailed notes were taken during meetings.

5.4.5 Feedback and questionnaire amendments

All participants reported that the questions were closely related to reality and covered all the crucial aspects in relation to safety management in the Chinese construction industry and safety rule violations among workers. However, 11 participants revealed their concerns directly about the sensitivity of some questions. It was suggested to mix positive statements and negative statements in the questionnaire with the positive ones as the majority. In addition, all participants with no exception reported that they felt it was difficult to choose between "strongly disagree" and "disagree" as well as between "agree" and "strongly agree". Participants explained that Chinese are reluctant to choose extreme answers, especially when it is negative, i.e. "strongly disagree". However, in some cases, it was felt by participants that "disagree" could not express their perceptions or opinions accurately. As participants explained, almost all the question items covered rather complex issues and it was difficult to give a definite clear answer. Therefore it was suggested to add one more scale on both sides between "strongly disagree" and "disagree" as well as between "strongly agree" and "agree". Furthermore, all participants felt the language used in the questionnaire was too formal and

suggested some amendments to the wording. In addition to the above mentioned comments on the general design of the questionnaire, participants also added question items in different sections of the questionnaire.

Based on participants' feedback, amendments were first made to the Chinese version of the questionnaire. In addition to the amendments of wording, questions were added to various sections of the questionnaire. Among the newly-added question items, two were control questions; one was in the section of managers and the other one was in the section of safety management. The control question "*Managers' safe behaviour has no influence on workers' attitudes towards safety and their behaviour*" controlled the question "*If managers always comply with safety rules, workers are more likely to do the same*" and the control question "*Work in compliance with safety rules is not always the best way of working, but is certainly always the safest way*" controlled the question "*The safety rules do not always describe the safest way of working. Sometimes it is safer not to comply with the safety rules at work*". In addition, extra attention was paid to the sensitivity of the questions. With the principle of not losing crucial factors in the questionnaire, amendments were made to the questions whenever it was possible.

Taking participants' feedback into account, the answer scale was also amended in a way that 7-point scale was used instead of 5-point scale. Between "Strongly disagree" and "Disagree" a scale named "Basically disagree" was added, and between "Strongly agree" and "Agree" a scale named "Basically agree" was added. Similarly for questions with answers other than asking about agreement level, a scale starting with "Basically" was

added on each side of the answering scale, for example, "Basically satisfied" and "Basically unsatisfied".

After the first round amendments to the questionnaire, all participants were contacted again by telephone, and with their consent, the new version of questionnaire was sent to each of them by email. All participants were asked to give further comments on the amended questionnaire. No additional changes were made.

The amended Chinese version of the questionnaire was then translated into English by the author. The English version of questionnaire was discussed in-depth with the author's supervisors and colleagues. Further amendments were made to the wording of the questionnaire to make the English language more authentic and comprehensive. Both the English version and the Chinese version of the questionnaire were reviewed and revised repetitively with discussion and consultation from the author's supervisors, colleagues, and practitioners until it was assured that both versions were conceptually equivalent and expressed accurately the intended meanings of questions. No major amendment was made to the question items. The English version and the Chinese version of the complete questionnaire are to be found in Appendix XI and XII respectively.

5.5 Stage III – Pilot study

5.5.1 Study design

The purpose of the pilot study was to test the questionnaire with five managers in the Chinese construction industry to find out if the managers could understand the questions, and if they had difficulties in filling out the questionnaire with the existing designed style. Participants were welcomed to make any comments on the questionnaire and their experience of completing

it. The study was designed to include a good mixture of managers with different backgrounds in terms of age, gender, education and work experience in order to represent the large number of survey participants.

5.5.2 Participants

Five managers from five different organisations participated in the pilot study. Table 15 lists their demographic information.

Table 15. Questionnaire pilot study participants' demographic information

Participants	Gender	Age	Education	Organisation type	Location	Job title	Years worked in the construction industry
1	M	56	Master	State construction health and safety ministry	Dongguan	Director	34
2	M	51	Bachelor	State construction inspection ministry	Beijing	Senior inspector	28
3	M	30	Master	State owned company	Beijing	Safety officer	8
4	F	42	Occupational college	State owned company	Tianjin	Health and safety officer	20
5	M	36	Occupational college	Private company	Shenzhen	Project manager	17

5.5.3 Ethical considerations

The current pilot study aimed to test the design of the questionnaire including managers' comprehension of the questions and language, as well as their acceptance of the answering style. As the study was a questionnaire pilot study, no personal information received during the study process was to be used for final analysis. No personal experience or sensitive topics was discussed during the study. The questionnaire was sent to participants either via email or delivered by the author in person after receiving participants' consent for doing so over the phone. Participants were asked to complete the

questionnaire alone in a quiet place. The purpose of the research project and the current study were explained clearly on the phone before sending questionnaire to the participants. The study only took place when the participants had agreed to participate and to share their opinions.

5.5.4 Procedure

All participants were carefully selected from the pool of candidates that encompassed senior managers and foremen that participated in the interviews in the previous year, along with new contacts gathered during the preparation period for the questionnaire survey. The aim of the selection was to include senior managers, inspectors, and safety officers with different backgrounds in terms of age, gender, education, location, types of organisation, and work experience.

The study was carried out during the first two weeks of September 2011. Eight candidates were selected from the pool of candidates for first round telephone contacts. After contacting six candidates, five agreed to participate. Therefore, telephone calls were not made to the remaining two candidates. The candidate who did not participate explained he had extremely busy schedule during that time. The purpose of the research project and the pilot study was explained to all candidates clearly on telephone before asking their consent of participation. After candidates had agreed to participate, the author then delivered the questionnaire to participants' offices in Beijing at a pre-arranged time. Because of time and monetary limitations, participants located outside Beijing received the questionnaires via email after telephone contact. All participants were asked to read the introduction and instruction carefully before answering any question and to complete the questionnaire alone in a quiet place.

Participants located in Beijing completed and returned the questionnaire during the author's visits. While participants were completing the questionnaire, they were asked to verbally describe why they were making their choices so that an insight into their decision process and their understandings of the questions were obtained. Participants located outside Beijing sent the questionnaire back to the author via email within three days after receiving it. A short telephone interview was conducted after receiving the questionnaire from participants. During the interview, participants were asked about their reasons for their decisions on questions that were answered very differently from the ones completed in Beijing. All participants were asked to make any comments on the design of the questionnaire, e.g. the question layout, the colour of the questionnaire, the font used, the answer format, and their opinions on the comprehensiveness and the depth of the questions.

5.5.5 Feedback and questionnaire amendments

Positive feedback was received from participants on the design of the questionnaire. No difficulty in completion was reported. All participants reported that the questions were comprehensive and realistic; the questions covered all of the most important issues related to safety management in the Chinese construction industry and associated factors affecting safety rule violations among workers. No amendment was made after the pilot study.

5.6 Stage IV – Survey

5.6.1 Study Design

Because of the inconvenient access to computers and internet on construction sites, the questionnaire survey was designed to be carried out with pen and paper only. The questionnaires were distributed on sites by the

author or by companies' 'champions' to each participant. The survey was targeted at the people whose job roles were closely related to safety management in the Chinese construction industry, such as investors, senior managers, foremen, safety officers, quality control officers, inspectors, engineers, finance officers, and administrators. Because the questionnaire focused mainly on the big picture of how various factors at different levels of the work system affect one another and ultimately affect workers' behaviour, as well as the current safety management situation in the Chinese construction industry along with existing issues in the society, the participants included in the study may provide valuable insight information reflecting their various perspectives given their job roles. The direct contact and interview experience with construction workers in the previous qualitative study showed that construction workers had a very limited insight into understanding of different factors that may affect their behaviour, and very often the workers had difficulties with reading, therefore construction workers were excluded from this study. Fang and his colleagues (2004) made similar decision during their survey research on the safety management on the Chinese construction sites. They argued that "workers can hardly tell whether their workplace is safe or whether the workplace safety management is well performed" and thus question items on workers' perception should be avoided (Fang et al., 2004, p.45). In order to gather more comprehensive and representative data, the survey was planned to be carried out in different areas within China.

5.6.2 Participants

A total of 700 valid questionnaires were received from participants from 62 construction sites. Participants had an average age of 33.04 years (SD=9.18), an industrial tenure of 9.96 years (SD=8.91). See Table 16 and

17 below for the number of participants categorised by their job titles and for participants' demographic information.

Table 16. Numbers of questionnaire survey participants categorised by their job titles

No.	Categories	Job title	No. of people
1	Senior managers	Project managers	40
		Project deputy manager	24
		Department manager	31
2	Line managers	Construction members	130
3	Safety officers	Safety Officer	99
4	Foreman	Foreman (plumbing, electrical, steel, tower crane, carpenters, welders, metal)	84
5	Technicians	Technician	53
		Engineering surveying officer	13
		Engineering designer	8
		Engineer	21
		Tester	6
		Quality control officer	45
6	Finance officers	Cost engineers	28
		Accountant	6
7	Materials and equipments management officers	Materials and equipments management officer	7
8	Administrators	General officer	6
		Documentation officer	57
9	Investor	Investor/owner	3
10	Third party inspectors	Inspector	39
		Total	700

Table 17. Survey participants' demographic information

Age			Gender			Years of work		
	No. of people	**%**		**No. of people**	**%**		**No. of people**	**%**
18-29 years old	311	44.4	**Female**	87	17.4	**<=5**	290	41.5
30-39 years old	227	32.5	**Male**	613	82.6	**6-10**	164	23.3
40-49 years old	106	15.1				**11-15**	91	13
50 and older	56	8				**16-20**	69	9.9
						21-25	35	5
						26-30	21	3
						>30	30	4.3

5.6.3 Ethical considerations

The study was reviewed and approved by the school's ethics committee. All respondents were provided with an information sheet as the first separate page of the questionnaire explaining the purpose of the study, dissemination of results, researcher's contact details, security of data storage, and their rights to confidentiality and withdrawal from the study. All participants were asked to tick the box at the bottom of the information sheet if they understood their rights and were willing to participate.

5.6.4 Procedure

The questionnaire survey process was carried out between early October 2011 and late February 2012. The questionnaires were distributed and collected in three ways. One way was through pre-arrangement with companies and construction sites which the author had personal contacts through networking and the questionnaires were distributed and collected by the author. In this case, visits to the companies or the construction sites were

pre-arranged by companies' 'champions' who were normally senior managers or safety officers. The purposes of the research project and the survey were explained in detail to the 'champions' at the beginning of the visits. Then the 'champions' arranged meetings with the survey-targeted groups of people in meeting rooms. After a short introduction of the author's background and the purpose of visits by the 'champions', the author explained in detail the purpose of the research and the survey as well as their rights to anonymity and withdrawal to the participants. 'Champions' then reconfirmed the anonymity of the survey and encouraged participants to give genuine answers. Once they confirmed that they all understood their rights by ticking the box on the information page, and they had no further questions regarding their tasks, participants started to fill out the questionnaires in the presence of the author. All questionnaires were then collected one-by-one by the author once completed. Each questionnaire was checked to make sure there were not any missing questions. Participants were asked to answer the missing questions immediately once being spotted.

Another way of distribution was through the safety officers without the author being present. Some companies had several construction sites in one city. Given the time constraints and budgets, at least one safety officer from each construction site joined the initial meetings arranged by the 'champions'. After explaining their rights to anonymity and privacy, the safety officers and the 'champions' were asked to fill out the questionnaires during the meetings. It was followed by a short training session from the author to the safety officers about how to distribute the questionnaires and the key points they needed to pay attention to while people completed the questionnaire, e.g. to make sure people understood their rights to anonymity and to withdrawal and to tick the box on the information sheet when they fully understood their rights and were willing to participate, as well as to make sure people did not

discuss their answers with each other, make sure people understood the answer format before they start writing, make sure people wrote down their personal information at the end of the questionnaire, and to make sure there was no missing questions while collecting questionnaires. The safety officers then went back to their sites and carried out the survey on their own. The questionnaires were normally then returned to the author two days later.

The third way of distribution was by random visits to construction sites by the author. In this case, the author paid random visits to the construction sites in the city she lived whenever she passed them. The receptionists at the construction sites led the author to meet either project manager or safety officers on the site. After an introduction and explanation of the purpose of her visit by the author, the contacted person decided if they were willing to participate. Once the contacted person agreed to participate, they arranged relevant people on the construction site to either gather together in one office to fill out the questionnaires or to complete the questionnaires separately in their own offices. The purpose of the research as well as their rights to anonymity and withdrawal were explained to the participants. The questionnaires were then collected and checked by the author after completion.

The name of the participant company and the date of the collection were recorded once the questionnaires returned. All questionnaires were then numbered according to the sequence of return with the initials of the company's name, for example, participant 100 from the China Construction Group No. 1 Co. Ltd (*zhong jian yi ju*) was numbered as ZJY100.

A total of 2,216 questionnaires were distributed on construction sites and all questionnaires were returned.

5.6.5 Data analyses

Valid questionnaires' results were typed first into MS Excel. There were four reasons for determining the invalidity of a questionnaire.

Firstly, if the answers given in the questionnaire were all the same, the questionnaire was considered as invalid. For example, if all questions were answered as "agree" with no exception. Secondly, if both control questions failed to be answered correctly the questionnaire was rejected. Thirdly, if a large proportion of the questionnaire was not completed, i.e. one or more sections in the questionnaire were not answered, the questionnaire was rejected; and finally, if all answers in the questionnaire were copied from another questionnaire, i.e. all answers were exactly the same as another questionnaire, the copied questionnaire(s) were considered as invalid. The number of copied questionnaires of one specific questionnaire ranged from three-21 copies. Some of the questionnaires had the same handwriting and some had different handwriting, but all copied questionnaires had exactly the same answers. Some questionnaires were photocopies of other questionnaires. Only the first questionnaire in the copied group was kept as valid if the questionnaire met all other validation criteria. The numbers of rejected questionnaires for each rejection reason are listed below in Table 18.

Table 18. Number of invalid questionnaires for each rejection reason

Reasons for rejection	No. of questionnaires
Question items have all the same answers, e.g. all questions were answered in "agree" or "disagree"	23
Incomplete questionnaires	14
Copied questionnaires	773
Questionnaires with both control questions failed to answer logically	630

Implementing the response rate formula defined by the Board of Directors of the Council of American Survey Research Organizations (CASRO) in 1982 as follows:

$$\frac{Number\ of\ completed\ interviews\ with\ responding\ units}{Number\ of\ eligible\ responding\ units\ in\ the\ sample}$$

The current survey has a 31.79% of response rate.

After the valid questionnaires were being selected, descriptive analyses were conducted using SPSS 16.0. It was followed by an exploratory factor analysis (EFA) in order to determine the underlying factors in the dataset.

The questionnaire was designed to serve three purposes: 1) to obtain a large number of managers' perceptions on the current situation of safety management in the Chinese construction industry, 2) to test interviewees' statements on the existing issues in the Chinese construction industry and in the society as well as workers' characteristics in a larger sample of managers, 3) to explore the factors associated with workers' rule violation using exploratory factor analysis. Prior to conducting EFA the question items those were not designed to measure the factors underlying the dataset, and those did not receive confirmation from the majority of participants, were selected. The question item selection process is as follow:

1) Select out the question items (excluding control questions) which received less than half of the survey participants' agreement with the statement– the issues described by these statements were not confirmed by the majority of survey participants (> 50%), and therefore are considered not as existing common issues. The selected question items are listed below:

1. The health and safety training provided on most construction sites is not designed at the appropriate level for most workers

2. It is impossible to complete jobs on time while following all safety rules

3. The most important reason why managers care about safety at work is because they do not want to lose their jobs and go to prison

4. Many constructions use the budget money for safety environment and equipment on other purposes

5. Most people I know believe accidents are a matter of fate; they are predetermined and nothing can stop them from happening

6. Workers violate rules or take risks while working because they are curious

7. Workers violate rules or take risks while working because they have an antipathy against 'safety management' and rebel against it

8. Workers violate rules or take risks while working because they just need to blow off some steam

9. Workers violate rules or take risks while working because they want to cause some damage

10. Workers violate rules or take risks while working because they do not know how to work safely

11. Workers violate rules or take risks while working because their co-workers often violate rules or take risks while working

2) Select out question items that were designed to obtain survey participants' perceptions of the current situation of safety management in the Chinese construction industry – these question items do not describe existing issues related to workers' rule violation. The selected question items are listed below:

1. How comprehensive is safety legislation that is relevant to the construction industry

2. How satisfactory is the overall implementation by companies of safety management legislation in the Chinese construction industry?

3. How stringent is current inspection and enforcement of safety management legislation in the Chinese construction industry

4. How satisfactory do you think the overall state of safety management is in the Chinese construction industry?

5. Overall, which of the following factors do you think is the biggest safety management problem in the Chinese construction industry?

3) Select out questions asking about managers' perceptions of the reasons for workers behaving safely were also excluded for EFA - these question items cover specific individual factors behind workers' safe

behaviour but not workers' rule violations. These question items are listed below:

Workers behave safely because:

1. Their family and friends tell them to do so
2. They don't want to cause unhappiness for their families
3. They want the company to develop sustainably
4. They want to avoid hurting themselves
5. They want to avoid hurting others
6. They want to avoid being caught and punished
7. They always follow rules and regulations
8. Their co-workers work safely
9. They are in a habit of working safely

4) Select out the question items that were designed to test interviewees' statements on the existing issues in the Chinese construction industry and in the society as well as workers' characteristics in a larger sample of managers – these question items do not describe the factors and their effects on workers' rule violation. These question items are listed below:

1. Most of the workers on construction sites have lower than high school level education
2. Most workers are aware of important safety rules on construction sites
3. Nowadays, managers at all levels are more interested in safety than production
4. Work in compliance with safety rules is not always the best way of working, but is certainly always the safest way
5. Because the investment in safety managemet is long term and the effect is not obvious sometimes, many construction companies are reluctant to invest in safety management
6. Managers of small construction companies have the resources to invest in safety management. They do not do so because they only want to maximise their profit
7. Most accidents are caused by workers' rule violation or risky behaviour and have nothing to do with managers
8. The safety rules do not always describe the safest way of working. Sometimes it is safer not to comply with the safety rules at work
9. There is constant pressure to work at a high speed in order to finish projects on time

Having finalised the question items that are suitable for EFA, the remaining 46 question items in the questionnaire were subjected to factor analysis. The following four steps were followed: (1) screening individual items for their suitability to be included in the factor analysis and examining the suitability of conducting EFA on the remaining items; (2) extracting factors using principle components analysis to produce a minimum number of factors that explain the variance in the data; (3) rotating the extracted factors to transform them into interpretable factors; (4) interpreting the rotated factors solution. The factor analysis results are presented first in the following section. Descriptive analysis results are presented hereafter.

5.6.6 Results

1) Exploratory factor analysis (EFA)

Item screening. An examination of the coefficients of skewness and kurtosis shows that many of the variables are affected by skew and kurtosis while the majority of variables have the coefficients of skewness and kurtosis less than +/- 2.0 (see Appendix XIII). Muthen and Kaplan (1985) argued that some degree of univariate skew and kurtosis is acceptable as long as for the majority of variables neither coefficient exceed +/- 2.0. In addition, Muthen and Kaplan (1985) argued that if many correlations in the initial correlation matrix are low (<0.2), then greater skew is acceptable. Ferguson and Cox (1994) further defined the cut off point for the percentage of low correlation as 60% or more for acceptability. They argued that if 60% or more correlations in the initial correlation matrix are below 0.2, either skew and/or kurtosis would not adversely affect the final solution. The initial correlation matrix of the variables used for EFA in the current study shows 94% of correlations are lower than 0.2 (see Appendix XIV). Thus, all the variables are remained in the analysis.

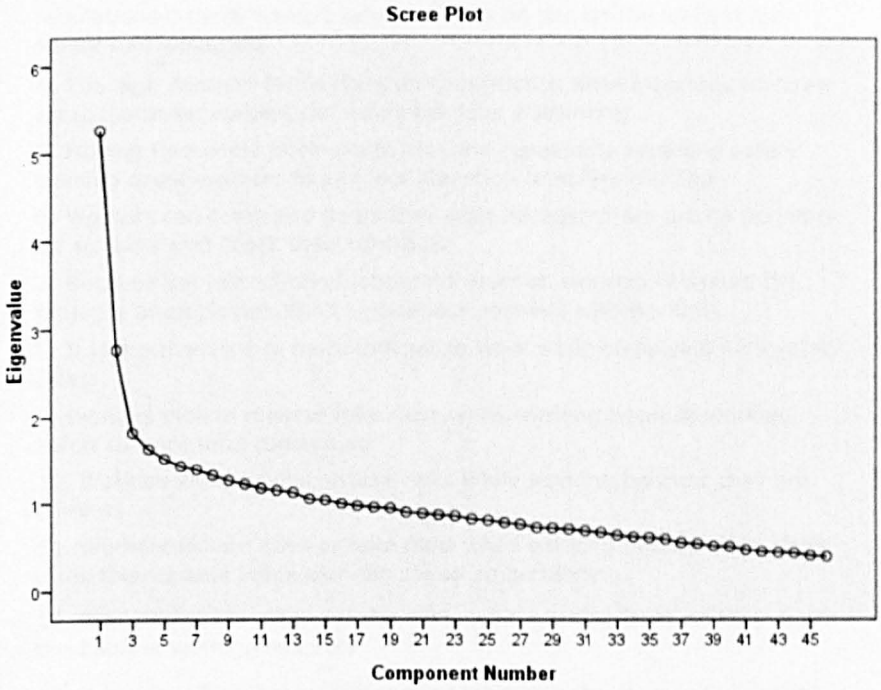
Suitability to factor analysis. To ascertain the suitability of conducting an EFA on the remaining 46 question items, factorability of the data was assessed. The sample size (n=700) of the current study conformed to the recommendation of 10 to 1 ratio of subject and question items (Everitt, 1975). The Kaiser-Meyer-Olkin coefficient was 0.78, above the commonly recommended value of 0.6, and Bartlett's test of sphericity was significant ($p < 0.001$). Many variables used in the factor analysis were significant correlated with each other (see Appendix XIV). The communalities were all above 0.3, further confirming that each item shared some common variance with other items. All of these overall indicators support the suitability of EFA.

Extraction of factors. Principle components analysis (PCA) was used to identify and compute composite scores for the factors underlying the designed questionnaire. The initial eigenvalues indicated that the first 15 factors exceeding 1.00 (see Table 19 for the variance explained by each factor respectively and the cumulative variance). The scree plot suggested factor solutions of two, three, four, and five (see Figure 13).

Table 19. The initial eigenvalues of the first 15 factors that exceed 1.00 in PCA

Component	% of Variance	Cumulative %
1	11.45	11.45
2	6.01	17.46
3	3.94	21.40
4	3.53	24.93
5	3.28	28.21
6	3.09	31.30
7	3.01	34.31
8	2.87	37.18
9	2.74	39.92
10	2.64	42.56
11	2.54	45.10
12	2.48	47.58
13	2.43	50.01
14	2.26	52.27
15	2.23	54.50

Figure 13. Scree plot showing the principle components analysis with Varimax rotation of the 46 items in the questionnaire



Different numbers of factor solutions (two, three, four, and five) were examined. Through the analysis process 29 question items were eliminated because they did not contribute to a simple factor structure, failed to meet a minimum criterion of having a primary factor loading of 0.32 or above (Tabachnick & Fidell, 2001), or failed to have a communality of more than 0.30 (Hair, et al., 1998). The eliminated items are listed below.

1. Workers' educational levels limit their ability to understand the training provided

2. Workers violate rules or take risks while working because they are not aware of the serious consequences of their behaviour

3. Workers would not comply with safety rules and operational regulations if there weren't safety officers on site on the lookout for safety rule violations

4. The high demand for workers on construction sites increases turnover rates (because workers can easily get jobs elsewhere)

5. Moving frequently from site to site and repeatedly receiving safety training cause workers to pay less attention to safety training

6. Workers can come and go as they wish because there are no penalties for workers who break their contracts

7. Because the restriction of labour contract on workers is limited the majority of employers don't sign labour contract with workers

8. It is inconvenient or more difficult to work while complying with safety rules

9. Workers violate rules or take risks while working because working safely is more time consuming

10. Workers violate rules or take risks while working because they are careless

11. Workers violate rules or take risks while working because they don't think their unsafe behaviour can cause an accident

12. Workers violate rules or take risks while working because they are in the habit of working unsafely

13. It is very often the case that rule violation behaviour and accidents are due to insufficient investment in safety

14. Severe disciplinary action for safety rule violations is needed to achieve sustainable improvement in the safe behaviour of both managers and workers

15. Incentives or reward systems are/would be more effective than severe disciplinary actions in reducing unsafe behaviour

16. Poor management and design of policies are the root causes of preventable accidents at work

17. Workers rush to finish their work early because the payment system encourages them to do so

18. The shortage of skilled workers means construction companies are not in a position to select workers. Thus, they have to employ whoever is available

19. High turnover rates make it very easy to lose track of workers unless there are systematic management procedures

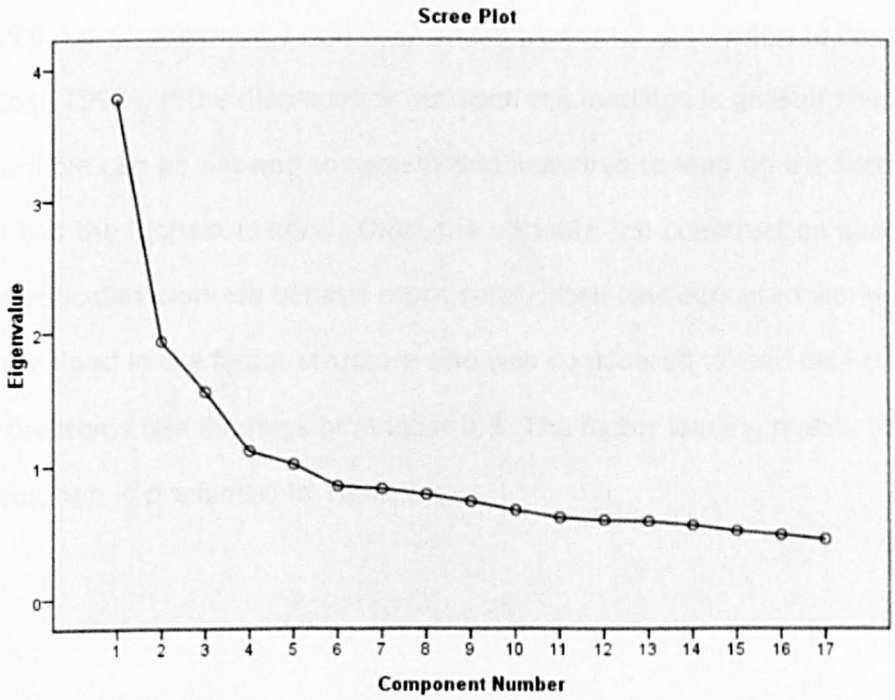
20. Safety officers are very important for keeping construction sites safe; without them accidents would happen more frequently
21. A caring and considerate management style helps prevent workers' unsafe behaviour
22. The large number and high turnover rates of workers make it difficult for managers to get to know each operator well and to allocate work based on their preferences and skill set; this can affect workers' safety behaviour
23. Untidy and dirty working sites are associated with workers' unsafe behaviour
24. The sheer size and geographical spread of contemporary construction projects causes difficulties for project and human resources
25. The provision of modern, good quality equipment improves workers' attitude towards safety and their safety behaviour
26. The increase of workers' salary and the general living condition in the society improves workers' self protection awareness
27. People want to achieve things quickly. This reflects on daily behaviour in workplaces in China
28. Being 'good enough is fine' is a culture. This is reflected in daily behaviour at work by both managers and workers
29. People are happy to take risks because they assume bad things will not happen to them

At the final stage, a PCA of the remaining 17 items was conducted. PCA revealed the presence of five components with eigenvalues exceeding 1.00, explaining 55.25% of the variance (see Table 20). An inspection of the spree plot suggested that solutions of two, three, four, and five were possible (see Figure 15). The three factor solution, which explained 42.74% of the variance, was considered as the best solution among all options. It was because the two factor solution explained less than the recommended 40% of the variance (Tabachnick & Fidell, 2001), and had the problem of interpreting some of the factors. In addition, the results of Parallel Analysis revealed three components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the same size (17 variables * 700 respondents), which supported the three factor solution. Thus, three factors were retained for further investigation.

Table 20. The initial eigenvalues of the first five factors that exceed 1.00 in PCA

Component	% of Variance	Cumulative %
1	22.23	22.23
2	11.36	33.59
3	9.15	42.74
4	6.54	49.28
5	5.97	55.25

Figure 14. Scree plot showing the principle component analysis with Varimax rotation of the 17 items



Rotation of the extracted factors. Both Varimax and Direct Oblimin rotations were conducted to rotate three factor solutions. Direct Oblimin rotation was first conducted to examine the degree of correlation between factors, as recommended by Pallant (2011). The component correlation matrix revealed that there were weak correlations among the three factors (see Table 21). Thus the factors can be assumed to be independent. Varimax rotation was then conducted to rotate three factor solutions as it is a

rotational technique for uncorrelated (independent) factor solutions (Pallant, 2011).

Table 21. Principle component analysis component correlation matrix

Component	1	2	3
1	1		
2	0.15	1	
3	0.16	0.09	1

The Varimax rotated solution revealed simple factor structure. Apart from one variable which loaded on two components, all the other variables loaded strongly on only one component. The variable that had cross loadings loaded 0.4 on component 1 and 0.63 on component 3. According to Ferguson and Cox (1993), if the discrepancy between the loadings is greater than 0.2, the variable can be allowed to remain and assumed to load on the factor for which has the highest loading. Thus, the variable "on construction sites, better educated workers behave more safely than less educated workers" was remained in the factor structure and was considered to load on Factor 3. All of the items had loadings of at least 0.5. The factor loading matrix for this final solution is presented in Table 22.

Table 22. Principle components analysis (with Varimax rotation) loadings of factors associated with workers' rule violation and communalities

	Component 1	Component 2	Component 3	Communa-lities
Foremen play an extremely important role in shaping workers' attitudes towards safety and ensuring that workers act in a safe manner	**0.70**			0.51
If corrective action is always taken as soon as managers discover unsafe practices, workers are less likely to violate rules or taking risks while working	**0.68**			0.50
If it is clear that the managers are genuinely concerned about workers' safety, workers are more likely to pay attention to health and safety	**0.66**			0.50
Senior managerial commitment and attitudes towards safety are crucial factors in keeping construction sites safe	**0.61**			0.41
More training is needed for both managers and workers in order to improve safety at construction sites	**0.59**			0.40
Workers can offer valuable suggestions on how to improve health and safety. Taking their advice can help reduce accidents on sites	**0.55**			0.36
If managers always comply with safety rules, workers are more likely to do the same	**0.53**			0.37
Frequent communication between managers and operators on safety issues can reduce operators' unsafe behaviour	**0.51**			0.30
Managers' safety behaviour has no influence on workers' attitudes towards safety and their behaviour	**-0.50**			0.34
It is very difficult for small construction companies to make a profit from their projects. This leaves them very little money to invest in safety management		**0.65**		0.48
Many standards and regulations about safety training in the construction sector are taken from developed countries, but are not suitable for the reality of Chinese society and the Chinese construction sector, and are difficult to implement properly		**0.61**		0.46
Having a good 'Guanxi' with the local authority and responsible institutions can help companies avoid being discovered and punished for safety rule violations. It affects the stringent implementation of legal regulations, especially in remote areas		**0.59**		0.43
There is less media attention and rigorous inspection from responsible institutions of projects carried out by small construction companies because the projects are normally small and in remote areas. Therefore smaller companies are more likely to take risks and violate rules		**0.53**		0.38
"Worshiping money" is a common phenomenon in the modern society. It threatens the values of "integrity", "striving for excellent quality", "taking social responsibility" among some people		**0.49**		0.31
On construction sites, older workers behave more safely than younger workers			**0.73**	0.59
On construction sites, experienced workers behave more safely than less experienced workers			**0.65**	0.56
On construction sites, better educated workers behave more safely than less educated workers	0.40		**0.63**	0.49

Interpretation of rotated factors solution. The three factors, identified by factor analysis, are interpreted as follows:

(1) Factor one. Factor one is a management related factor. Nine variables, as shown in Table 22, are identified to interpret it. They are: managers' genuine concern about workers' safety, foremen's important role in shaping workers' attitudes towards safety, senior managerial commitment and attitudes towards safety, managers' immediate rectification and reform once hazards are discovered, the need for more safety training for both managers and workers, managers' exemplary safety behaviour under any circumstances, frequent communication between managers and workers, and workers' empowerment. Having worded negatively, the variable "managers' safety behaviour has no influence on workers' attitudes towards safety and their behaviour" is loaded negatively on factor one. The nine variables indicate that managerial issues may improve safety levels on construction sites and positively influence workers' safety attitude and safety behaviour.

(2) Factor two. Factor two is an external environment related factor. The variables grouped within this factor explain how issues related to culture, extra-organisational standards, regulations, and inspections, as well as social media affect construction companies' implementation of legal regulations, especially in remote areas. Among the identified five variables, two variables describe the poor safety rule compliance from small construction companies because of less media attention, having good *guanxi* with the local authority, and a lack of rigorous inspection from responsible institutions on construction project. One variable describes the unsuitability of the existing standards and regulations about safety training in the construction sector given the reality of the Chinese society and the Chinese construction sector. One variable

explains the difficulty for small construction company to invest in safety management with little financial resources. Another variable explains that worshiping money, as a common phenomenon in the modern society, threatens the values of integrity, striving for excellent quality, and taking social responsibility among some people in the society. Summarily, the factor indicates the influence of issues in the external environment on the implementations of legal regulations relevant to safety management.

(3) Factor three. Factor three is a workers' demographic characteristics related factor. The three variables grouped within this factor describe the association between workers' age, educational level, experience, and their unsafe behaviour respectively. Explained by combining the three variables, this factor indicates the effects of workforce demographic characteristics on workers' behaviour.

Reliability. The reliabilities of all 17 questions regarding factors associated with workers' violation of safety rules as well as the subscales within each emerged factor were tested. Table 23 below shows the results of Cronbach's alpha test on both the scale as a whole and their subscales.

Table 23. Cronbach's alpha test results of the reliability of the questionnaire scale and subscales

Scale	No. of items	Cronbach's alpha
All questions regarding factors associated with workers' safety rule violation	17	0.74
Subscale		
Workers' characteristics related factor	3	0.59
Managerial issues related factor	9	0.79
External environment issues related factor	5	0.63

DeVellis (2003) advocated that ideally the Cronbach's alpha coefficient of a scale should be above 0.7. The Cronbach's alpha values of the scale as a

whole (alpha=0.74) and the subscale of managerial issues related factor (alpha=0.79) suggest good internal consistency reliability for the scale and the particular subscale with the sample in this study. However, Cronbach's alpha values are quite sensitive to the number of items in the scale. Pallant (2000) mentioned that it is common to find quite low Cronbach values (e.g. 0.5) with short scales, for example, scales with fewer than 10 items. As shown in Table 23, two subscales, with shorter scales, show relatively lower internal consistency than the subscale of managerial issues related factor. Pallant (2011) suggested that in cases of short scales it may be more appropriate to examine the mean inter-item correlation for the items. Briggs and Cheek (1986) recommended a range between 0.2 and 0.4 as the optimal range for the inter-item correlation. Table 24 and 25 below show the inter-item correlation matrix for the subscales of workers' characteristics related factor and external environment issues related factor respectively. The mean inter-item correlations for the items within workers' characteristic related factor and external environment issues related factor are 0.32 and 0.26 respectively. Both values are within the recommended optimal range for the inter-item correlation. The results indicate that these two subscales have also good internal consistency.

*Table 24. Inter-item correlation matrix for the subscale of workers' characteristics related factor (**p<0.001)*

	1	**2**	**3**
1. On construction sites, older workers behave more safely than younger workers	1		
2. On construction sites, experienced workers behave more safely than less experienced workers	0.39**	1	
3. On construction sites, better educated workers behave more safely than less educated workers	0.31**	0.27**	1

*Table 25. Inter-item correlation matrix for the subscale of external environment issues related factor (**p<0.001)*

	1	2	3	4	5
1. It is very difficult for small construction companies to make a profit from their projects. This leaves them very little money to invest in safety management	1				
2. There is less media attention and rigorous inspection from responsible institutions of projects carried out by small construction companies because the projects are normally small and in remote areas. Therefore smaller companies are more likely to take risks and violate rules	0.23**	1			
3. Having a good 'Guanxi' with the local authority and responsible institutions can help companies avoid being discovered and punished for safety rule violations. It affects the stringent implementation of legal regulations, especially in remote areas	0.23**	0.40**	1		
4. Many standards and regulations about safety training in the construction sector are taken from developed countries, but are not suitable for the reality of Chinese society and the Chinese construction sector, and are difficult to implement properly	0.39**	0.21**	0.23**	1	
5. "Worshiping money" is a common phenomenon in the modern society. It threatens the values of " integrity", "striving for excellent quality", "taking social responsibility" among some people	0.24**	0.15**	0.20**	0.28**	1

2) Descriptive results.

As mentioned earlier, some of the question items were designed to test interviewees' statements and to obtain participants' perceptions of the current situation of safety management in the Chinese construction industry. Descriptive analyses were conducted on these question items. The descriptive results are presented in the following.

Opinions about workers' characteristics

The majority of the questionnaire survey participants (57.1%) basically agreed/agreed/strongly agreed that most of the workers on construction sites have lower than high school level education. The result confirmed interviewees' statement on workers' educational level. Another 57.2% of survey participants believed that most workers are aware of important safety

rules on construction sites. The result indicates that it is unlikely that workers violate safety rule because of their lack of acknowledgement in important safety rules.

	Total % of strongly disagree, disagree & basically disagree	Neutral	Total % of strongly agree, agree & basically agree
Most of the workers on construction sites have lower than high school level education	**23.9**	**19.6**	**57.1**
Most workers are aware of important safety rules on construction sites	**17.8**	**25**	**57.2**

Opinions about work pressure

Over 96% of questionnaire survey participants basically agreed/agreed/strongly agreed that there is constant pressure to work at a high speed in order to finish projects on time. The result is in alignment with interviewees' statement. It is clear that construction companies' managers are under high work pressure.

	Total % of strongly disagree, disagree & basically disagree	Neutral	Total % of strongly agree, agree & basically agree
There is constant pressure to work at a high speed in order to finish projects on time	**0.9**	**2.4**	**96.8**

Opinions about safety rules and regulations

More than 70% of participants (76.3%) did not agree that safety rules do not always describe the safest way of working and sometimes it is safer not to comply with the safety rules at work. Only 10% of participants supported the statement. Meanwhile, 81% of survey participants basically agreed/agreed/strongly agreed that working in compliance with safety rules is not always the best way of working, but is certainly always the safest way.

The results indicate that the vast majority of participate managers perceive safety rule compliance as important and necessary for maintaining safety level on construction sites.

	Total % of strongly disagree, disagree & basically disagree	Neutral	Total % of strongly agree, agree & basically agree
The safety rules do not always describe the safest way of working. Sometimes it is safer not to comply with the safety rules at work	76.3	13.7	10
Work in compliance with safety rules is not always the best way of working, but is certainly always the safest way	7.4	11.6	81

Overall satisfaction with the overall state of safety management in China

When asked about their opinions regarding the satisfactory levels of the overall state of safety management in the Chinese construction industry, 30.6% believed it is basically satisfactory and another 6.5% had the opinion that the current state was satisfactory or very satisfactory. Meanwhile, 63% of participants did not believe that the overall state of safety management in China was basically satisfactory/satisfactory/very satisfactory. The result indicates that the majority of participants were not satisfied with the overall state of safety management in the Chinese construction industry.

	Very unsatisfactory	Unsatisfactory	Basically unsatisfactory	Neutral	Basically satisfactory	Satisfactory	Very satisfactory
How satisfactory do you think the overall state of safety management is in the Chinese construction industry?	2	6.6	12.7	41.7	30.6	5.6	0.9

Perceptions of the safety management legislation and regulations as well as their implementations

In relation to the national legislation and regulations relevant to the construction industry, managers and safety officers reported during interviews that there were comprehensive national constitutional laws as well as sectoral health and safety management regulations. Similar opinion was also shown from the majority of questionnaire survey participants. A total of 59.4% of survey participants believed that safety legislation relevant to the construction industry was basically comprehensive/comprehensive/very comprehensive.

	Total % of very incomprehensive	Total % of incomprehensive	Total % of basically incomprehensive	Total % of neutral	Total % of basically comprehensive	Total % of comprehensive	Total % of very comprehensive
How comprehensive is safety legislation that is relevant to the construction industry?	**1.4**	**3.6**	**6.6**	**29**	**44**	**13.7**	**1.7**

However, regardless of the comprehensiveness of the legislation and regulations, managers and safety officers reported during interviews that the implementation of the legislation and regulations was problematic. The questionnaire survey showed a similar result. Just over one third of participants (36.4%) believed the overall implementation by companies of safety management legislation in the Chinese construction industry was basically satisfactory/ satisfactory. Only 0.4% of participants were very satisfied with the overall level of implementation.

	Total % of very unsatisfactory	Total % of unsatisfactory	Total % of basically unsatisfactory	Total % of neutral	Total % of basically satisfactory	Total % of satisfactory	Total % of very satisfactory
How satisfactory is the overall implementation by companies of safety management legislation in the Chinese construction industry?	**1.4**	**7**	**14.7**	**40**	**27**	**9.4**	**0.4**

In addition, the questionnaire survey also showed that less than half of questionnaire survey participants (42.4%) believed that current inspections and enforcement of safety management legislation in the Chinese construction industry were basically stringent/stringent/very stringent. Such phenomenon was also mentioned by participants during interviews. Poor inspection and enforcement of safety management legislation represent an aspect of poor implementation of safety management legislation by third-party inspectors and relevant government officials.

	Total % of not stringent at all	Total % of not stringent	Total % of basically not stringent	Total % of neutral	Total % of basically stringent	Total % of stringent	Total % of very stringent
How stringent is current inspection and enforcement of safety management legislation in the Chinese construction industry?	**1.7**	**6.9**	**12.6**	**36.4**	**26.4**	**13.1**	**2.9**

The biggest safety management problem in the Chinese construction industry

When participants were asked about their opinion on which factors they believed to be the biggest safety management problem in the Chinese construction industry, the most commonly chosen factor was "lack of safety

awareness and necessary skills among workers" (32%). The second most chosen factor was "poor implementation of safety legislation" (17.7%) which was followed by the factor "lack of strict inspection and management from safety managers and officers of construction companies" (14%). These two reported issues are consistent with the observational study results and interviewees' comments in relation to the poor implementation of the written legislation and regulations. The least chosen factor was "lack of adequate safety management legislation" (3%). It confirmed the interviewees' report and the survey participants' responses on the comprehensiveness of the current safety management legislation.

Overall, which of the following factors do you think is the biggest safety management problem in the Chinese construction industry?	**%**
Lack of adequate safety management legislation	3
Poor implementation of safety legislation	17.7
Lack of legal enforcement from responsible institutions	6.7
Lack of awareness and commitment of managers to safety management	9.4
Lack of strict inspection and management from safety managers and officers of construction companies	14
Companies' lack of money to invest in safety management	11.6
Construction companies use the budget money for safety management on other purposes	5.6
Lack of safety awareness and necessary skills among workers	32

5.7 Discussion and conclusions

The previous qualitative study - interviews and focus groups - focused on obtaining in-depth information on individual experiences and perceptions in relation to the factors and their effects associated with workers' violation. Having been informed by the previous qualitative study, the study reported here focused on examining further the underlying factors in the large set of variables obtained from previous study using a different methodological

approach. It collected questionnaire survey data from 700 investors, senior managers, foremen, safety officers, quality control officers, inspectors, engineers, finance officers, and administrators. This study provided complementary information and triangulation evidence for the findings of the previous observation and document analysis study as well as interviews and focus groups study. Together with the qualitative study, this study addressed the first aim of the current research, namely, exploring the factors that have direct and indirect effects on safety rule violations among Chinese construction workers.

The main purpose of the current study was to explore the interrelationships among the variables included in the questionnaire using EFA in order to capture the minimum number of common factors associated with workers' rule violations. A factor structure consists of three common factors were extracted out of 17 variables. The three factors were labelled by the author as managerial issues, external environment issues, and workers' demographic characteristics.

Among the three factors, the factor of managerial issues is the first factor. According to factor analysis theory, the first factor accounts for the largest part of total variance of the cases and is normally considered as the most important factor (Jae-On & Mueller, 1978). It implies that managerial issues such as the variables grouped within the factor in this study, namely, managers' genuine concern about workers' safety, senior managerial commitment and attitudes towards safety, managers' immediate rectification and reform once hazards are discovered, safety training for both managers and workers, managers' exemplary safety behaviour under any circumstances, frequent communication between managers and workers, and workers' empowerment, are crucial elements in influencing workers' rule

violation. The importance of management in maintaining safety levels on construction sites and controlling workers' rule violation revealed by this study is consistent with the findings obtained from the previous observation and document analysis study as well as interview and focus groups study. The first four variables with the highest loadings within the first factor are all question items designed to describe the effects of management attitudes and commitment towards safety. The results further confirmed the past research findings on the crucial effects of management attitudes and commitment on influencing workers' safety attitude, violation behaviour, and consequently the safety performance of the organisation (e.g. Bloom, 1999; Clarke, 1999; Pfeffer, 1998; Zohar, 1980).

The factor of external environment issues is the second factor extracted from the variables by means of EFA in this study. The five variables grouped within this factor cover issues related to extra-organisational standards and regulations, lack of media attention and rigorous inspection in remote areas, little financial resource for safety investment, social phenomena such as worshiping money, and cultural issues such as relying on *guanxi* for punishment avoidance. Some of the variables in the current study have been identified by Alper and Karsh (2009) through their systematic review and were listed in the macroergonomic framework of safety violations under the level of what they named as external environment, for example, extra-organisational rules, standards, and legislation. However, they did not identify any evidence supporting their proposed factor of industry social influence, and they did not include cultural issues in their framework. The EFA results of the current study extend their findings by showing the effects of social media and cultural elements on safety management and consequently on workers' violation behaviour.

The factor of workers' demographic characteristics including age, educational level, and work experience is the third factor extracted from the variables in the study. Inconsistent findings have been reported in the literature in relation to the association between age, experience, and rule violation (e.g. Beilock, 1995; Hobbs & Williamson, 2002; Laurence, 2005; Li & Baker, 1995). The current study demonstrates that in the Chinese construction industry workers' age and the length of work experience are negatively associated with the likelihood of violation behaviour. In addition, the EFA result shows that educational level is another workers' characteristic that is linked to rule violation. Alper and Karsh (2009) proposed the potential association between education and violation in their macroergonomic framework of safety violation but failed to identify any evidence in their systematic review. The current study provides empirical support to their theoretical stance.

The three-factor structure revealed by EFA provides a slightly different but complementary source of information to the findings obtained from the thematic analysis in the interviews and focus groups study prior to the questionnaire survey study. While both studies revealed factors of workers' individual characteristics as well as managerial factors, the external environment factor extracted through EFA covers issues related to both the Chinese construction industry as well as national and cultural phenomena, which were classified into two separate categories in the thematic analysis in the previous qualitative study. Both survey study and interviews and focus groups study demonstrate that there are various levels of influential factors associated with workers' safety rule violation. It confirms the multilevel nature of the macroergonomic framework of safety violation proposed by Alper and Karsh (2009), and it supports Rasmussen's (1997) argument about the necessity of taking a systematic approach for safety management in the

dynamic work settings, considering the interactions and interrelationships among all the components within the system.

In addition to EFA, descriptive analyses were conducted on some of the question items in this study to obtain participants' perceptions of the importance of safety rule compliance, workers' educational level and their acknowledgement of important safety rules, and the current situation as well as existing problems of safety management in the Chinese construction industry. The purposes of these analyses were firstly, to provide alternative triangulation for interviewees' report on some of the existing issues during the previous interview and focus groups study, and secondly, to obtain a general understanding of participants' perceptions of the current situation as well as existing problems of safety management in the Chinese construction industry. Participants' responses on workers' educational level and their acknowledgement of important safety rules confirmed interviewees' statements. According to interviewees and survey participants, most construction workers in China have lower than high school education, and the majority of the workers are aware of the important safety rules on construction sites. Alper and Karsh (2009) suggested that industry workforce characteristics may have an influential effect on workers' safety behaviour. Thus, it is necessary to acknowledge the characteristics of Chinese construction workers in case of designing safety management interventions. Descriptive analyses also revealed that the vast majority of the participants believed safety rule compliance as important and necessary for maintaining safety level on construction sites. It demonstrates the significance of understanding and controlling the causes of rule violations, as well as promoting safety rule compliance in order to reduce accidents. The descriptive analyses on the question items related to participants' perceptions of the overall state of safety management as well as the current

safety management legislation reveal that although the majority of the participants believed that the current legislation is basically comprehensive/comprehensive/very comprehensive, just over one third of participants were satisfied with their implementations, and less than half of participants believed that the current inspection and enforcement of safety management legislation as basically stringent/stringent/very stringent. Similarly, less than half of participants were satisfied with the overall state of safety management. These results confirm interviewees' report on these issues. Participants' responses on the existing legislation and regulations as well as their implementations are consistent with the findings obtained from the previous observation and document analysis study as the findings demonstrate that the observed safety management measures in reality were different from the written policies on some of the participate construction sites. In terms of the biggest safety management problem in the Chinese construction industry, the descriptive analysis result shows that the most commonly chosen issue was the lack of safety awareness and necessary skills among workers. Such result highlights the main safety management problem in the Chinese construction industry that deserves the most attention.

5.8 Chapter summary

This chapter has presented the third study of the research – questionnaire survey. So far, the previous qualitative study and the current study have addressed the first aim of the research, namely, exploring the factors that have direct and indirect effects on safety rule violations among Chinese construction workers. Having acknowledged the influential factors, the next step is to rank the factors in descending order according to their influential power on safety rule violation and to determine the main factors need to be focused on for effective interventions. It is achieved by conducting

another questionnaire survey using Delphi method and the modified G1 method. The following chapter introduces this study which serves the second aim of the current research.

6. Study IV – Questionnaire survey using Delphi method and the modified G1 method

6.1 Chapter overview

This chapter introduces the last research study – questionnaire survey using Delphi method and the modified G1 method. The rationale of the study and its functions in meeting the research objectives are introduced at the beginning of the chapter (Section 6.2). The complete procedure of the research study is introduced comprehensively in Section 6.3 and the study analysis results are presented in Section 6.4. The chapter ends with a discussion on the findings of the study in light of research objective and practical implications.

6.2 Introduction to the study

The previous studies of the current research including interviews and focus groups as well as questionnaire survey revealed the influential factors associated with workers' rule violation, and their sequential as well as combined effects on one another and ultimately on worker's violation behaviour. Having acknowledged the factors and their effects, the current study aims to evaluate the importance levels of the factors in influencing workers' safety rule violations. This study reaches the third stage of the research plan – prioritise influential factors (see Section 2.2, Figure 7). The findings of the study are used to serve the objective of the last stage of the research – providing effective intervention suggestions targeting at the main influential factors associated with workers' rule violation.

6.3 Study method

6.3.1 Questionnaire design

The draft of the questionnaire for this study was designed on the basis of the findings from the previous qualitative study and questionnaire survey study. The question items and their representative influential factors included in the questionnaire are the integration of the factors obtained from the previous two studies. The factor structures revealed from the interviews and focus group study as well as the questionnaire survey study provide the conceptual framework for the questionnaire design of the current study. The questionnaire for this study comprises seven categories of factors associated with workers' rule violation, namely, workers' individual factors, managerial factors, labour market factors, relevant legislation and regulations and their implementation factors, factors related to the change of government as well as general population's attitude towards safety and the value of life, China's rapid development factors, and Chinese cultural factors. Table 26 below demonstrates the categories and subcategories of factors emerged from thematic analysis in the qualitative study, the three common factors extracted through EFA in the questionnaire survey study along with example question items grouped within the factors, as well as the seven categories of factors with their attributes that are enlisted in the questionnaire for the current study.

Table 26. The categories of factors revealed from the previous qualitative study and questionnaire survey study as well as the factors and their attributes used for the modified G1 method survey

Four categories of factors revealed from qualitative study		Three common factors extracted through EFA		Seven categories of factors used for the modified G1 method survey	
Workers' individual factors	***Workers' past experiences***, e.g., workers' educational experience, experience of working on farms before working on construction sites, experience of working unsafely on construction sites, experience of accidents on construction sites ***Workers' personal gains by violating safety rules***, e.g., convience and physical comfort, reduced working time	**Workers' demographic characteristics**	***Workers' age*** - older workers behave more safely than younger workers ***Workers' work experience*** - experienced workers behave more safely than less experienced workers ***Workers' educational level*** - better educated workers behave more safely than less educated workers	**Workers' individual factors**	***Age and work experience*** - Workers violate rules because of their young age and lack of working experience ***Education*** - Workers' lack of safety awareness as a result of their limited educational experience ***Work experience on farm*** - Workers' lack of safety awareness as a result of their long experiences of working on farms before working on construction sites ***Bad working habits resulted from working unsafely on sites*** - The development of bad working habits after many years of violating safety rules while working on construction sites ***Experience of accident*** - Workers' lack of safety awareness as a result of no direct experience of accidents or little acknowledgement of accidents on sites ***Convenience and physical comfort*** - Workers violate safety rules for personal convenience and physical comfort ***Reduced working time*** - Workers violate safety rules to reduce working time (Continued)

Four categories of factors revealed from qualitative study		Three common factors extracted through EFA		Seven categories of factors used for the modified G1 method survey	
Managerial factors	***Management attitudes and commitment towards safety***, e.g., financial investment on safety management and protection equipment, immediate rectification and reform once hazards are discovered, strictly following of safe construction procedures and regulations under the pressure of tight working schedule, reward system, exemplary safety behaviour, genuine concern about workers' general well-being ***Safety training for workers***, e.g., the frequency of safety training, the materials used for safety training, the style of safety training ***Safety management policies on sites***, e.g., designated reponsibilities for safety on site, inspections and immediate follow-up actions, communication and report system, materials and equipment management, physical environment management	**Management related factors**	***Management attitudes and commitment towards safety***, e.g., if corrective action is always taken as soon as managers discover unsafe practices, workers are less likely to violate rules or taking risks while working; if managers always comply with safety rules, workers are more likely to do the same ***Safety training***, e.g., more training is needed for both managers and workers in order to improve safety at construction sites ***Communication between managers and workers***, e.g., frequent communication between managers and workers on safety issues can reduce workers' unsafe behaviour; workers can offer valuable suggestions on how to improve health and safety, taking their advice can help reduce accidents on sites.	**Managerial factors**	***Management attitudes and commitment towards safety*** - Management attitudes and commitment towards safety, reflected in areas such as investment in safety management, immediate rectification and reform once hazards are discovered, exemplary safety behaviour ***Safety training*** - Workers' safety training, including frequency of training, content, method and styles ***Safety management policies on sites*** - Safety management policies on sites including stringent inspection and immediate follow-up actions, communication and report system, clear safety responsibilities for each individual ***Safety management policies on sites*** - Safety management policies relevant to the management of materials, equipment, working and living conditions (Continued)

Four categories of factors revealed from qualitative study		Three common factors extracted through EFA		Seven categories of factors used for the modified G1 method survey	
Sectoral and labour market factors	***Shortage of high quality workers and managers***, e.g., shortage of experienced and skilled workers, shortage of experienced and competent managers at all levels ***Unregulated labour market***, e.g., few workers have labour contracts, labour services companies do not fulfil their responsibilities ***National and sectoral health and safety management legislation and regulations as well as their implementation***, e.g., national constitutional law, sectoral health and safety management regulations, implementation as formality ***Hidden businss 'rules'***, e.g., different 'cooperation styles', unwritten rules for successful bid, default payment	**External environment related factors**	***Sectoral health and safety management legislation and regulations as well as their implementation***, e.g., many standards and regulations about safety training in the construction sector are taken from developed countries, but are not suitable for the reality of Chinese society and the Chinese construction sector, and are difficult to implement properly.	**Labour market factors**	***Shortage of high quality workers*** - Shortage of high quality workers on construction sites ***Shortage of high quality managers*** - Shortage of experienced managers on construction sites ***Few workers have labour contracts*** - Unregulated labour market within the construction industry, workers' high turnover rates, few workers have labour contracts ***Labour service companies*** - Labour service companies do not fulfill their responsibilities
				Relevant legislation and regulations and their implementations factors	***Legislation and regulations*** - National and industrial health and safety management legislation and regulations ***Implementations of legislation and regulations*** - Implementations of relevant legislation and regulations by construction companies and inspection companies as well as other relevant institutions ***Hidden businss 'rules'*** - Hidden rules within the industry and default payment (Continued)

Four categories of factors revealed from qualitative study		Three common factors extracted through EFA		Seven categories of factors used for the modified G1 method survey	
National and cultural factors	***China's extremely rapid development***, e.g, demand for fast completion of large scale infrastructure construction, development of the belief of 'time is money'	**External environment related factors**	***Social influence***, e.g. worshiping money is a common phenomenon in the modern society. It threatens the values of integrity and striving for excellent quality, taking social responsibility among some people ***Cultural element***, e.g., having a good guanxi with the local authority and responsible institutions can help companies avoid being discovered and punished for safety rule violations. It affects the stringent implementation of legal regulations, especially in remote areas.	**China's rapid development factors**	***Many construction projects*** - China has developed rapidly, large-scaled construction projects are all over China
	Improved living conditions and quality of life, e.g., improved living conditions in rural areas, improved quality of life and changed attitudes				***Tight schedule*** - Construction projects have tight schedule; they need to be completed quickly
	The Central Government attitudes and commitment towards safety and 'people oriented' policy, e.g., 'safety first' policy, 'people oriented' policy				***The mentality of 'time is money'*** - The mentality of 'time is money' becomes a commonality
	Raised status of migran workers and protection of them, e.g., the Central Government demands for raising the status of migrant workers in the society, the Central Government-issued legislation and policies to protect migrant workers			**Factors related to the change of government as well as general population's attitude towards safety and the value of life**	***Improved living conditions and quality of life across China*** - Improved living conditions and quality of life across China, people have changed their attitudes towards life ***The Central Government attitudes and commitment towards safety and 'people oriented' policy*** - The Central Government advocates 'safety first' and 'people oriented' policies ***Raised status of migran workers and protection of them*** - The Central Government demands for raising the status of migrant worker in the society and issued a series of legislation and policy to protect migrant workers
	Qing Li Fa (Emotion Reason Law), e.g., Guanxi, lack of elements of being precise and obeying rules			**Chinese cultural factors**	***Guanxi*** - The importance of *guanxi* to get things done, especially in remote areas; project successful bid, return payment, inspection on sites, punishment for violating rules and regulations and many other issues may all be affected by *guanxi*
					Lack of elements of being precise and obeying rules - People lack the habits of being precise and obeying rules

For each category of factors enlisted in the questionnaire, there are two questions; the first question is to ask participants to order the factors according to their levels of importance in influencing workers' rule violation behaviour, and the second question is to ask participants to pair-wise compare neighbouring indices they selected in the previous question, and to choose the respective answer from the rating scale. At the beginning of the questionnaire, the same two questions are asked with regard to the seven main categories of factors. Participants' demographic information – namely age, job title, and years of working in the construction industry – are asked at the end of the questionnaire.

The questionnaire for this particular study was first designed in Chinese based on the principle of the AHP and the modified G1 method, as well as the results obtained from the previous qualitative and quantitative studies. The questionnaire was first designed in Chinese because the author had the opportunity at the time to receive direct supervision from two Chinese academic researchers who had comprehensive knowledge and research experience in AHP, the G1 method, and the modified G1 method. One of the researchers is the founder of the G1 method and the other researcher is the person who proposed the modified G1 method and who has also carried out extensive research using the G1 method. The questionnaire was translated by the author to English once the Chinese version was completed, with the decentering translation approach implemented for previous questionnaire translation (see Section 5.3). The translated version of the questionnaire was discussed with the author's colleague and supervisor. Corrections to the wording were made wherever necessary, until a consensus of concepts and meanings was achieved from both the Chinese and English versions of the questionnaire. Both English and Chinese versions of the questionnaire can be found in Appendix XV and XVI respectively.

6.3.2 Pilot study

After receiving approval from both the Chinese researchers and the author's supervisor, a pilot study was conducted with three participants selected from the pool of candidates. The aim of the selection was to include well-experienced senior managers working in the Chinese construction industry. Participants' demographic information is shown in Table 27. All participants were working in Beijing. Thus, the questionnaire was delivered by the author in person to each participant after receiving their consent for doing so over the phone. The purpose of the pilot study was also explained clearly on the phone. The questionnaire was completed and returned to the author during her visit. Participants did not have difficulty in understanding the questions, nor in completing the questionnaire.

Table 27. Demographic information of participants in the pilot study using the modified G1 method

Participant No.	Age	Gender	Job title	Years of working in the construction industry
1	60	M	State-owned construction company CEO	39
2	58	M	Inpection company senior inspector	31
3	37	M	Project manager	14

6.3.3 Participants

Because the assignment of the weight of different indices requires not only comprehensive understanding and knowledge of the current situation in the Chinese construction industry and indices to be assessed, but also relatively high-level of logical and analytical thinking, only relevant experts or professionals who may provide penetrating insights were valuable to an empirical inquiry. Thus, all participants for this study were carefully selected.

In addition, it has been argued that a large sample for AHP survey is not necessary since it is a subjective method and focuses on examining specific issues (Cheng & Li, 2002; Lam & Zhao, 1998). Cheng and Li (2002) advocated that large sample size may not be practical for the AHP method, and could generate a great tendency of arbitrary answers, resulting in a very high degree of inconsistency. AHP surveys using a small sample size have been conducted in previous research. For example, Cheng and Li (2002) undertook a survey using AHP method with nine construction experts to test comparability of critical success factors for constructing partnering; Lam and Zhao (1998) invited eight experts for their quality-of-teaching survey; Wong and Li (2006) conducted AHP survey among 10 experts to analyse selection criteria for intelligent building systems. The modified G1 method is based on the AHP method, therefore a small group of experts were included in the study. A total of 17 experts participated in the study.

Participants had an average age of 46.94 (Std=5.51) and an average of 23.71 years (Std=5.82) of working experience in the construction industry. Participants' demographic information can be found in Table 28.

Table 28. Demographic information of participants of survey using the modified G1 method

Participant No.	Age	Gender	Job title	Years of working in the construction industry
1	43	M	Senior manager	20
2	49	M	Project manager	22
3	42	M	Safety manager	25
4	47	F	Senior engineer	26
5	45	M	Safety manager	27
6	45	M	Senior manager	20
7	48	M	Safety manager	24
8	40	M	Safety manager	19
9	53	M	Senior manager	35
10	40	F	Senior engineer	20
11	60	M	Senior manager	40
12	52	M	Senior engineer	20
13	48	M	Senior engineer	20
14	52	M	Senior manager	20
15	51	M	Safety manager	27
16	41	M	Senior inspector	20
17	42	M	Senior inspector	18

6.3.4 Ethical considerations

The questionnaire was sent to each participant via email or delivered in person by the author for completion after receiving participants' consent for doing so over the telephone. All respondents were provided with an information sheet as the first separate page of the questionnaire explaining the purpose of the study, dissemination of results, researcher's contact details, security of data storage and their rights to confidentiality, and withdrawal from the study. All participants were asked to tick the box at the bottom of the information sheet if they understood their rights and were willing to participate.

6.3.5 Procedure

After the pilot study was completed and the questionnaire was finalised, 24 potential participants were selected from the participants' pool, which included all the contacts the author collected during the time of the current

research. To pass the first round of the selection, the person needed to be at senior management positions, i.e. senior project manager, senior safety manager, and senior inspector; they needed to have at least 15 years of working experience in the construction industry; the person showed the author their relatively high interests in the author's research and good analytic skills as well as logic thinking abilities during previous contacts.

Once the selection completed, all potential participants were contacted individually firstly over the telephone during the last week of May 2012. Thirteen participants agreed to take part in the survey after the first round of telephone contacts. The rest of the potential participants were either on business trips and asked to be contacted again a few days later, or could not be reached by telephone. Meeting schedules were arranged with participants located in Beijing on the phone once they had agreed to participate in the survey. Because of time and monetary limitations, questionnaires were sent via email immediately after the telephone contacts to participants who agreed to take part in the survey but were located outside Beijing. A second round of phone calls to the remaining 11 potential participants took place during the first week of June 2012, and a further four participants agreed to take part in the survey. Again, questionnaires were either delivered by the author in person to participants in Beijing or sent via email to the participants located outside Beijing. By the end of the third week of June 2012, all 17 questionnaires were returned.

Data analysis using the modified G1 method was conducted after receiving all questionnaires. Based on the Delphi method, the analysis results – illustrating factors in descending order according to their average values of weight and participants' own responses – were then emailed to all 17 participants. The results and participants' personal responses were discussed

afterwards either in person or through telephone with participants on a one-to-one appointed time basis at their convenience. Surprisingly, all participants agreed with the analysis results and believed that the results demonstrated a more accurate status of influential power held by different factors than their own judgements. Thus, the Delphi process ceased after the second round of expert survey.

6.3.6 Data analyses

Data analysis software package MATLAB 7.0 was used to analyse the survey findings. Using the numerical computation principle proposed by Liu (2007, see Section 2.3.4) the calculation procedure was as follows, taking the judgments of participant 15 for the first two questions as examples:

Participant 15 first ranked seven main factors which affected workers' safety rule violations according to their importance of influence based on his own experiences and understanding (1= most important influence, 7 = least important influence). The participant was then asked to pair-wise compare neighbouring indices. See Table 29 and 30 for participant 15's judgments for the first two questions in the survey.

Table 29. Participant 15's ranking result for the seven main categories of factors

Seven categories of factors	Rank
Individual factors, for example, workers' young age and lack of work experience, workers' lack of safety awareness as a result of their limited education and long experiences of working on farms before working on construction sites; the development of bad working habits after working long time with violation behaviour; direct and indirect accident experiences; violate rules for personal convenience and physical comfort; violate rules to reduce working time	2
Managerial factors, for example, management's attitudes and commitment towards safety which are reflected in areas such as investment in safety management, immediate rectification and reform once hazards are discovered, exemplary safety behaviour; workers' safety training; safety management policies on sites including for example stringent inspection and immediate follow-up actions, management of materials, equipment, workers and physical environment	1
Labour market factors, for example, shortage of high quality workers; workers' high turnover rates; unregulated labour market	4
Relevant legislation and regulations and their implementation factors, including national and sectoral health and safety management legislation and regulations; their implementation by different organisations and institutions; hidden rules within the industry and default payment	5
Factors related to the change of government's as well as general population's attitudes towards safety and the value of life, for example, 'safety first' and 'people oriented' policies; The Central Government demands for raising the status of migrant worker in the society and issued a series of legislation and policy to protect migrant workers; people put more value on life	3
China's rapid development factors, including demands for fast completion of large scale infrastructure construction; the development of the belief of ' time is money'	6
Chinese cultural factors, for example, the importance of *guanxi* in getting things done; lack of habits of being precise and obeying rules	7

Table 30. Participant 15's pair-wise comparison judgments for the seven main categories of factors

	Equal importance	Between equal importance and somewhat more important	Somewhat more important	Between somewhat important and much more important	Much more important	Between much more important and very much more important	Very much more important	Between very much more important and absoultely more	Absolute more important
Foctor 1 vs. Factor 2									√
Foctor 2 vs. Factor 3							√		
Foctor 3 vs. Factor 4									√
Foctor 4 vs. Factor 5					√				
Foctor 5 vs. Factor 6						√			
Foctor 6 vs. Factor 7			√						

Based on the scaling values for the modified G1 method (see Section 2.3.4, Table 5) and numerical computation principles,

$$\gamma_2 = \frac{\omega_1}{\omega_2} = A^8,\ \gamma_3 = \frac{\omega_2}{\omega_3} = A^6,\ \gamma_4 = \frac{\omega_3}{\omega_4} = A^8,\ \gamma_5 = \frac{\omega_4}{\omega_5} = A^4,$$

$$\gamma_6 = \frac{\omega_5}{\omega_6} = A^5,\ \gamma_7 = \frac{\omega_6}{\omega_7} = A^2$$

So, the ratio of the most important index to the least one is

$$\frac{\omega_1}{\omega_7} = \prod_{i=2}^{7} \gamma_i = A^{33}$$

According to $A^{33} \leq 9$, it can be computed $A = 1.0688$.

Therefore

$$\sum_{k=2}^{7} \prod_{i=k}^{7} r_i = 31.0952$$

$$\omega_7 = (1+31.0952)^{-1} = 0.0312,\ \ \omega_6 = \omega_7\gamma_7 = 0.0356,$$

$$\omega_5 = \omega_6\gamma_6 = 0.0497, \omega_4 = \omega_5\gamma_5 = 0.0648,\ \ \omega_3 = \omega_4\gamma_4 = 0.1104,$$

$$\omega_2 = \omega_3\gamma_3 = 0.1646, \omega_1 = \omega_2\gamma_2 = 0.2804$$

The same calculation procedure was conducted for all questions in survey questionnaires. Once the value of weight for each factor was obtained from each participant, an average value of the weight for each factor was calculated. The value of weight for each factor was then multiplied by their respective main factor's value of weight in order to obtain the value of weight of each factor in relation to all other factors.

6.4 Results

Table 31 to 38 demonstrate the analysis results. Factors are ranked in descending order based on their average values of weight. A graphical illustration of all the factors in descending order according to their average values of weight is demonstrated in Figure 15. For the purpose of clear presentation, the factors in the figure are presented in their abbreviations. It is worth mentioning that within the AHP and G1 method context, the decision makers cannot provide deterministic preferences, but perception-based judgement intervals. The values of weight obtained in the current study represent only *relative* values for the effects imposed by the factors included in the study.

Table 31. Seven main categories of factors that are associated with workers' rule violation behaviour in descending order based on their average values of weight

	Factors in descending order according to their values of weight	Average value of weight
Seven main categories of factors	Managerial factors (M)	0.2733
	Individual factors (I)	0.2233
	Labour market factors (LM)	0.1323
	Relevant legislation, regulations and their implementation factors (RL)	0.1113
	Factors related to the change of government as well as general population's attitudes towards safety and the value of life (GA)	0.1071
	China's rapid development factors (RD)	0.0763
	Chinese cultural factors (C)	0.0427

Table 32. Workers' individual factors that are associated with workers' rule violation behaviour in descending order according to their average values of weight

	Factors in descending order according to their values of weight	Average value of weight
Individual factors	1. Workers' lack of safety awareness as a result of their limited educational experience (I1)	0.2571
	2. The development of bad working habits after many years of violating safety rules (I2)	0.2275
	3. Workers' lack of safety awareness as a result of their long experiences of working on farms (I3)	0.2091
	4. Workers violate safety rules for personal convenience and physical comfort (I4)	0.1375
	5. Workers' lack of safety awareness as a result of no direct experience of accident or little acknowledgement of accidents on sites (I5)	0.1253
	6. Workers violate rules to reduce working time (I6)	0.1131
	7. Workers violate rules because of their young age and lack of working experience (I7)	0.0504

Table 33. Managerial factors that are associated with workers' rule violation behaviour in descending order according to their average values of weight

	Factors in descending order according to their values of weight	Average value of weight
Managerial factors	1. Safety management policies on sites including for example stringent inspection and immediate follow-up actions, clear safety responsibilities for each individual (M1)	0.4391
	2. Management attitudes and commitment towards safety, reflected in areas such as investment in safety management, immediate rectification and reform once hazards are discovered, exemplary safety behaviour (M2)	0.3960
	3. Workers' safety training, including frequency of training, content, method and styles (M3)	0.2317
	4. Management of materials, equipment, working and living conditions (M4)	0.0674

Table 34. Labour market factors that are associated with workers' rule violation behaviour in descending order according to their average values of weight

	Factors in descending order according to their values of weight	Average value of weight
Labour market factors	1. Unregulated labour market within the construction industry, workers' high turnover rates (LM1)	0.3114
	2. Shortage of experienced managers on construction sites (LM2)	0.2652
	3. Shortage of high quality workers on construction sites (LM3)	0.2119
	4. Labour service companies do not fulfil their responsibilities (LM4)	0.2022

Table 35. Relevant legislation and regulations and their implementation factors that are associated with workers' rule violation behaviour in descending order according to their average values of weight

	Factors in descending order according to their values of weight	Average value of weight
Relevant legislation, regulations and their implementation factors	1. Implementations of relevant legislation and regulations by construction companies and inspection companies as well as other relevant institutions (RL1)	0.4692
	2. National and sectoral health and safety management legislation and regulations (RL2)	0.2580
	3. Hidden rules within the industry and default payment (RL3)	0.1796

Table 36. Factors related to the change of government's as well as general population's attitudes towards safety and the value of life that are associated with workers' rule violation behaviour in descending order according to their average values of weight

	Factors in descending order according to their values of weight	**Average value of weight**
Factors related to the change of government's as well as general population's attitudes towards safety and the value of life	1. Improved living conditions and quality of life across China, people have changed their attitudes towards life (GA1)	0.3547
	2. The Central Government advocates 'safety first' and ' people oriented' policies (GA2)	0.2954
	3. The Central Government demands for raising the status of migrant worker in society and issued a series of legislation and policies to protect migrant workers (GA3)	0.2490

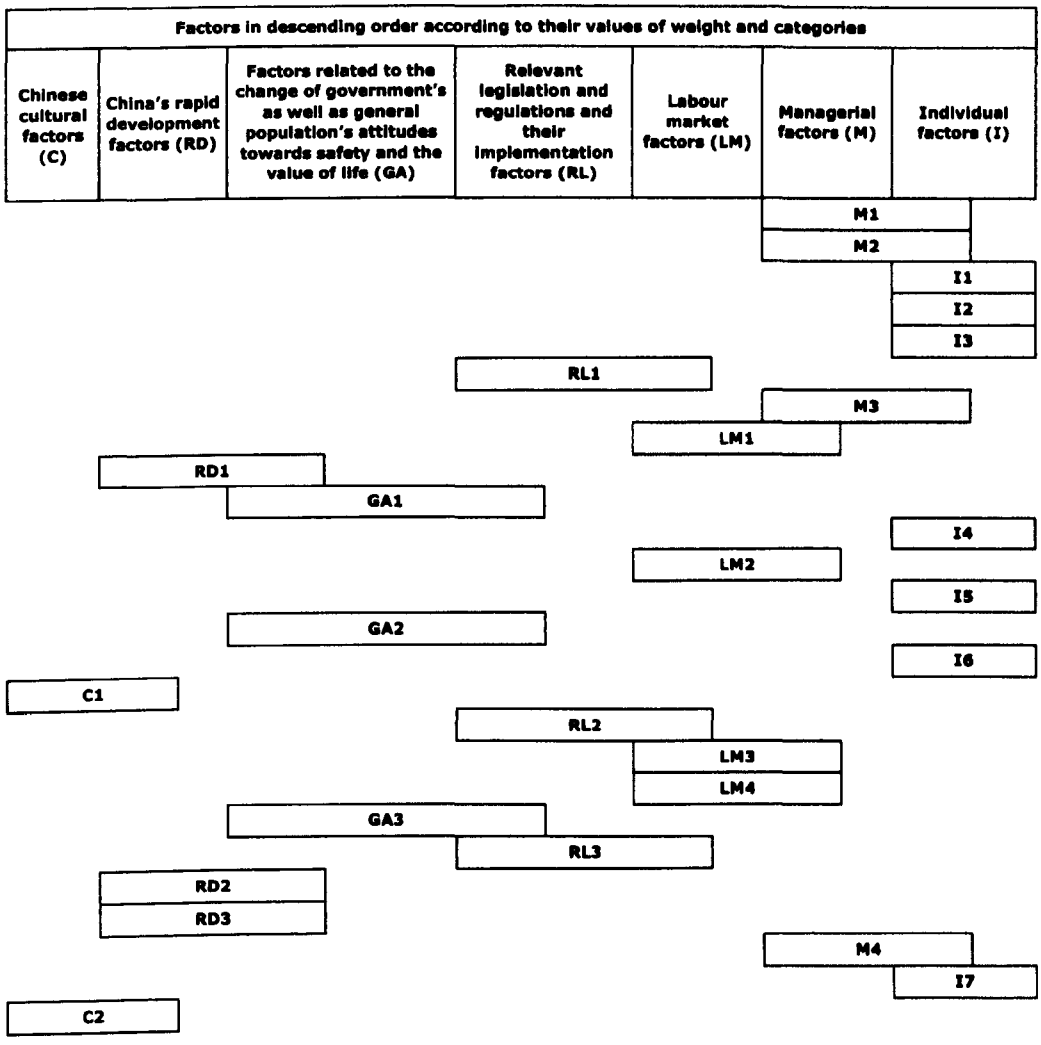
Table 37. China's rapid development factors that are associated with workers' rule violation behaviour in descending order according to their average values of weight

	Factors in descending order according to their values of weight	**Average value of weight**
China's rapid development factors	1. Construction projects have tight schedule; they need to be completed quickly (RD1)	0.5068
	2. China has developed rapidly, large-scaled construction projects are all over China (RD2)	0.2514
	3. The mentality of 'time is money' becomes a commonality (RD3)	0.2060

Table 38. Chinese cultural factors that are associated with workers' rule violation behaviour in descending order according to their average values of weight

	Factors in descending order according to their values of weight	**Average value of weight**
Chinese cultural factors	1. People lack the habits of being precise and obeying rules (C1)	0.6882
	2. The importance of *guanxi* to get things done, especially in remote areas; project successful bid, return payment, inspection on sites, punishment for violating rules and regulations and many other issues may all be affected by *guanxi* (C2)	0.3118

Figure 15. Graphical illustration of factors in descending order according to their average values of weight



6.5 Discussion and conclusions

The ranking results of the seven main categories of factors showed that managerial factors have the highest average value of weight. In other words, managerial factors were considered by survey participants to hold the highest importance in influencing workers' safety rule violations when it was considered in the context where various main factors interact. Individual factors were ranked in the second position. As shown in Table 31, the following three categories of factors in the ranking order belong to the sectoral and labour market factors revealed from thematic analysis in the

qualitative study, and the last two categories of factors in the ranking order are grouped within the national and cultural factors. Thus, the remaining factors were ranked as sectoral and labour market factors with higher importance of influence than national and cultural factors. According to the factor structure extracted through EFA in the previous questionnaire survey study, the remaining factors were grouped within the external environment related factor. Therefore, when the influential factors are examined on the basis of the factor structure obtained through EFA, the ranking order of the factors shows that the external environment related factors have the least influential power on workers' violation behaviour compared with management related factors and workers' individual characteristics. This finding is slightly different from the factor analysis result in the previous questionnaire survey study in which the external environment related factor shares the second highest variance among the three common factors, slightly higher than the factor of workers' individual characteristics. The low shared variance value of the factor of workers' individual characteristics in the EFA may be due to the small number of variables included in the factor; only three variables were included in the factor. Because the results of EFA depend on the questions being asked, the ranking order of the influential factors based on their shared variance values may not reflect truly the actual situation. It is the reason for conducting another round of questionnaire survey using Delphi method and the modified G1 method. With this approach, the ranking order of the factors in terms of their influential power represents experts' direct opinions without being affected by the design of the question items and the researcher's subjective interpretation. Thus, the ranking order of the influential factors obtained from the current study should be considered as a more accurate presentation of participants' perception.

An interesting finding revealed from the results was that when sub-factors were ranked according to their average values of weight in relation to all other factors, some of the workers' individual factors were ranked at higher positions than some of the managerial factors. In addition, among the top five positions of the ranking, three individual factors were included. It outnumbered the managerial factors, of which two were among the top five in the ranking (Figure 15). These results seem to contradict the previous ranking results of the seven main factors. The explanatory assumption is that at a higher level, when the added effects of numerous sub-factors are considered, managerial factors have more influential power on controlling workers' safety rule violation, albeit the effects of particular individual factors may outweigh the effect of certain singular managerial factor, since individual factors have more direct effects on individual intention and behaviour. A large number of empirical studies have demonstrated that safety climate has strong direct and indirect effect on safety behaviour (e.g. Glennon, 1982; Neal et al., 2000; Thompson et al., 1998). However, because safety climate is a collection of all aspects of safety management and safety attitudes of people under the climate, the ranking order of the managerial and individual factors as a whole as well as their sub-factors implies that improving one or two constructs of safety climate is insufficient to alter individuals' attitude and commitment towards safety as well as their rule violation behaviour. Having said that, two managerial factors, namely, 'safety management policies on sites regarding stringent inspections and immediate follow-up actions, clear safety responsibilities for each individual' and 'management attitudes and commitment towards safety' were ranked in the top two positions respectively among all 24 sub-factors. It demonstrates that although it requires an overall high quality of safety management to change individuals' attitude and commitment towards safety as well as their

violation behaviour, safety management policies along with management attitudes and commitment towards safety are the two most crucial elements among all factors and the two key issues among all managerial factors in influencing workers' rule violation behaviour.

Surprisingly, participant experts rated workers' safety training with relatively low values; the factor of workers' safety training was ranked in the seventh position among all 24 factors, after the sectoral and labour market factor of 'implementations of relevant legislation and regulations by construction companies and inspection companies as well as other relevant institutions'. Safety training has always been considered as one of the most important safety interventions practiced in the previous research (e.g. Cheng et al., 2004; Fang et al., 2004). However, with the acknowledgment of safety management problems in the Chinese construction industry, and the cultural traditions, the result confirmed that without well implemented relevant legislation and regulations by construction sites, in terms of delivering appropriate and genuine training to workers, training provisions alone can only remain as a show, with little effect on raising workers' safety awareness and improving necessary skills. The present study supports Hofmann and Stetzer's (1996) argument that advocated that training and incentives are over-stated when examining the cause of accidents and safety interventions. Vredenburgh (2002, p. 274) has also demonstrated through her study on safety management practices in a hospital setting that "training in itself is not adequate". She argued that training is only effective in reducing injury rates if the contents of training are well implemented in the work areas. The ranking also demonstrated that safety training has more influential power than personal convenience and physical comfort, workers' lack of safety awareness, as a result of no direct experience of accidents or little acknowledgement of accidents on sites, as well as workers' young age and

lack of work experience. It can be argued that if safety training is delivered frequently with well-designed case study training materials, the negative effects of attempting for personal convenience and physical comfort, workers' lack of safety awareness, because of little acknowledgement of accidents on sites, as well as workers' young age and lack of work experience can be minimised.

In contrast to other managerial factors, the factor of safety management policies relevant to the management of materials, equipment, and working and living conditions, was ranked at the second last position among all factors. Expert participants explained when being consulted during the second round of the survey, that although the factor was an important element of safety management, its main effects lay in eliminating accidents on sites and less on controlling rule violation behaviour, compared to other managerial factors. Thus, it is an indispensable aspect in creating a safety climate on construction site, but has less direct influence on workers' behaviour.

Although the majority of the factors other than individual factors and managerial factors were ranked in the lower half of the ranking, five of those factors were ranked within the upper half of the ranking: 1) implementations of relevant legislation and regulation by construction companies and inspection companies, as well as other relevant institutions, 2) unregulated labour market and workers' high turnover rates, 3) tight construction schedule, 4) improved living conditions and quality of life as well as people's changed attitudes towards life, and 5) shortage of experienced managers on construction sites. Having previously discussed the first factor, the following is focused on discussing the latter four factors. Among the four factors, the first two factors and the last factor demonstrate the strong negative effects of

the by-products of China's rapid development while the second last factor illustrates the bright side of the coin. China is at a rather unique transitional period, with the old traditional systems and beliefs meeting the new modern concepts and desires under the nation's extremely fast economic development. Thus, it can be argued that many of the influential factors revealed during the current research are unavoidable issues within the transition process, and may alter with time. However, during this specific period of time, the government's concerns about health and safety issues, and its enforcement on safety management, are deemed to hold especially important influential effects on guiding people's attitudes towards safety and regulating their behaviour. Zhou and his colleagues (2008) suggested that a "joint strategy", controlling both safety climate factors and individual factors simultaneously, is the most effective solution for improving workers' safety behaviour on construction sites. Based on the current research findings, it can be argued that their "joint strategy" concept should be extended to include the joint effort from all relevant official institutions and the Central Government in controlling issues that negatively affect safety management in a wider context.

Taking the results of both main factors ranking and sub-factors ranking into consideration, it can be concluded that firstly, among the seven enlisted factors, managerial factors and individual factors have the most influential power on workers' rule violation behaviour; secondly, as illustrated in Figure 15, sub-factors within each main category of factors have their own importance of effects, and these effects do not always follow the same ranking order as the main categories, which confirmed the argument that the issue of workers' safety rule violations are rather complex, and attempts to control such behaviour need to take a holistic approach; thirdly, because managerial factors as whole were ranked in the top position, it can be

concluded that, with high management standards and commitment towards safety, as well as effective well-implemented safety management policies and safety training, the negative effects of workers' lack of safety awareness, poor attitudes towards rule violation behaviour, as well as bad habits, can be largely controlled. If management holds positive attitudes and strong commitment towards safety, the negative effects of some of the sectoral and labour market factors, as well as national and cultural factors, could also be minimised. The results highlighted again the importance of managers' attitudes and commitment towards safety in determining the safety levels of companies within a hazardous industry. Having said that, the important influential power of the factors in the wider sectoral, social, and national context demonstrated by the research findings must not be overlooked.

Comparing the rankings obtained from the current survey with the ranking result of 'the biggest safety management problem in the Chinese construction industry' from the previous survey study of the current research (see Section 5.6.6, p. 205), it is worth mentioning that the top three biggest safety management problems rated by the highest proportion of participants were also the factors ranked at the top position within individual factors, sectoral factors, and managerial factors respectively. In other words, the top three biggest safety management problems are also the factors that have great influence on workers' safety rule violations. It can be argued that if the top three safety management problems were dealt with effectively, workers' safety rule violations could also be well controlled.

This study evaluated the influential factors revealed from earlier qualitative and quantitative studies using Delphi method and the modified G1 method. The findings fill the gaps that exist in the current body of research in this area since to the author's knowledge, there is no research that evaluated

and ranked the influential power of factors towards safety rule violations among Chinese construction workers. Information on the differentiated influential power of each factor on rule violation behaviour could facilitate practitioners and researchers to design more efficient and targeted intervention measures for controlling workers' safety rule violation acts.

6.6 Chapter summary

This chapter has reported the last study of the current research which examines the ranking order of the factors associated with workers' rule violations in terms of their influential power by means of questionnaire survey using Delphi method and the modified G1 method. Along with previous three studies of Chapter 3, 4, and 5, all research aims and objectives were achieved by exploring and examining the factors and their influential effects associated with rule violations among Chinese construction workers. Having presented the results and discussion of the four studies in the current research, the following chapter provides a general discussion of the significant results obtained from all of these empirical studies and elaborates on the implications of these findings.

7. General discussion, implications and future directions

7.1 Chapter overview

The chapter starts with a brief summary of the research findings obtained from the four studies carried out to meet the research objectives (Section 7.2). It is followed by discussion on the implications of the research findings for theory, method, practice, and policy in Section 7.3 to Section 7.5. It then proceeds to discuss the limitations and contributions of the current research in Section 7.6 and 7.7 respectively. The chapter concludes by discussing the possibilities for future research that would extend the work of the current thesis (Section 7.8).

7.2 Summary of research findings

The Chinese construction industry is a hazardous industry with high annual accident rates. The majority of the workers who work in this particular industry are young males with limited education and training, living in poor conditions. According to previous research findings, the characteristics of these workers make them more likely to experience workplace accidents (e.g., Dembe et al., 2005; Frone, 1998; Kirschenbaum, Oigenblick & Goldberg, 2000; Swaen et al., 2003). Over the years, the research on accident causations concluded rule violations as the major cause of accidents (Heinrich, 1950; Reason, 1990). Thus, in order to improve health and safety in the Chinese construction industry and to protect people who work in this industry from occupational accident and injuries, it is necessary to study rule violations and to understand the factors associated with such behaviour. Through their systematic review, Alper and Karsh (2009) suggested a macroergonomic framework of safety violation which includes four levels of situation and influencing factors that may cause violation. Their findings

demonstrate that the predictors of violation are multi-factorial, and violation in industry needs to be examined independently from violations in other settings such as recreational driving and general precautions, in particular, the factors that are associated with violation within a specific industrial sector need to be explored with independent focus. It lead to the work of the current thesis.

The current research was carried out to answer two research questions: 1) what are the factors affecting workers' safety rule violations in the Chinese construction industry, and how these factors affect such behaviour, 2) among all the influential factors, which of them have the highest influential power on workers' violation behaviour. To answer these questions, the research was broken down into two specific aims: 1) to explore the factors that have direct and indirect effects on safety rule violations among Chinese construction workers, 2) to determine factors which have a strong influence on workers' violation behaviour and are suitable for interventions. To meet the research aims, the current research adopted a mixed-method approach, with four main studies, combining observational study and document analysis, interviews and focus groups, and two rounds of questionnaire survey, to collect opinions of people who work around China in the construction industry.

Before starting to address the aims of the current research, a literature review was performed. In Section 1.4, the review identified the distinct gaps within the research on safety rule violations among Chinese construction workers. In particular, the review identified that 1) there were very limited research studies to date exploring factors and their effects on workers' rule violations in the Chinese construction industry, 2) Rasmussen (1997) and Alper and Karsh (2009) emphasised the multilevel nature of accident

causations as well as the factors associated with industrial rule violation. However, the existing research studies focused on one particular horizontal level, namely, the management level, but overlooked other levels in the hierarchical structure of the work system, 3) there were no systematic research studies examining the influential power of a comprehensive list of factors associated with workers' safety rule violations. The knowledge on factors' influential power is necessary because it may help researchers and practitioners to have a better understanding of the complex factors, and in turn facilitate the design of more actionable and effective intervention measures. The research gaps identified in the existing body of literature generated the research aims and objectives, and consequently lead to the following empirical studies in the current thesis. The discussion in Chapter 2 explained the sequences of stages in the research, and justified the necessity and suitability of the methodologies employed in the current research to meet the requirements of each stage in the research.

Chapter 3 introduced the first study of the research – on-site observation and document analysis. The observations conducted on 10 participant construction sites illustrated that safety rule violation among Chinese construction workers, at least on some construction sites, is still a frequent phenomenon. In addition, the frequency of violation observed on participant construction sites seemed to be negatively associated with the scores on their work and living conditions. For example, the construction site in Chongqing had the highest frequency of violation behaviour, and the lowest score on the cleanliness and tidiness of the physical environment of working and living areas, the stringency of the inspections on site, as well as communication styles among managers, safety officers, foremen and workers. However, the construction sites in Xiamen and Wuhan, which showed low frequency of rule violation but scored high on their work and

living conditions. These findings clearly showed that the phenomenon of safety rule violation on construction sites is only one problem above many underlying issues; in a sense it is like the tip of an iceberg, but the hidden issues underneath such phenomenon cannot be ignored, since they form the basis on which the revealed problems sit.

Chapter 4 and 5 introduced the second and the third studies of the current research which were conducted to serve the first research aim - to explore the factors that directly or indirectly influence safety rule violations among Chinese construction workers, and to explore the influential effects among these factors. Qualitative and quantitative studies were conducted to meet this aim. Firstly, in Chapter 4, the qualitative study explored a breadth of information regarding interviewees' experience of working on construction sites, their opinions on factors that have effects on workers' rule violations, as well as in-depth and detailed explanations in relation to how different factors affect one another and how these factors, as a result, lead to violations of safety rules. The qualitative analyses revealed that there were four main categories of factors that were associated with workers' violation behaviour; individual factors, managerial factors, sectoral and labour market factors, and national and cultural factors. Each of these categories was further divided into two levels of sub categories of factors, covering specific issues associated with workers' rule violations. The qualitative analysis results along with the situations and influential factors reported by Alper and Karsh (2009) in their macroergonomic framework of safety rule violation provided the conceptual framework for the questionnaire design in the following questionnaire survey study. In Chapter 5, by means of EFA, a factor structure consists of three common factors were extracted from 17 variables. The three factors were labelled by the author as managerial issues, external environment issues, and workers' demographic characteristics. The

descriptive analysis results from the survey data confirmed interviewees' statements on some of the existing issues in the Chinese construction industry as well as in the society, for example, most workers have lower than high school education, the existing safety management legislation and regulations are comprehensive but their implementations are poor. In addition, the descriptive analysis on the question of the biggest safety management problem in the Chinese construction industry revealed three major problems selected by the top three highest percentages of questionnaire survey participants: 1) lack of safety awareness and necessary skills among workers, 2) poor implementation of safety legislation and regulations, and 3) lack of strict inspections and management from safety managers and officers of construction companies. Both studies in Chapter 4 and 5, using two different methodological approaches, provided complementary information on the categories of influential factors. Together, they paint a full and reliable picture in answering the first research question.

According to participants, national and cultural factors cultivate the context that generates the existing issues within the construction industry and labour market. National and cultural factors also imperceptibly influence the attitudes, beliefs, and perceptions of each individual who lives within the context. Participants believed that the fundamental cause of most, if not all, existing issues within the construction industry, was China's rapid development. Such development generated the mentality of 'time is money, efficiency is life'. Under the influence of such mentality, individuals as well as society as a whole seeks the highest profit within the shortest possible time. Profits in this case are not limited to monetary rewards, but also include fame, political power, and self-realisation. As a result of the rapid economic development, participants agreed that there had been great improvements in living conditions and life quality across the nation. Such improvements have

inevitably changed people's attitudes towards life and safety. The Central Government has also placed more attention on protecting and enhancing human value. However, participants revealed that good intentions cannot alter the fact that there is a large discrepancy between what is being demanded from managers and what the current situation is available to offer, within the context of fast development. Both interview and questionnaire survey participants' responses confirmed the importance of management attitudes and commitment towards safety management as well as safety training and other safety management policies in controlling safety levels on site and workers' violation behaviour. Such opinion is consistent with the previous research findings in safety management (e.g., Clarke, 1999; Varonen & Mattila, 2000; Zohar, 1980). However, participants revealed that because of China's historical and cultural reasons, the characteristics of migrant workers, such as lack of safety awareness, lack of adequate skills and knowledge for their jobs, and lack of labour contracts, not only endanger workers' own safety and rights, but also generate difficulties in educating as well as managing them for the managers. In addition, the hidden business rules, such as default payment, corruption, and exploitation through sub-contracting, leave managers of construction companies little financial resources for investment in safety management. The negative effects of these issues are more obvious under the pressure of rapid development. Participants' explanations demonstrated, on the one hand, how it has been well recognised that managerial factors play a crucial role in safety management; on the other hand, the characteristics of migrant workers, as well as the factual issues within the construction industry and the society, are equally important factors that deserve attention.

Chapter 6 introduced the fourth study of the research – questionnaire survey using Delphi method and the modified G1 method. This study was

conducted to serve the second aim of the research, namely, to determine factors which have a strong influence on workers' violation behaviour and are suitable for interventions. As far as the author was aware, this was the first time a body of literature examined the ranking order of a comprehensive list of factors on the basis of their influential power on rule violation behaviour among Chinese construction workers. The analyses using the modified G1 method showed that at a higher level of main categories of factors, managerial factors were seen to play the most important role in influencing workers' violation behaviour. This finding is in consensus with the analysis results in the previous observation and document analysis study as well as qualitative and quantitative studies. However, under closer scrutiny, some individual factors, especially workers' lack of safety awareness and bad working habits, were rated in higher positions than some of the managerial factors. Nevertheless, two managerial factors, namely, safety management policies on sites including stringent inspection and immediate follow-up actions, clear safety responsibilities for each individual, and management's attitudes and commitment towards safety, were rated at the top two positions. It implies that although some of the workers' individual factors had high effects of generating rule violation behaviour, through either habitual responses, lack of safety awareness, or negative safety attitudes and low commitment, if well managed, they may be to some extent well controlled. In contrast, when managerial factors or regulatory enforcement, that controls rule violations and supports compliance behaviour, are not effectively executed, the individual factors, with high influential power, may take control and violation behaviour may occur. This result emphasises again the importance of management related factors in controlling workers' violation behaviour. Having said that, the modified G1 method analyses also revealed that some of the national and cultural factors, as well as sectoral and labour

market factors, had higher influential power compared to some of the individual factors and managerial factors. The results demonstrated again the importance of recognising the influential effects of factors in the wider environmental context.

7.3 Theoretical implications

The four studies conducted for the current research, although with different methodological approaches, all shared one common finding, namely, management plays a crucial role in influencing workers' attitudes and commitment towards safety, controlling workers' safety rule violation, as well as maintaining safety levels on construction sites. The importance of management related factors such as management attitudes and commitment towards safety, safety training, open communication between managers and workers have been well documented in the previous body of literature (e.g., Clarke, 1999; Fang et al., 2004; Sawacha, Naoum & Fong, 1999; Zohar, 1980). In consistent with the previous findings, the current research demonstrated again the strong association between management and safety performance.

In addition to the support for the importance of management, the findings on the factor structure from the interviews and focus group study as well as questionnaire survey study confirmed the multilevel nature of the factors associated with workers' violation proposed by Alper and Karsh (2009). As explained in Section 4.5, the influential factors of violations can come from any level of the work system. It can be as specific as workers' educational level or their bad working habits, and as broad as unregulated labour market in the construction sector or a general mentality in the society. Very often the studies on safety rule violation focus on factors at one horizontal level. The current research, however, demonstrated that the

influential factors of violations are manifold and more complex. In order to have a complete understanding of the predictors of violations, it is important to recognise the multilevel nature of the work system and to examine the factors and their effects not only horizontally at one level but also vertically across the whole system.

Within the work system, the findings of the current research demonstrated the important influential effects of factors in the external environment which include sectoral and labour market as well as national and cultural phenomena. Some of these factors were identified by Alper and Karsh (2009) through their systematic review, for example, extra-organisational rules, standards, and legislation. Some other factors grouped within external environment in the current research were proposed by Alper and Karsh (2009) but were not identified through their review, namely, extra-organisational enforcement, industry social influence, and industry workforce characteristics. These findings provided empirical support for Alper and Karsh's (2009) theoretical concept. In addition to the factors already listed in the macroergonomic framework of safety violation (Alper & Karsh, 2009), the current study revealed the effects of some newly found factors, namely, cultural factors. The findings of the current study demonstrate the importance of recognising not only the influential factors at individual and managerial levels, but also the factors at the external environment level such as sectoral and labour market factors as well as national and cultural factors.

7.4 Methodological implications

The methodology chosen for a study must be appropriate for achieving the aims and objectives of the study. Because one of the purposes of the current research was to determine the influential factors associated with

workers' rule violations, interviews, focus groups, and questionnaire survey were conducted as part of the research. These research methods allow participants to specify the influential factors and their interactive relationships, as well as to share insight information on their individual experience, thoughts, and beliefs. These methods were also suggested by Alper and Karsh (2009), and were widely used by other empirical studies for identifying the causes of violations (e.g., Beatty & Beatty, 2004; Hobbs & Williamson, 2002; Laurence, 2005; Lawton, 1998).

Self-report methodologies such as the ones mentioned above have been proved to be easier to conduct, and effective in obtaining insight information relevant to research topic. However, they are subject to biases in participants' reports, especially on information that most people cannot accurately describe, or events that subjects are motivated to distort or omit in reporting. Because safety rule violation is generally considered as undesirable among the people working in the construction industry, in order to capture a more realistic picture of the prevalence of such behaviour on construction sites, observational methodology is more appropriate for achieving this task. Having said that, when conducting observational study on safety rule violation, it is important to ensure that firstly, the specific criteria for determining what constitute a violation are clear, and secondly, people being observed feel comfortable behaving in their natural way when they are under observation. During the observational study in the current research, the author took a number of precautions to ensure the quality of the study, for example, the criteria for the violation behaviours to be observed were pre-selected and were enlisted on a checklist, the author kept the maximum possible distance from the workers without compromising the ability to see their behaviours and hear their conversations, and no recording devices such as camera, video camera, and recorder was carried on sites. In addition to

the observational study, document analysis was conducted in the current research to obtain a different source of information than the one received from self-report. Document analysis enabled the researcher to have a better understanding of the organisational structure, managerial roles, accident rates, and safety management strategies in the participant companies. Both observational study and document analysis provided triangulation information for some of the findings of the following studies using self-report approach.

The methods used for the last study of the research, namely, Delphi method and the modified G1 method, are rarely used for studying influential factors of safety violations. However, as discussed in Section 2.3.4, both methods have their advantages that can serve the research aims and objectives better in the current research settings comparing with other conventional methods. In particular, the main contributions of Delphi method are firstly, enabling a group of experts to convey their individual opinions without having to compromise or shift their judgements because of peer pressure or fear of losing face (Myers & Lamm, 1976; Stasser, Kerr & Davis, 1989); and secondly, enabling the achievement of consensus on the research topic that is currently uncertain with an incomplete state of knowledge (Delbecq, Van de Ven & Gustafson, 1975). The modified G1 method stems from the AHP (Saaty, 1977). The advantage of AHP is that it allows subjects to make direct judgement on the importance of criteria of the qualitative data (Ishizaka & Labib, 2009; Yuen, 2009). It is different from methods such as factor analysis which evaluates relative weights of criteria based on eigenvalues assigned to factors with researcher's interpretation of the existence and the meaning of factors according to her/his theoretical convictions and knowledge.

The use of multiple methodologies to study safety rule violations is recommended by Alper and Karsh (2009). Combining qualitative and quantitative research methodologies may not only maximise the strengths and minimise the weaknesses of both approaches, but also provide the researcher varying degrees of participants' interpretation regarding the research topic. The four studies in the current research, using four different research methods, allow convergent support and triangulation from multiple sources.

7.5 Practical and policy implications

In Chapter 5, the descriptive analysis on the question of the biggest safety management problem revealed that workers' lack of safety awareness and necessary skills was the most commonly chosen issue. In Chapter 6, workers' lack of safety awareness as a result of their limited educational experience was ranked as the most influential individual factor associated with workers' violation behaviour. Thus, intervention policies and practices should first target at raising workers' safety awareness by providing more effective safety education and professional training. Traditionally, safety education and professional training have always been implemented in the workplace to raise workers' safety awareness and to improve their professional skills. However, given the high turnover rate among workers in the Chinese construction industry, and their varied levels of knowledge and professional skills, training for workers is not always as effective as one would like them to be. Thus, one important task in future practice is to design a standard training system that includes the design of training materials suitable for workers' different levels of comprehension and professional competence, periodic and comprehensive evaluations on workers' levels of safety knowledge and professional skills, and detailed records of workers'

training history as well as their results of evaluation tests. In addition, safety training should focus more on raising workers' safety awareness and eliminating their illusory beliefs and blind confidence. With such a standard training and record system within the construction industry across China, a large amount of financial investment in unnecessary, repeated training for workers can be saved, and, most importantly, workers can receive useful training that targets their needs.

In Chapter 6, workers' bad working habits resulted from many years of working unsafely on construction sites was ranked by survey participants at the second highest position among all individual factors. In order to alter workers' behaviour, as already discussed in Section 4.5.3, Skinner's reinforcement theory (Skinner, 1974) and the behavioural economic theory (Battmann & Klumb, 1993) can be applied to future intervention measures. Safety management policies including stringent on-site inspections and immediate follow-up actions such as executing fines on workers' violation acts were ranked as the most influential factor among all factors associated with workers' violation in Chapter 6. It demonstrates that these policies are effective intervention measures in controlling workers' violation behaviour. Meanwhile, well-designed and scientific reward systems need to be developed and implemented in safety management on construction sites. The stick and carrot method leaves workers no other choice but to comply with safety rules, since rule compliance brings them the best outcome compared with other alternatives.

To ensure that workers take responsibility for their own actions, and are not able to escape punishment by moving to other construction sites, it is suggested that a record system with detailed descriptions of workers' performance for each worker should be implemented. Workers' extraordinary

performance in the workplaces should also be recorded in the system. Such a record system can be combined with the one mentioned earlier for workers' training history and their evaluation results. The record for each worker can also include workers' basic information, such as date of birth and gender, as well as information on the workers' physical condition and whether they have obtained social benefits such as health insurance, accident insurance, and pensions. Because Chinese construction workers are a floating population, the traditional contract-based relationship between employers and employees at local level are no longer sufficient to manage this special workforce. Instead, the main responsible institutions and persons within the construction industry need to work together to create a standard management system for all workers in the industry. Such a system may not only benefit construction companies in terms of reduced costs and improved efficiency in human resource management, but also protect workers' safety and rights. To realise the design and the implementation of such a standard system, the Central Government's avocations and enforcement are crucial.

Poor implementation of safety management legislation and regulation is a ubiquitous issue in the current Chinese construction industry, and was rated by the second highest number of survey participants as the biggest safety management problem. As explained earlier in Section 4.5.1, it is an issue associated with Chinese cultural traditions and various existing social issues. It is a problem embedded in many aspects of daily activities in the workplace, for example, financial investment, safety training for workers and other relevant employees, and provision of safety equipment. To solve this problem, it is suggested that three different approaches need to be taken. Firstly, relevant institutions need to examine the existing safety management legislation and regulations to ensure their consistency and practicality. It is important that relevant responsible persons acknowledge the current issues

in the construction industry and design policies and standards that are suitable for China's social and business context, with the help of advanced western safety management strategies. Secondly, standard professional training needs to be periodically provided to construction company managers as well as inspectors who are associated with not only safety management, but also all other aspects of business activities. Innovative evaluation methods need to be introduced into the current exam system in order to control the genuine levels of the test results and to ensure that people who are being examined really grasp the content of training. Thirdly, the Central Government needs to provide encouragement through rewarding people in society who inspect and report any business activity that violate relevant legislation and regulations, and help protect these individuals. Meanwhile, the Central Government should also allow the media to fully execute its power in exposing under-table business activities to society.

7.6 Limitations

One of the main limitations of the research is the sampling in the third study – questionnaire survey study. In particular, the questionnaire survey focused on investors, senior managers, foremen, safety officers, quality control officers, inspectors, engineers, finance officers, and administrators, but excluded workers. Although Fang and his colleagues (2004) argued in their survey research on safety management on Chinese construction sites that it should be avoided to seek workers' perception on workplace safety management in case of survey studies because of workers' lack of education and their limited understanding on safety management performance, excluding workers in the survey study cannot obtain the insight information on the psychological factors affecting workers' rule violation. Unfortunately, given the reality of workers' educational as well as understanding levels, the

survey study in the current research had to rely on the reports from people who have had better education and more comprehensive knowledge in safety management and its related issues. However, because the survey study included participants such as foremen and senior managers who were once worked as workers and have had long frontline working experience in the Chinese construction industry, their insight information and perceptions of workers' motivation for violating safety rules can be considered as trustworthy and accurate. In addition, the participants in the survey study had various job roles in the Chinese construction industry, their responses provided dynamic perspectives of the full picture in relation to the factors associated with workers' rule violation and safety management in the Chinese construction industry.

Another limitation of the research is that the numbers of questionnaires collected on each construction site as well as in each city for the third study – questionnaire survey study – are very different because of the various sizes of the construction projects, the different numbers of people who were willing to participate the study, as well as the various numbers of construction sites the author had access to in different cities. In addition, some construction sites returned a large number of invalid questionnaires, which resulted in some situations only few valid questionnaires from a particular location were suitable for further analysis. Because of the large differences in the numbers of questionnaires collected from participant construction sites, as well as the very small number of the valid questionnaires in some locations, it was not appropriate to compare the differences in analysis results based on location. However, because the main purposes of the current exploratory research were to obtain a general overview of the influential factors as well as their effects associated with workers' rule violation, pooling the data across all construction sites provided sufficient information to meet the research aims

and objectives. For future research, it would be beneficial to examine the differences in influential factors of violations based on location.

7.7 Contributions

Although there are weaknesses in the present research, its strengths have added significance to safety rule violation literature and safety management practice.

Firstly, the present research filled the gap in the body of literature by conducting a series of studies exploring and examining a comprehensive list of factors and their effects associated with safety rule violations among Chinese construction workers. To the author's acknowledgment, it is the first piece of systematic research up to date that has focused on this topic. As an exploratory research, the findings of the present research would stimulate further theoretical explanation and exploration about the influential factors of rule violations and their interactive relationships that create the complex situation in which violation is generated.

Secondly, the present research demonstrated the multilevel nature of the influential factors of violation. It provides empirical support for the existing theoretical stance. In addition, the findings of the present research illustrated the effects of cultural factors on workers' rule violation. This is a set of factors that have been overlooked in the previous research. It expands the current knowledge of influential factors of rule violations, and will help with leading to the recognition from both researchers and practitioners of the factors in the wider environment external to the organisations. It may facilitate the future design of more effective and suitable safety management policies and intervention measures regarding the characteristics of the workers, as well as social and cultural phenomena.

7.8 Directions in research

At a methodological level, future research could be directed toward an increased use of multiple methods for understanding the predictors of violations as well as their effects. Most safe/unsafe behaviour research to date has relied on self-report questionnaires (e.g., Garcia et al., 2004; Jiang et al., 2010; Seo, 2005; Zhou et al., 2008). The present research took a multi method approach. It was proved to be beneficial because such approach allows the obtainment of rich information on the research topic, and it builds in reliability to the research.

At a theoretical level, further research on the psychological mechanisms behind rule violation using behaviour theories such as the planned behaviour theory (Ajzen, 1991), the protection motivation theory (Rogers, 1975), and the behavioural economics theory (Battmann & Klumb, 1993) is recommended. The majority of the research up to data focuses on exploring the influential factors of rule violations (e.g., Fang et al., 2004; Patterson et al., 2006). Very little research has examined the effects of these factors on individuals' motivation for choosing to violate or to comply with safety rules. It makes sense to study violations using behaviour theories because violations are behaviours (Beatty & Beatty, 2004). With a better understanding of the mechanisms behind violations, it may help with designing more effective intervention measures that prevent individuals from violation and encourage rule compliance.

At a practical level, pro-active accident and rule violation intervention measures that are suitable for particular population as well as sectoral, social and cultural situations need to be designed to control violation and to reduce accident rates to the minimum possible level. The design and evaluation of these measures are necessary for the future research.

7.9 Conclusions

The current research has well demonstrated that workers' rule violation behaviour in the Chinese construction industry is a phenomenon that is influenced by the interactions of complex issues in the multilevel work system. The influential factors associated with workers' rule violation appeared to be related to the individual worker, the management, and extra-organisation situations including safety management standards, legislation, regulations, and their implementations, labour market, social phenomena, as well as cultural elements. Among the factors, management related factors were identified as the ones that hold the most influential power in affecting workers' rule violation. However, because the management related factors are cultivated and shaped by many other situations and factors in the wider external environment, the author propose practicing holistic and systematic thinking in the future research on violations as well as the design of intervention measures. Much more research is needed to determine the factors and their influential effects at different levels of the work system in order to help overcome the complex obstacles in safety management in hazardous industries.

Accidents undoubtedly have severe detrimental effects not only on the victims, but also their family members, friends, organisations, and society as a whole. As advocated by Professor Jorma Saari, from the Finnish Institute of Occupational Health: "It is a basic human right to return home safely from work ... one accident is too many" (Saari, 2001, p.3). Although accidents can never be completely eliminated, well-implemented effective intervention measures may control accident rates below the possible minimum level. It requires the collective effort from not only every person who works within the industry, but also the nation's government and every person in society. A

hope is that the present thesis has contributed to tackling the challenge of reducing rule violations and improving safety levels at workplaces by illustrating the importance of factors in the wider environment, emphasising holistic and systematic thinking both in research as well as in practice, and stimulating further research in this important area.

References

Aamodt, A. (1991). Ethnography and epistemology: Generating nursing knowledge. In J. M. Morse (Ed.), *Qualitative Nursing Research: A Contemporary Dialogue* (pp. 40-53). Newbury Park, CA: Sage.

Abdelhamid, T. S. & Everett, J. G. (2000). Identifying root causes of construction accidents. *Journal of Construction Engineering and Management, 126*(1), 52-60.

Adams, A. & Cox, A. L. (2008). Questionnaire in-depth interviews and focus groups. In P. Cairns & A. L. Cox (Eds.), *Research Methods for Human Computer Interaction* (pp. 17-34). Cambridge: Cambridge University Press.

Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behaviour and Human Decision Processes, 50,* 179-211.

Akintoye, A. S. & MacLeod, M. J. (1997). Risk analysis and management in construction. *International Journal of Project Management, 15*(1), 31-38.

Alkin, M. C., Daillak, R. & White, P. (1979). *Using Evaluations: Does Evaluation Make a Difference?* Beverly Hills: Sage.

Alon, I. (2006). *Service Franchising: A Global Perspective*. New York: Springer US.

Alper, S. J. & Karsh, B. T. (2009). A systematic review of safety violations in industry. *Accident Analysis and Prevention, 41*, 739-754.

Altmann, J. (1974). Observational study of behaviour sampling methods. *Behaviour, 49*(3), 227-267.

Amnesty International Report (2007) *People's Republic of China: Internal Migrants: Discrimination and Abuse. The Human Cost of an Economic 'Miracle'*. Available from http://www.amnistia-internacional.pt/dmdocuments/China_relatorio_migrantes.pdf

Aronson, J. (1994). A pragmatic view thematic analysis. *The Qualitative Report, 2*(1). Available from http://www.nova.edu/ssss/QR/BackIssues/QR2-1/aronson.html

Australian Bureau of Statistics (2010). Work-Related Injuries, Australia, 2009-10. Retrieved 10 April 2013 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/6324.0Main+Features12009-10?OpenDocument

Battmann, W. & Klumb, P. (1993). Behavioural economics and compliance with safety regulations. *Safety Science, 16*(1), 35-46.

Beatty, P. C. W. & Beatty, S. F. (2004). Anaesthetistis' intentions to violate safety guidelines. *Anaesthesia, 59*, 528-540.

Beilock, R. (1995). Schedule-induced hours-of-service and speed limit violations among tractor-trailer drivers. *Accident Analysis and Prevention, 27*(1), 33-42.

Belton, V. & Stewart, T. (2002). *Multiple Criteria Decision Analysis: An Integrated Approach.* Dordrecht: Kluwer Academic Publishers.

Betzig, L. L. & Turke, P. W. (1985). Parental investment by sex on Ifaluk. *Ethology and Sociobiology, 7*(1), 29-37.

Beynon, M. (2002). DS/AHP method: A mathematical analysis, including an understanding of uncertainty, *European Journal of Operational Research, 140*(1), 148-164.

Bloom, M. (1999). The performance effects of pay dispersion on individuals and organizations. *Academy of Management Journal, 42*(1), 25-40.

Boehm, C. (1996). Emergency decisions, cultural-selection mechanics, and group selection. *Current Anthropology, 37*, 763-793.

Borgman, C. L. (1986). The user's mental model of an information retrieval system: an experiment on a prototype online catalogue. *International Journal of Man-Machine Studies, 24*, 47-64.

Bouma, G. D. & Atkinson, G. B. J. (1995). *A Handbook of Social Science Research* (2nd ed.). Oxford: Oxford University Press.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal, 9*(2), 27-40.

Boyatzis, R. E. (1998). *Transforming Qualitative Information: Thematic Analysis and Code Development.* Thousand Oaks, CA: Sage.

Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101.

Brewer, J. & Hunter, A. (1989). *Multimethod Research: A Synthesis of Style.* Newbury Park, CA: Sage.

Briggs, S. R. & Cheek, J. M. (1986). The role of factor analysis in the development and evaluation of personality scales. *Journal of Personality, 54*, 106-148.

Bureau of Labor Statistics (BLS, 2012). National Census of Fatal Occupational Injuries in 2011 (Preliminary Results). Retrieved 26 December 2012 from http://www.bls.gov/news.release/pdf/cfoi.pdf

Burnard, P. (1991). A method of analyzing interview transcripts in qualitative research. *Nurse Education Today, 11*, 461-466.

Bust, P., Gibb, A., Pink, S. (2008). Managing construction health and safety: migrant workers and communication safety messages. *Safety Science, 46*(4), 585-602.

Calson, E. (2000). A case study in translation methodology using the health promotion lifestyle profile II. *Public Health Nursing, 17*(1), 61-70.

Cao, Y. (2011). Analysis of problems in construction safety supervision and management with their countermeasure. (浅析建筑施工安全监督管理工作面临的几个问题及解决对策). Available from http://www.doc88.com/p-214942359977.html

CASRO-Council of American Survey Research Organizations (1982). *On the definition of response rates: a special report of the CASRO Task Force on completion rates.* Port Jefferson, New York: CASRO.

Cervone, D. & Pervin, L. A. (2008). *Personality, Theory and Research.* New York: John Wiley and Sons.

Che, L. (2011). China's young migrant workers project policies recommendations report (中国青年农民工项目综合政策建议报告). Retrieved May 31, 2012, from http://www.chinadaily.com.cn/hqgj/jryw/2011-12-16/content_4694028.html

Cheng, E. W. L. & Li, H. (2002). Construction partnering process and associated critical success factors: quantitative investigation. *Journal of Management in Engineering, 18*(4), 194-202.

Cheng, E. W. L, Li, H., Fang, D. P. & Xie, F. (2004). Construction safety management: an exploratory study from China. *Construction Innovation: Information, Process, Management, 4*(4), 229-241.

China News (2011). The number of Chinese migrant workers reached 242 million and their income doubled in five years (中国农民工总数已达2.42亿，收入五年增长近一倍). Retrieved August 16, 2012, from http://www.chinanews.com/gn/2011/02-14/2840604.shtml

Ching, S. (1996). A simple characterization of plurality rule. *Journal of Economic Theory, 71*(1), 298-302.

Choubhry, R. M. & Fang, D. P. (2008). Why operatives engage in unsafe work behaviour: Investigating factors on construction sites. *Safety Science, 46*(4), 566-584.

Chu, K. W. (2010). Constructing ruins: new urban aesthetics in Chinese art and cinema. Master dissertation. Available from *http://hub.hku.hk/bitstream/10722/56746/1/FullText.pdf?accept=1*.

Clarke, S. (1999). Perceptions of organizational safety: implications for the development of safety culture. *Journal of Organizational Behavior, 20*(2), 185-198.

Clarke, S. (2006). The relationship between safety climate and safety performance: a meta-analytic review. *Journal of Occupational Health Psychology, 11*(4), 315-327.

Cole, J. & Gardner, K. (1979). Topic work with first-year secondary pupils. In E. Lunzer & K. Gardner (Eds.). *The effective Use of Reading* (pp.167-192). London: Heinemann.

Colvin, C. R., Block, J., Funder, D. C. (1995). Overly positive self evaluations and personality: negative implications for mental health. *Journal of Personality and Social Psychology, 68*(6), 1152-1162.

Connolly, P. (1998). 'Dancing to the wrong tune': Ethnography generalisation and research on racism in schools. In P. Connolly & B. Troyna (Eds.), *Researching Racism in Education: Politics, Theory, and Practice* (pp.122-139). Buckingham, UK: Open University Press.

Cooper, M. D. & Phillips, R. A. (2004). Exploratory analysis of the safety climate and safety behaviour relationship. *Journal of Safety Research, 35*(5), 497-512.

Couper, M. P. (2000). Web survey: a review of issues and approaches. *Public Opinion Quarterly, 64*(4), 464-494.

Coyle, G. (2004). *The analytic hierarchy process (AHP) - Practical Strategy.* Open Access Material. Pearson Education Limited. Available from http://www.booksites.net/download/coyle/student_files/AHP_Techniqu e.pdf

Coyle, I. R., Sleeman, S. D. & Adams, N. (1995). Safety Climate. *Journal of Safety Research, 26*(4), 247-254.

Daily Economy News (2011). Four labour chaotic phenomena plague the construction industry, over 70 percent of workers have no labour contracts (四大用工乱象困扰建筑行业，超七成工人未签合同). Retrieved May 4, 2012, from http://www.fjgh.org.cn/2011-12/07/content_7100206_4.htm

Dasgupta, P. & Maskin, E. (2008). On the robustness of majority rule. *Journal of the European Economic Association, 6*(5), 949-973.

Dawson, D. A. (1994). Heavy drinking and the risk of occupational injury. *Accident Analysis & Prevention, 26*(5), 655-665.

Dejoy, D. M. (2005). Behavior change versus culture change: Divergent approaches to managing workplace safety. *Safety Science, 43*(2), 105-129.

Dembe, A., E., Erickson, J. B., Delbos, R. G. & Banks, S. M. (2005). The impact of overtime and long work hours on occupational injuries and illnesses: new evidence from the United States. *Occupational and Environmental Medicine, 62,* 588-597.

Deng, K. F. (2011). Labour issues in the construction industry and solutions（建筑业劳务用工存在问题及其对策）. *Construction Times*. Retrieved May 18, 2012, from http://www.chengbiancun.com/2011/0915/18684.html

DeSantis, L. & Ugarriza, D. N. (2000). The concept of theme as used in qualitative nursing research. *Western Journal of Nursing Research, 22*(3), 351-372.

DeVellis, R. F. (2003). *Scale Development: Theory and Applications* (2nd ed.). Thousand Oaks, California: Sage.

Dey, E. L. (1997). Working with low survey response rates: the efficacy of weighing adjustments. *Research in Higher Education, 38*(2), 215-227.

Dong, X., Fujimoto, A., Ringen, K., Men, Y. (2009). Fatal falls among Hispanic construction workers. *Accident Analysis and Prevention, 41*(5), 1047-1052.

Elo, S. & Kyngas, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing, 62*(1), 107-115.

Erlandson, D. A., Harris, E. L., Skipper, B. L. & Allen, S. D. (1993). *Doing Naturalistic Inquiry: A Guide to Methods.* London: Sage.

Everitt, S. (1975). Multivariate analysis: the need for data, and other problems. *British Journal of Psychiatry, 126*, 237-240.

Ferguson, E. & Cox, T. (1993). Exploratory factor analysis: A users' guide. *International Journal of Selection and Assessment, 1*(2), 84-94.

Ferguson, J. L., McNally, M. S., & Both, R. F. (1984). Individual characteristics as predictors of accidental injuries in naval personnel. *Accident Analysis and Prevention, 16,* 47-54.

Firestone, W. A. (1993). Alternative arguments for generalizing from data as applied to qualitative research. *Educational Researcher, 22*(4), 16-23.

Forster, N. (1994). The analysis of company documentation. In C. Cassell & G. Symon (Eds.) *Qualitative Methods in Organizational Research. A Practical Guide* (pp. 147-166). London: SAGE.

Free, R. J. (1994). The Role of Procedural Violations in Railway Accidents. Unpublished PhD thesis, University of Manchester.

Frei, F. X. & Harker, P. T. (1999). Measuring aggregate process performance using AHP. *European Journal of Operational Research, 116*(2), 436-442.

French, J. R. P. (1950). Field experiments: Changing group productivity. In J. G. Miller (Ed.), *Experiments in Social Process: A Symposium on Social Psychology,* (pp. 85). New York: McGraw-Hill.

Frith, H. & Gleeson, K. (2004). Clothing and embodiment: men managing body image and appearance. *Psychology of Men & Masculinity, 5*(1), 40-48.

Frone, M. R. (1998). Predictors of work injuries among employed adolescents. *Journal of Applied Psychology, 83*(4), 565-576.

Garcia, A. M., Boix, P., & Canosa, C. (2004). Why do workers behave unsafely at work? Determinants of safe work practices in industrial workers. *Occupational Environmental Medicine, 61*(3), 239-246.

General Office of the State Council of the People's Republic of China (2006). *National Rural-Urban Workers Survey Report (中国农民工调研报告).* Beijing: China Yan Shi Publisher.

Glennen, D. P. (1982). Measuring organisational safety climate. *Australian Safety News, January/February*, 23-28.

Golden, B. L., Wasil, E. A., Harker, P. T. (Eds.) (1989). *The Analytic Hierarchy Process: Applications and Studies*. New York: Springer-Verlag.

Gonçalves, S., Silva, S., Lima, M. L. Melià, J. (2008). The impact of work accidents experience on causal attributions and worker behaviour. *Safety Science, 46*, 992-1001.

Grant, A., Christianson, M. & Price, R. (2007). Happiness, health, or relationships? Managerial practices and employee well-being tradeoffs. *Academy of Management Perspectives, 21*(3), 51-63.

Gu, Y. C. (2009). *Western Low-carbon Economy and Green Building Industry Forum.* Retrieved May 30, 2012, from http://www.crcc.cn/g282/s1302/t15755.aspx

Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *Educational Communication and Technology Journal, 29*(2), 75-91.

Guba, E.G. (1990). The alternative paradigm dialog. In E. G. Guba (Ed.), *The Paradigm Dialog* (pp.17-30). Newbury Park, CA: Sage.

Guba, E. G. & Lincoln, Y. S. (1985). *Naturalistic Inquiry.* Newbury Park, CA: Sage.

Guest, G., MacQueen, K. M. & Namey, E. E. (2012). *Applied Thematic Analysis.* Newbury Park, CA: Sage.

Guo, Y. J. (2006). *The Comprehensive Evaluation Theory and Methods.* Beijing: Science Press.

Gyekye, S. A. & Salminen, S. (2009). Age and workers' perceptions of workplace safety: a comparative study. *The International Journal of Aging and Human Development, 68*(2), 171-184.

Häder, M. & Häder, S. (1995). Delphi und Kognitionspsychologie: Ein Zugang zur theoretischen Fundierung der Delphi-Methode, in: *ZUMA-Nachrichten, 37*(19), 12.

Hadjimanolis, A. & Boustras, G. (2013). Health and safety policies and work attitudes in Cypriot companies. *Safety Science, 52*, 50-56.

Hair, J. F., Tatham, R. L., Anderson, R. E. & Black, W. (1998). *Multivariate data analysis. (Fifth Ed.)* London: Prentice-Hall.

Hale, A. R. & Glendon, A. I. (1987). *Individual Behavior in the Control of Danger.* Elsevier, Amsterdam.

Hansen, C. P. (1989). Personality characteristics of accident involvement employee. *Journal of Business and Psychology, 2*(4), 346-365.

Hao, S. Y. (2009). Focus on solving the two basic problems of short-term and long-term development plan(注意解决好近期发展和远期规划两个根本问题). *Construction and Architecture, 3,* 13-14.

Harker, P. T. & Vargas, L. G. (1987). The theory of ratio scale estimation: Saaty's analytical hierarchy process. *Management Science, 33*(11), 1388-1403.

Harris, P. R. & Middleton, W. (1994). Unrealistic optimism about health and the illusion of control: On being less at risk but no more in control than others. *British Journal of Social Psychology, 33,* 369-386.

Hastie, R. & Kameda, T. (2005). The robust beauty of majority rules in group decisions. *Psychological Review, 112*(2), 494-508.

Hawkes, K., Kaplan, H., Hill, K. & Hurtado, M. (1987). A problem of bias in scan sampling. *Journal of Anthropological Research, 43*(3), 239-246.

Hayes, N. (1997). Theory-led thematic analysis: social identification in small companies. In N. Hayes (Ed.), *Doing Qualitative Analysis in Psychology* (pp. 93-114). Hove, UK: Psychology Press.

He, M. S. (2005). Regulate the construction market trading behaviour: to curb the phenomenon of colluding bid and countermeasures (规范建筑市场交易行为，遏制围标、串标现象的对策研究). In L. F. An (Ed.), *Constructing Harmony: 6th Excellent Research Paper on Construction Market and Bidding from 7 Provinces* (*构建和谐——七省市第六届建筑市场与招投标优秀论文集*). Beijing: China Radio International Press.

Healy, M. & Perry, C. (2000). Comprehensive criteria to judge validity and reliability of qualitative research within the realism paradigm. *Qualitative Market Research, 3*(3), 118-126.

Heinrich, H. W. (1931). *Industrial Accident Prevention*. New York: McGraw-Hill.

Heinrich, H. W. (1950). *Industrial Accident Prevention (3rd. Ed)*. New York: McGraw-Hill.

Heinrich, H. W. (1959). *Industrial Accidents Prevention (4th. Ed)*. New York: McGraw-Hill.

Heinrich, H. W., Petersen, D. & Roos, N. (1980). *Industrial Accident Prevention: A Safety Management Approach.* New York: McGraw-Hill, Inc.

Hinde, R. A. (1973). On the design of check-sheets. *Primates, 14*(4), 393-406.

Hobbs, A. & Williamson, A. (2002). Unsafe acts and unsafe outcomes in aircraft maintenance. *Ergonomics, 45*(12), 866-882.

Hofmann, D. A. & Stetzer, A. (1996). A cross-level investigation of factors influencing unsafe behaviours and accidents. *Personnel Psychology, 49*(2), 307-339.

Hollnagel, E. (2002). Understanding accidents – from root causes to performance variability. In J. J. Persensky, B. Hallbert & H. Blackman (Eds) (pp. 1-6). *Proceedings of IEEE 7th Conference on Human Factors and Power Plants: New Century, New Trends*, Scottsdale, Arizona.

Hollnagel, E. (2004). *Barriers and Accident Prevention.* Hampshire, Ashgate.

Holloway, I. & Todres, L. (2003). The status of method: flexibility, consistency and coherence. *Qualitative Research, 3*(3), 345-357.

Horvath, A. (1999). Construction for sustainable development - A research and educational agenda. Submitted for the Berkeley-Stanford

Construction Engineering & Management Workshop, August 26-28, 1999. Available from http://www.rpd-mohesr.com/uploads/custompages/Horvath.pdf

Howell, G. A., Ballard, G., Abdelhamid, T. S. & Mitropoulos, P. (2002). Working near the edge: a new approach to construction safety. Proceedings of the 10th Annual Conference of the International Group for Lean Construction. Gramado, Brazil. August 6-8, 2002. Available from http://p2sl.berkeley.edu/2009-09-09/Howell&Ballard&Abdelhamid&Mitropoulos%202002%20Working%20Near%20the%20Edge%20=%20LCISAfetyWP.pdf

Ishizaka, A. & Labib, A. (2009). Analytic hierarchy process and expert choice: benefits and limitations. *OR Insight,* 201-220. Available from http://www.palgrave-journals.com/ori/journal/v22/n4/pdf/ori200910a.pdf

Ishizaka, A. & Labib, A. (2011). Review of the main developments in the analytic hierarchy process. *Expert Systems with Applications, 38*(11), 14336-14345.

Iversen, R. D. & Erwin, P. J. (1997). Predicting occupational injury: the role of affectivity. *Journal of Occupational and Organizational Psychology, 70,* 113-128.

Jae-On, K. & Mueller, C. W. (1978). *Introduction to Factor Analysis- What It Is and How To Do It.* London: Sage.

Jiang, L., Yu, G. T., Li, Y. J. & Li, F. (2010). Perceived colleagues' safety knowledge/behavior and safety performance: safety climate as a moderator in a multilevel study. *Accident Analysis and Prevention, 42,* 1468-1476.

Karapetrovic, S. & Rosenbloom, E. (1999). A quality control approach to consistency paradoxes in AHP. *European Journal of Operational Research, 119*(3), 704-718.

Kendon, A. (1982). The organization of behaviour in face-face interaction: Observations on the development of a methodology. In K. Scherer & P. Ekman (Eds.), *Handbook of Methods in Nonverbal Behavior Research* (pp. 440-505). Cambridge: Cambridge University Press.

Kirschenbaum, A., Oigenblick, L., & Goldberg, A. I. (2000). Well being, work environment and work accidents. *Social Science & Medicine, 50*(5), 631-639.

Kirwan, B. (2001). Coping with accelerating socio-technical systems. *Safety Science, 37,* 77-107.

Kouabenan, D. R. (1998). Beliefs and the perception of risks and accidents. *Risk Analysis: An International Journal, 18*(3), 243-252.

Kouabenan, D. R. (2002). Occupation, driving experience, and risk and accident perception. *Journal of Risk Research, 5*(1), 49-68.

Kouabenan, D. R. (2009). Role of beliefs in accident and risk analysis and prevention. *Safety Science, 47*(6), 767-776.

Kouabenan, D. R., Gilbert, D., Médina, M., Bouzon, F. (2001). Hierarchical position, gender, accident severity, and causal attribution. *Journal of Applied Social Psychology, 31*(3), 553-575.

Kwiesielewicz, M. & van Uden, E. (2004). Inconsistent and contradictory judgements in pair-wise comparison method in AHP. *Computers and Operations Research, 31*(5), 713-719.

Laflamme, L., Menckel, E. & Lundholm, L. (1996). The age-related risk of occupational accidents: the case of Swedish iron-ore miners. *Accident Analysis and Prevention, 28*(3), 349-357.

Lam, K. & Zhao, X. (1998). An application of quality function deployment to improve the quality of teaching. *International Journal of Quality Reliability Management, 15*(4), 389-413.

Laughery, K. R., Vaubel, K. P. (1989). The role of accident experiences on subsequent accident events. In: A. M., Feyer & A. Williamson (Eds.), *Occupational Injury: Risk, Prevention and Intervention* (pp.33-43). London: Taylor & Francis.

Laurence, D. (2005). Safety rules and regulations on mine sites – the problem and a solution. *Journal of Safety Research, 36*, 39-50.

Lawton, R. (1998). Not working to rule: Understanding procedural violations at work. *Safety Science, 28*(2), 77-95.

Leigh, J. P. (1986). Individual and job characteristics as predictors of industrial accidents. *Accident Analysis and Prevention, 18,* 209-216.

Leininger, M. M. (Ed). (1985). *Qualitative Research Methods in Nursing.* Orlando, FL: Grune & Stratton.

Lewin, C. (2005). Elementary quantitative method. In B. Somekh & C. Lewin (Eds.), *Research Methods in the Social Sciences* (pp. 215-225). London: Sage.

Li, G. & Baker, S. P. (1995). Crash and violation experience of pilots involved in prior commuter and air taxi crashes: a historical cohort study. *Aviation, Space, and Environmental Medicine, 66*(12), 1131-1135.

Lincoln, Y. S. (1995). Emerging criteria for quality in qualitative and interpretive research. *Qualitative Inquiry, 1*, 275-289.

Lincoln, Y. S. & Guba, E. G. (1985). *Naturalistic inquiry.* Beverly Hills: Sage.

Liu, J. (2007). *Examining the methods for assessing urban emergency capability.* (Unpublished doctorial dissertation). Beijing Technology University, Beijing, China.

Liu, R. (2010). The status of municipal engineering and project management solutions. *Friend of Science Amateurs*, *12*(2), 87-88.

Liu, Y. S. (2005). The discuss of unsafe behaviour in safety management (安全管理中人的不安全行为的探讨). *West-China Exploration Engineering, 109*(6), 226-228.

Lootsma, F. A. (1989). Conflict resolution via pair-wise comparison of concessions. *European Journal of Operational Research*, *40*(1), 109-116.

Manion, M. (1994). Survey research in the study of contemporary China: learning from local samples. *The China Quarterly*, *139*, 741-765.

Marchionini, G. & Teague, J. (1987). Elementary students' use of electronic information services: an exploratory study. *Journal of Research on Computing in Education, 20*(2), 139-155.

Marsh, T. W., Davies, R., Phillips, R. A., Duff, A. R., Robertson, I. T., Weyman, A., & Cooper, M. D. (1998). The role of management commitment in determining the success of a behavioural safety intervention. *Journal of the Institution of Occupational Safety & Health*, *2*(2), 45-56.

Marshall, M. N. (1996). Sampling for qualitative research. *Family Practice, 13*(6), 522-525.

Martino, J. P. (1983). *Technological Forecasting for Decision Making* (2nd ed.). New York: North Holland.

Mason, S. (1997). Procedural violations – causes, costs and cures. In F. Redmill, & J. Rajan (Eds.), *Human Factors in Safety-Critical Systems* (pp. 287-318). Oxford, UK: Butterworth-Heinemann.

Matson, J. L. & Taras, M. E. (1989). A 20 year review of punishment and alternative methods to treat problem behaviours in developmentally delayed persons. *Research in Developmental Disabilities*, *10*(1), 85-104.

Matz, C. M. (2000). *Administration of web versus paper survey: mode effects and response rates.* (Unpublished master's research paper). University of North Carolina, Chapel Hill, US.

McCall, G. J. (1984). Systematic field observation. *Annual Review of Sociology, 10*, 263-282.

McKenna, F. P. (1993). It won't happen to me: Unrealistic optimism or illusion or control? *British Journal of Psychology, 84*(1), 39-50.

McKenzie, R. B. & Tullock, G. (1975). *The New World of Economics: Explorations into the Human Experience.* Chicago: Rand McNally.

McKeon, C. M., Fogarty, G. J. & Hegney, D. G. (2006). Organizational factors: impact on administration violations in rural nursing. *Nursing and Healthcare Management and Policy, 55*(1), 115-123.

Medley, D. M. & Mitzel, H. E. (1963). Measuring classroom behavior by systematic observation. In N. L. Gage (Ed.), *Handbook of Research on Teaching* (pp. 247-328). Chicago: Rand McNally.

Merriam, S. B. (1998). Qualitative Research and Case Study Applications in Education. San Francisco: Jossey-Bass.

Miles, M. B. & Huberman, A. M. (1994). *Qualitative Data Analysis: An Expanded Sourcebook.* Thousand Oaks, CA: Sage.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review, 63*(2), 81-97.

Ministry of Health of China (2011). A summary of occupational disease prevention work in 2010 and the focus of the work in 2011 (2010 年职业病防治工作情况和 2011 年重点工作). Retrieved August 20, 2012, from http://www.moh.gov.cn/publicfiles/business/htmlfiles/mohwsjdj/s5854/201105/51676.htm

Mintzberg, H. (1973). *The Nature of Managerial Work.* New York: Harper & Row.

MOHURD – Ministry of Housing and Urban-Rural Development of the People's Republic of China (2011). The 12th five year plan for the development of the construction industry. Available from www.mohurd.gov.cn/zcfg/jsbwj_0/.../W020110818041453.doc

Mueller, D. C. (1989). *Public Choice II.* New York: Cambridge University Press.

Mullen, J. (2004). Investigating factors that influence individual safety behavior at work. *Journal of Safety Research, 35*(3), 275-285.

Murphy, G. & Goodall, E. (1980). Measurement error in direct observations: a comparison of common recording methods. *Behaviour Research and Therapy, 18*, 147-150.

Muthen, B. & Kaplan, D. (1985). A comparison of some methodologies for the factor analysis of non-normal Likert variables. *British Journal of Mathematical and Statistical Psychology, 38*, 171-189.

Myers, D. G. & Lamm, H. (1976). The group polarization phenomenon. *Psychology Bulletin, 83*(4), 602-627.

Nanfang Weekend (2008). A survey on the health of migrant workers: mortgaging their future health (外来工健康状况调查：为生计透支未来). Retrieved June 4, 2010, from http://www.lesnhk.org/node/143.

National Bureau of Statistics of China. (2010). *China statistical yearbook 2010*. Beijing: China Statistics Press.

National Bureau of Statistics of China (2011). Survey report on Chinese migrant workers in 2011 (2011 年我国农民工调查监测报告). Retrieved August 20, 2012, from http://www.stats.gov.cn/tjfx/fxbg/t20120427_402801903.htm

Neal, A., Griffin, M. A. & Hart, P. M. (2000). The impact of organisational climate on safety climate and individual behaviour. *Safety Science, 34*(1-3), 99-109.

Osborne, J. W. (1994). Some similarity and differences among phenomelological and other methods of psychological qualitative research. *Canadian Psychology, 35*(2), 167-189.

Pallant, J. (2000). Development and validation of a scale to measure perceived control of internal states. *Journal of Personality Assessment, 75*(2), 308-337.

Pallant, J. (2011). *SPSS Survival Manual – A Step by Step Guide to Data Analysis Using SPSS (4th Ed.).* Australia: Allen & Unwin.

Pan, Y., Lu, H. L. & Zhang, H. P. (2012). Class Formation: the Collective Struggle of Labour Control and Construction Workers on the Construction Sites (阶级的形成：建筑工地上的劳动控制与建筑工人的集体抗争). Retrieved October 25, 2012, from http://www.impactchina.com.cn/sixiangzaichang/shehui/xiwu/2012-07-09/643.html

Parker, D., Reason, J. T., Manstead, A. S. R., Stradling, S. G. (1995). Driving errors, driving violations and accident involvement. *Ergonomics, 38*(5), 1036-1048.

Patton, M. Q. (1990). *Qualitative Evaluation and Research Methods.* London: Sage.

Patterson, E. S., Rogers, M. L., Chapman, R. J., Render, M. L. (2006). Compliance with intended use of bar code medication administration in

acute and long-term care: an observational study. *Human Factors, 48*(1), 15-22.

Peng, G. C. & Nunes, M. B. (2008). Issues and difficulties in doing participative research in China: lessons learned from a survey in information systems research. *Proceedings of the 7th European Conference on Research Methodology for Business and Management Studies*, June 19-20, 2008, London, UK.

Perrow, C. (1984). *Normal Accidents: Living with High-Risk Technologies.* New York, Basic Books.

Pershing, J. L. (2002). Using document analysis in analyzing and evaluating performance. *Performance Improvement, 41*(1), 36-42.

Pfeffer, J. (1998). *The Human Equation.* Cambridge, MA: Harvard Business School Press.

Ping, H. & Pieke, F. (2003). *China Migration Country Study*. Available from http://www.sociology.cass.cn/shxs/s09_shx/zlk/huangping/DFID_Web_Paper_3.pdf

Polit, D. F. & Beck, C. T. (2004). *Nursing Research. Principles and Methods.* Philadelphia, PA: Lippincott Williams & Wilkins.

Polit, D.F. & Hungler, B. P. (1999). *Nursing Research, Principles and Methods (6th ed.)*. Philadelphia: J. B. Lippincott Company.

Preece, R. (1994). *Starting Research: An Introduction to Academic Research and Dissertation Writing*. London: Printer.

Qi, X. (2011). The formation and reproduction of wage back-payment mechanism in the Chinese construction industry (建筑业欠薪机制的形成与再生产分析). *Sociological Studies, 26*, 55-79.

Qureshi, Z. H. (2007). A review of accident modeling approaches for complex socio-technical systems, *Conference Proceedings of 12th Australian Workshop on Safety Related Programmable Systems (SCS'07).* Retrieved 8th January 2013 from http://www.crpit.com/confpapers/CRPITV86Qureshi.pdf

Rasmussen, J. (1997). Risk management in a dynamic society: a modelling problem. *Safety Science, 27*(2/3), 183-213.

Reason, J. T. (1987). The Chernobyl errors. *Bulletin of the British Psychological Society, 106,* 321-331.

Reason, J. T. (1990). *Human Error.* New York: Cambridge University Press.

Reason, J. T. (2000). Human error: models and management, *BMJ, 320*, 768-770.

Reason J. T. (2005). Safety in the operating theatre – Part 2: Human error and organisational failure. *Quality & Safety in Health Care, 14,* 56–61.

Reason, J. T., Manstead, A. S. R., Stradling, S. G., Baxter, J. & Campbell, K. (1990). Errors and violations on the roads: a real distinction? *Ergonomics, 33*(10-11), 1315-1332.

Reason, J. T., Parker, D., Lawton, R. (1995). A systems-approach to organizational error. *Ergonomics, 38*(8), 1708-1721.

Reason, J. T., Parker, D., Lawton, R. (1998). Organizational controls and safety: the varieties rule-related behaviour. *Journal of Occupational and Organizational Psychology, 71*, 289-304.

Reeves, S., Kuper, A. & Hodges, B. D. (2008). Qualitative research methodologies: ethnography. *BMJ, 337*, 512-514.

Research Office Project Team, State Council (2006). Research Report on Rural Migrant Workers in China (中国农民工问题研究总报告), *Reform*, 5.

Rhodes, S. R. (1983). Age-relate differences in work attitudes and behavior: a review and conceptual analysis. *Psychological Bulletin, 93*(2), 328-367.

Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. *Journal of Psychology, 91*(1), 93-114.

Rogoff, B. (1981). Adults and peers as agents of socialization: A Highland Guatemalan profile. *Ethos, 9*(1), 18-36.

Rowe, G., Wright, G. & Bolger, F. (1991). Delphi: a re-evaluation of research and theory. *Technical Forecasting Social Change, 39*(3), 235-251.

Rundmo, T., Hestad, H. & Ulleberg, P. (1998). Organisational factors, safety attitudes and workload among offshore oil personnel. *Safety Science, 29*(2), 75-87.

Ryan, G. & Bernard, H. R. (2000). Data management and analysis methods. In N. Denzin & Y. Lincoln (Eds.), *Handbook of Qualitative Research* (pp. 769-802). Thousand Oaks, CA: Sage.

Saari, J. (2001). Accident prevention today. *Preventing Accidents at Work, European Week 2001.* Luxembourg: Office for Official Publications of the European Communities. Available from http://osha.europa.eu/en/publications/magazine/4

Saaty, T. L. (1977). A scaling method for priorities in hierarchical structures. *Journal of Mathematical Psychology, 15*(3), 234-281.

Saaty, T. L. (1980). *The Analytic Hierarchy Process*. New York: McGraw-Hill.

Saaty, T. L. (1989). Decision making, scaling, and number crunching. *Decision Sciences, 20*(2), 404-409.

Saaty, T. L. (1990). An exposition of the AHP in reply to the paper "Remarks on the Analytic Hierarchy Process". *Management Science, 36*(3), 259-268.

Saaty, T. L. & Alexander, J. (1989). *Conflict Resolution: The Analytic Hierarchy Process*. New York: Praeger.

Saha, A., Kumar, S. & Vasudevan, D. (2008). Factors of occupational injury: a survey in a chemical company. *Industrial Health, 46,* 152-157.

Salo, A. A. & Hämäläinen, R. P. (1997). On the measurement of preferences in the analytic hierarchy process. *Journal of Multi-Criteria Decision Analysis, 6*(6), 309-319.

Sandelowski, M. (2000). Focus on research methods – combining qualitative and quantitative sampling, data collection, and analysis techniques in mixed-method studies. *Research in Nursing and Health, 23*, 246-255.

Sawacha, E., Naoum, S. & Fong, D. (1999). Factors affecting safety performance on construction sites. *International Journal of Project Management, 17*(5), 309-315.

Sax, L. J., Gilmartin, S. K. & Bryant, A. N. (2003). Assessing response rates and nonresponse bias in web and paper surveys. *Research in Higher Education, 44*(4), 409-432.

Seo, D. C. (2005). An explicative model of unsafe work behavior. *Safety Science, 43*(3), 187-211.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information, 22*(2), 63-75.

Silverman, D. (2000). *Doing Qualitative Research: A Practical Handbook*. London: Sage.

Simard, M. & Marchand, A. (1994). The behaviour of first-line supervisors in accident prevention and effectiveness in occupational safety. *Safety Science, 17*(3), 169-185.

Skinner, B. F. (1974). *About Behaviorism*. New York: Vintage.

Slater, P. J. B. (1978). Data collection. In P. N. Colgan (Ed.), *Quantitative Ethology* (pp. 7-24). New York: John Wiley & Sons.

Smith, J. & Firth, J. (2011). Qualitative data analysis: the framework approach. *Nurse Researcher, 18*(2), 52-62.

Smith, J. A. & Osborn, M. (2008). Interpretative phenomenological analysis. In J. A. Smith (Ed.) *Qualitative Psychology: A Practical Guide to Research Methods* (pp. 53-80). London: Sage.

Smith, N. J. (2003). *Appraisal, Risk and Uncertainty (Construction Management Series).* London: Thomas Telford Ltd.

Spaeth, H. J. & Segal, J. A. (1999). *Majority Rule or Minority Will: Adherence to Precedent on the U.S. Supreme Court.* Cambridge: Cambridge University Press.

Stasser, G., Kerr, N. L. & Davis, J. H. (1989). Influence processes and consensus models in decision-making groups. In P. Paulus (Ed.), *Psychology of Group Influence* (pp. 279-326). Hillsdale, NJ: Erlbaum.

State Administration of Work Safety (2007). *The Regulations on Accidents Report, Investigation, and Penalty Measures* (*生产安全事故报告和调查处理条例*). Retrieved October 29, 2012, from http://www.chinasafety.gov.cn/newpage/Contents/Channel_20697/2011/0907/158292/content_158292.htm

Statistics New Zealand (2012). *Injury Statistics – Work-related Claims: 2011.* Retrieved 26th December 2012 from http://www.stats.govt.nz/browse_for_stats/health/injuries/InjuryStatistics_HOTP11/Definitions.aspx

Stemler, S. (2001). An overview of content analysis. *Practical Assessment, Research & Evaluation, 7*(17). Retrieved 8th May 2013 from http://PAREonline.net/getvn.asp?v=7&n=17

Stenbacka, C. (2001). Qualitative research requires quality concepts of its own. *Management Decision, 39*(7), 551-555.

Strong, P. (1977). *The Ceremonial Order of the Clinic.* London: Routledge.

Sutherland, V. J. & Cooper, C. L. (1991). Personality, stress and accident involvement in the offshore oil and gas industry. *Personality and Individual Differences, 12*(2), 195-204.

Swaen, G. M. H., van Amelsvoort, L. G. P. M., Bultmann, U. & Kant, I. J. (2003). Fatigue as a risk factor for being injured in an occupational accident: results from the Maastricht Cohort Study. *Occupational and Environmental Medicine, 60*(1), 88-92.

Tabachnick, B. G. & Fidell, L. S. (2001). *Using Multivariate Statistics.* Boston: Allyn and Bacon.

Tam, V. & Fung, I. (2011). Tower crane safety in the construction industry: a Hong Kong study. *Safety Science, 49*(2), 208-215.

Taylor, G. W. & Ussher, J. M. (2001). Making sense of S&M: a discourse analytic account. *Sexualities, 4*(3), 293-314.

Thompson, R. C., Hilton, T. F. & Witt, L. A. (1998). Where the safety rubber meets the shop floor: a confirmatory model of management influence on workplace safety. *Journal of Safety Research, 29*(1), 15-24.

Tung, S. L. & Tang, S. L. (1998). A comparison of the Saaty's AHP and modified AHP for right and left eigenvector inconsistency. *European Journal of Operational Research, 106*(1), 123-128.

Tuñón, M. (2006). *Internal Labour Migration in China: Features and Responses*. Beijing: ILO Office.

Varonen, U. & Mattila, M. (2000). The safety climate and its relationship to safety practices, safety of the work environment and occupational accidents in eight wood processing plants. *Accident Analysis and Prevention, 32*(6), 761-769.

Vredenburgh, A. G. (2002). Organizational safety: which management practices are most effective in reducing employee injury rates? *Journal of Safety Research, 33*, 259-276.

Waldon, I. (1988). *Gender and Health-Related Behavior.* New York: Plenum Press.

Wang, X. H. (2011). "Tight money" is prominent at the end of the year, MOHRSS inspect wages payment for migrant workers (年关将至"钱紧"突出 人保部督察农民工欠薪). *China Times*. Retrieved May 10, 2012, from http://www.chinatimes.cc/yaowen/hongguan/2011-10-28/26776.shtml

Weick, K. E. (1968). Systematic observational methods. In G. Lindzey & E. Aronson (2nd ed.), *Handbook of Social Psychology* (pp. 357-451). Reading, MA: Addison-Wesley.

Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology, 39*(5), 806-820.

Weinstein, N. D. (1982). Unrealistic optimism about susceptibility to health problems. *Journal of Behavioral Medicine, 5*(4), 441-460.

Wells, S. & Macdonald, S. (1999). The relationship between alcohol consumption patterns and car, work, sports and home accidents for different age groups. *Accident Analysis and Prevention, 31*(6), 663-665.

Wenner, C. A. & Drury, C. G. (2000). Analyzing human error in aircraft ground damage incidents. *International Journal of Industrial Ergonomics, 26,* 177-199.

Williamson, A. M., Feyer, A. M., Cairns, D. & Biancotti, D. (1997). The development of a measure of safety climate: the role of safety perceptions and attitudes. *Safety Science, 25*(1-3), 15-27.

Wilson, D. S. (1994). Reintroducing group selection to the human behavior sciences. *Behavior and Brain Sciences, 17*, 585-654.

Winter, G. (2000). A comparative discussion of the notion of validity in qualitative and quantitative research. *The Qualitative Report, 4(3&4)*. Retrieved October 15, 2012, from http://www.nova.edu/ssss/QR/QR4-3/winter.html

Wong, D. F. K., Li, C. Y. & Song, H. X. (2006). Rural migrant workers in urban China: Living a marginalized life. *International Journal of Social Welfare, 16*(1), 32-40.

Wong, J. K. W. & Li, H. (2006). Application of the analytic hierarchy process (AHP) in multi-criteria analysis of the selection of intelligent building systems, *Building and Environment, 43*(1), 108-125.

Woudenberg, F. (1991). An evaluation of Delphi. *Technological Forecasting and Social Change, 40,* 131-150.

Xie, J. X., Qin, Y., Meng, X. L., Xu, J. & Wang, L. (n.d.). The fuzzy comprehensive evaluation of the highway emergency plan based on G1 method. Available from http://www.meeting.edu.cn/meeting/UploadPapers/1282703969546.pdf

Xinhua News Agency (2006). 8 Major Obstacles in Occupational Disease Intervention in China, One Hundred Billion Yuan Annual Direct Loss (8大问题困扰中国职业病防治，年直接损失千亿元). Retrieved October 25, 2012, from http://news.xinhuanet.com/health/2006-07/16/content_4840345.htm

Yan, Y. X. (1996). *The Flow of Gifts: Reciprocity and Social Networks in the Chinese Village*, Stanford, CA: Stanford University Press.

Yang, M. M. (1994). *Gifts, Favors, Banquets: The Art of Social Relationships in China*. Ithaca: Cornell University Press.

Yuen, K. K. F. (2009). On limitations of the prioritization methods in analytic hierarchy process: a study of transportation selection problems. *Proceedings of the International MultiConference of Engineers and Computer Scientists,* Vol. II, March 18-20, 2009, Hong Kong. Available from http://www.iaeng.org/publication/IMECS2009/IMECS2009_pp2064-2069.pdf

Zeller, D. B. (1986). "Heinrich revisited." *Professional Safety*, October, 40-42.

Zhang, C. H. (2004). *On the Human-being-in-itself: The Core Notion of the Idea of Scientific Development (以人为本：科学发展观的核心理念)*. (Master thesis). University of Anhui, China. Retrieved on May 13, 2012, from http://www.edu-hb.com/Html/200907/17/20090717152123.htm

Zhou, J. H. (2005). Discussions about the unfair competition during the process of project bidding (试论工程招标中的不正当竞争行为). In L. F. An (Ed.) (2009) *Constructing Harmony: 6th Excellent Research Paper on Construction Market and Bidding from 7 Provinces (构建和谐—— 七省市第六届建筑市场与招投标优秀论文集)*. Beijing: China Radio International Press.

Zhou, Q., Fang, D. P. & Wang, X. M. (2008). A method to identify strategies for the improvement of human safe behaviour by considering safety climate and personal experience. *Safety Science, 46*(10), 1406-1419.

Zohar, D. (1980). Safety climate in industrial organisations: Theoretical and applied implications. *Journal of Applied Psychology, 65*(1), 96-102.

Appendices

I – Workers' safety rule violation behaviour observation checklist (English version)

II - Workers' safety rule violation behaviour observation checklist (Chinese version)

III - Introduction (verbal) to organisations' 'champions', line managers/foremen, and workers (English version)

IV - Introduction (verbal) to organisations' 'champions', line managers/foremen, and workers (Chinese version)

V - Interview Consent Form (English version)

VI - Interview Consent Form (Chinese version)

VII- Interview Schedule for Managers and Foremen (English version)

VIII - Interview Schedule for Workers (English version)

IX - Interview Schedule for Managers and Foremen (Chinese version)

X - Interview Schedule for Workers (Chinese version)

XI - Questionnaire (English version)

XII - Questionnaire (Chinese version)

XIII – Descriptive statistics of question items retained for exploratory factor analysis

XIV – Correlation matrix of question items retained for exploratory factor analysis

XV - Questionnaire – Delphi method and the modified G1 method (English version)

XVI - Questionnaire – Delphi method and the modified G1 method (Chinese version)

Appendix I

Workers' safety rule violations observation checklist

(English Version)

Location of Work		Time and Date	
		Start: End: Date:	
Workers' General Rule Violation Behaviour			
Safety rule violations being observed	**Standard**	**Frequency of safety rule violations**	**No. of workers observed**
Workers don't wear safety helmet with chin strap	Wear safety helmet with chin strap on construction site		
Workers don't wear anti-slipery shoes	Wear anti-slipery shoes on construction site		
Workers smoke on site	No smoking on construction site		
Workers don't wear proper safety clothes, including life jacket	Wear safety clothes on construction site; workers work near water wear life jacket		
Workers' Rule Violation Behaviour When Working at Height			
Safety rule violations being observed	**Standard**	**Frequency of safety rule violations**	
Workers don't wear safety harness during erection/alteration/ dismantle of scaffolds	Wear safety harness during erection/alteration/ dismantle of scaffolds		
Safety harness of workers is not attached to independent lifeline OR proper anchor point	Wear safety harness attached to independent lifelines continuously secured at proper anchorage point		
Workers stack materials near the edge of working platform	Material should not be placed near the edge of the working platform against falling objects		
Workers do not maintain a clear passageway on the working platform in placing construction materials and equipment	A clear passageway should be upkept		
Workers' Rule Violation Behaviour During Mechanical Lifting Using Mobile Cranes			
Safety rule violations being observed	**Standard**	**Frequency of safety rule violations**	
Load/unload material without clearance of traffic, pedestrians, overhead cables, or other obstructions	Keep clear of other traffic and obstructions in the lifting operation		
Workers stay at the bottom of lifting or moving load when lifting operation is carried out overhead	Keep clear of other traffic and obstructions in the lifting operation		
Operate the lifting appliance while its moving parts not properly guarded	Moving parts should be effectively guarded		
Do not rig the material properly before lifting operation	The loads should be adequately secured		

Appendix II

Workers' safety rule violations observation checklist

(Chinese Version)

工地地点		时间	
		开始:　　结束:　　日期:	
工人一般违规行为			
观察到的违规行为	行为标准	违规行为次数	观察到的工人人数
工人在戴安全帽的时候不系带子	戴安全帽时应系带子		
工人不穿防滑鞋	在工地上应穿防滑鞋		
工人在工地上吸烟	在工地上不许吸烟		
工人不穿正规的安全服，包括救生衣	在工地上施工应穿正规的安全服，水上作业的工人穿救生衣		
工人高空作业违规行为			
观察到的违规行为	行为标准	违规行为次数	
工人在搭建、改装、拆除支架时不戴安全吊带	在搭建、改装、拆除支架时应戴安全吊带		
工人的安全吊带没有连接到独立救生绳上或者指定的定位点上	安全吊带应连接到独立救生绳上或者指定的定位点上		
工人在工作平台边缘附近堆放建筑材料	建筑材料不应堆放在工作平台边缘附近		
工人在放置建筑材料和器械时没有保持通道的畅通	通道应随时保持畅通		
工人在操作移动式起动机时的违章行为			
观察到的违规行为	行为标准	违规行为次数	
在加载、卸载材料时没有确保没有车辆、行人、架空电缆或其他障碍物的存在	确保没有车辆、行人、架空电缆或其他障碍物的存在		
在起重作业过程中有工人在底部交叉作业	确保没有车辆、行人、架空电缆或其他障碍物的存在		
在起重作业过程中其活动部分没有确保固定好	活动部分需要确保固定好		
在起重作业开始前没有固定好起重材料	起重材料需确保安全地固定好		

Appendix III

Introduction (verbal) to organisations' 'champions', line managers/foremen, and workers

(English version)

Introduction (verbal) to organisations' 'champions'

Thank you very much for your interest in participating in my research project.

My name is Dandan Wang. I am a PhD student from the University of Nottingham in England. My research interest is health and safety among the Chinese migrant construction workers. In particular, I am looking at what might cause workers to ignore safety rules and to look for practical solutions to such problems.

I would like to interview senior managers, safety officers, foremen, and construction workers themselves. I would like to do about 25 interviews in all: 3-4 senior managers, 3-4 safety officers, 4-5 foremen, and about 10 construction workers. Each interview should last about 30 minutes.

But first I need to familiarise myself with the company, the construction site, the work that the construction workers do and so forth. I would like to observe workers going about their business on site, and to learn about the company's basic health and safety policies and rules as well as the organisational structure, the current project, and the accident rates of the project. It would be very helpful for me to know a bit about the migrant workers' backgrounds – their origin, typical educations/qualifications, approximate ages, and so on. All the information I get relating to the company and the workers during my research is confidential and is for research purposes only, but I will happily provide a summary of the results for you.

I will in total visit more than 10 construction organisations in China. Based on all the information I get I will design a short questionnaire that I hope to distribute when I will return in June next year.

I expect you will advise me about any basic safety training/induction I need before I can set foot on site. I would very much appreciate having a named person who will help me gain access to the site, who will show me around and who will help me arrange interviews.

Can I answer any questions for you?

Thank you very much for your cooperation.

Introduction (verbal) to line managers/foremen

Hello, my name is Dandan Wang. I am a PhD student from the University of Nottingham in England. I am currently doing a research on Health and Safety on Chinese construction sites. I would like to know how you think about health and safety management on Chinese construction sites from a line manager/foreman's perspective. It is entirely voluntary and whatever you say will be completely confidential: I will not note down your name. So I do not have to write lots of notes during our talk, it would be very helpful for me if I could leave the recorder running while we talk. I would not record your name on it and I will erase it at the end of the project.

Introduction (verbal) to workers

Hello, my name is Dandan Wang. I am a student. As you know, the issues of migrant workers' working conditions, safety, and quality of life have attracted a lot of attention recently in our society. I have some homework which is to understand your living and working conditions. Can I ask you a few questions? It is entirely voluntary and whatever you say will be completely confidential: I will not note down your name. So I do not have to write lots of notes during our talk, it would be very helpful for me if I could leave the recorder running while we talk. I would not record your name on it and I will erase it at the end of the project.

Appendix IV

Introduction (verbal) to organisations' 'champions', line managers/foremen, and workers

(Chinese version)

介绍-管理层

非常感谢您参与我的研究项目。我叫王丹丹。我是英国诺丁汉大学的博士生。我的研究课题是关于中国农民工，主要是建筑工人的健康安全问题。具体讲，我研究的是造成工人违反公司安全制度的因素并针对这些因素提出改进措施。

我的这个研究分 5 个步骤。第一步是阅读大量关于中国文化，中国农民工，中国社会经济现状以及关于健康安全管理和违章的大量文献。这是对于开展下面的研究进行的准备阶段。我用了过去 12 个月的时间从事这项工作。

第二个阶段是让我熟悉了解现实中建筑行业中的企业，施工现场，工人的实际工作等内容。这是我现在需要做的事情。在这个阶段里，我希望能够到施工现场观察工人的日常工作并且了解公司内部基本的关于健康安全的规章制度以及公司现在的组织架构、现在建设的项目的信息和事故率。另外，我还希望能够了解一些关于公司一线建筑工人的背景情况，比如他们老家的区域，教育程度，大体年龄等等。这些还需要公司为我提供一些基本材料。我计划这个阶段用不超过两个星期。

第二个阶段结束后，为了能使我更具体地了解公司和公司内部的工人，在第三个阶段里我希望能够访谈公司管理层的领导，包括高层领导，安全员和施工队的工头，以及一线的建筑工人。我希望能够一共做至少 25 个访谈，其中包括 3-4 位高层领导，3-4 位安全员，4-5 位工头，和 10 位左右一线建筑工人。每一次访谈大概 45 分钟左右。这个阶段的时间取决于参加访谈人员的时间安排。我希望能够在两周内完成。

我这次回国的主要任务就是完成第二和第三阶段。我一共将要调查 10 多个建筑行业的企业。在此之后，我会回英国对我收集的数据进行分析，并且和我的导师进行讨论。在我们的分析结果以及现有的文献的基础上，我会设计一套专门适合中国企业和社会背景的问卷。这是第四个阶段。问卷调查计划在 6 月份开始。所有我在研究中收集的资料都是保密的，而且仅用于此次研究。人名和公司的名字都不会出现在任何公开场合。

再最后一个阶段，如果公司有这个要求和希望，我会把我的总体研究结果和提出的方案向公司进行一次汇报。

这些是关于我的研究计划的简单介绍。您有什么问题吗？

出于对我个人和施工现场的安全问题的考虑，我希望在我进入施工现场之前能够接受一些公司的安全培训或者讲解。另外，我希望您能指派一位员工作为对接人员带我进入施工现场并且帮助我安排访谈的时间。

介绍 - 工长

您好，我叫王丹丹。我现在是一名英国诺丁汉大学的博士研究生。我现在正在做一个关于中国建筑行业安全健康管理的研究。我希望能够了解一下您从工长的这个角度对中国建筑行业安全管理的想法。您的参与完全是自愿的。所有您告诉我的信息我全都会保密，我也不会记录您的名字。为了让我在我们的谈话过程中不必记录很多东西，我希望您能允许我把我们的对话录音下来。录音里不会有您的名字。我们的录音在调研结束后都会被销毁。

介绍 - 工人

您好，我叫王丹丹。我是一名学生。我现在有个作业是要调查关于建筑工人的生活和工作环境。您知道，现在农民工的生活和工作条件以及安全问题受到社会很大的关注。我能不能问您几个问题？所有您告诉我的信息都是保密的。我不会记录您的姓名。

Appendix V

Interview Consent Form

(English version)

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA
I-WHO Institute of Work, Health & Organisations

Interview Consent Form

Health and Safety on Construction Sites

The overall purpose of the project is to understand health and safety management issues on Chinese construction sites and to suggest methods of effecting change within the complex interactions between organisational, social and cultural contexts in which behaviour is regulated.

The purpose of this interview is to gather detailed information about the employees' perception of the health and safety management within the company.

The interview will last for approximately *30 minutes*. It will be recorded on tape, if you are in agreement. The tape is purely to assist the interviewer in remembering what has been said and to save time during the interview. You may switch the tape recorder off at any point during the interview, if you wish. The content of the tape will not be disclosed to anyone beyond the research team and the tapes will be destroyed at the end of the project.

You may terminate the interview at any stage and may withdraw your consent for the use of information gained from the interview.

Any personal material from your interview that is used in project reports, academic papers and feedback to the organisation will be quoted anonymously and anything that could identify you will be removed.

During the interview you will be asked about your own experiences. You do not have to answer any question that you find upsetting and the interviewer will respect your decision. However, the interviewer is not a trained counsellor and if you find that you are upset during the interview or at some later time, you should approach your occupational health service or your staff counsellor.

Thank you for agreeing to take part in this interview.

Consent to participate and assurance of confidentiality

I agree to be interviewed about Health and Safety on construction sites. I have been told what the study is about and that:

I do not have to answer any questions I do not want to;

I can stop our talk at any time if I want to;

I can ask for to switch off the tape recorder at any time during the interview;

I understand that our talk is completely confidential and that the tape will be destroyed at the end of the project and I would not be identifiable in any case.

Signature	**Date**

Name of interviewee

Although I have noted your name here, it will be kept completely separate from the information I get in our talk. If you would prefer not to write your name, please just mark 'X' in both boxes.

Organisation

Appendix VI

Interview Consent Form

(Chinese version)

同意访谈认定表

建筑工地中人员的健康和安全

此研究项目的主要目的是了解关于在建筑工地中对于员工健康和安全管理的现状，并试图提出在这个社会，组织以及文化相互融合的错综复杂的体系里相对有效的管理改善措施。

访谈的主要目的是收集关于员工对于企业健康安全管理的理解的具体信息。

访谈将持续不超过 30 分钟。如果您同意，访谈将被录音。录音仅为帮助研究人员准确全面地记录访谈内容。您可以随时要求停止录音。所有录音内容都不会暴露给除课题研究人员以外的任何人员或者组织。所有录音都将在研究结束后被清除。

您可以随时提出结束访谈并要求清除所有访谈内容。

所有关于您的个人信息将始终保密。如有在项目总结报告或科研论文中出现的必要，任何您在访谈中提供的内容都将采用匿名出现。

在访谈期间有些问题将会涉及到您的个人经历。您可以拒绝回答任何您不想回答的问题。我个人不是专业的心理咨询师，如果我们的对话对您有情绪上的影响，请您及时去和有关心理专家联系。

非常感谢您的参与。

我同意接受关于建筑施工现场健康和安全管理的访谈。我明白：

我不要回答任何我不愿回答的问题；

我可以在任何时间终止我们的谈话；

我可以在访谈过程中任何时候要求停止录音；

我们的谈话内容都是匿名、保密的。访谈录音在研究结束后将被消除。

姓名：　　企业及部门名称：　　日期：

虽然我在这里记录下了您的姓名，此文件将与我们的谈话内容文件分开保存。如果您不希望留下您的名字，您可以在“姓名”处打“X”。

Appendix VII

Interview Schedule for Managers and Foremen

(English version)

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

I-WHO
Institute of Work, Health & Organisations

Participant ID:_____

INTERVIEW SCHEDULE

(Managers and Foremen)

CONFIDENTIAL

SAFETY MANAGEMENT AND RULE VIOLATION BEHAVIOUR AMONG CHINESE CONSTRUCTION WORKERS

1. General questions

What is your position in the company?

How long have you worked for this particular company?

How long have you worked in the construction industry? Have you worked in both private and state-owned construction companies?

Have you had any experience of, or had to deal with the result of any serious accidents at work?

Do you think a lot about how to prevent accidents?

Can you tell me a little bit about the background of the construction workers in the company? For example, their age range, education level, origin etc.

In your view, what are the 5 most important safety rules that you hope every worker knows about?

2. Causes of accidents

In your opinion, what are the causes of accidents at work?

Main human factors?

Social/peer group pressure?

Fatigue? (e.g. living conditions, long working hours, distracted by family worries)

Main physical/equipment causes?

Do you think fate/bad luck plays a role?

3. Responsibility

Who do you think is responsible for accident prevention at work?

How much do you think it is the company's responsibility or managers' responsibility or the worker's responsibility to prevent accidents?

What are the difficulties in encouraging everyone to comply with company safety regulations?

4. Interventions

What measures does the company take to prevent accidents?

4.1. Safety Communication

How does the company communicate with workers about safety issues?

What are the difficulties of communicating with employees about safety issues?

Do you personally often talk to the employees about working safely?

Does the company encourage employees to report any worries they have about safety?

Does the company motivate the workers to work more safely? If yes, how does the company motivate the workers?

4.2. Inspection

What are the company's safety control and inspection routines?

4.3. Training

What kind of safety-related training do the workers undertake before they start working on the site?

What kind of safety-related training do the workers get during the time they work for the company?

Wearing PPE

Handling dangerous equipment

Emergency procedure (E.g. Evacuation, fire, explosion)

5. Safety attitudes

What do you think about the measures the company takes to prevent accidents?

How effective do you think the measures are?

Is safety a top priority here?

Are targets/production sometimes more important than safety?

Do you think accident prevention is worth the effort?

6. Violations

In this company, which safety rules are most commonly disobeyed?

Which are the most dangerous?

Why do you think people disobey the rules?

What are the company's procedures for dealing with workers who disobey the rules?

Do you think sometimes it is necessary to turn a blind eye when people disobey the rules? Why?

7. Working and living conditions

What do you think about your working environment? What about the working environment for the construction workers?

Where do the workers live? How acceptable are their living conditions?

Do you feel pressured by production targets?

Do you think that the workers also feel under pressure from production targets?

If a worker experienced difficulties at work, who would he get help from?

Company support systems/advisors/counsellors?

Informal support groups? (e.g. a network of people from the same village)

Appendix VIII

Interview Schedule for Workers

(English version)

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

I-WHO Institute of Work, Health & Organisations

Participant ID:_____

INTERVIEW SCHEDULE

(Workers)

CONFIDENTIAL

SAFETY MANAGEMENT AND RULE VIOLATION BEHAVIOUR AMONG CHINESE CONSTRUCTION WORKERS

1. General questions

Where are you from originally?

How long have you been in (the city's name)?

Do you like it here? If not, why?

How did you find this job?

How long have you worked in the construction industry?

Have you worked in both private and state-owned construction companies?

How long have you worked for this particular company?

Could you tell me briefly what your job involves?

What is a normal day like for you?

What time do you get up?

What time do you start work?

How long do you work?

How long are your breaks?

What time do you stop working?

What time do you go to sleep?

How many days off do you have per week?

Have you had any experience of any serious accidents at work?

Do you mind if I ask how old you are?

2. Working and living conditions

What do you think about your working environment?

Do you feel under pressure from targets?

Where do you live?

What are your living conditions like?

Are you good friends with some of your co-workers?

Are you a member of a fellow villager group?

Are there many groups of this kind here?

3. Causes of accidents

In your opinion, what are the causes of accidents at work?

What are the major human factors that cause accidents?

Is there something people can do to avoid them?

Do you think luck plays a role?

Do you think that if bad things happen, it is because they were meant to be?

4. Responsibility

Who do you think is responsible for accident prevention at work?

How much do you think the company's responsibility is to prevent accidents at work? Why?

Do you think if employees follow company rules and regulations, they can avoid on-the-job accidents?

5. Intervention

What do people do when they see a co-worker doing something dangerous?

What does the company do to prevent accidents?

What does the company do when there is an accident?

Does the company regularly communicate with the workers about safety issues?

What kind of safety equipment are you provided with by the company?

What kind of safety training have you undertaken?

Is there anyone in your team responsible for safety inspection?

What do you do to prevent accidents?

6. Safety attitudes

Do you think your job is dangerous? If yes, please give an example.

Do you pay attention to safety at work?

Do you think a lot about how to prevent accidents?

Is safety a top priority for you when you are at work?

What do you normally do when you are under production pressure? Do production targets sometimes take priority over safety?

In your opinion, does the company pay enough attention to safety? Why do you say that?

In your opinion, does your foreman pay enough attention to the safety issues at work? Why do you say that?

What do you think about the measures the company takes to prevent accidents?

Do you think accident prevention worth the effort? Why?

7. Violations

In your opinion, what are the most 5 important safety regulations in the company?

In this company, which safety rules are most commonly disobeyed?

Which are the most dangerous?

Why do you think people disobey the rules?

What are the company's procedures for dealing with workers who disobey the rules?

Do you think sometimes it is necessary to turn a blind eye when people disobey the rules? Why?

Are people treated fairly and equally when they are found disobeying safety rules?

Is it possible to avoid being punished for disobeying the rules? How?

Appendix IX

Interview Schedule for Managers and Foremen

(Chinese version)

被访谈人代码: -------

访谈问题

(管理层和工头)

保密

中国建筑工人的安全管理以及违规行为

1. 一般问题

您在公司从事什么职位？

您在现在这个公司工作多久了？

您在建筑行业工作多久了？

您在国有建筑企业和私人建筑企业都工作过吗？

您经历过或者处理过任何比较严重的施工事故吗？如果有，发生了什么事情？

这个经历对您有什么影响？

您能不能告诉我一些公司内建筑工人的背景情况？比如，他们的年龄段，教育程度，老家的省份地区等。

2. 事故原因

您认为造成施工事故的原因是什么？

您认为主要造成施工事故的人为因素是什么？

同伴压力？

疲劳（例如，生活环境，长时间工作，家庭困扰）？

您觉得运气在这里有没有起到作用？如果有，有多大作用？

您觉得一般如果坏的事情发生了，它是不是命中注定的？

人们可以如何防止事故的发生？

3. 责任

您觉得预防施工事故的责任在谁？

您觉得在预防施工事故上谁的责任最大？为什么？

您认为如果员工遵守公司的规章制度，他们可以防止施工事故吗？

4. 干预

公司对于预防施工事故采取了哪些措施？

4.1. 安全沟通

公司如何与工人沟通关于安全施工的问题？

与工人沟通关于安全施工问题有哪些困难？

您自己亲自与员工谈论关于安全施工的问题吗？

公司鼓励员工汇报他们关于安全问题的任何担忧吗？

公司激励员工更安全的施工吗？如果是，公司如何激励员工安全施工？

鼓励公司每一位工人遵守公司安全规章制度的难处是什么？

4.2. 检查

公司的安全控制和检查的步骤是什么？

4.3. 培训

工人在上岗之前都需要接受哪些安全培训？

工人在他们工作期间都需要接受哪些安全培训？

佩戴个人安全保护设备？

如何运送危险设备？

紧急措施 （例如，紧急撤离，火灾，爆炸）

安全态度

安全生产在公司里是不是重中之重？如果不是，什么是最重要的 ？

在您需要赶工期的时候，您一般都如何平衡安全保障和施工压力？

施工指标的压力或者赶工期的需要有时候会不会造成对于安全施工的忽视？

安全施工是不是企业文化的一部分？是如何体现的？

您是如何看待公司对于预防施工事故采取的措施的？

预防措施有多有效？如果无效，为什么？

有没有办法使措施更有效？

您认为公司值得付出努力去预防施工事故吗？为什么？

5. 违章

您能不能告诉我几条公司里您认为很重要的安全规章制度您希望每一位工人都了解？

在这个公司里，哪些安全规章制度是最经常被违反的？

您认为违反哪几条规章制度会造成最严重的危害？

您认为工人为什么有时候违反公司安全制度？

公司如何处理违反安全规章制度的工人？

您觉得有时候是不是有必要对于违反规章制度的工人睁一只眼闭一只眼？为什么？

6. 工作和生活环境

您觉得工人的工作有多危险？

工人都住在哪里？他们的住宿条件如何？

您有没有感觉施工任务指标的压力？

您觉得工人会不会感觉施工任务指标的压力？如果是，您认为施工任务指标是如何影响工人在施工现场的安全行为的？

如果工人在工作期间经历一些工作或生活困难，他会去到哪里寻求帮助？

公司内部工会、辅导站？

非正式帮助组织（例如，同乡会）？

Appendix X

Interview Schedule for Workers

(Chinese version)

被访谈人代码: -------

访谈问题

(工人)

保密

中国建筑工人的安全管理以及违规行为

1. 一般性问题

您的老家是哪里的？

您在现在这个城市生活多久了？

您喜欢这里吗？为什么喜欢/为什么不喜欢？

您是如何找到现在这份工作的？

您在建筑行业工作多久了？

您是否在国有建筑企业和私营建筑企业都工作过？

您在现在这家公司里工作多久了？

您能不能给我大体讲讲您现在的 工作都包括什么内容？

您一般每天的作息时间是怎样的？

您几点起床？

几点开始工作？

工作多长时间？

您上班的中间休息时间有多长？

您几点下班？

几点睡觉？

您一个星期休息几天？

您工作中有没有经历过或者见过比较严重的事故？如果有，发生了什么？您觉得这个经历对您有什么影响？

您是否介意我问您的年龄？

2. 工作和生活环境

您有没有感觉施工任务带来的压力？

您住在哪里？

您住的条件如何？

您和您的一些工友是好朋友吗？

您是不是同乡会的成员？

在这个城市里有没有很多类似同乡会的组织？

3. 事故原因

您认为什么是造成工作事故的原因？

主要造成工作事故的人为因素是什么？

人们如何可以防止事故的发生？

您觉得运气在这里有没有起到作用？如果有，有多大作用？

您觉得一般如果坏的事情发生了，它是不是命中注定的？

4. 责任

您觉得预防施工事故的责任在谁？

您觉得在预防施工事故上谁的责任最大？为什么他们的责任最大？

您认为如果员工遵守公司的规章制度，他们可以防止施工事故吗？

5. 干预

当工人看到他的工友在做一些比较危险的事情时，工人一般做些什么？

工人之间是不是经常互相提醒注意安全的问题？如果是，工人一般都说什么？

您的家人（父母，爱人，孩子）是不是经常提醒您注意安全？如果是，他们的提醒对您有什么影响？

公司采取什么样的措施预防施工事故的发生？

您觉得公司采取的预防施工事故的措施如何？

公司在出现施工事故的时候做些什么？

公司经常和工人沟通关于安全的问题吗？

公司为您提供哪些安全设备？

您上岗之前参加过哪些安全培训？

您工作期间参加过哪些安全培训？

您觉得这些安全培训有多有用？

技术方面？

安全知识方面？

安全意识方面？

在您的这个施工队里有没有人专门负责安全检查？如果有，负责安全检查的人都做什么？

您自己是如何预防施工事故的？

6. 安全态度

您觉得您的工作危险吗？如果是，您能不能举个例子说明？

您考虑很多关于如何预防事故的问题吗？

在施工现场，安全问题对于您是不是首要问题？如果不是，什么是最重要的？

您是如何平衡安全问题和施工压力的？施工压力有时候会不会造成对于安全问题的忽视？

您认为公司有没有足够地关注施工安全问题？您为什么这么讲？

您认为工头有没有足够地关注施工安全问题？您为什么这么讲？

您认为值得付出努力去预防施工事故吗？为什么？

7. 违章

您能不能告诉我几条公司里您认为很重要的安全规章制度？

在这个公司里，哪些安全规章制度是最经常被违反的？

您认为违反哪几条规章制度会造成最严重的危害？

您认为工人为什么有时候违反公司安全制度？

公司如何处理违反安全规章制度的工人？

您觉得有时候是不是有必要对于违反规章制度的工人睁一只眼闭一只眼？为什么？

当工人被发现违反了安全制度，公司是不是很公平合理地对待他们？

当工人被发现违反了安全制度，工人有没有可能采取一些办法避免处罚？如何避免处罚？

Appendix XI

Questionnaire

(English version)

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

I-WHO
Institute of Work, Health & Organisations

Participant ID:_____

QUESTIONNAIRE

CONFIDENTIAL

HEALTH AND SAFETY ON CHINESE CONSTRUCTION SITES

This independent research project looks at managers' experience and perception of health and safety management issues on construction sites. It explores individual behaviour and the organisational contexts in which they take place. It aims to suggest helpful changes.

I would be very grateful if you would complete this simple voluntary questionnaire. It will only take about 15 minutes. It asks about your own opinions. In completing the questionnaire, please be honest and frank; there are no right or wrong answers. The questionnaire is completely confidential to the research team at the University of Nottingham. All the information gathered will be summarised anonymously: nothing can be traced back to you.

We hope that you will find the questionnaire interesting. After you have completed it, please put it in the envelope provided and return it to the person who gave it to you.

In order to participate in the research you will need to give your informed consent. By ticking the box below you are indicating that you understand the nature of the survey and that you agree to help us. Please tick the box if you agree to take part:

□

I understand that all information I provide will remain anonymous and kept in accordance with the Data Protection Act, UK (1998). I understand that I have been provided with an explanation of the survey in which I am participating in and have been given the name and contact details of an individual to contact if I have questions about the research. I understand that participation in the survey is voluntary and that I can withdraw at any time.

Thank you very much for your help

The questionnaire is completely anonymous. So please do not write your name on it. But if you would like any more information about the research project, or if you would like to know the overall results of the project, please contact me:

Dandan Wang

Email: lwxddw1@nottingham.ac.uk

Institute of Work, Health and Organisations

University of Nottingham, UK

Or, if you wish, you can leave your telephone number or email address below, and I will contact you. This personal information will be kept completely separately from the attached questionnaire, be stored safely and remain confidential. It will be destroyed when the project is finished.

Email address: .....

Telephone number: .....

Please indicate what you think about each of the following statements by ticking **one** of the seven boxes beside each statement (from 'strongly disagree' to 'strongly agree').

WORKERS							
	Strongly disagree	**Disagree**	**Basically disagree**	**Neutral**	**Basically agree**	**Agree**	**Strongly agree**
On construction sites, older workers behave more safely than younger workers							
On construction sites, experienced workers behave more safely than less experienced workers							
On construction sites, better educated workers behave more safely than less educated workers							
Most of the workers on construction sites have lower than high school level education							
Workers' educational levels limit their ability to understand the training provided							
Most workers are aware of important safety rules on construction sites							
The health and safety training provided on most construction sites is not designed at the appropriate level for most workers							
Workers violate rules or take risks while working because they are not aware of the serious consequences of their behaviour							
Workers would not comply with safety rules and operational regulations if there weren't safety officers on site on the lookout for safety rule violations							

The high demand for workers on construction sites increases turnover rates (because workers can easily get jobs elsewhere)							
Moving frequently from site to site and repeatedly receiving safety training cause workers to pay less attention to safety training							
Workers can come and go as they wish because there are no penalties for workers who break their contracts							
Because the restriction of labour contract on workers is limited the majority of employers don't sign labour contract with workers							

Workers behave SAFELY because:							
	Strongly disagree	Disagree	Basically disagree	Neutral	Basically agree	Agree	Strongly agree
Their family and friends tell them to do so							
They don't want to cause unhappiness for their families							
They want the company to develop sustainably							
They want to avoid hurting themselves							
They want to avoid hurting others							
They want to avoid being caught and punished							
They always follow rules and regulations							
Their co-workers work safely							
They are in a habit of working safely							

Workers violate rules or taking risks while working because:							
	Strongly disagree	Disagree	Basically disagree	Neutral	Basically agree	Agree	Strongly agree
It is inconvenient or more difficult to work while complying with safety rules							
Working safely is more time consuming							
They are careless							
They are curious							
They don't think their unsafe behaviour can cause an accident							
They have an antipathy against safety management and rebel against it							
They just need to blow off some steam							
They want to cause some damage							
They don't know how to work safely							
Their co-workers often violate rules or take risks while working							
They are in the habit of working unsafely							

MANAGERS

	Strongly disagree	Disagree	Basically disagree	Neutral	Basically agree	Agree	Strongly agree
If corrective action is always taken as soon as managers discover unsafe practices, workers are less likely to violate rules or taking risks while working							
If it is clear that the managers are genuinely concerned about workers' safety, workers are more likely to pay attention to health and safety							
Most accidents are caused by workers' rule violation or risky behaviour and have nothing to do with managers							
If managers always comply with safety rules, workers are more likely to do the same							
Senior managerial commitment and attitudes towards safety are crucial factors in keeping construction sites safe							
Foremen play an extremely important role in shaping workers' attitudes towards safety and ensuring that workers act in a safe manner							
Nowadays, managers at all levels are more interested in safety than production							
The most important reason why managers care about safety at work is because they don't want to lose their jobs and go to prison							
Managers' safety behaviour has no influence on workers' attitudes towards safety and their behaviour							

SAFETY MANAGEMENT IN CONSTRUCTION COMPANIES

	Strongly disagree	Disagree	Basically disagree	Neutral	Basically agree	Agree	Strongly agree
It is very often the case that rule violation behaviour and accidents are due to insufficient investment in safety							
It is impossible to complete jobs on time while following all safety rules							
The safety rules do not always describe the safest way of working. Sometimes it is safer not to comply with the safety rules at work							
More training is needed for both managers and workers in order to improve safety on construction sites							
Severe disciplinary action for safety rule violations is needed to achieve sustainable improvement in the safe behaviour of both managers and workers							
Incentives or reward systems are/would be more effective than severe disciplinary actions in reducing violation behaviour							
Poor management and design of policies are the root causes of preventable accidents at work							
Workers rush to finish their work early because the payment system encourages them to do so							
The shortage of skilled workers means construction companies are not in a position to select workers. Thus, they have to employ whoever is available							
High turnover rates make it very easy to lose track of workers							

Safety officers are very important for keeping construction sites safe; without them accidents would happen more frequently							
Workers can offer valuable suggestions on how to improve health and safety. Taking their advice can help reduce accidents on sites							
Work in compliance with safety rules is not always the best way of working, but is certainly always the safest way							
Frequent communication between managers and workers on safety issues can reduce workers' rule violation behaviour							
A caring and considerate management style helps prevent workers' rule violation behaviour							
The large number and high turnover rates of workers make it difficult for managers to get to know each operator well and to allocate work based on their preferences and skill set; this can affect workers' safety behaviour							
Untidy and dirty working sites are associated with workers' rule violation behaviour							
The sheer size and geographical spread of contemporary construction projects causes difficulties for project and human resources management							
The provision of modern, good quality equipment improves workers' attitudes towards safety and their safety behaviour							
The increase of workers' salary and the general living condition in the society improves workers' self- protection awareness							

THE CONSTRUCTION SECTOR IN CHINA							
	Strongly disagree	Disagree	Basically disagree	Neutral	Basically agree	Agree	Strongly agree
There is constant pressure to work at a high speed in order to finish projects on time							
Because the investment in safety management is long term and the effect is not obvious sometimes, many construction companies are reluctant to invest in safety management							
It is very difficult for small construction companies to make a profit from their projects. This leaves them very little money to invest in safety management							
Managers of small construction companies have the resources to invest in safety management. They don't do so because they only want to maximise their profit							
There is less media attention and rigorous inspection from responsible institutions on projects carried out by small construction companies because the projects are normally small and in remote areas. Therefore smaller companies are more likely to take risks and violate rules							

	Strongly disagree	Disagree	Basically disagree	Neutral	Basically agree	Agree	Strongly agree
Having a good *guanxi* with the local authority and responsible institutions can help companies avoid being discovered and punished for safety rule violations. It affects the stringent implementation of legal regulations, especially in remote areas							
Many constructions use the budget money for safety environment and equipment on other purposes							
Many standards and regulations about safety training in the construction sector are taken from developed countries, but are not suitable for the reality of Chinese society and the Chinese construction sector, and are difficult to implement properly							

How satisfactory do you think the overall state of safety management is in the Chinese construction industry? *(Please tick ONE box underneath the appropriate statement which shows your opinion)*

Very unsatisfactory	Unsatisfactory	Basically unsatisfactory	Neutral	Basically satisfactory	Satisfactory	Very satisfactory

Overall, which of the following factors do you think is the biggest safety management problem in the Chinese construction industry? *(Please tick **ONE** box only)*

Lack of adequate safety management legislation	
Poor implementation of safety legislation	
Lack of punishment from responsible institutions on safety rule violation activities in construction companies	
Lack of awareness and commitment of managers to safety management	
Lack of strict inspection and management from safety managers and officers of construction companies	
Companies' lack of money to invest in safety management	
Construction companies use the budget money for safety management on other purposes	
Lack of safety awareness and necessary skills among workers	

How comprehensive is safety legislation that is relevant to the construction industry? *(Please tick **ONE** box underneath the appropriate statement which shows your opinion)*

Very incomprehensive	Incomprehensive	Basically incomprehensive	Neutral	Basically comprehensive	Comprehensive	Very comprehensive

How satisfactory is the overall implementation by companies of safety management legislation in the Chinese construction industry? *(Please tick **ONE** box underneath the appropriate statement which shows your opinion)*

Very unsatisfactory	Unsatisfactory	Basically unsatisfactory	Neutral	Basically satisfactory	Satisfactory	Very satisfactory

How stringent is current inspection and enforcement of safety management legislation in the Chinese construction industry? *(Please tick **ONE** box underneath the appropriate statement which shows your opinion)*

Not stringent at all	Not stringent	Basically not stringent	Neutral	Basically stringent	Stringent	Very stringent

THE GENERAL POPULATION							
	Strongly disagree	Disagree	Basically disagree	Neutral	Basically agree	Agree	Strongly agree
People want to achieve things quickly. This reflects on daily behaviour in workplaces in China							
Being 'good enough is fine' is a culture. This is reflected in daily behaviour at work by both managers and workers							
Most people I know believe accidents are a matter of fate; they are predetermined and nothing can stop them from happening							
People are happy to take risks because they assume bad things will not happen to them							
"Worshiping money" is a common phenomenon in the modern society. It threatens the values of "integrity", "striving for excellent quality", "taking social responsibility" among some people							

ABOUT YOU

Age _____ **Your gender**_____

Your job title _____ **No. of years worked in construction industry**_____

Thank you very much for your time.

If you have any further comments on safety management on construction sites in China, please mention them here.

Appendix XII

Questionnaire

(Chinese version)

答卷人代码: -------

调查问卷

保密

中国建筑工地的安全管理

首先，非常感谢您能在百忙之中抽出时间填写这份问卷。本问卷旨在通过对目前建筑工程在建工地（简称建筑工地，下同）施工安全、工地作业人员的安全意识、工程承建单位对作业人员安全教育和培训以及工程相关单位实施的安全管理的整体状况进行调查，进而为充分保证建筑工地施工安全提出更加科学化、规范化、人性化和切实可行的解决方案。

填写此问卷最多只需要占用您 15 分钟时间。本问卷采用不记名方式访问，所有的信息仅供英国诺丁汉大学此调研项目的专业研究人员使用，所有资料绝不对外公开。本问卷的问题均为询问您的个人意见，没有对错之分，请结合您的工作经历和工作中的体会给予回答。您的宝贵意见将对本研究有莫大的帮助。

您需要签署知情同意书进而参与此调研。当您在下面的方格中打勾就表明了您了解此调研问卷的目的和性质并且同意帮助我们回答问卷。如果您同意参与，请在下面的方格中打勾：

□

我了解我提供的所有信息将保持匿名，并根据英国的《数据保护法》（1998 年）的规定保存。我已经理解了此调研项目的目的和性质。如果我有关于此研究项目的问题我知道我可以联系的人的名称和详细联系方式。我了解参与此调研项目是完全自愿的，我可以在任何时候终止。

如果您想了解关于此调研项目的更多信息或调研项目的最终结果，请联系我：

王丹丹（英国诺丁汉大学工作、健康和组织学院）

电子邮箱：lwxddw1@nottingham.ac.uk

或者，如果您愿意，您也可以把您的电子邮箱和电话填写在下面，我将会与您取得联系。这些个人信息将与问卷分开保存，所有个人信息在此次调研结束后全部销毁。

电子邮箱：----------

电话号码：----------

请在下面每句话之后的空格中选择一个最能代表您想法的答案。

作业人员							
	非常不赞同	不赞同	基本不赞同	一般	基本赞同	赞同	非常赞同
在建筑工地，年长的作业人员比年轻的作业人员更能安全地作业							
在建筑工地，经验丰富的作业人员比经验较少的作业人员更能安全地作业							
在建筑工地，文化程度高的作业人员比文化程度低的作业人员更能安全地作业							
建筑工地上大部分作业人员是初中或者小学文化程度							
文化程度限制了作业人员对施工安全教育培训内容的理解							
大部分作业人员都了解建筑工地上重要的安全管理规章制度和操作规程							
大部分施工单位提供的施工安全教育培训没有根据作业人员的理解能力而设计							
作业人员违章或冒险作业是因为他们不了解他们的违章或冒险行为可能造成的严重后果							
如果没有专职安全员的现场监督，作业人员就不会按照规章制度和操作规程的要求进行现场作业							
建筑工人流动性大的主要原因是建筑工地大量需要工人，建筑工人可以很容易地在其它工地找到工作							
建筑工人频繁换工作单位导致了他们对施工安全教育培训的麻木和不重视							
建筑工人可以来去自由是因为大部分建筑工人违反劳动合同不会受到惩罚							
由于劳动合同对建筑工人的约束性不高，大部分用人单位（施工单位）不与建筑工人签订劳动合同							

作业人员安全作业因为:							
	非常不赞同	不赞同	基本不赞同	一般	基本赞同	赞同	非常赞同
他们的家人和朋友告诉他们这样做							
他们为了家庭的幸福和睦							
他们为了企业安全稳定地发展							
他们想避免伤害到别人							
他们想避免伤害到自己							
他们想避免受到惩罚							
他们总是按照规章制度和操作规程要求进行作业							
他们的同事都安全作业							
他们养成了安全施工的习惯							

作业人员违章或冒险作业因为:							
	非常不赞同	不赞同	基本不赞同	一般	基本赞同	赞同	非常赞同
按照规章制度和操作规程要求进行作业会对工作造成不便或困难							
按照规章制度和操作规程要求进行作业工作效率会较低							
他们不小心							
他们好奇							
他们认为违章或冒险作业不会造成事故							
他们对安全管理有抵触心理							
他们有发泄情绪							
他们故意搞破坏							
他们不知道如何按照规章制度和操作规程要求进行作业							
他们的同事经常违章或冒险作业							
他们养成了违章或冒险作业的习惯							

管理人员							
	非常不赞同	不赞同	基本不赞同	一般	基本赞同	赞同	非常赞同
如果每次管理人员发现安全隐患后都立即采取整改措施，作业人员违章或冒险作业的可能性会降低							
如果管理人员能真正地关心作业人员的安全问题，并且能明显地体现在日常工作中，作业人员会更注意他们自己的健康和安全							
大部分施工安全事故是由作业人员的违章或冒险作业造成的，和管理人员没有任何关系							
如果管理人员自己总是严格按照规章制度和操作规程要求工作，作业人员也会更加遵守相关的安全管理规定							
高层管理人员对安全管理工作的态度和决心是保证施工现场安全的决定性因素							
带班作业人员在作业人员安全意识的形成过程中以及保证按照规章制度和操作规程作业中起到了非常重要的作用							
如今各个层级的管理人员相对施工进度而言更重视施工安全管理问题							
管理人员非常重视安全问题是因为他们不希望丢掉工作甚至受到刑事处罚							
管理人员个人的安全行为对操作人员的安全意识以及他们的行为没有影响							

建筑工地的安全管理							
	非常不赞同	不赞同	基本不赞同	一般	基本赞同	赞同	非常赞同
施工单位对建筑工地施工安全管理的投入不足是造成作业人员的违章或冒险作业以及施工安全事故的主要原因							
如果完全按照安全规定施工根本无法在规定的工期内完成施工项目							
符合安全规定的工作方式并不总是最安全的工作方式。有些时候不按照安全规定施工反而更安全							
为了提高施工现场的安全度，管理人员和作业人员都需要接受更多的安全教育培训							
对违章或冒险作业进行严厉惩罚是保证管理人员和作业人员安全施工的必要措施							
在降低违章或冒险作业行为上，科学、公开、公平的奖励措施会比严厉的惩罚措施更有效							
不完善的管理以及施工安全管理制度缺陷，是造成可预防性施工安全事故的根本原因							
作业人员的薪酬制度鼓励他们赶工，以便提前完成施工任务							
有技术、经验的作业人员的短缺导致施工单位无法挑选合适的作业人员在现场施工。因此施工单位被迫雇佣所有来应聘的作业人员							
作业人员的高流动率会造成施工单位很难精确记录每一员工入职和离职的情况							
专职安全员对保证施工现场的安全非常重要，没有他们施工安全事故发生的可能性会增加							
作业人员可以提供非常有价值的改善健康安全管理的建议，采纳他们的意见可以帮助降低施工现场的事故率							
符合安全管理规定的工作方式并不总是最好的工作方式，但一定是最安全的工作方式							

管理人员与作业人员之间关于安全的频繁沟通可以降低作业人员的不安全行为							
人文关怀的管理措施是降低作业人员的不安全行为的一种有效措施							
作业人员数量大、流动率高，导致管理人员无法深刻了解每一个作业人员并且根据个人性格特点和经验进行管理。这对于降低作业人员的不安全行为造成障碍							
脏乱的施工现场和作业人员的违章或冒险作业行为有关系							
如今的很多建筑项目规模大、战线长。这给项目以及人员管理造成很大的挑战							
使用现代化、安全系数高的施工设备可以提高作业人员的施工安全意识，从而改善他们的施工作业行为							
作业人员劳务工资的增高以及人们整体生活水平的提高在一定程度上增强了作业人员的自我保护意识							

中国的建筑行业							
	非常不赞同	不赞同	基本不赞同	一般	基本赞同	赞同	非常赞同
现在的施工单位总是在施工进度上有很大的压力							
由于施工安全的投入是长期的，效果有的是不明显的，很多施工单位不愿意在施工安全方面投入费用							
规模较小的施工单位很难从他们的项目中获得利润。因此他们没有足够的资金投入到安全管理中去							
规模较小的施工单位的管理人员虽有足够的资金，但并不将资金投入到安全管理中去，是因为他们追求的是利益最大化							
规模较小的建筑公司的项目规模相对也较小，并且一般都位于小的城市或地区，因此这些项目很难受到媒体的关注和建设主管部门严格的监管，他们更容易铤而走险，违章施工							
在中国尤其是在比较偏远的地区，与当地地方政府部门和建设主管部门搞好关系可以帮助一些违章施工的单位避免严格监管或受到处罚，这影响了施工单位对法律和安全规定的严格执行							
很多施工单位将建设工程概算的安全作业环境及安全施工措施所需费用挪作它用							
中国建筑行业内很多项目管理标准以及制度与国际接轨，但脱离了中国社会以及建筑行业的现状。在一定程度上这造成了制度执行和落实的难度增大，导致很多管理工作形式化							

中国建筑行业的安全管理的整体情况：（*请选择一个最符合您想法的答案并在相应的方格中打勾*）

令人非常不满意	令人不满意	令人基本不满意	一般	令人基本满意	令人满意	令人非常满意

中国建筑行业的安全管理存在的最大的问题是：（*请选择一个您认为最突出的问题并在相应的结论旁边的方格中打勾*）

建筑行业缺乏关于安全管理的法律规定	
建筑工地施工安全法律法规执行力度不强	
建设主管部门对建筑工地施工安全违法违规行为处罚不力	
建设施工单位管理人员安全意识淡薄	
建筑施工单位安全管理人员对建筑工地不安全行为缺乏有力监管	
施工单位缺少能够用来投入到安全管理的资金	
施工单位将安全生产、文明施工措施费用挪作它用	
部分作业人员缺乏安全意识以及安全作业的经验和技能	

与建筑施工相关的安全生产法律法规及文件：（*请选择一个最符合您想法的答案并在相应的方格中打勾*）

非常不完善	不完善	基本不完善	一般	基本完善	完善	非常完善

目前中国建筑企业对于现有的建筑工程施工安全的法律法规及相关标准的执行情况：（*请选择一个最符合您想法的答案并在相应的方格中打勾*）

令人非常不满意	令人不满意	令人基本不满意	一般	令人基本满意	令人满意	令人非常满意

目前在中国建筑行业里对于建筑工程施工安全的法律法规及相关标准的执法力度：

（请选择一个最符合您想法的答案并在相应的方格中打勾）

非常不严厉	不严厉	基本不严厉	一般	基本严厉	严厉	非常严厉

一般人群

	非常不赞同	不赞同	基本不赞同	一般	基本赞同	赞同	非常赞同
人们都希望能快速地赚到钱。这在平日施工现场的作业人员行为上有所体现							
“差不多就行”是一种文化。这在平日施工现场上管理人员和作业人员的行为中有所体现							
我认识的大部分人都认为事故或者意外是命里注定的，不管人做什么也无法躲避							
人们铤而走险是因为他们认为倒霉的事情不会发生在他们身上							
一切向“钱”看的思想是现代社会的一个普遍现象。这种思想动摇了一部分人的“诚信”、“精益求精”、“承担社会责任”等价值观							

关于您个人情况

年龄 _____　　您的性别_____

工作职位_____　　在建筑行业工作的时间_____

请将问卷放入信封并交还发给您问卷的人。再次感谢您的支持与帮助！

如果您对中国建筑行业的安全管理有其他的想法，请写在下面的空白处。如填写不下，可以在本页背面继续。

Appendix XIII

Descriptive statistics of question items retained for exploratory factor analysis

Items	N	M	SD	Skewness		Kurtosis	
				Statistic	S.E.	Statistic	S.E.
1. On construction sites, older workers behave more safely than younger workers	700	4.16	1.68	-0.212	0.092	-1.087	0.185
2. On construction sites, experienced workers behave more safely than less experienced workers	700	5.19	1.52	-0.907	0.902	0.153	0.185
3. On construction sites, better educated workers behave more safely than less educated workers	700	4.43	1.58	-0.41	0.092	-0.752	0.185
4. Workers' educational levels limit their ability to understand the training provided	700	4.39	1.61	-0.388	0.092	-0.967	0.185
5. Workers violate rules or take risks while working because they are not aware of the serious consequences of their behaviour	700	4.61	1.58	-0.525	0.902	-0.704	0.185
6. Workers would not comply with safety rules and operational regulations if there weren't safety officers on site on the lookout for safety rule violations	700	4.85	1.34	-0.7	0.092	0.13	0.185
7. The high demand for workers on construction sites increases turnover rates (because workers can easily get jobs elsewhere)	700	5.35	1.22	-1.061	0.092	1.215	0.185
8. Moving frequently from site to site and repeatedly receiving safety training cause workers to pay less attention to safety training	700	5.28	1.31	-1.196	0.902	1.322	0.185
9. Workers can come and go as they wish because there are no penalties for workers who break their contracts	700	5.57	1.04	-1.598	0.092	4.341	0.185
10. Because the restriction of labour contract on workers is limited the majority of employers don't sign labour contract with workers	700	5.7	0.90	-1.297	0.092	3.527	0.185
11. Workers violate rules or take risks while working because it is inconvenient or more difficult to work while complying with safety rules	700	5.16	1.40	-1.125	0.902	0.915	0.185
12. Workers violate rules or take risks while working because working safely is more time consuming	700	5.52	0.93	-1.288	0.092	3.287	0.185
13. Workers violate rules or take risks while working because they are careless	700	5.41	0.97	-1.049	0.092	2.894	0.185
14. Workers violate rules or take risks while working because they don't think their unsafe behaviour can cause an accident	699	5.11	1.40	-1.242	0.902	1.299	0.185
15. Workers violate rules or take risks while working because they are in the habit of working unsafely	700	5.31	1.30	-1.343	0.092	2.064	0.185
16. If corrective action is always taken as soon as managers discover unsafe practices, workers are less likely to violate rules or taking risks while working	700	5.72	1.26	-1.661	0.092	3.283	0.185
17. If it is clear that the managers are genuinely concerned about workers' safety, workers are more likely to pay attention to health and safety	700	5.69	1.92	14.103	0.902	309.131	0.185
18. If managers always comply with safety rules, workers are more likely to do the same	700	5.32	1.17	-0.817	0.092	0.74	0.185
19. Senior managerial commitment and attitudes towards safety are crucial factors in keeping construction sites safe	700	5.54	1.27	-1.057	0.092	1.223	0.185
20. Foremen play an extremely important role in shaping workers' attitudes towards safety and ensuring that workers act in a safe manner	700	5.71	1.05	-1.135	0.902	2.055	0.185
21. Managers' safety behaviour has no influence on workers' attitudes towards safety and their behaviour	700	2.59	1.23	1.051	0.092	0.975	0.185

(continued)

Items	N	M	SD	Skewness		Kurtosis	
				Statistic	S.E.	Statistic	S.E.
22. It is very often the case that rule violation behaviour and accidents are due to insufficient investment in safety	698	5.17	1.29	-1.096	0.902	1.106	0.185
23. More training is needed for both managers and workers in order to improve safety at construction sites	700	5.78	1.14	-1.43	0.092	2.869	0.185
24. Severe disciplinary action for safety rule violations is needed to achieve sustainable improvement in the safe behaviour of both managers and workers	700	5.15	1.37	-0.926	0.092	0.329	0.185
25. Incentives or reward systems are/would be more effective than severe disciplinary actions in reducing unsafe behaviour	700	5.36	1.25	-0.853	0.902	0.78	0.185
26. Poor management and design of policies are the root causes of preventable accidents at work	700	5.19	1.24	-0.959	0.092	1.087	0.185
27. Workers rush to finish their work early because the payment system encourages them to do so	700	5.25	1.21	-1.101	0.092	1.425	0.185
28. The shortage of skilled workers means construction companies are not in a position to select workers. Thus, they have to employ whoever is available	700	4.88	1.39	-0.918	0.902	0.342	0.185
29. High turnover rates make it very easy to lose track of workers unless there are systematic management procedures	700	5.19	1.21	-1.167	0.092	1.654	0.185
30. Safety officers are very important for keeping construction sites safe; without them accidents would happen more frequently	700	5.59	1.07	-1.173	0.092	2.347	0.185
31. Workers can offer valuable suggestions on how to improve health and safety. Taking their advice can help reduce accidents on sites	700	5.28	1.22	-0.845	0.902	0.544	0.185
32. Frequent communication between managers and workers on safety issues can reduce workers' unsafe behaviour	700	5.42	1.16	-1.155	0.092	1.67	0.185
33. A caring and considerate management style helps prevent workers' unsafe behaviour	700	5.18	1.23	-0.721	0.902	0.217	0.185
34. The large number and high turnover rates of workers make it difficult for managers to get to know each operator well and to allocate work based on their preferences and skill set; this can affect workers' safety behaviour	700	5.27	1.07	-1.239	0.092	2.211	0.185
35. Untidy and dirty working sites are associated with workers' unsafe behaviour	700	5.41	1.00	-1.049	0.092	2.377	0.185
36. The sheer size and geographical spread of contemporary construction projects causes difficulties for project and human resources management	700	5.52	0.97	-0.859	0.902	1.96	0.185
37. The provision of modern, good quality equipment improves workers' attitude towards safety and their safety behaviour	700	5.05	1.34	-1.011	0.092	0.825	0.185
38. The increase of workers' salary and the general living condition in the society improves workers' self protection awareness	700	5.47	1.04	-1.029	0.092	1.779	0.185
39. It is very difficult for small construction companies to make a profit from their projects. This leaves them very little money to invest in safety management	700	5.34	1.16	-1.142	0.092	1.798	0.185

(continued)

Items	N	M	SD	Skewness		Kurtosis	
				Statistic	S.E.	Statistic	S.E.
40. There is less media attention and rigorous inspection from responsible institutions of projects carried out by small construction companies because the projects are normally small and in remote areas. Therefore smaller companies are more likely to take risks and violate rules	700	5.36	1.23	-1.156	0.092	1.508	0.185
41. Having a good 'Guanxi' with the local authority and responsible institutions can help companies avoid being discovered and punished for safety rule violations. It affects the stringent implementation of legal regulations, especially in remote areas	700	5.41	1.24	-1.089	0.092	1.387	0.185
42. Many standards and regulations about safety training in the construction sector are taken from developed countries, but are not suitable for the reality of Chinese society and the Chinese construction sector, and are difficult to implement properly	700	4.81	1.39	-0.605	0.092	0.029	0.185
43. People want to achieve things quickly. This reflects on daily behaviour in workplaces in China	700	5.47	1.03	-0.99	0.092	2.056	0.185
44. Being 'good enough is fine' is a culture. This is reflected in daily behaviour at work by both managers and workers	700	5.39	1.10	-1.129	0.902	1.953	0.185
45. People are happy to take risks because they assume bad things will not happen to them	700	4.66	1.35	-0.639	0.092	-0.171	0.185
46. "Worshiping money" is a common phenomenon in the modern society. It threatens the values of "integrity", "striving for excellent quality", "taking social responsibility" among some people	700	5.59	1.15	-1.275	0.092	2.654	0.185

Appendix XIV

Correlation matrix of question items retained for exploratory factor analysis

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	**0.39****	**0.31****	**0.16****	0.05	0.03	0.04	0.001	0.07	0.04	0.03	-0.01	-0.05	-0.07	**-0.09 ***	**0.09***	-0.03	0.06	**0.11****	**0.15****
2		1	**0.27****	**0.21****	**0.09***	0.05	0.06	0.02	-0.004	0.02	0.02	-0.02	-0.03	-0.05	-0.06	**0.19****	**0.08***	**0.15****	**0.09***	**0.22****
3			1	**0.29****	0.03	0.03	-0.03	0.02	0.02	0	0.04	0.01	-0.02	-0.01	-0.02	0.04	-0.003	0.04	**0.09***	**0.11****
4				1	**0.11****	**0.10****	0.07	**0.08***	-0.02	-0.05	0.05	-0.03	0.06	**0.09***	-0.06	-0.02	-0.05	-0.01	0.04	0.06
5					1	-0.01	**0.11****	**0.11****	-0.01	0.06	-0.04	-0.05	-0.01	**0.1***	-0.02	**0.14****	**0.08***	**0.09***	**0.11****	**0.14****
6						1	**0.11****	**0.11****	0.06	0.06	0.02	0.01	0.07	0.02	0.03	0.06	0.05	-0.02	-0.03	0.01
7							1	**0.18****	**0.17****	**0.08***	0.06	-0.01	0.01	**0.13****	-0.01	0.05	-0.04	0.04	0.03	0.05
8								1	**0.19****	**0.09***	0.003	0.03	0.05	**0.08***	0.05	**0.08***	0.03	**0.13****	0.07	**0.12****
9									1	**0.13****	0.04	0.02	0.06	**0.1***	**0.11****	0.03	0.01	0.01	0.06	0.03
10										1	-0.004	0.03	0.01	0.04	**0.09***	0.07	0.05	0.06	0.06	**0.14****
11											1	**0.1****	0.09	0	-0.03	0.05	0	-0.07	0.06	-0.05
12												1	0.001	0.07	0.05	0.06	0.06	0.03	0	0.06
13													1	0.002	0.01	0.03	-0.01	-0.01	-0.04	0.02
14														1	**0.14****	**0.09***	0.03	0.05	0.07	0.07
15															1	0.01	-0.03	-0.04	0.001	0.04
16																1	**0.50****	**0.33****	**0.36****	**0.42****
17																	1	**0.38****	**0.38****	**0.39****
18																		1	**0.4****	**0.34****
19																			1	**0.47****
20																				1

(continued)

	21	22	23	34	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	-0.02	0.07	0.01	0.04	**0.07***	0.02	0.01	**0.11****	0.002	0.06	**0.1***	0.06	**0.17***	**0.08***	-0.02	0.07	0.07	0.01	-0.02	0.03
2	**-0.14****	0.01	**0.15****	0.07	**0.1***	**0.1***	0.01	0.03	-0.06	**0.12****	**0.26****	**0.16****	**0.17****	0.06	0.03	0.06	**0.1****	0.04	-0.04	0.002
3	0.01	0.07	0.07	0.02	**0.12****	**0.08***	0.01	**0.13****	-0.001	0.07	0.07	**0.1***	**0.13****	0.07	0.07	-0.002	0.06	0.06	0.06	0.05
4	**0.09***	-0.01	**0.12****	**0.12****	**0.08***	0.05	0.03	**0.17****	**0.11****	**0.13****	0.07	0.06	**0.08***	**0.14****	**0.12****	-0.003	**0.11****	-0.01	**0.17****	**0.08***
5	-0.07	**0.08***	**0.15****	0.05	0.03	**0.15****	-0.02	0.001	-0.003	0.03	0.03	0.002	**0.08***	0.04	**0.11****	0.06	0.05	0.04	-0.01	**0.08***
6	0.03	-0.06	0.07	**0.08***	0.03	0.04	0.05	**0.08***	0.05	0.03	0.02	0.01	-0.01	-0.01	0.003	-0.01	0.02	0.07	-0.03	0.02
7	-0.04	0.04	0.002	-0.001	0.06	**0.12****	**0.1****	**0.17****	**0.16****	**0.08***	0.04	**0.1****	**0.08***	**0.8***	**0.09***	**0.08***	0.06	0.03	**0.08***	**0.13****
8	0.09	-0.04	0.03	-0.04	**0.14****	**0.12****	0.06	**0.13****	**0.1***	0.04	0.06	0.04	**0.08***	**0.09***	0.05	0.02	**0.09***	0.04	-0.01	**0.08***
9	-0.05	0.05	-0.06	-0.05	0.04	0.06	0.06	0.07	**0.08***	-0.02	-0.02	0.04	0.05	0.06	-0.02	-0.07	0.01	-0.02	0.03	**0.12****
10	0.04	-0.03	0.04	0.01	0.03	**0.11****	0.02	-0.01	0.07	0.05	0.02	0.02	0.01	0.05	-0.02	0	0.01	0.03	0.01	0.05
11	0.05	0.05	-0.01	-0.06	-0.05	**-0.08***	**0.09***	0.05	0.02	-0.06	-0.05	-0.05	**-0.08***	**0.08***	-0.004	-0.03	**-0.08***	0.06	0.05	0.06
12	-0.06	-0.04	-0.05	-0.02	-0.06	**-0.08***	0.02	**0.1****	**0.1****	0.06	-0.04	-0.03	-0.02	**0.1***	0.01	-0.03	0.03	-0.001	0.03	0.04
13	0.02	0.04	0.01	0.01	0.02	-0.04	-0.01	0.03	-0.03	-0.05	0.07	0.05	-0.02	0.04	-0.02	**-0.09***	0.03	**0.09***	0.04	0.06
14	-0.06	**0.08***	**0.08***	0.04	0.05	0.03	-0.01	**0.08***	0.06	0.06	0.07	-0.01	0.02	0.06	0.01	0.03	**0.08***	-0.04	0.07	**0.11****
15	0.01	0.06	0.05	0.01	0.04	0.05	0.03	-0.001	0.06	0.04	0.02	0.04	**0.08***	-0.07	-0.02	0.02	**0.13****	-0.01	0.01	0.04
16	**-0.34****	0.07	**0.33****	**0.15****	**0.18****	**0.16****	-0.02	**0.13****	**0.08***	**0.22****	**0.27****	**0.27****	**0.19****	0.06	0.03	**0.11****	**0.14****	**0.11****	-0.08	**0.09***
17	**-0.31****	0.05	**0.29****	**0.16****	**0.18****	**0.15****	0.02	0.07	0.01	**0.22****	**0.31****	**0.21****	**0.14****	0.06	**0.08***	**0.11****	**0.17****	**0.10****	**0.08***	**0.12****
18	**-0.25****	0.07	**0.17****	**0.12****	**0.15****	**0.25****	0.01	0.03	0.05	**0.16****	**0.17****	**0.19****	**0.17****	-0.01	0.01	**0.12****	**0.18****	**0.11****	-0.02	0.05
19	**-0.19****	0.05	**0.26****	**0.17****	**0.2****	**0.21****	0.01	0.07	0.04	**0.19****	**0.23****	**0.2****	**0.2****	0.01	0.07	**0.11****	**0.15****	**0.08***	-0.02	0.07
20	**-0.29****	-0.04	**0.39****	**0.2****	**0.22****	**0.22****	0.01	**0.12****	**0.08***	**0.19****	**0.29****	**0.25****	**0.25****	**0.11****	**0.12****	**0.16****	**0.23****	0.07	-0.03	**0.15****

(continued)

	41	42	43	44	45	46
1	0.02	0.05	0.07	0.03	-0.01	0.05
2	-0.02	0.05	0.01	-0.03	0.02	0.003
3	0.02	0.05	-0.02	0.04	0.06	0.05
4	0.03	**0.14****	0.04	0.05	**0.09***	0.04
5	0.03	0.04	0.06	-0.05	**0.09***	0.01
6	0.02	**0.08***	**0.13****	0.02	**0.13****	**0.11****
7	0.06	0.02	0.06	0.05	**0.16****	0.03
8	**0.08***	-0.07	0.001	0.004	0.07	0.01
9	0.06	0.03	0.06	0.02	**0.1****	**0.14****
10	0.05	0.06	**0.1****	**0.09***	-0.01	**0.16****
11	0.05	0.03	**0.1****	0.06	0.06	-0.02
12	0.06	-0.05	0.07	**0.11****	0.06	0.04
13	0.02	-0.02	-0.01	0.05	0.03	0.01
14	**0.16****	**0.13****	0.01	**0.11****	**0.14****	**0.11****
15	0.07	0.05	**0.12****	0.04	**0.12****	**0.1****
16	0.05	**0.15****	0.07	0	0.04	**0.14****
17	0.04	**0.10***	0.03	-0.02	0.03	0.05
18	0.02	-0.01	0.08*	-0.03	-0.03	0.01
19	0.05	0.06	-0.003	-0.04	0.06	0.06
20	0.07	**0.13****	**0.09***	0.03	0.05	**0.11****

(continued)

	21	22	23	34	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
21	1	-0.01	**-0.31****	**-0.09***	**-0.17****	**-0.17****	0.01	-0.02	-0.02	**-0.18****	**-0.2****	**-0.23****	**-0.1****	0.003	-0.01	**-0.11****	**-0.14****	-0.07	0.02	**-0.1****
22		1	0.05	**0.09***	-0.05	**0.08***	**0.1****	0.07	0.02	-0.01	-0.02	-0.01	0.02	0.04	**0.08***	0.02	**0.12****	**0.12****	**0.08***	**0.1****
23			1	**0.31****	**0.3****	**0.25****	0.002	0.06	0.03	**0.29****	**0.31****	**0.3****	**0.18****	0.07	**0.12****	**0.15****	**0.21****	0.02	-0.02	**0.12****
24				1	**0.15****	**0.15****	**0.08***	0.04	0.01	**0.17****	**0.14****	**0.14****	0.05	0.05	**0.15****	**0.09***	**0.25****	0.01	0.02	**0.11****
25					1	**0.24****	0.04	**0.11****	0.06	**0.22****	**0.33****	**0.24****	**0.23****	**0.12****	-0.01	**0.15****	**0.17****	-0.02	0.02	0.07
26						1	0.01	0.04	0.07	**0.22****	**0.17****	**0.12****	**0.24****	**0.14****	**0.12****	**0.08***	**0.11****	0.03	0.03	**0.16****
27							1	**0.12****	0.06	0.01	-0.06	-0.03	**0.08***	**0.12****	0.05	**0.08***	0.05	**0.12****	**0.08***	**0.12****
28								1	**0.26****	0.07	**0.1****	0.07	**0.09***	**0.22****	**0.09***	0.06	0.07	**0.11****	**0.12****	**0.18****
29									1	**0.15****	-0.02	0.03	0.05	**0.14****	0.09	**0.11****	**0.13****	0.05	**0.18****	**0.12****
30										1	**0.27****	**0.29****	**0.2****	**0.09***	**0.08***	**0.12****	**0.11****	0.05	-0.03	**0.09***
31											1	**0.38****	**0.28****	**0.09***	**0.1****	**0.15****	**0.21****	0.07	-0.01	0.04
32												1	**0.42****	**0.15****	**0.1****	**0.18****	**0.21****	**0.09***	-0.02	0.01
33													1	**0.16****	**0.23****	**0.14****	**0.26****	**0.1****	-0.01	**0.12****
34														1	**0.17****	**0.14****	**0.1****	**0.11****	**0.1****	**0.15****
35															1	**0.21****	**0.17****	0.07	0.05	**0.08***
36																1	**0.15****	**0.13****	**0.09***	**0.1***
37																	1	**0.22****	**0.08***	**0.08***
38																		1	0.01	0.06
39																			1	**0.22****
40																				1

(continued)

	41	42	43	44	45	46
21	-0.07	0.01	0.002	-0.01	-0.04	-0.05
22	**0.09***	0.06	-0.02	0.06	0.05	0.03
23	**0.11****	**0.17****	0.01	-0.01	0.07	**0.13****
24	0.07	**0.22****	0.09*	-0.01	0.004	0.02
25	**0.11****	**0.1****	0.01	-0.06	**0.1***	**0.09***
26	**0.14****	**0.23****	0.07	-0.04	**0.08***	**0.08***
27	**0.12****	0.07	**0.18****	0.02	0.07	0.05
28	**0.13****	**0.11****	**0.08***	0.06	**0.13****	**0.09***
29	**0.17****	**0.09***	**0.12****	**0.12****	**0.13****	**0.14****
30	**0.1***	0.06	0.04	0.01	0.05	**0.1****
31	**0.08***	**0.13****	-0.01	-0.06	0.05	0.07
32	0.07	**0.12****	0.06	-0.002	0.03	**0.12****
33	0.06	**0.21****	**0.11****	0.02	**0.08***	0.07
34	**0.13****	**0.2****	0.07	**0.1****	0.07	**0.12****
35	0.04	**0.1***	0.04	0.04	0.02	**0.11****
36	**0.17****	**0.09***	**0.12****	**0.08***	**0.1****	**0.13****
37	**0.11****	**0.15****	**0.08***	0.001	0.05	**0.11****
38	-0.02	0.03	0.05	0.05	0.03	0.06
39	**0.22****	**0.18****	0.07	**0.12****	0.06	**0.16****
40	**0.4****	**0.21****	**0.16****	**0.12****	**0.17****	**0.15****

(continued)

	41	42	43	44	45	46
41	1	**0.23****	0.07	**0.18****	**0.12****	**0.2****
42		1	**0.14****	**0.16****	**0.11****	**0.28****
43			1	**0.21****	**0.14****	**0.28****
44				1	0.06	**0.25****
45					1	**0.18****
46						1

Appendix XV

Questionnaire – Delphi method and the modified G1 method

(English version)

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA
I-WHO Institute of Work, Health & Organisations

Participant ID:_____

QUESTIONNAIRE

CONFIDENTIAL

FACTORS AFFECTING SAFETY RULE VIOLATIONS AMONG CHINESE CONSTRUCTION WORKERS

This is an independent research project exploring managers' experience and perception of health and safety management issues on construction sites within mainland China. It is concerned with individual behaviour and the organisational contexts in which violations take place. It aims to suggest helpful changes.

In completing the questionnaire, please be honest and frank, there are no right or wrong answers; your expertise in this field can provide invaluable insight on the key issues needing to be addressed. I would be very grateful to those willing to spend the 15 minutes it will take to complete this simple voluntary questionnaire. The questionnaire is completely confidential to the research team at the University of Nottingham. All the information gathered will be summarised anonymously: nothing can be traced back to you.

We hope that you will find the questionnaire interesting. **After you have completed it, please put it in the envelope provided and return it to the person who gave it to you.**

In order to participate in the research you will need to give your informed consent. By ticking the box below you are indicating that you understand the nature of the survey and that you agree to help us. Please tick the box if you agree to take part:

□

I understand that all information I provide will remain anonymous and kept in accordance with the Data Protection Act, UK (1998). I understand that I have been provided with an explanation of the survey in which I am participating in and have been given the name and contact details of an individual to contact if I have questions about the research. I understand that participation in the survey is voluntary and that I can withdraw at any time.

Thank you very much for your help

The questionnaire is completely anonymous. So please do not write your name on it. But if you would like any more information about the research project, or if you would like to know the overall results of the project, please contact me:

Dandan Wang

Email: lwxddw1@nottingham.ac.uk

Institute of Work, Health and Organisations

University of Nottingham, UK

Or, if you wish, you can leave your telephone number or email address below, and I will contact you personally. Any information provided will be kept separate from the attached questionnaire, and will remain completely confidential. It will be destroyed when the project is finished.

Email address:_____

Telephone number:_____

1. After over two years of research among managers and workers in the Chinese construction industry, as well as a comprehensive literature review, the results reveal that there are seven main categories of factors directly and indirectly affecting construction workers' rule violation behaviour. Please rank the following factors according to their importance of influence based on your own experiences and understanding: (1= most important influence, 7= least important influence)

Seven categories of factors	Rank
Individual factors, for example, workers' young age and lack of work experience, workers' lack of safety awareness as a result of their limited education and long experiences of working on farms before working on construction sites; the development of bad working habits after working long time with violation behaviour; direct and indirect accident experiences; violate rules for personal convenience and physical comfort; violate rules to reduce working time	
Managerial factors, for example, management's attitudes and commitment towards safety which are reflected in areas such as investment in safety management, immediate rectification and reform once hazards are discovered, exemplary safety behaviour; workers' safety training; safety management policies on sites including for example stringent inspection and immediate follow-up actions, management of materials, equipment, workers and physical environment	
Labour market factors, for example, shortage of high quality workers; workers' high turnover rates; unregulated labour market	
Relevant legislation and regulations and their implementation factors, including national and sectoral health and safety management legislation and regulations; their implementation by different organisations and institutions; hidden rules within the industry and default payment	
Factors related to the change of government's as well as general population's attitudes towards safety and the value of life, for example, 'safety first' and 'people oriented' policies; The Central Government demands for raising the status of migrant worker in the society and issued a series of legislation and policy to protect migrant workers; people put more value on life	
China's rapid development factors, including demands for fast completion of large scale infrastructure construction; the development of the belief of ' time is money'	
Chinese cultural factors, for example, the importance of *guanxi* in getting things done; lack of habits of being precise and obeying rules	

2. Please explain your ranking in more detail by comparing pair-wise the importance of influence of the neighbouring factors you ranked in the previous question and select the appropriate answer which shows your opinion. For example, if you ranked managerial factor as 1 in the previous question and individual factors as 2, please compare factor 1 and 2, namely managerial factors and individual factors, according to their importance of influence, and tick the box on the following page underneath the appropriate answer.

	Equal importance	Between equal importance and somewhat more important	Somewhat more important	Between somewhat important and much more important	Much more important	Between much more important and very much more important	Very much more important	Between very much more important and absoultely more	Absolute more important
Foctor 1 vs. Factor 2									
Foctor 2 vs. Factor 3									
Foctor 3 vs. Factor 4									
Foctor 4 vs. Factor 5									
Foctor 5 vs. Factor 6									
Foctor 6 vs. Factor 7									

3. Within every main category of factors there are numerous detailed factors which have been found through research that all influence workers' rule violation behaviour to certain extent. Please rank the following individual factors according to their importance of influence based on your experiences and understanding. The ranking method is the same as the question number 1. (1= most important influence; 7= least important influence).

Individual factors	Rank
Workers violate rules because of their young age and lack of working experience	
Workers' lack of safety awareness as a result of their limited educational experience	
Workers' lack of safety awareness as a result of their long experiences of working on farms before working on construction sites	
The development of bad working habits after many years of violating safety rules while working on construction sites	
Workers' lack of safety awareness as a result of no direct experience of accidents or little acknowledgement of accidents on sites	
Workers violate safety rules for personal convenience and physical comfort	
Workers violate safety rules to reduce working time	

4. Please explain your ranking more in detail by comparing pair-wise the importance of influence of the neighbouring factors you ranked in the previous question and select the appropriate answer which shows your opinion. The comparison method is the same as the question number 2.

	Equal importance	Between equal importance and somewhat more important	Somewhat more important	Between somewhat important and much more important	Much more important	Between much more important and very much more important	Very much more important	Between very much more important and absoultely more	Absolute more important
Foctor 1 vs. Factor 2									
Foctor 2 vs. Factor 3									
Foctor 3 vs. Factor 4									
Foctor 4 vs. Factor 5									
Foctor 5 vs. Factor 6									
Foctor 6 vs. Factor 7									

5. Please rank the following managerial factors according to their importance of influence based on your experiences and understanding. The ranking method is the same as the question number 1. (1= most important influence; 4= least important influence).

Managerial factors	**Rank**
Management attitudes and commitment towards safety, reflected in areas such as investment in safety management, immediate rectification and reform once hazards are discovered, exemplary safety behaviour	
Workers' safety training, including frequency of training, content, method and styles	
Safety management policies on sites including stringent inspection and immediate follow-up actions, clear safety responsibilities for each individual	
Safety management policies relevant to the management of materials, equipment, working and living conditions	

6. Please explain your ranking more in detail by comparing pair-wise the importance of influence of the neighbouring factors you ranked in the previous question and select the appropriate answer which shows your opinion. The comparison method is the same as the question number 2.

	Equal importance	Between equal importance and somewhat more important	Somewhat more important	Between somewhat important and much more important	Much more important	Between much more important and very much more important	Very much more important	Between very much more important and absoultely more	Absolute more important
Foctor 1 vs. Factor 2									
Foctor 2 vs. Factor 3									
Foctor 3 vs. Factor 4									

7. Please rank the following labour market factors according to their importance of influence based on your experiences and understanding. The ranking method is the same as the question number 1. (1= most important influence; 4= least important influence).

Labour market factors	Rank
Shortage of high quality workers on construction sites	
Shortage of experienced managers on construction sites	
Unregulated labour market within the construction industry, workers' high turnover rates	
Labour service companies do not fulfill their responsibilities	

8. Please explain your ranking more in detail by comparing pair-wise the importance of influence of the neighbouring factors you ranked in the previous question and select the appropriate answer which shows your opinion. The comparison method is the same as the question number 2.

	Equal importance	Between equal importance and somewhat more important	Somewhat more important	Between somewhat important and much more important	Much more important	Between much more important and very much more important	Very much more important	Between very much more important and absoultely more	Absolute more important
Foctor 1 vs. Factor 2									
Foctor 2 vs. Factor 3									
Foctor 3 vs. Factor 4									

9. Please rank the following relevant legislation and regulations and their implementation factors according to their importance of influence based on your experiences and understanding. The ranking method is the same as the question number 1. (1= most important influence; 3= least important influence).

Relevant legislation and regulations and their implementation factors	Rank
National and industrial health and safety management legislation and regulations	
Implementations of relevant legislation and regulations by construction companies and inspection companies as well as other relevant institutions	
Hidden rules within the industry and default payment	

10. Please explain *your ranking* more in detail by comparing pair-wise the importance of influence of the neighbouring *factors you ranked in the* previous question and select the appropriate answer which shows your opinion. The comparison method is the same as the question number 2.

	Equal importance	Between equal importance and somewhat more important	Somewhat more important	Between somewhat important and much more important	Much more important	Between much more important and very much more important	Very much more important	Between very much more important and absoultely more	Absolute more important
Foctor 1 vs. Factor 2									
Foctor 2 vs. Factor 3									

11. Please rank the following factors related to the change of government's as well as general population's attitudes towards safety and the value of life, according to their importance of influence based on your experiences and understanding. The ranking method is the same as the question number 1. (1= most important influence; 3= least important influence).

Factors related to the change of government's as well as general population's attitudes towards safety and the value of life	**Rank**
Improved living conditions and quality of life across China, people have changed their attitudes towards life	
The Central Government advocates 'safety first' and 'people oriented' policies	
The Central Government demands for raising the status of migrant worker in the society and issued a series of legislation and policy to protect migrant workers	

12. Please explain your ranking more in detail by comparing pair-wise the importance of influence of the neighbouring factors you ranked in the previous question and select the appropriate answer which shows your opinion. The comparison method is the same as the question number 2.

	Equal importance	Between equal importance and somewhat more important	Somewhat more important	Between somewhat important and much more important	Much more important	Between much more important and very much more important	Very much more important	Between very much more important and absoultely more	Absolute more important
Foctor 1 vs. Factor 2									
Foctor 2 vs. Factor 3									

13. Please rank the following China's rapid development factors according to their importance of influence based on your experiences and understanding. The ranking method is the same as the question number 1. (1= most important influence; 3= least important influence).

China's rapid development factors	Rank
China has developed rapidly, large-scaled construction projects are all over China	
Construction projects have tight schedule; they need to be completed quickly	
The mentality of 'time is money' becomes a commonality	

14. Please explain your ranking more in detail by comparing pair-wise the importance of influence of the neighbouring factors you ranked in the previous question and select the appropriate answer which shows your opinion. The comparison method is the same as the question number 2.

	Equal importance	Between equal importance and somewhat more important	Somewhat more important	Between somewhat important and much more important	Much more important	Between much more important and very much more important	Very much more important	Between very much more important and absoultely more	Absolute more important
Foctor 1 vs. Factor 2									
Foctor 2 vs. Factor 3									

15. Please rank the following Chinese cultural factors according to their importance of influence based on your experiences and understanding. The ranking method is the same as the question number 1. (1= most important influence; 2= least important influence).

Chinese cultural factors	Rank
The importance of *guanxi* to get things done, especially in remote areas; project successful bid, return payment, inspection on sites, punishment for violating rules and regulations and many other issues may all be affected by *guanxi*	
People lack the habits of being precise and obeying rules	

16. Please explain your ranking more in detail by comparing pair-wise the importance of influence of the neighbouring factors you ranked in the previous question and select the appropriate answer which shows your opinion. The comparison method is the same as the question number 2.

	Equal importance	Between equal importance and somewhat more important	Somewhat more important	Between somewhat important and much more important	Much more important	Between much more important and very much more important	Very much more important	Between very much more important and absoultely more	Absolute more important
Foctor 1 vs. Factor 2									

For the purpose of statistic analysis for the current research only, please make sure that you answer the following questions correctly:

Your age :

Year of working in the construction industry :

Your job title :

Thank you very much for your time.

Appendix XVI

Questionnaire –Delphi method and the modified G1 method

(Chinese version)

答卷人代码: -------

调查问卷

保密

影响中国建筑工人违规行为的因素

首先，非常感谢您能在百忙之中抽出时间填写这份问卷。本问卷旨在了解您对影响中国建筑工人违章施工行为的不同因素的看法，进而研究总结出这些因素对工人违章行为的影响程度。

填写此问卷最多只需要占用您 15 分钟时间。本问卷采用不记名方式访问，所有的信息仅供英国诺丁汉大学此调研项目的专业研究人员使用，所有资料绝不对外公开。本问卷的问题均为询问您的个人意见，没有对错之分，请结合您的工作经历和工作中的体会给予回答。您的宝贵意见将对本研究有莫大的帮助。

您需要签署知情同意书进而参与此调研。当您在下面的方格中打勾就表明了您了解此调研问卷的目的和性质并且同意帮助我们回答问卷。如果您同意参与，请在下面的方格中打勾：

□

我了解我提供的所有信息将保持匿名，并根据英国的《数据保护法》（1998 年）的规定保存。我已经理解了此调研项目的目的和性质。如果我有关于此研究项目的问题我知道我可以联系的人的名称和详细联系方式。我了解参与此调研项目是完全自愿的，我可以在任何时候终止。

如果您想了解关于此调研项目的更多信息或调研项目的最终结果，请联系我：

王丹丹（英国诺丁汉大学工作、健康和组织学院）

电子邮箱：lwxddw1@nottingham.ac.uk

或者，如果您愿意，您也可以把您的电子邮箱和电话填写在下面，我将会与您取得联系。这些个人信息将与问卷分开保存，所有个人信息在此次调研结束后全部销毁。

电子邮箱：----------

电话号码：----------

1. 在经过了两年多的与建筑行业里管理人员以及工人的调查研究以及文献分析之后， 结果表明有以下七大类因素直接或者间接地影响中国建筑工人违章行为。请您将以下七大类因素按照它们对工人违章行为的影响程度排序：(1=有最重要的影响， 7=有最次要的影响)

七大因素	排序
个人因素，如工人年轻缺少工作经验；工人的教育程度以及长时间做农民的经历导致缺少安全意识；长时间违章操作养成习惯；直接或者间接的事故经历；为了工作方便和身体上的舒服；为了节省时间	
管理因素，如管理人员对待安全的态度和决心，其表现在比如安全投资，及时整改，管理人员以身作则上；对于工人的安全培训；公司安全管理规定包括比如严厉的监管和处罚，对施工材料、设备、工作和生活环境的管理	
建筑行业劳务市场因素，如建筑行业工人紧缺，流动性大；劳动市场不规范；	
相关法律法规及落实因素，包括国家发布的对于建筑行业内安全管理及监督的法律法规；各有关部门及企业对于法律法规的落实情况；行业内的潜规则和拖欠款现象	
国家及个人对安全以及生命的价值的观念改变，比如国家提出的‘安全第一’‘以人为本’的政策；国家强调提高农民工地位并出台了一系列相应的保护政策和措施；人们更加珍惜生命	
国家的迅速发展因素，包括在全国进行大规模基础设施建设且建设速度快；“时间就是金钱”的观念普遍存在	
中国文化因素，如办事讲关系；缺少精益求精和严格遵守规章制度的习惯	

2. 下面请您对您上面的排序进行进一步地解释。请您比较并选择每两个临近排序因素之间影响程度的大小。比如，如果您给出的排序是管理因素为 1，个人因素为 2，请比较 1 和 2，即管理因素和个人因素，它们对工人违章行为的影响程度。并在相应的结论下面的方格中打勾。

	具有同样重要性	介于同样重要和稍微重要之间	稍微重要	介于稍微重要和明显重要之间	明显重要	介于明显重要和强烈重要之间	强烈重要	介于强烈重要和极端重要之间	极端重要
因素1相比 因素2									
因素2相比 因素3									
因素3相比 因素4									
因素4相比 因素5									
因素5相比 因素6									
因素6相比 因素7									

3. 每一个大的因素里包含了具体的因素。调研结果表明它们对工人的违章行为都有不同程度的影响。请您根据这些个人因素对工人违章行为的影响程度对下面的这些因素进行排序。方法如第 1 题。(1=最重要的影响，7 =最次要的影响)

个人因素	排序
工人违章操作因为他们年轻，缺少工作经验	
工人的教育程度导致他们缺乏安全意识	
工人长时间做农民的经历导致缺乏安全意识	
工人长时间违章操作养成习惯	
工人没有事故经历或缺少事故见闻导致安全意识不强	
为了工作方便和身体上的舒服	
为了缩短工作时间，挣更多的钱	

4. 下面请您对您上面的排序进行进一步地解释。请您比较并选择每两个临近排序因素之间影响程度的大小。方法和第 2 题一样。

	具有同样重要性	介于同样重要和稍微重要之间	稍微重要	介于稍微重要和明显重要之间	明显重要	介于明显重要和强烈重要之间	强烈重要	介于强烈重要和极端重要之间	极端重要
因素1相比 因素2									
因素2相比 因素3									
因素3相比 因素4									
因素4相比 因素5									
因素5相比 因素6									
因素6相比 因素7									

5. 请您根据不同的管理因素对工人违章行为的影响程度对下面的这些因素进行排序。方法如第 1 题。(1=最重要的影响，4 =最次要的影响)

管理因素	排序
管理人员对待安全的态度和决心，其表现在比如安全投资，及时整改，管理人员以身作则上	
对于工人的安全培训，包括培训的频率、内容和方法	
公司的安全管理规定，包括比如严厉的监管和处罚，责任到人，	
管理人员对施工材料、设备、工作和生活环境的管理	

6. 下面请您对您上面的排序进行进一步地解释。请您比较并选择每两个临近排序因素之间影响程度的大小。方法和第 2 题一样。

	具有同样重要性	介于同样重要和稍微重要之间	稍微重要	介于稍微重要和明显重要之间	明显重要	介于明显重要和强烈重要之间	强烈重要	介于强烈重要和极端重要之间	极端重要
因素1相比 因素2									
因素2相比 因素3									
因素3相比 因素4									

7. 请您根据建筑行业劳务市场因素对工人违章行为的影响程度对下面的这些因素进行排序。方法如第 1 题。(1=最重要的影响，4 =最次要的影响)

建筑行业劳务市场因素	排序
建筑工地缺乏有经验的工人	
建筑工地缺乏有经验的管理人员	
建筑行业劳动市场不规范，工人流动性大	
劳务公司没有尽职尽责	

8. 下面请您对您上面的排序进行进一步地解释。请您比较并选择每两个临近排序因素之间影响程度的大小。方法和第 2 题一样。

	具有同样重要性	介于同样重要和稍微重要之间	稍微重要	介于稍微重要和明显重要之间	明显重要	介于明显重要和强烈重要之间	强烈重要	介于强烈重要和极端重要之间	极端重要
因素1相比 因素2									
因素2相比 因素3									
因素3相比 因素4									

9. 请您根据建筑行业相关的法律法规以及其落实情况因素对工人违章行为的影响程度对下面的这些因素进行排序。方法如第 1 题。(1=最重要的影响，3 =最次要的影响)

建筑行业相关的法律法规以及其落实情况因素	排序
建筑行业安全管理的相关法律法规	
建筑公司以及监管部门对于建筑行业安全监督管理的相关法律法规的落实	
行业潜规则以及拖欠款现象	

10. 下面请您对您上面的排序进行进一步地解释。请您比较并选择每两个临近排序因素之间影响程度的大小。方法和第 2 题一样。

	具有同样重要性	介于同样重要和稍微重要之间	稍微重要	介于稍微重要和明显重要之间	明显重要	介于明显重要和强烈重要之间	强烈重要	介于强烈重要和极端重要之间	极端重要
因素1相比 因素2									
因素2相比 因素3									

11. 请您根据国家及个人对安全以及生命价值的观念改变因素对工人违章行为的影响程度对下面的这些因素进行排序。方法如第 1 题。(1=最重要的影响，3 =最次要的影响)

国家及个人对安全以及生命价值的观念改变因素	排序
人民生活水平以及生活质量提高，人们对待生活和生命的态度有所改变	
中央政府提倡‘安全第一’‘以人为本’	
中央强调提高农民工地位并出台了一系列保护农民工的法律法规	

12. 下面请您对您上面的排序进行进一步地解释。请您比较并选择每两个临近排序因素之间影响程度的大小。方法和第 2 题一样。

	具有同样重要性	介于同样重要和稍微重要之间	稍微重要	介于稍微重要和明显重要之间	明显重要	介于明显重要和强烈重要之间	强烈重要	介于强烈重要和极端重要之间	极端重要
因素1相比 因素2									
因素2相比 因素3									

13. 请您根据国家迅速发展因素对工人违章行为的影响程度对下面的这些因素进行排序。方法如第 1 题。(1=最重要的影响，3 =最次要的影响)

国家迅速发展因素	排序
中国发展速度飞快，大规模建筑施工项目在全国各地遍地开花	
建筑施工项目工期紧，需要快速竣工	
人们普遍存在“时间就是金钱”的观念	

14. 下面请您对您上面的排序进行进一步地解释。请您比较并选择每两个临近排序因素之间影响程度的大小。方法和第 2 题一样。

	具有同样重要性	介于同样重要和稍微重要之间	稍微重要	介于稍微重要和明显重要之间	明显重要	介于明显重要和强烈重要之间	强烈重要	介于强烈重要和极端重要之间	极端重要
因素1相比因素2									
因素2相比因素3									

15. 请您根据中国文化因素对工人违章行为的影响程度对下面的这些因素进行排序。方法如第 1 题。(1=最重要的影响，2 =最次要的影响)

中国文化因素	排序
办事靠关系，尤其在比较偏远的地区，项目的竞标、中标、回款、监管、处罚等一系列问题都有可能受到关系的左右	
人们普遍缺少精益求精和严格遵守规章制度的习惯	

16. 下面请您对您上面的排序进行进一步地解释。请您比较并选择每两个临近排序因素之间影响程度的大小。方法和第 2 题一样。

	具有同样重要性	介于同样重要和稍微重要之间	稍微重要	介于稍微重要和明显重要之间	明显重要	介于明显重要和强烈重要之间	强烈重要	介于强烈重要和极端重要之间	极端重要
因素1相比因素2									

为了做更好的统计分析工作，请您务必将以下内容如实填写。

您的年龄:

您在建筑行业的工作时间:

您的职位:

请将问卷交还发给您问卷的人。再次感谢您的支持与帮助!