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Factors Affecting Safety Management in Building Construction-Psychological Capital

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Abstract

With the rapid development of China's construction, construction projects in our country both from the level and scale have walked in the forefront of the world, but the ensuing safety management problems are also increasingly highlighted, a large number of safety incident reports has long indicated that people are the main cause of accidents, and unsafe behavior of individuals accounts for at least 88% of all safety accidents. Therefore, how to effectively reduce and avoid the unsafe behavior of construction workers, reduce the occurrence of safety accidents in construction projects and thus improve the safety performance of construction production has become an urgent problem. Safety accidents are often caused by human safety behavior, and human behavior is bound to receive the influence of the psychological state, psychological capital as a response to the individual in the process of growth and development of a positive psychological state, is beyond the human capital and social capital, a core psychological elements, is to promote personal growth and performance enhancement of the psychological resources, the impact of the individual safety behavior, enhance safety performance have an important role. Based on the psychological capital theory, this paper combines the behavioral decision-making theory and the characteristics of building construction projects, using questionnaire analysis methods, then using SPPS and AMOS to analyze the survey data in order to obtain a comprehensive understanding of psychological capital. The results of this study will contribute to the enhancement of safety measures in the construction industry, ultimately reducing accidents and improving the well-being of workers.

Key words: Construction engineering; Construction workers; Safety management; Psychological Capital; Data analysis

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1. INTRODUCTION

1.1 Background of the Research

With the rapid development of the construction industry, a large number of people enter the construction industry, providing a large number of labors for the industry. However, the mobility of the construction industry determines that the living environment and working environment of such employees are often changing, which brings great psychological pressure to the construction employees. (Yan, 2021) When employees have psychological problems, it will not only reduce their work efficiency and increase the construction cost of enterprises, but also lead to frequent safety accidents and affect the healthy development of enterprises. Analysis of the causes of many accidents is nothing more than unsafe behavior of people and unsafe state of things. For example, American scientist Heinrich analyzed that people's unsafe behavior caused 88% safety accidents; Statistics from DuPont show that 96% of accidents are caused by people's unsafe behaviors; The United States Security Council (NSC) concluded that 90% of safety accidents were caused by people's unsafe behaviors. Research in China shows that 85% of accidents are caused by people's unsafe behavior. It can be seen that people's unsafe behavior is the most important factor leading to accidents. If we can control the occurrence of unsafe

behaviors and reduce the number of unsafe behaviors, it will inevitably reduce the possibility of accidents and play a very positive role in safe production. Human behavior is closely related to psychology. It is of great practical and guiding significance to study the influence of human psychological factors on illegal behavior and discuss how to improve the safety awareness of construction workers and eliminate illegal behavior from the psychological point of view, so as to reduce casualties and protect the health and life and property safety of construction workers. Therefore, relieving the psychological pressure of employees and promoting their mental health have become an important topic of ideological and political work in construction enterprises, and their mental health is related to the survival and development of enterprises.

1.2 Problem Statement

The construction industry in China is experiencing rapid growth and development. However, while increasing, the occupational hazards and safety risks of construction workers are also increasing. The safety of construction workers is a concern, because accidents and injuries will not only bring human suffering, but also affect the overall productivity and sustainable development of the industry. Although China has been making efforts to improve safety measures, there are still major challenges in ensuring a safe working environment for the construction industry in China. The mental health and mentality of workers play a vital role in their safe behavior. Psychological factors such as self-efficacy, optimism, hope and resilience are collectively called psychological capital, which will affect employees' participation in safe behavior. However, in the construction industry of China, people's understanding of the relationship between psychological capital and safe behavior is still limited. (Zhou & Yan, 2018)

Therefore, it is necessary to conduct a comprehensive investigation on the factors affecting the safety behavior of the construction industry in China. This study aims to meet this demand by paying attention to the psychological capital of construction workers. The statement of the problem can be summarized as follows: Although China has been striving to strengthen safety measures, the construction industry in China still faces challenges in ensuring a safe working environment. There is a lack of comprehensive understanding of the influence of psychological capital on the safety behavior of this industry. Therefore, it is necessary to investigate these factors in order to formulate evidence-based interventions, improve safety practices, and ultimately reduce accidents and improve the well-being of construction workers in China.

1.3 Research questions and hypotheses

Research Question: What is the relationship between psychological capital and safety behavior in the Chinese construction industry?

-How does psychological capital, including factors such as self-efficacy, optimism, hope, and resilience, affect the safety behavior of Chinese construction workers?

-Do construction workers with higher levels of psychological capital exhibit more proactive safety behaviors and higher safety compliance?

-How can construction workers' psychological capital be enhanced to promote positive safety behaviors in the Chinese construction industry?

These research questions will guide the data collection and analysis process, allowing us to comprehensively explore the factors influencing safety behaviors in the Chinese construction industry, with a particular focus on safety education, corporate culture, and psychological capital dimensions.

Hypothesis: psychological capital:

H0: There is no significant relationship between psychological capital and safety behavior in the Chinese construction industry.

H1: There is a positive relationship between psychological capital and safety behavior in the Chinese construction industry.

These hypotheses will be tested through statistical analyses such as correlation analysis, regression analysis and mediation/moderation analysis. The results of the hypotheses testing will provide insights into the relationship and influence of safety education, corporate culture and psychological capital on safety behavior in the Chinese construction industry.

1.4 Research objectives

The main objective of this research project is to explore the relationship between psychological capital and safety behavior in the Chinese construction industry.

1.5 Significance of this study

The ultimate significance of this study includes a comprehensive understanding of the factors that affect the safety behavior of the construction industry in China. These findings will provide insights for formulating evidence-based interventions to improve safety practices and reduce accidents. This study will also contribute to the knowledge of psychological capital, thus providing information for the policy decision-making and industry practice of the construction industry in China.

2. LITERATURE REVIEW

2.1 Construction safety management of construction projects

In the construction process, perfect safety supervision system is conducive to the construction enterprises to avoid the safety accidents caused by human error, and timely eliminate hidden safety problems. At the same time, construction companies can also carry out safety education and training activities to further enhance the

safety awareness of construction personnel, and then ensure the construction quality and construction efficiency. In short, construction companies can simultaneously use a variety of construction safety management methods, in order to effectively avoid the occurrence of safety accidents in the construction process, thereby adversely affecting the construction progress, personnel safety and corporate benefits. (Gao, 2019)

2.2 Behavioral safety management

Behavioral safety management refers to the use of scientific and reasonable ways and methods to conduct research related to human and safety issues and to discover the laws of human behavior in the production environment. Behavioral safety management is also a method and theory of scientific analysis and control of human behavior from a safety perspective. Some data studies have shown that the implementation of behavioral safety management only requires two percent of the personnel's time and can achieve a ten percent improvement in personnel safety behavior. Behavioral safety management adopted by the main improvement method is through a large number of observation and improvement of personnel behavior, attitude, awareness to achieve the level of unsafe behavior of the personnel to improve the safety hazards can be eliminated before the accident occurs, the unsafe behavior to correct, so that personnel to improve the awareness of safety behaviors, to develop safe behavioral habits, and ultimately to achieve the prevention of safety accidents, reduce the occurrence of safety accidents. (Wang & Liu, 2019)

2.3 Psychological Capital and Behavioral Safety Relationship

Psychological capital focuses on how to improve the psychological capabilities of employees in the workplace to enhance performance. The concept of psychological capital in psychology was firstly proposed by Seligman in 2002, who included the psychological factors that motivate individuals' positive behaviors into the scope of psychological capital. Subsequently, it has attracted research from scholars in various fields such as psychology and management, among which the most representative one is Luthans et al. who proposed in 2004 that psychological capital is a view of the core psychological elements that individuals possess in general and positively, and put forward the four elements of psychological capital, namely, self-efficacy, hope, joy, and resilience. These elements can visualize how these psychological states affect people's cognition and behavior. In recent years, Shahid et al. suggested that enhancing employees' psychological capital has the potential benefit of effectively improving work performance. Stratman et al. also found that positive psychological capital has a significant effect on reducing insecure behaviors through an intervention test. Based on the above theoretical foundations, this paper develops a psychological capital scale and an unsafe behavior scale suitable for Chinese water conservancy project construction workers based on a large number of literature analyses, on-site interviews, and research and questionnaire surveys on several large-scale water conservancy projects in Hunan Province, from the perspective of the field of water conservancy project construction and the discussion of experts, in order to provide tools and bases for improving the safety performance of project management from the perspective of paying attention to the psychological aspects of the workers. We hope to provide a tool and a basis for improving the safety performance of project management from the perspective of workers' psychology.

3. RESEARCH METHOD

3.1 Survey of a sample and a questionnaire

The data collection process for this quantitative study was designed to investigate the factors influencing safety behaviors in the Chinese construction industry, with a focus on safety education. The selected sample consists of workers in six prevalent occupations in the construction industry, namely scaffolders, masons, steelworkers, carpenters, electricians and other workers. The study will be conducted in five construction companies in Guangdong, China with a total of 2,760 workers.

To ensure the reliability and representativeness of the sample, the researcher will use the Yamane method to determine the appropriate sample size. According to the Yamane formula, the required sample size can be calculated which is based on the total population of the study and the required margin of error (e). In this case, the researcher chose a margin of error of 5% in order to achieve a reasonable level of accuracy in the results of the study.

By applying Yamane's formula, the study demonstrated that a maximum of 400 samples could be collected from 2,760 workers. The sample size selected ensured adequate representation of the labor force while maintaining statistical significance and validity of the results. A sample of 400 participants was considered an acceptable representation of the population and allowed for a manageable data collection process .

The data collection process consisted of designing a comprehensive questionnaire to collect information about safety education. The questionnaire will be pretested with a small group of participants to identify possible problems with the survey instrument and to make necessary improvements.

In order to identify participants for the study, the researcher will purposefully select workers from six major occupations in five construction companies. Ensuring that different occupational groups are represented will help provide a comprehensive understanding of safety behaviors across the workforce.

Data will be collected through self-administered questionnaires, either on paper or online, depending on the convenience and preference of the participants. Ethical approval will be obtained from the relevant institutional review board prior to data collection to ensure compliance with ethical guidelines and to protect the rights and confidentiality of participants.

Structured questionnaires will be developed based on the study objectives and literature review. The questionnaire will include both closed-ended and Likert scale items. It will assess participants' perceptions of safety education. The questionnaire has undergone a pilot testing phase to ensure its clarity, reliability and validity.

3.2 Statistical analysis

The distribution of the questionnaire 400, recovered 400, on the recovery of the questionnaire organization and analysis, excluding the existence of missing items, omission of invalid questionnaires 0, the questionnaire recovery efficiency is 100%. The distribution of participants whose occupational structure is mainly different job scopes shows that there is a slight difference in the composition of the sample. Among the participants, 72 (18%) were masons and 60 (15%) were carpenters. There were 71 (17.8%), 70 (17.5%) and 65 (16.3%) scaffolders, electricians and steel fixers respectively. There were 62 painters (15.5%).

3.3 Data analysis

This study plans to use a single methodology with a particular focus on quantitative data collection and analysis to investigate the factors influencing safety behaviors in the Chinese construction industry.

By employing a quantitative approach to data collection and analysis, this study will provide numerical insights into the factors that influence safety behaviors in the Chinese construction industry. The results of the analysis will help identify significant relationships, predictors and potential interventions to enhance safety practices and reduce accidents. This study collects information and analyzes it through physical questionnaires and online surveys. The Statistical Package for the Social Sciences (SPSS) version 23.0 was used in the analysis process. The analysis included the following sections: descriptive analysis, factor analysis, Pearson correlation reliability test, binary logistic regression analysis, and regression analysis.

Since the study delves into the complex relationship between psychological capital and safety behaviors in the Chinese construction industry, sophisticated analytical tools are required to reveal the underlying patterns and associations. Advanced Structural Equation Modeling (SEM) provides a powerful solution for analyzing the interconnections between multiple variables and assessing their direct and indirect effects. In this context, AMOS v23.0 (Momentum Structural Analysis) has been created as a complementary software that enables researchers to perform a comprehensive and rigorous statistical analysis of study results.

In addition, AMOS provides a visual representation of the structural equation modeling, which helps to communicate the results of the study to stakeholders, safety practitioners, and policy makers in the Chinese construction industry. AMOS is an indispensable auxiliary software tool in the process of analyzing the results of this study. The ability of AMOS to deal with complex structural equation modeling and to perform a wide range of statistical analyses enables this study to explore the intricacies of the relationship between safety education and safety behavior. The ability of AMOS to handle complex structural equation models and conduct extensive statistical analyses allowed this study to explore the intricate relationship between safety education and safety behaviors. By using AMOS, the research team was able to gain evidence-based insights that will deepen their understanding of safety behaviors in China's construction industry and contribute to a safer work environment for construction workers.

4. DATA ANALYSIS AND HYPOTHESIS

4.1 Confirmatory factor analysis

Factor analysis examines the interrelationships among a large number of variables and then attempts to explain them in terms of their underlying dimensions. It allows researchers to reduce a large number of variables or scale objects to smaller, more manageable dimensions or elements. This approach is commonly used to determine the underlying structure when constructing scales and measures (Pallant, 2011). According to Tabachnick and Fidell (2013), two statistical measures created by IBM SPSS to help assess the factorizability of data are Bartlett's test of sphericity (1954) and the Kaiser-Meyer-Olkin (KMO) sample. Olkin (KMO) measures of sample adequacy (Kaiser, 1970, 1974).

To determine the appropriateness of a component analysis, Bartlett's test of sphericity must be significant ($p < 0.05$).The KMO index ranges from 0 to 1, with 0.6 being considered the minimum value for a good factor analysis (cited in Pallant, 2011).An alternative suggestion for factor analysis values is made by Comrey and Lee (1992), who state that any loadings above 0.71 is very good, 0.63 is very good, 0.55 is good, 0.45 is fair, and 0.32 is bad (as cited in Tabachnick & Fidell, 2011). This study conducted a factor analysis of all the items that comprise the dependent and independent variables.

The psychological capital factor was the third component of the independent variable. This component consists of five subscales. The results of the KMO and Bartlett's test are shown in Table 1.

Table 2 shows the factor loadings of all the items of the independent variable. The KMO test was 0.796 which is higher than the recommended value of 0.6 (Kaiser, 1970, 1974).The Bartlett's test of sphericity (Barlett's

test of sphericity (Bartlett's test of sphericity, 1954) had a significant value of 0.000.

Table 1
KMO and Bartlett's test of mental capital

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.796
Bartlett's Test of Sphericity	Approx. Chi-Square	301.348
	df	8
	Sig.	.000

Table 2
Factor Analysis of Psychological capital

Items	Factor loading
Major decisions regarding site safety issues, always take place after consulting with site workers / subcontractors	.832
Managers and superiors do encourage feedback regarding safety issues from site workers	.828
I am always encouraged to raise any safety concern with my site supervisor	.802
Safety problems are openly discussed between workers and supervisors	.719
Workers are always being consulted regarding preparation of site safety plans	.713
Generally workers follow safety rules without being told to do so	.700
I am allowed to act decisively if I find any situation contrary to safe conditions on site	.694
Safety rules should not be broken, even when worker believes it affects the production	.665
Safety decisions made by the management usually seems to be more effective than decisions made by workers	.601
Eigenvalue	1.046
Variance (%)	60.930

4.2 Multivariate regression analysis

According to Zikmund (2003), the most appropriate method to confirm whether the hypotheses are correct or not is multiple regression, which assesses the linear relationship between the dependent and independent variables (Zikmund, 2003). Multiple regressions were conducted to determine the independent factors, as well as the effects of safety education, safety climate, corporate culture and psychological capital on the dependent variable, safety behavior.

To test the proposed hypotheses, covariance and correlation tables were extracted from the output of the measurement model, which was done on AMOS v23.0. Therefore, we proceeded to test the hypothesized relationships in the model. The following tables and figures depict the path coefficients of the hypothesized relationships in the proposed research model.

H3 Psychological capital has a positive relationship on safety behaviour

Table 3
Research hypothesis test finding for psychological capital

	Hypothesized Effects	Std. Estimate (β)	SE	CR	p
H3	Psychological capital has significant positive influence on safety behaviour	0.800	0.166	4.810	

: p<0.001; : p<0.01; : p<0.05

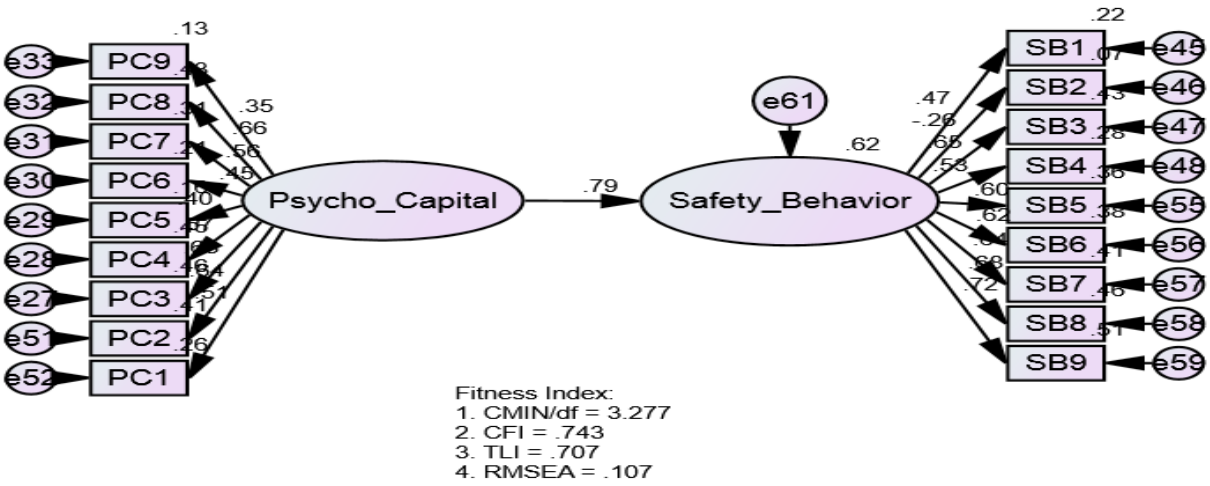

Figure 1
Measurement model between psychological capital and safety behaviour

Table 4
Hypothesis results summary

	Hypothesis	Result
H3	There is a positive relationship between psychological capital and the Safety Behaviour.	Accepted

4.3 Conclusion

According to research, psychological capital is found to be positively correlated with safety behavior, indicating that workers with higher levels of psychological capital exhibit more proactive safety behavior. Psychological capital, which includes optimism, resilience, hope, and self-efficacy, enhances workers' ability to face safety challenges and develop a positive safety mindset. These findings support the study by Chen et al. (2019) and emphasize the importance of considering employee mental health in safety initiatives.

5. CONCLUSION AND SUGGESTION

The purpose of this study is to explore the relationship between safety psychological capital as an independent variable and safety behavior as a dependent variable. It aims to understand how these factors influence the safety behaviors of construction personnel in the dynamic and challenging environment of the Guangdong construction industry.

Safety psychological capital, including optimism, resilience, hope, and self-efficacy, can influence how construction workers respond to safety challenges and cope with safety-related stressors. Workers with higher levels of safety psychological capital should exhibit more proactive and safety-oriented behaviors because they possess the psychological resources to deal effectively with safety risks.

This study aims to provide valuable insights into enhancing safety practices and fostering a safety-conscious culture in Guangdong construction firms by examining the interactions between safety psychological capital and safety behaviors. The findings can inform evidence-based strategies to improve safety training programs, create positive safety environments, and promote workers' psychological well-being, ultimately contributing to safer work environments and fewer accidents in the construction industry.

This study found that safety psychological capital (SPC) was significantly and positively correlated with safety behaviors of construction workers. Employees with higher levels of safety-related optimism, resilience, hope, and self-efficacy exhibited more proactive safety behaviors. Workers with greater HPC were better able to cope with safety challenges, maintain positive attitudes toward safety, and proactively ensure their own safety and that of their coworkers. This finding emphasizes the importance of fostering workers' psychological well-being to enhance safety practices.

This study also reveals the important role of safety psychological capital (SPC) in shaping the safety behavior of construction workers. Employees who show higher optimism, flexibility, hope and self-efficacy about safety show more active safety behaviors. This study emphasizes the importance of considering the psychological dimension of safety in safety interventions and projects. It illustrates how psychological capital profoundly affects individuals' perception and response to security challenges, and emphasizes the need to take measures aimed at improving employees' mental health in order to cultivate a safer and more flexible workforce.

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