

Factors Affecting Behavioral Safety of Construction Workers in Building Construction-Corporate Culture

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Abstract

It is well known that the risk of on-site accidents in the construction industry is high. Then, preventing the risk of accidents requires the implementation of corporate culture measures. Construction enterprise culture is an important guarantee for safety management and a key issue in studying construction management factors. Construction enterprise culture construction plays a pivotal role in the safety of construction personnel behavior. The level of enterprise culture directly affects construction safety and efficiency, and is the safety guarantee for construction operation. It is the core competitiveness of construction enterprises to cultivate the safety awareness and safety responsibility of construction personnel. Therefore, it is of great significance to study the influence of the safety culture of construction enterprises on the behavior of construction personnel on the safe construction of building sites and the safe and stable development of the construction industry.

The study shows that there is a positive and significant influence relationship between the safety behavior of construction personnel and the culture of construction enterprises. Thus, it ensures the full implementation of the safety culture in order to reduce accidents at the construction site and achieve zero industrial accidents.

Key words: Construction; Safety management; Corporate culture; Construction workers; Behavioral safety

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1. INTRODUCTION

1.1 Background of the Research

As one of the five pillar industries pulling China's economic development, the annual gross output value of the construction industry continues to rise. The summary of the output value of the construction industry in China in the past ten years, the statistics show that the total output value of the construction industry has risen from 96,031,113,000,000 Yuan in 2010 to 248,445,577,000,000 Yuan in 2019; the proportion of the added value of the construction industry to the GDP has also shown a trend of increasing year by year, and the added value of the construction industry in 2019 accounted for 7.16% of the GDP, and the number of people working in the construction industry accounted for the ratio of the number of national employed people in the past ten years was above 5%, and the proportion exceeded 7% in the past five years. Changes from the data reflect the important position and development program of the construction industry, not only in the construction industry added value accounted for the increase in the total proportion of GDP, in addition to the construction industry employees accounted for the proportion of the national employment, to safeguard employment, and improve the people's standard of living has made great contributions. In order to promote the upgrading and development of the construction industry, the state made to strengthen the new infrastructure construction and new urbanization construction, according to the city policy, help in the balanced and healthy development of the real estate market and the construction industry upgrading of this major industrial deployment policy, as

the content of the government work report of the National People's Congress in 2020, the development of China's construction industry and infrastructure construction to a new climax.

As China's modernization and urbanization process continues to accelerate, major projects and infrastructure are widely distributed, the safety production situation in the construction industry has a more complex trend, the seriousness and complexity of the safety production situation is manifested in two aspects, one of which is manifested in the fact that the number of safety accidents in some areas is more frequent, the accidents are larger, and the year-on-year rise is more, such as in Sichuan in 2019, 117 safety accidents occurred, 126 people deaths; 75 safety accidents occurred in Jiangsu, resulting in a total of 88 deaths, a year-on-year increase of more than 50%, the second aspect is manifested in the occurrence of major accidents of mass deaths and injuries of construction workers has not been effectively curbed, Hebei Hengshui, a project under construction in the process of installation of construction lifts there are safety hazards in the process of construction of lifts fell, resulting in the deaths of 11 people; Shanghai Changning, a factory building due to the A factory building in Changning, Shanghai, was not constructed in accordance with construction standards, and collapsed in the course of its use, resulting in 12 deaths.

In order to explore the deep causes of construction safety accidents, scholars have carried out a wide range of in-depth research Heinrich was the first to put forward the theory of accident causation causation theory, causation theory is the core content of the human unsafe behavior and the unsafe state of the object as the main cause of accidents to be studied, and in the process of construction, the unsafe behavior of the human is prevalent, such as habitual unsafe behavior, compliance with safety regulations, etc., which led to the construction site, the construction site is not in accordance with the construction norms, resulting in 12 deaths. safety regulations, etc., which leads to the occurrence of production safety accidents at construction sites. Statistics from the Ministry of Housing and Construction in 2019 showed that fall from height accidents accounted for 53.69% of the total number of production safety accidents, and some studies have shown that the main reason for the occurrence of fall from height is due to the fact that the workers don't wear the protective measures according to the regulations when they work on the high place. Therefore, improving the safety behavior of construction workers and upgrading the level of safety behavior of construction workers has a very important impact on reducing the safety production accidents in construction enterprises. (Yang, 2021)

1.2 Problem Statement

Civil engineering construction is a large-scale, complex activity involving multiple technologies and personnel, and

the importance of its safety risk management cannot be ignored. Historical data show that accidents in the field of engineering construction are frequent, which not only lead to huge economic losses, but also may cause irreparable casualties. (Qian and Liu, 2024) Safety management is a part of construction enterprises and has an important role in the process of construction. Strengthening safety management improves the productivity of construction enterprises, thus comprehensively promoting the sustainable and healthy development of construction enterprises. Upon investigation, human factors cause more than 80% of construction accidents. Therefore, regulating the safety behavior of construction personnel is an effective way to prevent construction accidents, and it is the root of the stable production of construction enterprises. Strengthening the safety management of building construction, comprehensively improving the safety behavior of employees, and establishing safety thinking are the primary problems faced by construction enterprises, and are also the basis for the safe production of enterprises. At present, in the field of construction industry, there is almost no research on the role of corporate culture in influencing the behavior of construction personnel. This paper adopts the method of quantitative research on the basis of relevant literature research. According to the characteristics of construction enterprises, through the questionnaire survey of construction personnel, it establishes a structural equation model with the characteristics of construction enterprises, and comprehensively and systematically demonstrates the role of the influence of construction enterprise culture on the safety behavior of construction personnel, with a view to providing useful reference or reference for the work of construction enterprise culture construction. (Liu, 2019)

1.3 Research questions and hypotheses

Research Question 2: What are the key factors in corporate safety culture that influence the safety behavior of employees in the Chinese construction industry?

-How do management commitment and leadership influence safety behaviors in Chinese construction companies?

-What role does effective communication play in promoting safety behaviors in the corporate safety culture of Chinese construction companies?

-How do safety policies, procedures, and incentives influence the safety behavior of construction workers in the Chinese construction industry?

-How can corporate safety culture be improved to foster a positive safety culture in the Chinese construction industry?

Hypothesis 2: Corporate safety culture:

H0: There is no significant relationship between corporate safety culture and safety behavior of construction employees in China's construction industry.

H1: There is a significant positive relationship between corporate safety culture and safety behavior of construction workers in China's construction industry.

1.4 Research objectives

The main objective of this study is to investigate the influence of construction corporate culture on the safety behavior of construction workers in China's construction industry.

1.5 Significance of this study

It has been and will continue to be the development of the construction industry in our country, and in the case that the total number of safety accidents in building construction enterprises is still very large, it is necessary to carry out theoretical research on building construction enterprise culture to give reference to practical work. Therefore, the significance of this study is:

Promoting the construction enterprise culture construction can effectively prevent the occurrence of safety accidents and safety hazards, and the construction enterprise culture has strategic significance for the long-term development of enterprises.

It is in line with the development trend of construction enterprise management. With the standardization of the construction market, the competitiveness of the building construction enterprises in the market is no longer only the output value and other indicators, will gradually turn to the comprehensive management of the enterprise competition. Comprehensive management of building construction enterprises can be understood as the concept of safety culture of building construction enterprises, safety production management, and so on, so the enterprise culture will have a greater impact on the development of enterprises. If the building construction enterprise wants to get eternal development, it must be people-oriented, and ensure the safety of workers is the biggest premise of people-oriented, so as to embark on the road of scientific management, which is of great practical significance to the construction and development of enterprises.

2. LITERATURE REVIEW

2.1 Construction safety management of construction projects

Construction safety management is based on the safety problems in the process of construction, through planning, planning, control and other activities, to reduce or avoid the occurrence of construction accidents, especially the control of casualties, equipment accidents and various disasters, so as to achieve the goal of production safety. The goal of production safety here does not only point to the protection of laborers, but also includes the protection of production, property and the environment. The causes of safety accidents in building construction

mainly involve human, material, environmental and management factors. Specifically: (1) human factors. Failure occurs due to the errors of construction workers in the operation process. (2) Physical factors. It mainly points to the fact that accidents occur due to the fall of machines and equipment, tower cranes, and other reasons. (3) Environmental factors. Mainly refers to the temperature high and low, rain and snow, etc. on the building construction activities to bring different degrees of influence, but the environmental hazards generally will not continue to construction. (4) Management factors. It mainly points to the defects of the management system or management chaos that leads to the emergence of human unsafe behavior and the unsafe state of the environment and things. (Yuan, 2015)

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 research shows that the implementation of behavioral safety management only needs to use two percent of the personnel's time, and can achieve the improvement of ten percent of the personnel's safety behavior. (Wang and Liu, 2019) Human unsafe behaviors are defined as behaviors that can cause safety production accidents or may cause safety production accidents, which can be divided into unsafe behaviors that directly lead to accidents and unsafe behaviors that indirectly lead to accidents (Zhang and Fang, 2012) & Xiao Guoqing, Chen Baozhi, Wang Hao (2003). Unsafe behaviors that directly lead to accidents are manifested as the failure to properly defend against accidents or potential sources of danger or intentionally committing them. Unsafe behaviors of construction workers mainly refer to the three aspects of unauthorized command, unauthorized operation, and violation of labor discipline (Fu, et al, 2005), such as failure to correctly wear a helmet when entering the construction site, failure to wear reflective undershirts, failure to use a safety belt for work at heights, failure to use a safety belt for work at the construction site, and smoking on construction sites, etc. (Ye, Chen, and Wang, 2016) & Kong Deming (2010). Behavioral safety management adopts 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 personnel, can eliminate potential safety hazards before the accident occurs, the unsafe behavior is corrected, so that the personnel to improve the awareness of safe behavior, the development of safe behavior habits, and ultimately to achieve the prevention of safety accidents, reduce the incidence of safety accidents.

2.3 Relationship between corporate safety culture and behavioral safety management

From the connotation point of view, the construction of enterprise safety culture is based on the overall situation by the enterprise managers, according to the enterprise's internal production environment and external competitive conditions for the leading, and to formulate the safety as the premise, to promote the development of the enterprise's important strategic plan. In the process of enterprise safety culture construction, managers need to combine the actual needs of the enterprise production, the establishment of a three-dimensional safety culture system, which should not only cover the development goals of the enterprise, but also clarify the needs of cultural construction and management mode. From the value point of view, the construction of enterprise safety culture is the premise and necessary guarantee of enterprise safety production management, which can not only promote the production activities to be carried out safely, but also protect the staff's life and health. (Sun, 2024)

In addition, safety culture in enterprise safety management is not only the spiritual power to unite people's hearts, but also the soul and driving force for enterprises to realize sustainable development. The safety culture of the enterprise is to change "I want to be safe" into "I want to be safe", and then enhance the realm of safety work. Strengthen the construction of people-oriented enterprise safety culture, adhere to the "safety culture, culture to protect safety" principle, the real safety culture casting safety shield, in order to realize the essence of enterprise safety to lay the foundation (Su, 2022) & Wang Shengjiang, Ji Yongjin (2009). Safety culture can be described as a system that adjusts the human factors in safety management, limits the human factors behind accidents by changing human unsafe behaviors, and thus coordinates the management of the system, the production environment, and other types of safety production management. (Wang and Deng, 2024) Koivula and Nina believe that encouraging and advocating employees to understand and recognize the enterprise's safety culture in the execution of their work is of great significance to the improvement of the enterprise's safety management, and scholars such as Reber and Andrew Hopkins start from the depth of the accidents to explore the connection between the causes of the accidents and the development of the enterprise's culture and management system, and analyze the relationship between safety culture and the rate of the accidents. Reber and Andrew Hopkins and other scholars start from the deeper level of accidents to explore the connection between the causes of accidents and the culture and management system of enterprise development, and deeply analyze the relationship between safety culture and the rate of accidents occurred.

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 example, the researcher has chosen a margin of error of 5% to achieve a reasonable level of precision in the results of the study.

By applying the Yamane formula, the study demonstrated that a maximum sample size of 400 participants could be collected from 2760 workers. The sample size selected ensured an 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 procedures include the design of a comprehensive questionnaire to collect information on safety education. The questionnaire will be pre-tested with a small group of participants to identify possible problems in the survey instrument and to make necessary improvements.

To identify participants for the study, researchers 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 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

This time, 400 questionnaires were distributed and 400 were recovered. The recovered questionnaires were sorted and analyzed, and 0 invalid questionnaires with missing or omitted items were excluded, and the validity rate of questionnaire recovery was 100%. Work experience was mainly for participants with different years of work experience, and there were slight differences in the composition of the sample. Among the participants, 25 participants (6.3%) had less than 5 years of work experience, 75 participants (18.8%) had 5 to 10 years of work experience, 150 participants (37.5%) had 11 to 15 years of work experience, 104 participants (26%) had 16 to 20 years of work experience, and 46 participants (11.5%) had more than 20 years of work experience.

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.

Through data collection and analysis using quantitative methods, this study will provide numerical insights into the factors influencing safety behaviors in the Chinese construction industry. The results of the analysis will help identify important 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) measure 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 (as 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). In this study, a factor analysis was conducted on all the items constituting the dependent and independent variables.

The second component of the independent variable is safety climate and corporate culture. This component consists of nine components. Table 1 provides the results of the KMO and Bartlett's test, while Table 2 shows the factor loading for all the independent variable items. The KMO test result was 0.838, which is higher than the required threshold of 0.6 (Kaiser, 1970, 1974), while Bartlett's test of sphericity (Bartlett, 1954) had a significant value of 0.000.

Table 1
KMO and Bartlett's Test Safety atmosphere and corporate culture

| | | |
|--------------------------------------------------|--------------------|---------|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .838 |
| | Approx. Chi-Square | 240.240 |
| Bartlett's Test of Sphericity | df | 8 |
| | Sig. | .000 |

Table 2
Factor Analysis of Safety atmosphere and corporate culture

| Items | Factor loading |
|----------------------------------------------------------------------------------------------|----------------|
| 1. My site managers, foremen and supervisors always inform me of safety concerns and issues. | .810 |
| 2. I am never encouraged to raise any safety concern | .777 |
| 3. Management do encourage feedback regarding safety issues from site workers | .776 |
| 4. Safety training is provided on skills specific to individual tasks and equipment | .774 |
| 5. Potential risks and consequences are identified in training | .732 |
| 6. I am clear about what my responsibilities are for safety | .711 |
| 7. I am aware of my trade relevant safety procedures | .698 |
| 8. Safety inspections are carried out on regular basis | .690 |
| 9. I believe that prevention of accidents is the responsibility of everyone | .665 |
| Eigenvalue | 1.938 |
| Variance (%) | 58.761 |

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.

H2 Safety atmosphere and corporate culture has a positive relationship on safety behaviour

Table 3
Research hypothesis test finding for Safety atmosphere and corporate culture

| Hypothesized Effects | Std. Estimate (β) | SE | CR | p |
|------------------------------------------------------------------------------------------------|---------------------------|-------|-------|---|
| Safety atmosphere and corporate culture has significant positive influence on safety behaviour | 0.991 | 0.224 | 4.055 | |

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

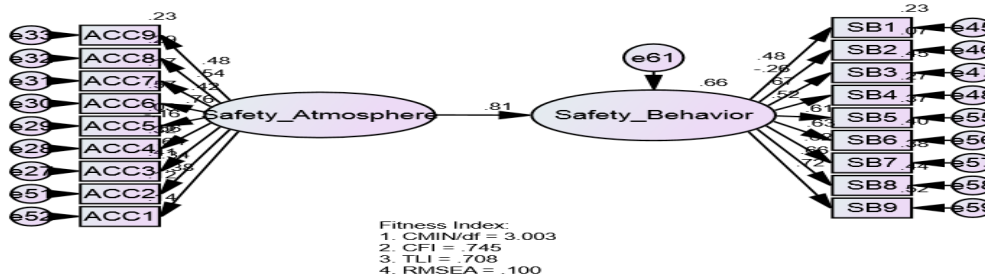


Figure 1
Measurement model between Safety atmosphere and corporate culture towards safety behaviour

Table 4
Summary of hypothetical results

| Hypothesis | Result |
|---------------------------------------------------------------------------------------------------------------|----------|
| H2 There is a positive relationship between Safety atmosphere and corporate culture and the Safety Behaviour. | Accepted |

4.3 Conclusion

Overall, the results of the correlation and regression analyses were a valuable validation tool, ensuring that the relationships observed in the actual data analysis were consistent and reliable across conditions. They reinforce confidence in the findings and the importance of the relationship between corporate culture and safety behavior in the Chinese construction industry.

These synthesized findings are relevant to China’s construction industry. Based on a comprehensive understanding of the factors that influence safety behavior, the study can provide evidence-based recommendations to improve safety practices and create a positive safety culture. For example, fostering a supportive corporate culture that values safety and provides adequate resources can improve the effectiveness of safety measures.

In summary, the incorporation of data analysis into the study of factors influencing safety behaviors in China’s construction industry provided a comprehensive understanding of the research topic. By combining quantitative data analysis and direct effect findings,

this study gained valuable insights into the complex interactions between corporate culture and safety behavior. The synthesized findings contribute to evidence-based recommendations to promote the positive development of safety culture in the Chinese construction industry.

5. CONCLUSION AND SUGGESTION

Focusing on corporate culture, this study examines the factors that influence safety behavior in the Chinese construction industry. The purpose of this study was to examine the relationship between factors and safety behaviors, explore potential mediating and moderating effects, and provide evidence-based recommendations for enhancing safety practices. The integration of quantitative data analysis and direct effect analysis with the findings contributed to a comprehensive understanding of the research topic.

According to the study corporate culture was found to be positively related to safety behavior. A supportive and safety-oriented corporate culture promotes a positive safety environment, encourages employees to follow safety protocols, and contributes to a safer work environment. This result is consistent with the findings of Huang et al. (2018) and highlights the role of organizational culture in shaping safety behaviors.

Safety climate, also known as safety culture or safety climate, refers to the general perceptions and attitudes towards safety within an organization. It encompasses the shared values, beliefs, norms, and practices related to safety among employees and management. A positive safety climate fosters a sense of collective responsibility for safety, encourages open communication about safety issues, and promotes compliance with safety rules and procedures.

The safety climate within a construction company significantly influences the perceptions and attitudes of construction workers toward safety. A positive safety culture, trust and open communication can motivate workers to prioritize safety and thus improve safety behaviors.

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