Research on Influencing Factors of Unsafe Behavior of Prefabricated Building

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Abstract. There are obvious differences between the assembly construction method and the traditional cast-in-place construction. At present, the assembly construction technology and management standards have not been perfected in our country, and the acceleration of technology can create unparalleled cascades of benefits as well as new risks of catastrophe. Through a lot of literature research, this paper designs questionnaires including risk perception, convenience perception, managerial pressure, co-worker pressure, and judgement ability based on the theory of planned behavior, and conducts factor analysis on the collected data. Finally, based on the analysis results, corresponding management level factors, workers level factors and self-perception factors of unsafe behaviors in prefabricated buildings are proposed.

1. Introduction
China vigorously promotes the development of prefabricated buildings to promote the industrialization upgrade of architecture. The construction industry has always been an industry with higher safety risks, second only to mining. The unsafe behavior of construction workers is the main cause of construction accidents [1-2]. Industrialization upgrade of architecture have also done a lot of research, pointing out that the safety abilities and attitudes of construction workers [3-4], the safety atmosphere of projects and teams [5-8] and so on are important factors that affect the occurrence of unsafe behaviors. However, the objects of these studies are traditional cast-in-place buildings, and there are very few studies on unsafe behaviors that take prefabricated buildings as objects.

In this article, based on the theory of planned behavior, the structural hierarchical relationship of the factors on the unsafe behaviors of prefabricated construction workers is sorted out, and the relative importance of individual factors is determined by the factor analysis method, finally, I put forward targeted measures for the unsafe behavior of assembled construction workers.

2. The theory planned behavior
The planned behavior theory is considered to be the most widely used and popular social psychology theory to study individual behavior decision-making mechanism and behavior development process [9]. The theory of planned behavior deems that people must consider and plan appropriately before they perform a specific behavior.

Behavioral attitude refers to emotional attitude and instrumental attitude in planned behavior theory. The more positive the individual’s attitude is, the more likely he is to produce a certain behavioral intention. Conversely, the more negative the individual’s attitude is, the less likely he is to produce a certain behavioral intention. Applying it in the field of construction safety, construction workers are more likely to behave safely when they have a positive attitude.
Subjective norms refer to the social pressure caused by the important others in the group of an individual to perform a certain behavior [10]. Applying it in the field of building construction safety behavior, that is, if managers pay more attention to certain behaviors, then workers are more likely to take this kind of safety behavior.

Perceived behavior control refers to the level of control that individuals can perceive the difficulty or ease of a certain behavior to be performed [10]. It mainly includes two aspects, for one is the self-efficacy factor, and the other one is the behavior control perception factor. Applying it in the field of building construction safety behavior, whether it has the ability to perform safety behavior and whether the outside world has corresponding conditions that can implement safety behavior, these directly affect the possibility of safety behavior implementation.

Behavioral intention refers to the individual's preference for an individual to take a certain behavior. Generally, the stronger of the intention to carry out a certain behavior, then the more likely this behavior is to occur. The structural diagram of the planned behavior theory is shown in Figure 1 below:

![Figure 1. The structural diagram of the planned behavior theory](image)

3. Main construction factors of unsafe behaviors of prefabricated construction workers

3.1. Behavioral attitude factors
Risk perception: every employee's expectation of himself and his coworkers is that no safety accidents. When the construction worker is choosing behavior, he will first assess the risk of this behavior and choose the behavior according to his own understanding. If the construction personnel pay high attention to behaviors, it will greatly improve the safety of the construction personnel. [11]

Convenience perception: the implementation of a safe behavior may have an impact on the convenience of the construction personnel's behavior. Choosing to use standard safe behaviors may take more time and energy than using unsafe behaviors. Therefore, some construction workers use unsafe behaviors to carry out construction activities. [12]

3.2. Subjective normative factors
Managerial pressure: if the supervisor has strong supervision, or the construction worker will face severe penalties when unsafe behavior is found, or the manager will reward the construction worker for his safe behavior, these will enhance the safety of the construction worker. [13]

Worker pressure: construction workers want their coworkers to appreciate them, and this idea will directly affect his behavior. When many people work together (1) for efficiency reasons, they may choose unsafe behavior; (2) choosing unsafe behavior will have an impact on coworkers, so they will not choose unsafe behavior; (3) to prove that they are brave, then choose unsafe behavior. [14]
3.3. Perceived behavior control factors

Judgment of knowledge and ability: behavior control is the judgment that construction personnel to choose which behavior to implement. The basis of judgment here includes two aspects: (1) knowledge and ability, whether the worker has the knowledge and ability to take safe behavior; (2) external conditions that affect the implementation of the behavior, if the worker realizes that he wants to take a certain safe behavior, but due to the lack of external safety equipment or the quality of safety equipment, unsafe behavior will also still happen.

| Category                        | Specific reason                                      |
|---------------------------------|------------------------------------------------------|
| Risk perception                 | A1. Workers believe that no safety measures will result in safety accidents |
|                                 | A2. Workers have confidence in their ability to perceive risks |
|                                 | B1. Workers think it would be more efficient not to wear protective equipment |
|                                 | B2. From the perspective of comfort, workers tend to not wear protective equipment |
|                                 | B3. Workers think wearing protective equipment is more cumbersome |
| Convenient perception           |                                                       |
| Managerial pressure             | C1. Turn a blind eye to workers’ unsafe behavior     |
|                                 | C2. No punishment for workers’ unsafe behavior       |
| Coworker pressure               | D1. Workers laughed at each other for protective measures |
|                                 | D2. There is a bad habit of neglecting safe behavior among workers |
| Judgment of knowledge and ability| E1. Overestimate your ability and knowledge to carry out unsafe behavior |
|                                 | E2. Individuals do not actively participate in establishing a good security atmosphere |
|                                 | E3. Not confident in your ability to perform safe behaviors |

4. Research methods

4.1. Questionnaire survey

Considering the scientificity and rationality of the factors affecting the unsafe behavior of assembly construction, the indicators proposed in Table 1 above need to be investigated in practice. The questionnaire was evaluated using the Likert Scale scale, and the degree of approval of the question was divided into five levels, namely 1-strongly disagree, 2-relatively disagree, 3-neutral, 4-agree, 5-strongly agree. The questionnaire survey targets are assembled construction workers and researchers, then a total of 105 complete and valid questionnaires were collected.

4.2. Reliability and validity test

Using SPSS19.0 software to analyze the data from the questionnaires, when analyzing the influencing factors of unsafe behaviors in prefabricated buildings, it was found that the KMO level was 0.792 and the Sig Bartlett spherical test value was 0.000. Compared with the standard reference of the KMO value range, the questionnaire design table is suitable for factor analysis. Using Cronbach coefficient for reliability analysis, the result of this table is 0.736. Generally, this coefficient is higher than 0.8, which means that the reliability is high, and the coefficient is between 0.7~0.8, indicating that the reliability is good. Therefore, the questionnaire data is reliable and can be analyzed.

4.3. Factor analysis

Basing on the data of the questionnaire survey, this paper uses factor analysis to further analyze each influencing factor to draw a more reasonable conclusion. Factor analysis is a mathematical statistical method that uses multiple statistical analyses and linear algebra to convert multiple variables into multiple factors. It is through analyzing the main components to achieve the purpose of analyzing the original variables. Basic steps: (1) confirming that the original variables to be analyzed are suitable for factor analysis; (2) designing factor variables; (3) using the rotation method to make factor variables easier to interpret; (4) calculating the scores of factor variables.
Table 2. Variance interpretation rate table

| Number | Characteristic root | Variance interpretation rate% | Rotation front difference interpretation rate | Explained rate of variance after rotation |
|--------|---------------------|-------------------------------|-----------------------------------------------|------------------------------------------|
|        | Characteristic root | Accumulative total %         | Characteristic root | Variance interpretation rate% | Accumulative total % | Characteristic root | Variance interpretation rate% | Accumulative total % |
| 1      | 4.009               | 33.409                        | 4.009                          | 33.409                         | 33.409                         | 3.018                          | 25.147                         | 25.147                         |
| 2      | 2.991               | 24.926                        | 2.991                          | 24.926                         | 58.335                         | 2.916                          | 24.299                         | 49.446                         |
| 3      | 0.978               | 8.149                         | 0.978                          | 8.149                          | 66.484                         | 1.736                          | 14.471                         | 63.916                         |
| 4      | 0.76                | 6.334                         |                                |                               | 72.818                         |                                |                               |                                |
| 5      | 0.71                | 5.914                         |                                |                               | 78.732                         |                                |                               |                                |
| 6      | 0.598               | 4.986                         |                                |                               | 83.719                         |                                |                               |                                |
| 7      | 0.555               | 4.625                         |                                |                               | 88.344                         |                                |                               |                                |
| 8      | 0.469               | 3.91                          |                                |                               | 92.254                         |                                |                               |                                |
| 9      | 0.373               | 3.111                         |                                |                               | 95.365                         |                                |                               |                                |
| 10     | 0.243               | 2.027                         |                                |                               | 97.392                         |                                |                               |                                |
| 11     | 0.16                | 1.334                         |                                |                               | 98.726                         |                                |                               |                                |
| 12     | 0.153               | 1.274                         |                                |                               | 100                            |                                |                               |                                |

In the sum matrix after factor rotation, deleting the factors with the common degree less than 0.4, the first main factors C1, C2, E1, E2 can be summarized as Management hierarchy factor; the second main factors B1, B2, B3, D2 are more relevant and can be summarized as Worker hierarchy factor; the third factors are more related to A1 and A2 and can be summarized as Self-perception factor, as shown in Table 3 below:

Table 3. Rotated component matrix

| Influence factor | Component         |
|------------------|-------------------|
|                  | Management hierarchy factor | Worker hierarchy factor | Self-perception factor |
| C1               | 0.698             |                  |                     |
| E1               | 0.912             |                  |                     |
| C2               | 0.823             |                  |                     |
| E2               | 0.891             |                  |                     |
| B1               | 0.858             |                  |                     |
| B2               | 0.867             |                  |                     |
| B3               | 0.843             |                  |                     |
| D2               | 0.757             |                  |                     |
| A1               |                   |                  | 0.747              |
| A2               |                   |                  | 0.598              |

It can be seen from Tables 2 and 3 above: (1) the variance contribution rate of the management level factor is the largest of the three common factors, which is 25.15%. According to the four variables, factor loads of E1 and E2 variables are relatively high, indicating that "judgment of knowledge and ability" variable is the most important factor affecting unsafe behaviors of prefabricated buildings among management hierarchy factors; (2) the variance contribution rate of the worker-level factor is 24.299%, which is determined by B1, B2, B3, and D2, and factor loads of B1, B2, and B3 are relatively high, indicating that "convenient perception" variable is the most important factor affecting unsafe behaviors of prefabricated buildings among worker hierarchy factors;(3) the variance contribution rate of the worker-level factor is 14.47%. This factor is composed of two variables, A1 and A2, and the A1 variable has a high factor load, indicating that "ignoring danger" variable is the most important factor affecting unsafe behaviors of prefabricated buildings among Self-perception factors.
5. Countermeasures and suggestions for unsafe behavior of assembled construction workers

5.1. Strengthen safety publicity and education

From the above analysis, it can be seen that "judgment of knowledge and ability" and "disregarding danger, knowingly committing crimes" are important influencing factors for workers to take unsafe behaviors. Regular lectures are held to continuously transmit safety information and safety concepts to workers, so that prefabricated construction workers can fully understand the requirements of safety behavior standards and recognize the safety hazards in the work, so as to enhance "knowledge and ability judgment" and pay more attention to safety accidents. For example, for the use of safety belts, because when prefabricated buildings are built in contrast to traditional construction methods, they often require workers to look high, increasing the risk that workers will fall. The safety belts are their protection.

5.2. Increase supervision

In view of the "Convenient perception" factor of workers, they think that taking safe behaviors is inconvenient and uncomfortable, so they will take unsafe behaviors. We can increase supervision, such as establishing a complete safety reward and punishment system, criticizing workers who took unsafe behaviors. With the development of artificial intelligence, the early warning and control of unsafe behaviors based on video surveillance can also be used to increase the safety of every construction worker.

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