

PAPER • OPEN ACCESS

Application Research on BIM+AR Technology in Construction Safety Management

To cite this article: Zhenxian Huang 2020 *J. Phys.: Conf. Ser.* **1648** 042019

View the [article online](#) for updates and enhancements.

You may also like

- [Research on Safety Management of Construction Site Based on BIM](#)
Zhihong Yu
- [Application of BIM for Effective Construction Safety Management in High Rise Buildings](#)
K. L. Swaroop Devaiah and Vasanth Keshav
- [Application of BIM technology in safety management of construction engineering](#)
Baohua Yan



ECS
The
Electrochemical
Society
Advancing solid state &
electrochemical science & technology

DISCOVER
how sustainability
intersects with
electrochemistry & solid
state science research

Application Research on BIM+AR Technology in Construction Safety Management

Zhenxian Huang^{1,*}

¹Fuzhou University of International Studies and Trade, Fujian, China, 350003

*Corresponding author e-mail: 113696413@qq.com

Abstract. Safety management is an important work in the field of construction. Traditional safety management methods cannot simulate the complex field environment. At the same time, it can't allow real-time interaction between safety managers and field workers. Combined with BIM and AR technology, it is great of practical significance for the application on construction safety management. We discuss the safety management problem from the whole process of the project life cycle, which will have certain reference value for improving the construction safety management level of the whole industry. This paper first analyzes the current situation of building safety management. This paper first analyzes the current situation of building safety management. Then, this paper makes clear the development and advantages of Building Information Modeling(hereinafter referred to as BIM) and Augmented Reality (hereinafter referred to as AR) technology. Finally, this paper analyzes the application of BIM+AR technology in building safety management.

Keywords: BIM, AR, Construction Safety Management

1. Introduction

BIM technology also plays a strong guiding role in construction safety management. So, BIM technology has been highly respected since its emergence. However, in the actual project management process, the biggest defect of BIM is that engineering information can only be input artificially and there is no feedback from surrounding environment, construction technology and other factors^[1]. It cannot be effectively combined with the actual environment and construction situation of the project, and the feedback effect of site condition is poor. Therefore, the industry urgently needs to find a technology that can combine the model with practice. Only in this way, the construction project management will be more perfect.

2. Current situation of building safety management



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

With the rapid development of economy and society, the construction industry is also developing rapidly. However, the particularity of the construction industry often has many unsafe factors, such as, complex construction activities, variable construction environment, frequent mobility of construction personnel, strong continuity of construction work. These unsafe factors may cause a large number of casualties and great property losses^[2]. It is estimated that the construction industry has one death every 10 minutes, accounting for 16.9 percent of all safety accidents. According to statistics from the ministry of housing and urban-rural development, there were 1,768 safety accidents and 2,096 deaths in the production of public works nationwide from 2015 to 2017. Construction practitioners are participants in construction activities, and their unsafe behaviors are the direct factors leading to accidents. At present, our country's construction safety management measures are relatively traditional. Some construction units still identify and prevent the risk factors of the construction site according to the traditional safety management manual. Which makes the safety management efficiency relatively low, at the same time, it will have a bad impact on the construction safety management level. So, the scientific and effective safety management measures has become a top priority in the construction safety management work.

3. Development and advantages of BIM and AR technology

BIM technology has shown strong advantages in the construction of construction projects, with the advantages of visualization, coordination, simulation and dynamics. However, BIM technology cannot realize the exchange between virtual and reality. AR augmented reality technology is introduced to solve the practical problems through the interaction with virtual technology.

3.1. BIM technology

BIM technology can visually display the geometric, physical and functional information of a building project. As long as the BIM model is built, the required building information can be extracted from the model^[3]. The visualization of the BIM model will help managers and constructors identify all risk sources that exist throughout the construction process. Before construction, the manager can analyze the risk factors and formulate scientific countermeasures to prevent the occurrence of safety accidents according to the BIM model. During construction, managers and builders can integrate and summarize all data and information in the construction process, which will effectively improve the efficiency of construction management. At the same time, all participants can communicate with each other in the cloud model, so that security risks can be continuously concerned and solved in a timely manner. Managers and builders will achieve efficient and coordinated field management.

3.2. AR technology

AR technology is a brand-new human-computer interaction technology, which superimposes generated virtual objects, scenes, video, audio, animation and prompt messages into the virtual reality world through computer technology. AR technology presents a mixture of the real world and virtual world enhanced by information^[4]. Through the mixed technology, it is a high-level human-computer interface with the basic characteristics of interactivity and conception. Using AR technology, we can simulate the real scene, users can not only experience the "immersive" feeling through the virtual reality system. At the same time, we

can break through the limitations of time and space and other objective restrictions, and then feel the experience that cannot be experienced in the real world. At the same time, the user can also see the virtual information superimposed on the real environment, which will improve the user's perception of the virtual model.

3.3. Combination of BIM and AR

BIM integrates all the data information of the building. AR technology can present this data information in a completely new way, which makes communication between the parties more convenient, efficient and real. AR technology also has some features, such as integration of virtual and real world, real-time interaction, 3d tracking and positioning. Combination of BIM and AR, we can provide a more comprehensive, efficient and scientific basis for building safety management. First, according to the design requirements, engineering entity attributes, material properties and other engineering information, we can establish a visual model of the full information coverage with building, structure, mechanical and so on. Second, we need to perfect a virtual scene model combined with the real environment through AR technology, computer, image processing software, sensors and other technologies. Through specific devices, you can immerse yourself in the model environment and feel another virtual world similar to the real world. Finally, we get the feedback results after the model is fused with the surrounding environment through the environment fusion module. We will eventually achieve the visualization, interaction and sustainability of project management. The integration architecture of AR and BIM in engineering site is shown as the figure 1.

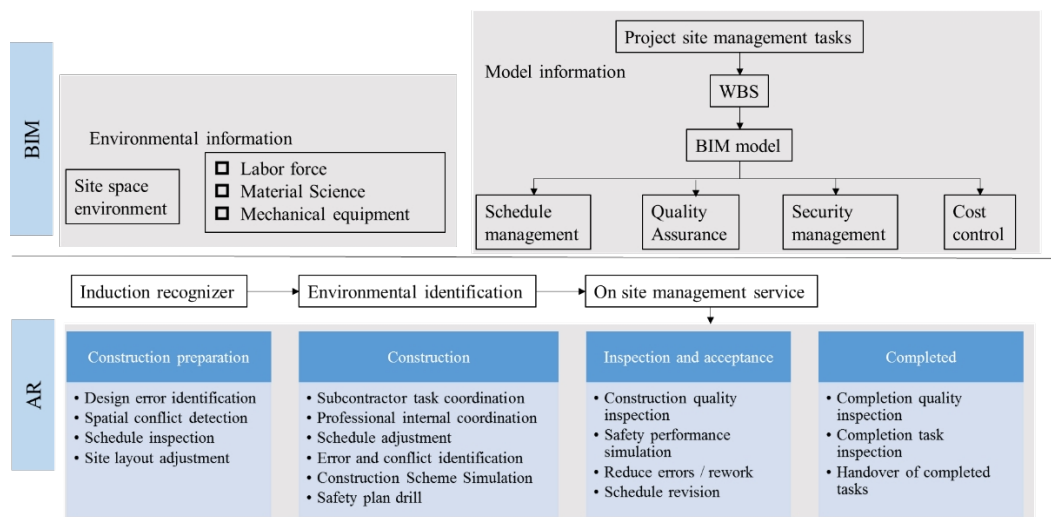


Figure 1. The integration architecture of AR and BIM in engineering site

4. Application on BIM+AR technology in building safety management

4.1. Safety technology disclosure and safety training

Before construction, we can use BIM technology to establish construction safety indexes and analyze various information data in the construction information model. Through the feedback information of simulated construction, we can optimize and perfect the safety index system. We highly associate the construction organization scheme with the construction safety index. In this way, we can realize real-time and effective monitoring of the construction site. Combined with AR technology, managers can more intuitively and efficiently describe project characteristics, technical quality requirements, construction safety and other relevant information. The management and construction personnel shall disclose the operation process, safety risk points and areas with potential safety hazards. According to the identified safety risk points of virtual construction, the construction personnel should be educated and trained. Which will facilitate the construction personnel in a safe state accurately and efficiently complete the corresponding construction tasks.

4.2. Hazard identification and safety notification

In the process of project advancement, the identification of hazard factors is the guarantee of safety management in all stages of construction. By obtaining relevant data information through 3D model and construction progress link, we can carry out 4D simulation through BIM in construction safety management^[5]. The 4D model can further strengthen the relationship between related staff. Through the effective combination of 4D construction model and construction scheme, we can effectively realize the optimal allocation of resources and reduce the use of materials. Which is of great help to improve the orderliness and safety of construction activities. At the same time, workers can see the danger they are facing and give workers the correct rescue measures to avoid misunderstanding through AR equipment^[6].

4.3. Information feedback and security walkthrough

BIM model is the virtual information representation of real buildings. Through the combination of BIM and AR technology, we can build a virtual construction environment with images, so that participants can completely immerse themselves in the emergency drilling environment according to their roles. By perceiving the environment, the drill personnel can fulfill the requirements of the emergency drill with high quality so as to truly achieve the effect of the emergency drill. The hazard source is marked on the model by BIM. When the safety officer instructs the construction on site, he can check the corresponding site position on the model and pay attention to the problems during the construction. These work can avoid the occurrence of safety accident to the greatest extent. After the completion of construction, the operation information in the whole construction process will be recorded and transmitted to the BIM database. They will eventually form a database of security information, providing a reliable basis for future projects.

5. Conclusion

Construction safety management is always an important part of construction management. Construction safety management is relatively difficult for the following reasons. For example, the construction environment is complex, the construction process is numerous, and there are many construction safety risks. By introducing BIM and AR technology, we can intuitively demonstrate the whole construction

process by building models. This can help managers more clearly understand the construction of each link, so as to constantly optimize the construction scheme. Through BIM and AR technology, we will nip all kinds of safety hazards in the bud, and comprehensively improve the safety and reliability of construction projects.

Acknowledgements

Study on Training Model of Building Safety Management under Virtual Simulation Technology (FJJKCG18-117).

References

- [1] MEZA S, TURKZ, DOLENC M. Component based engineering of a mobile BIM-based augmented reality system[J]. Automation in Construction, 2014, 42(6): 1-12.
- [2] SACKS R, WHYTE J. Safety by design: dialogues between designers and builders using virtual reality[J]. Construction Management and Economics, 2015, 33(1): 55-72.
- [3] Wang tingkui, Yang zawen. Case comparison and analysis of the application of BIM and AR in construction site training [J]. Construction technology, 2016, 45(6) : 44-48.
- [4] Ma Chunyue. Application of BIM and AR technology in construction site[J]. Engineering Construction, 2017(5).
- [5] Zhang Lu. Teaching Reform of Architecture Courses Based on BIM and AR/VR Technology - Taking the Course of Construction Engineering Technology as an Example[J]. Journal of Liming Vocational University, 2019(3).
- [6] QIN Yuejin, TANG Jiyu, TANG Gewei, et al. Application of BIM and AR technology in construction quality control[J]. Building Construction, 2018, 040(012): 2149-2150, 2154.