

Safety Inspection System Using BIM Integrated Unmanned Aircraft System (UAS)

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Recent studies on Building Information Modeling (BIM) have disseminated the advanced visualizations with multidimensional information in the construction industry. The visualized data assists the industry professionals to better understand the construction work sequences and management process during project life cycle. Specifically, in the area of safety, the construction industry has been developing safety plans and management process on BIM application. Traditionally, the construction safety coordinators interpret Two-Dimensional (2D) drawings and refer to construction procedures to establish preliminary safety plans. The quality of the planning relies on the level of experience and the ability of the safety professionals, and it may lead to inconsistent outcomes during the execution of the planning. Academic researchers in the field of construction safety have been focusing on the advanced technologies-integrated safety control systems, such as BIM or Unmanned Aircraft System (UAS). Zhang, et al. (2015) has developed safety planning based on the BIM environment in order to identify fall-related safety issues and prevent accidents before construction starts (Zhang et. al, 2015). However, the construction safety control requires the huge amount of resources, such as men-hour and cost. The lack of resource may hinder effective and efficient safety monitoring to execute the safety management plan on the construction phase. A UAS has recently been used for collecting visual data, such as still images or video for safety management on the construction environment (Irizarry et al., 2012). The UAS-based imagery can be generated to 3D point cloud-based model since it has geo-referenced data, and the model can be also imported into BIM applications. This study will present the integrated UAS and BIM safety management system could improve the efficiency of executing safety plans during the construction stage. This system is also able to allow the safety managers to compare the models on BIM environment and to find out safety problems to be addressed throughout the construction phase.

The main objectives of this research include: (1) developing a framework of UAS and BIM-integrated safety management process, (2) importing the 3D point cloud model presenting safety issues into BIM application, and (3) analyzing the safety-related issues as comparing the BIM data and imported 3D model. Based on these established research goals, the study consists of four main stages to achieve the goals; (1) establishing BIM-based safety management plan, (2) conducting field-testing with off-the-shelf UAS platform (collecting data) on the construction jobsite, (3) generating the 3D model and importing it into the BIM application (processing data), and (4) comparing the primary safety plans and the result of safety inspection using UAS (analyzing data). The library has the element temporary safety structures, such as safety nets, scaffoldings, and guardrails, has developed from a previous study. The author has suggested the best practice of UAS-based safety inspection on construction environments and has learned the lessons about the process of generating point cloud based 3D model and of importing the model into BIM applications from several field experiments. The outcome of this study will contribute to further studies on data exchange system between UAS and BIM for target-based safety inspections during the construction stage. UAS could inspect the targeted construction safety issues as following the safety plan developed on BIM. As a further step, BIM will enable to develop optimized UAS flight missions for automated target-based safety inspection on the construction phase.

Keywords: Unmanned Aircraft System, Building Information Modeling, Safety Planning, Safety Inspection

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