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A FRAMEWORK FOR 3D-MODEL BASED JOB HAZARD ANALYSIS

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ABSTRACT

The accident rate in the construction industry is the highest rate among all industries. In most cases, safety-planning is based on checklists and manual description which are not closely related to the actual and specific construction object. Safety planning in construction is a challenging task because of the large number of parties involved, the constantly changing conditions and the complexity of buildings. The objective evaluation of safety-planning methods regarding qualitative and quantitative factors could be considerably improved by applying innovative and integrated safety-planning tools. Modern technologies, such as Building Information Modeling (BIM), are offering an object-orientated planning approach towards the project's lifecycle. This paper solves this problem by applying an object-orientated and process-orientated job hazard analysis based on Building Information Models (BIM). The proposed rule-based system can detect a safety hazard early on in the design and planning process.

1 INTRODUCTION

Safety planning in the construction industry has to improve across the globe (Melzner et al. 2013). In the US, more than 300 construction workers die because of fall from high every year at work. This figure shows that safety in construction business is still a problem which must be faced. The nature of construction projects are separate stages in the planning process. This leads to unequal information distribution among the involved work planners. The digitalization in the construction industry and the application of modern information technologies bring great potential for improving the construction safety and health in the planning phases. Building Information Modeling (BIM) represents a promising development in the architecture, engineering and construction industries (Eastman et al. 2011). With this technology, accurate building models can be digitally displayed. It supports the design through all its phases until the project is completed, and allows better analysis and control than existing manual processes. The theme of "object-orientated hazard analysis in building construction projects" reflects a model-based analysis of the hazards and risks at construction sites. In this case, components of the object-oriented reference are added and hazards and risks identified. According to the object-orientated hazard analysis in building construction projects, there are some research approaches that can be divided into three categories (Melzner and Bargstädt 2013):

- Manual tools for improving safety planning:
- Possibilities of visualization and their potential for improving safety:
- Automatic construction safety analysis.

2 RESEARCH METHODOLOGY

This research contributes to the improvement of safety at construction sites. The identification of hazards and risks associated with the construction of a building can be divided into three categories: 1) hazards caused by the building geometry, 2) hazards caused by the building and construction environment, and 3) risks caused by the construction method. The architecture of a rule-based system consists of three parts (Fig. 1), and the input data is generated from three different sources. The building objects will be derived from the building information model. The data includes an object's ID, its name, and its geometrical and schedule information. By assigning one or more activity or sub-activity to each object, the entire workflow to build an object is represented. The next step in this approach is to design the rule-base for a geometrical and construction process related hazard.

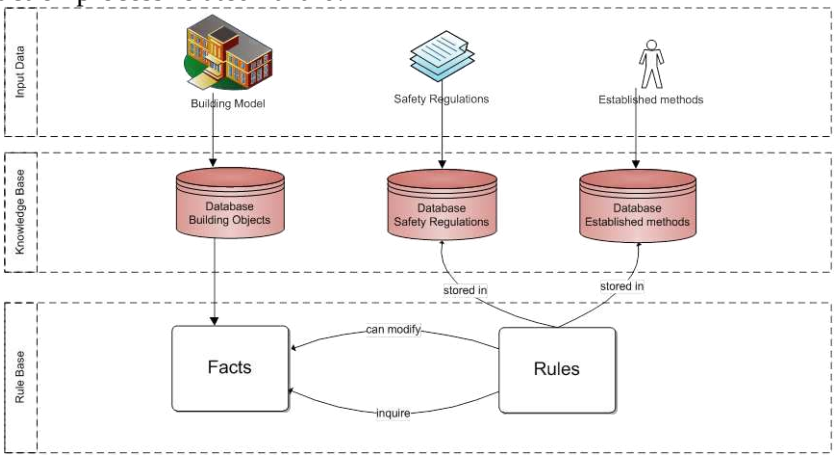

Figure 1: Architecture of the model-based hazard analysis (Melzner and Bargstädt 2012)

3 INTERMEDIATE RESULTS

The aim of this research is to allocate object risks and hazards, and to implement these in a 3D building model of an actual construction project and simulate different scenarios. The results of the implementation indicate a direct link between the risks and the components. They can be selected in the 3D view, and linked directly to one or more risks, and to one or more components. The output of the risk analysis is an automated color representation of the components. The output of the maximum risk value is on the analyzed component. In addition, various selected sets can be formed. The entire research also includes a concept, based on an object-oriented checklist, which also includes the output of an analog risk list and can be applied to the construction site. The topic of risk analysis, based on 3D building models and object-oriented implementation, allows a rapid and early detection of hazards and risks, whereby active measures for prevention can be adopted.

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