Using a Knowledge Based System for Automatic Site Equipment Planning

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Abstract. The site equipment (SE) planning is a fundamental part of the construction preparation. A suitable site equipment supports the timely, cost-efficient and qualitative execution of the construction progress. The use of scientifically based planning tools can both speed up the process of construction site planning and lead to better results. This paper proposes a rule-based knowledge inference system to support SE planners in a semi- or fully automated manner using input data from building information models and working schedules. The knowledge based system is built using the ASL 2 licensed business rule management system *Drools*. Exemplary rules for four types of site equipment have been developed and implemented. Using sample projects, the feasibility of the proposed approach has been proven by showing that site equipment can be generated instantly.

1. Introduction

A reasonable and appropriate site equipment planning supports the timely, cost-effective and high-quality implementation of a construction project. The purpose of the site equipment (SE) is to ensure an orderly, productive and safe execution of all tasks necessary during the construction, reconstruction or demolition of a building or construction. Poorly designed or inappropriately executed site layouts can slow down the construction process, generate unnecessary costs and even constitute actual safety risks, making the process of the construction site layout planning (CSLP) an indispensable step of the execution planning. The first step to create reasonable site layout plans is to identify all needed SE, and to determine the necessary dimensions of each element of the SE. To generate a site layout plan, the SE has to be placed on the available areas.

The necessary site equipment varies widely depending on the conditions of the specific construction project. Due to the large deviations of the circumstances and specific requirements in different construction projects, the site equipment has to be planned individually for each project. However, despite the large impact of the SE on the on-site overheads and productivity of the construction, the site planning process has been formalized very little. Usually, planners conduct the CSLP manually, without technological support. The dimensioning of the individual elements of the SE is mostly realized based on experience of the planners and rules of thumb, without qualitative or quantitative reviews. The results of the manual CSLP planning thus depend solely on the expert knowledge and practical experience of the executing planner.

A large set of information, which is traditionally acquired in very late planning stages, has to be considered during the CSLP process, and changes in the construction design and construction methods usually require the adjustment or re-planning of the SE. To reduce the planning efforts and prevent from repetitive re-planning phases, the CSLP is usually conducted only after decisions on the design and construction are final, depriving the possibility to include information about the necessary SE in the process. In this way, potentially expensive and inconvenient solutions might be condoned because the SE was not taken into account during the construction planning.

To be able to include aspects of the site layout in the planning considerations, a fast and easy way support planners in their decisions by partly or even completely automating the planning of the construction site. To support the planners during the generation of individual site facilities, knowledge based systems (KBS) form a very suitable basis. These systems are computer programs that formalize human knowledge in a strict logical and computable manner, allowing them to infer conclusions from given facts. They are used to assist humans in solving complex problems and tasks.