Rules Complexity Classification for Automated Compliance Checking

Seyedamir Hakim, Fulvio Re Cecconi, Mario Claudio Dejaco, Sebastiano Maltese
Politecnico di Milano, Italy
seyedamir.hakim@polimi.it

Abstract. Buildings are growing in complexity and so laws and standards; traditional code checking, as well as laws creation, are no more sustainable, especially in terms of information management (storage, elaboration, update, etc.). This research is focused on the creation of a new automated compliance checking process, looking not only at how rules are checked, but also at how rules are created; this involves the classification of rules in different categories and their elaboration, to translate them from plain language (although it usually is a "complex language") to computer-readable language, associated to attributes implemented in the Asset Information Model by the various stakeholders during building life (since early design to operation). This paper presents a preliminary classification of rules usually found in building codes, standards and laws. Some examples are shown to demonstrate the robustness of the classification provided.

1. Introduction

Automated compliance checking (ACC) is expected to reduce time, cost, and errors of compliance checking (Salama and El-Gohary, 2013; Hjelseth, 2012). Many efforts have thus attempted to automate the compliance-checking process, including: (1) SMARTcodes project by the International Code Council (ICC); (2) construction and real estate network (CORENET) project led by the Singapore Ministry of National Development; (3) REScheck and COMcheck software by the U.S. Department of Energy; and (4) the Solibri Model Checker (Eastman et al., 2009). However, despite their importance, these efforts are still limited in their automation and reasoning capabilities; the state of the art in ACC still uses ad hoc reasoning schema/methods, with lack of support for complete automation.

A common to automated code checking is systematic comparison, i.e. comparing each object or system in a building model representation with the constraints in a standard. The output is usually a non-conformant objects list (Dimyadi and Amor, 2013).

Rule checking on a building model is a complex problem. Much research work has been done in this area for the past 50 years, but with limited success. The complexity covers: (a) building data; (b) how the information is presented and how easy it is to access it; (c) rule specifications and requirements that present entirely different complexities with their construct and their limitless variations and various semantic meanings that often are domain dependent (Solihin and Eastman, 2015). Most of the efforts in rule checking often resulted in a very limited capability to solve building rules. Some solutions are too complex that the cost of implementation becomes prohibitively high, or too rigid that they are unable to adapt to even minor rules changes or variations.

This research is focused on the creation of a new ACC process, looking not only at how rules are checked, but also at how rules are created; this involves the classification of rules in different categories and their elaboration, to translate them from plain language (although it usually is a "complex language") to computer-readable language, associated to attributes implemented in the Asset Information Model (AIM) by the various stakeholders during building life (since early design to operation).

The aim of this paper is to provide an initial guide for creating a framework for rules classification that expresses both the process challenges and the technology needs to address