Towards Better Co-Design with Disciplinary Ontologies: Review and Evaluation of Data Interoperability in the AEC Industry

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Abstract

In the building industry, disciplines have specific requirements for capturing, storing and representing information. As a result, one physical object yields several disciplinary representations, allowing designers to describe design options discipline-specifically and thus explore design differently. In a co-design approach, data from disciplines must be integrated and interoperable. But in current practice, interoperability problems between different software often hinders data integration.

This paper presents a review and evaluation of interoperability paradigms in centralized, decentralized, and federated data, and it gives AEC application examples for each approach. It discusses data schemas (e.g. IFC) and interoperability tools (e.g. Speckle, BHoM). It also relates the interoperability tools to semantic web standards that are used to share information. It argues the advantages of federated data interoperability and suggests using design tools that employ such a mechanism. Furthermore, this paper suggests developing modular disciplinary ontologies to support collaborative design tools. Such federated interoperability, supported by modular disciplinary ontologies, can provide a solid ground to share and exchange data flexibly.

Keywords

Interoperability, Co-Design, Knowledge representation, Ontologies, Building Information Modelling (BIM), Data mapping and alignment

1. Introduction

Architecture, Engineering, and Construction (AEC) projects need multidisciplinary solutions, where each discipline has specific requirements for capturing, storing and representing information [1]. While a structural engineer would represent a building as a whole of columns, beams and slabs, which can be further simplified as linear elements during structural analysis, an architect would view columns and beams as solid three-dimensional objects and would instead idealise a building as an aggregation of spaces [2]. Similarly, other disciplines also have specific requirements for capturing, storing, and presenting relevant information [3]. Such disciplinary representations of buildings and building elements also allow a disciplinary exploration of design options. Analysis of each model

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