Ontology-Based Access Control Module for Digital Product Passports Within Built Environment

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Abstract

Digital Product Passport (DPP) is a digital identity card for products, components, and materials, which will store relevant information to support products' sustainability, promote their circularity and strengthen legal compliance. According to recent research, DPPs are developed to enhance transparency, traceability, circularity, and sustainability throughout a product's lifecycle. However, DPPs often contain sensitive product and operational data, managing secure and stakeholder specific access is a critical challenge. This study addresses the need for fine grained access control by implementing an Ontology-Based Access Control (OBAC) approach within a modular DPP architecture. The method combines a systematic literature review and expert interviews to identify access control requirements and inform the development of a security-focused ontology module. The OBAC framework integrates semantic rules and role-based constraints using OWL and SWRL to enforce dynamic, policy-driven access. The model was evaluated through selected DPP use case and validated via reasoning, SHACL constraint checking, and expert review. The findings demonstrate that OBAC can effectively enable secure, role-sensitive data exchange in DPP systems, while supporting FAIR data principles and regulatory alignment. This work contributes a reusable semantic framework for secure DPP implementation in the built environment.