Harmonization of Physical Asset Data

Leveraging Knowledge Graphs with a Semantic Approach using RDF and SHACL

Graduate

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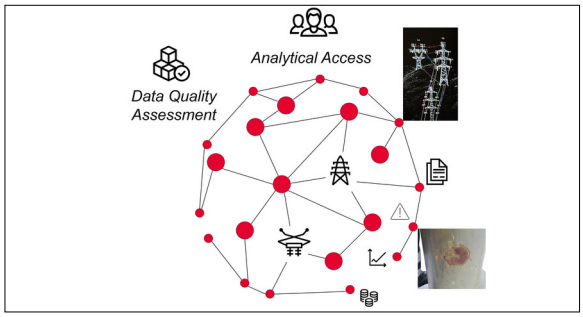
Introduction: As the asset management of the electricity transmission grid becomes increasingly digitalized, more and more data is being collected from various distributed systems. This data serves as a foundation for analysis and automated business processes. This demand requires robust data management and raises the concern for better data quality, leading to the need for automated data validation. This thesis explores the harmonization of physical asset data through a semantic approach using RDF and SHACL.

Approach / Technology: The thesis addresses the challenges faced by Swissgrid in managing diverse and distributed asset information and proposes a linked data approach to analyze data quality to improve data validation and integration.

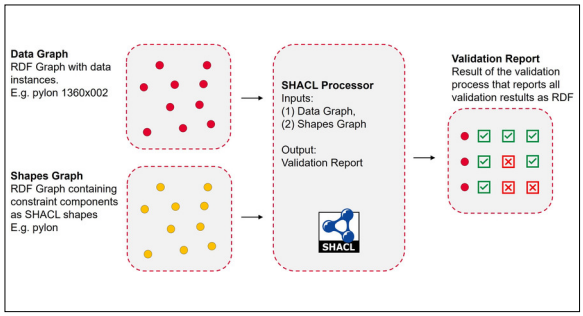
The first objective is to provide a foundation for the use of RDF and SHACL to establish an automated data validation process that ensures compliance with defined standards. Through the development of a conceptual framework and a proof-of-concept implementation of the validation workflow, it is demonstrated how data quality can be analyzed and evaluated. A method called SHACLer has been developed to automatically generate SHACL shapes from the Object Type Library to streamline the validation process.

Conclusion: The developed concept allows to validate different views and maturities of the data model, which is of particular interest for the validation of decentralized data stores and in the application of Linked Building Data. While SHACL has proven to be highly effective for base validations, it has limitations for complex validation methods. To address this, a method was developed to incorporate complex validations into the semantic validation process enabling the use of custom written constraint functions in Python. The findings highlight the potential of linked data technologies to facilitate a better digital representations of our physical infrastructure.

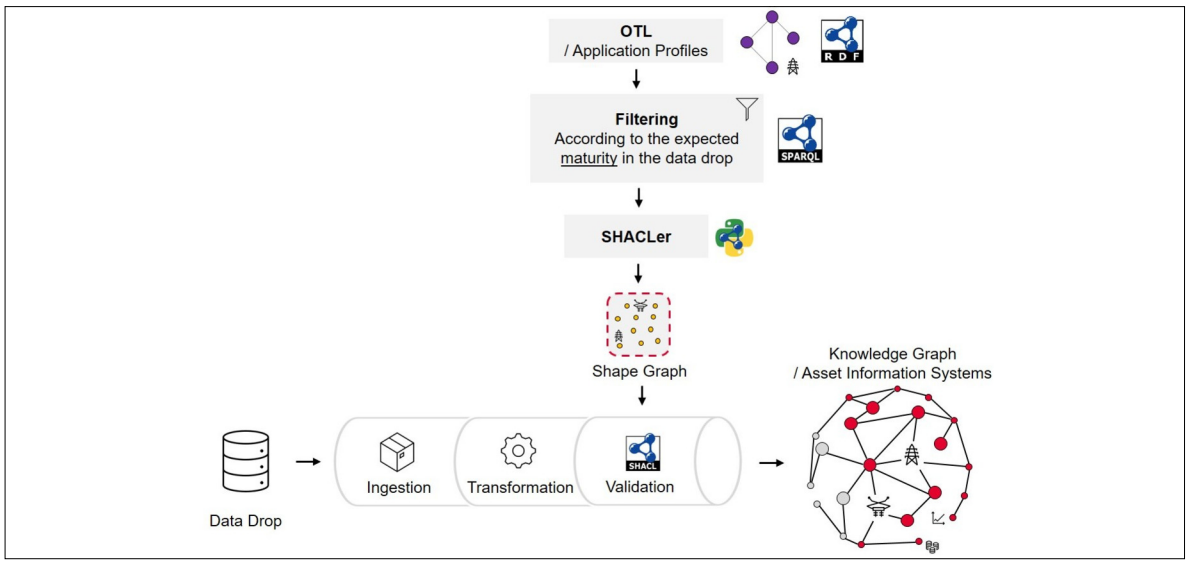
Asset Knowledge Graph
Own presentment



RDF Data Validation Process with Data- and Shape Graph
Own presentment



Data Validation for different Views and Data Maturities
Own presentment



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