Exploring the benefits of Semantic Web Technologies for providing holistic end of life analysis of civil infrastructure in the Netherlands

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Abstract

The Netherlands struggles with revitalizing its transport infrastructure stock due to physical and economic aging. Changing functionalities and (both man-made and climate-)threats give rise to new requirements. To make the transport infrastructure and land use fit for the future, asset managers need to carefully plan the interventions in a systematic way. It is thus essential to understand the changing demand of the area and the (designed and current) object characteristics and to get a grip on the effects of the aforementioned changes on those objects. The condition & properties of critical components of each infrastructure type, the impact on the network performance, and the effects of new developments in the transport systems together have intertwined relations. These relations play diverse roles in the object's overall performance. Together they contribute to a holistic age beyond their technical state. This holistic concept requires a multi-domain and multi-level approach and enables spotting unhealthy assets on-time to avoid major societal consequences such as in Bridge Itteren, Princess Margriet Tunnel, and Meerwede Bridge. Currently, there are knowledge gaps to fill for implementing the concept:

1. On the decision-making level: End-of-life decision rules are currently defined yet ambiguous. Such official documents represent generic conditions that do not help asset managers specify thresholds & information requirements per criteria, nor do they objectify on what bases the assets may reach end-of-life.
2. On a portfolio level: Asset managers miss the overview of their object knowledge. Information in terms of object type, critical components, material-specific degradation, observed damages, risks, and mitigation measures are periodically obtained but registered in various vendor-locked systems. Quantified design and changed demand properties on corridors exist but are also scattered in the asset management organization.
3. On the object level: Historical information, crucial to generate prior knowledge on assets, exists but is spread. There is also a large volume of output data and object information available through the evaluation of specific objects and selected failure modes via domain models. This is distributed over different departments and even organizations and also targeted at the tactical decision-making that deals with the component level. Even though the outcome of such evaluations contributes to generating asset knowledge, this object knowledge is not digitally represented, stored, and not always consolidated to the portfolio level.

Semantic Web (SW) Technologies, particularly ontology-driven rule-checking models present the potential to fill these gaps. This presentation will discuss the benefits of SW for the holistic age analysis of civil structures via use-case: 3 Lock Complexes at Twente Canal managed by the Dutch Road Authority. The presentation focuses on capturing knowledge in historical inspection reports, functional data, and inspection data sets and makes the wealth of enclosed information usable for their replacement and renovation processes through foreseen rule-checking and semantic reasoning. It will conclude with a road map for public asset managers via the example of the Road Authority..

Keywords

Knowledge graphs, Idea / Vision, Use case

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