

Knowledge modeling and provision for circular economy aspects of municipal infrastructure projects

Against the backdrop of constantly increasing demands on circular economy and sustainability, municipalities in particular are confronted with major challenges in their diverse areas of operation. The municipal infrastructure construction sector has a significant share here. The existing infrastructure is in a state of deterioration and therefore major investments are needed both now and, in the future, alongside planning and construction efforts to plan, create and operate a sustainable and resilient infrastructure that is viable for the future. In doing so, it is important to draw lessons from the past and think holistically about infrastructure projects. In addition, the assets must be considered within the municipal infrastructure network and municipal boundary conditions must be taken into account. It becomes clear that a wide variety of actors, processes, asset information and aspects of sustainability and the circular economy have to be considered for a valid decision-making process. The information required for decision-making is either explicitly available in widely heterogeneous data (silos) or is based on implicit (expert) knowledge.

In this context, the topics of linked (open) data and semantic web are therefore increasingly coming into focus for the municipalities. With *ByData*, there is already an open data platform published in Germany that allows to retrieve infrastructure knowledge from municipalities via a SPAQRL endpoint. Other federal states and municipalities are also pursuing projects to enable the semantic use of a wide range of municipal infrastructure data. Currently, the services and queries provided still mainly relate to a variety of government, weather, health, and particularly geodata (e.g. location information, maps and data from GIS systems).

The approach presented in this poster is intended to emphasize the provision and use of semantic information, especially for the world of highly complex municipal infrastructure projects. In a first step, a superordinate framework for infrastructure networks is presented. The framework addresses the linking of network, object, process and sustainability information, the formalization and provision of implicit process and decision-making knowledge including municipal boundary conditions and constraints, and the merging of life cycle aspects (design, planning, construction, operation & maintenance, demolition) in combination with sustainability assessment information.

This merging of information from the various areas relevant to infrastructure construction will enable the retrieval of material flows and resource hotspots (spatiotemporal) as well as the retrieval of details of actions at object level (specific-procedural).

The overarching objective of linking the heterogeneous and distributed information landscape is to create a queryable knowledge base that allows competence questions to be answered across different life cycle phases with the help of a developed ontology and a corresponding knowledge graph.

In summary, a framework for the comprehensive provision and use of knowledge is being developed, which is intended to support municipalities within the framework of their infrastructure management in order to provide transparent information on network-wide competence questions for sustainability aspects. Looking ahead, the developed solution is to be implemented and evaluated on the basis of specific use cases and projects (e.g. ongoing projects at our research group on geogrids or precast concrete elements), so that in addition to the provision of relevant knowledge, specific sustainability determinations are also to be made possible.

Keywords: Knowledge engineering; Life cycle considerations; Infrastructure management; Semantic Web/Linked Data