



An Integrated Approach to Street Works and Utilities Decision Making – The Asset Ontologies

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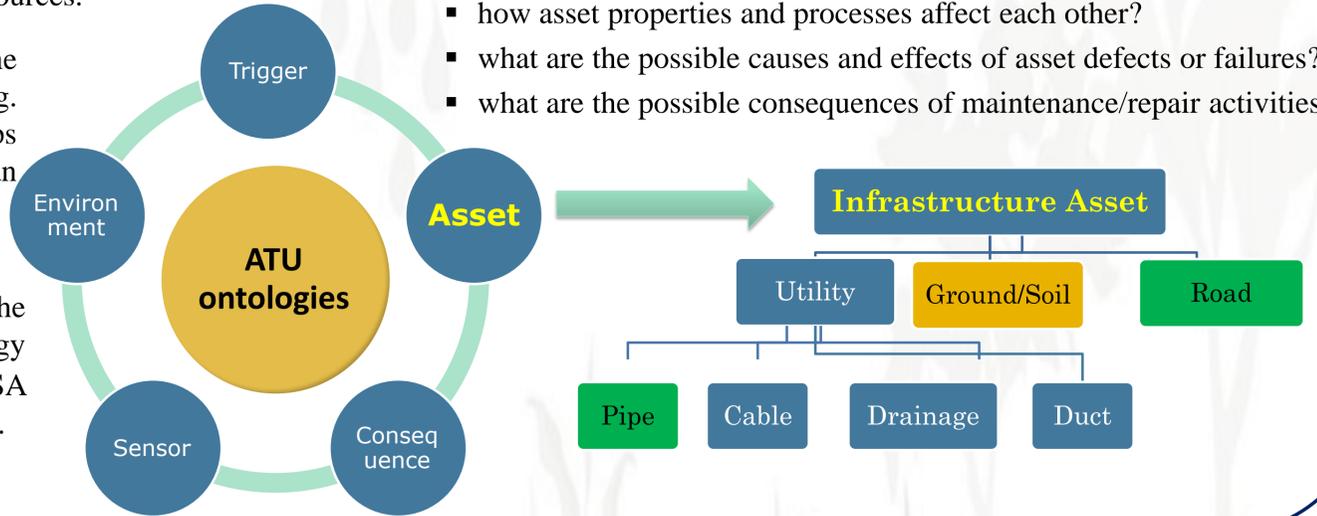
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A Family of Interlinked Modular Ontologies

An ontology defines a **common vocabulary** for people who need to share information in a domain (e.g. roads). It includes **machine-interpretable definitions** of basic concepts in a domain and relations among them. It provides a way of integrating data from multiple sources.

The **ATU infrastructure asset ontologies** define the **main concepts** describing buried utilities (e.g. pipes), ground, roads, as well as their relationships with the natural environment (e.g. rain) and human activities (e.g. maintenance).

The ATU infrastructure asset ontologies reuse the top-level concepts from the SWEET ontology (<https://sweet.jpl.nasa.gov>) developed by NASA and specify them for different infrastructure assets.



The ATU ontologies are used together in the ATU decision support system to help users understand:

- how different assets affect each other?
- how asset properties and processes affect each other?
- what are the possible causes and effects of asset defects or failures?
- what are the possible consequences of maintenance/repair activities?

An Ontology of Ground Properties and Processes

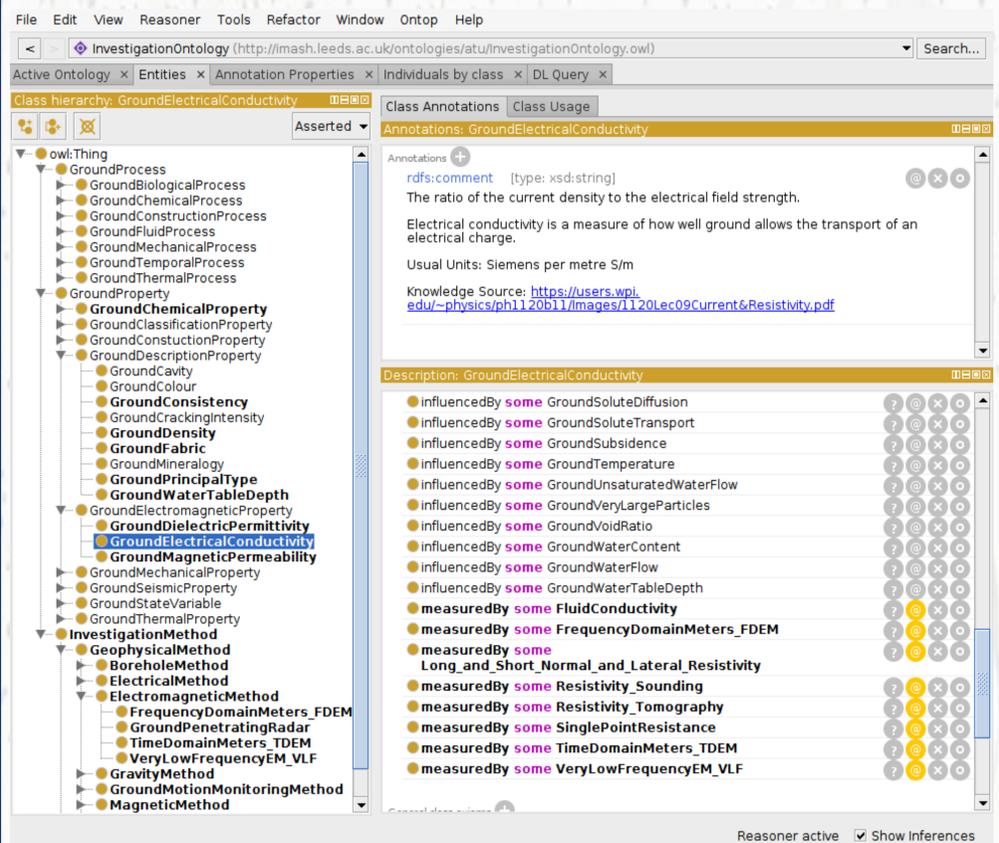
The ATU ground ontology describes:

- different kinds of ground properties and processes;
- how ground properties and processes affect each other, e.g. ground consolidation decreases ground porosity.



Other ATU Ontologies

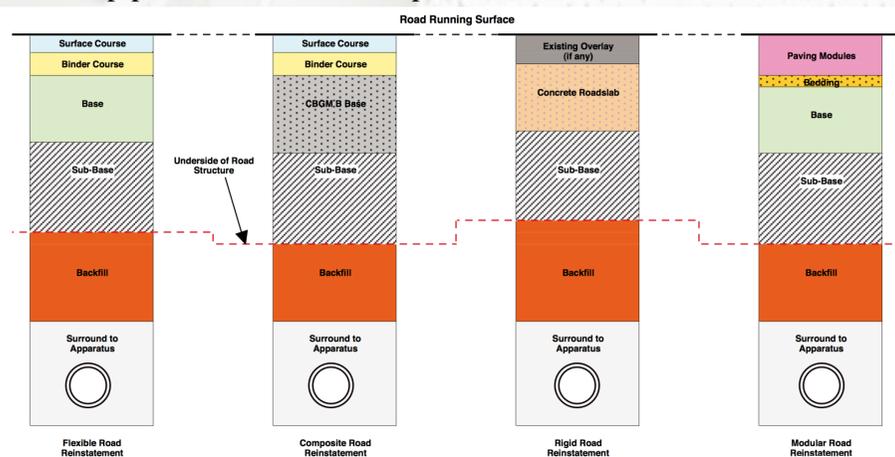
- The **Environment Ontology** models the environment factors (e.g. rainfall) affecting or being affected by the infrastructure assets based on several existing external ontologies (e.g. NASA's SWEET Ontology).
- The **Trigger Ontology** defines the categories and properties of events that require some decisions to be made in subsurface infrastructure asset management, e.g. loss of water pressure, potholes.
- The **Consequence Ontology** defines the categories/properties of undesirable consequences in asset management, e.g. road collapse.
- The **Investigation/sensor Ontology** encodes the knowledge of the available geophysical techniques in shallow (0-5m depth) street works surveys, e.g. the ground electrical conductivity can be measured by resistivity sounding.



Ontologies describing Roads and Pipes

The road and pipe ontologies describe:

- different kinds of roads/pipes, their properties and components;
- road/pipe defects, factors influencing or influenced by them, as well as possible causes and effects of defects;
- road/pipe maintenance and repair activities.



Structures of Different Types of Road

Source: New Roads and Street Works Act 1991 Specification for the Reinstatement of Openings in Highways

- The City Infrastructure Asset Ontologies are openly available from the University of Leeds data repository: <https://doi.org/10.5518/190>.

Visualization of the interlinked Ground and Investigation/Sensor ontologies using Protégé

The concepts and relation statements are created based on

- the knowledge of domain experts,
- existing ontologies, standards, textbook, etc.