



# ONTOLOGIES FOR MATERIALS, COMPONENTS, HVAC EQUIPMENT

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**Sustainable Places 2022,**  
**Nice 07.09.22**

# CONTENT



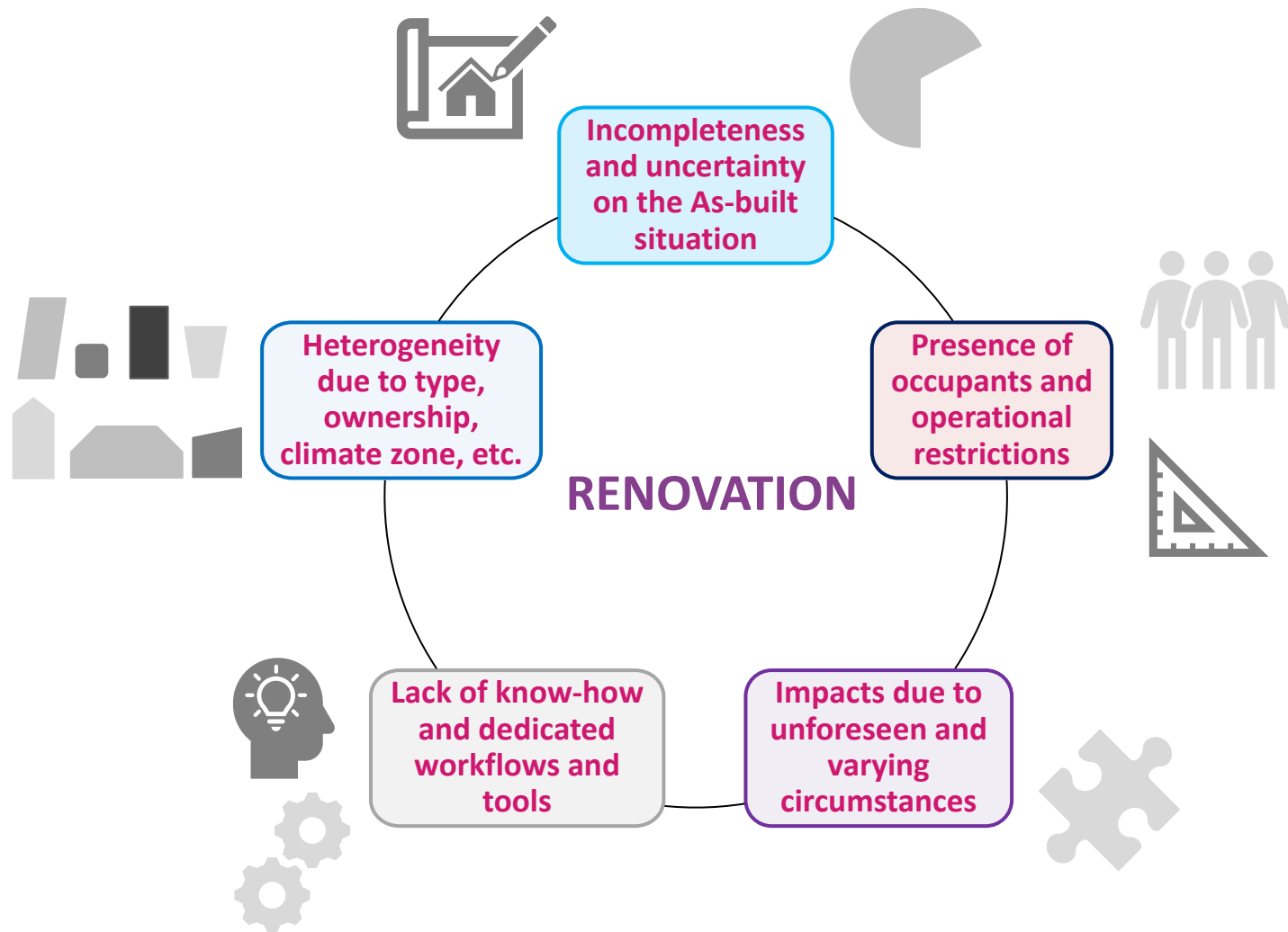
- Renovation projects
- Knowledge representation
- BIM-SPEED Knowledge models and methodology
- Exemplification: The Reno-Inst Ontology






# A CLOSER LOOK TO RENOVATION PROJECTS AND KNOWLEDGE REPRESENTATIONS

# RENOVATION PROJECTS



# WHAT IS A KNOWLEDGE REPRESENTATION?

A set of symbols and text that describe some information domain, it is a tool that helps stakeholders better understand a set of attributes and business rules [1].

A simple line-art icon of a lit lightbulb, with several short lines radiating from the top half to represent light or an idea.

An ontology is a representation that explicitly specifies concepts, terminologies, and relationships that are known in a particular domain. Establishing a common vocabulary for users, including machine-interpretable definitions of basic concepts in the domain and relations among them [2].

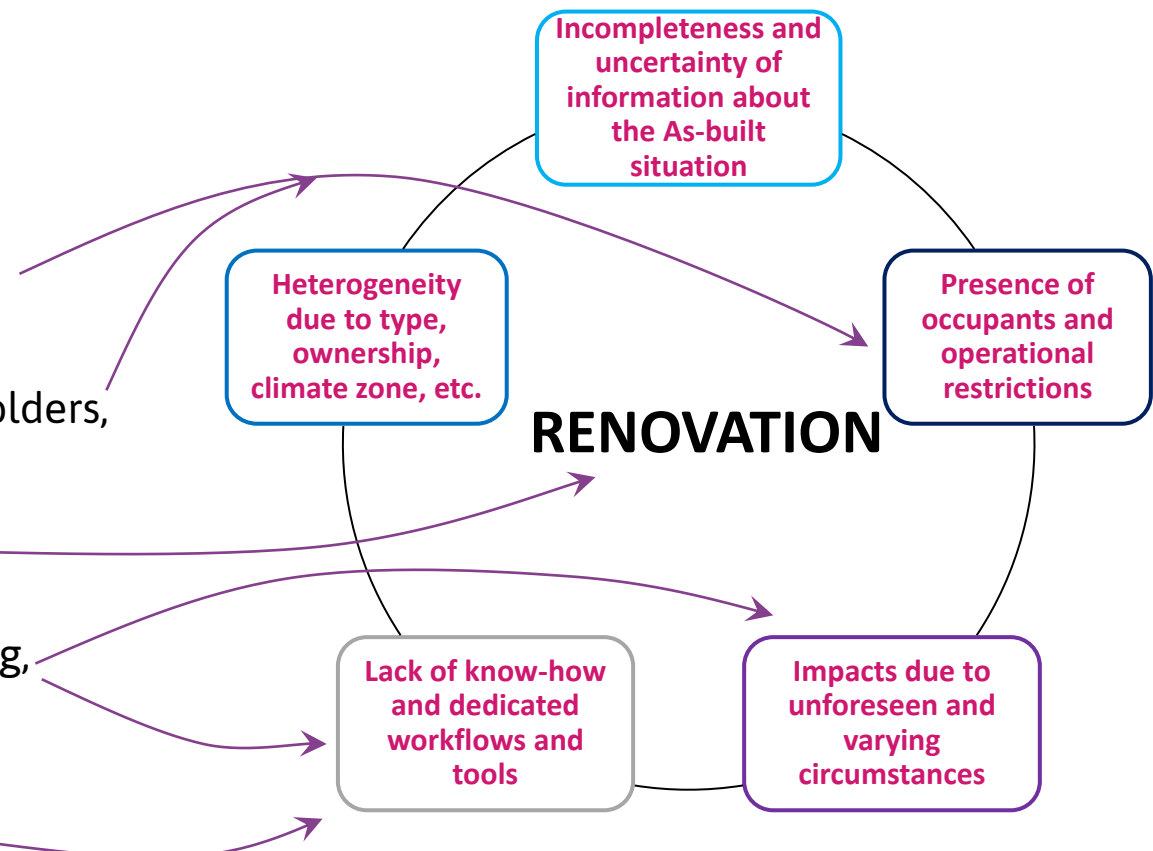
[1]. M. Uschold, M. and Gruninger, Ontologies: principles, methods and applications, Knowl. Eng. Rev. 11 (1996) 93-136.

[2]. N. Noy, D. McGuinness, Ontology development 101: A guide to creating your first ontology. Knowledge Systems Laboratory 32, 2001.

# WHY FOR RENOVATION?

An ontology can improve:

- The consistency and lack of ambiguity,
- Interaction between stakeholders,
- Interoperability,
- Knowledge reuse and sharing,
- and enable more reliable computational tools [2].



[2]. N. Noy, D. McGuinness, Ontology development 101: A guide to creating your first ontology. Knowledge Systems Laboratory 32, 2001.





# KNOWLEDGE MODELS AND METHODOLOGY

# FOCUS OF THE INITIATIVE

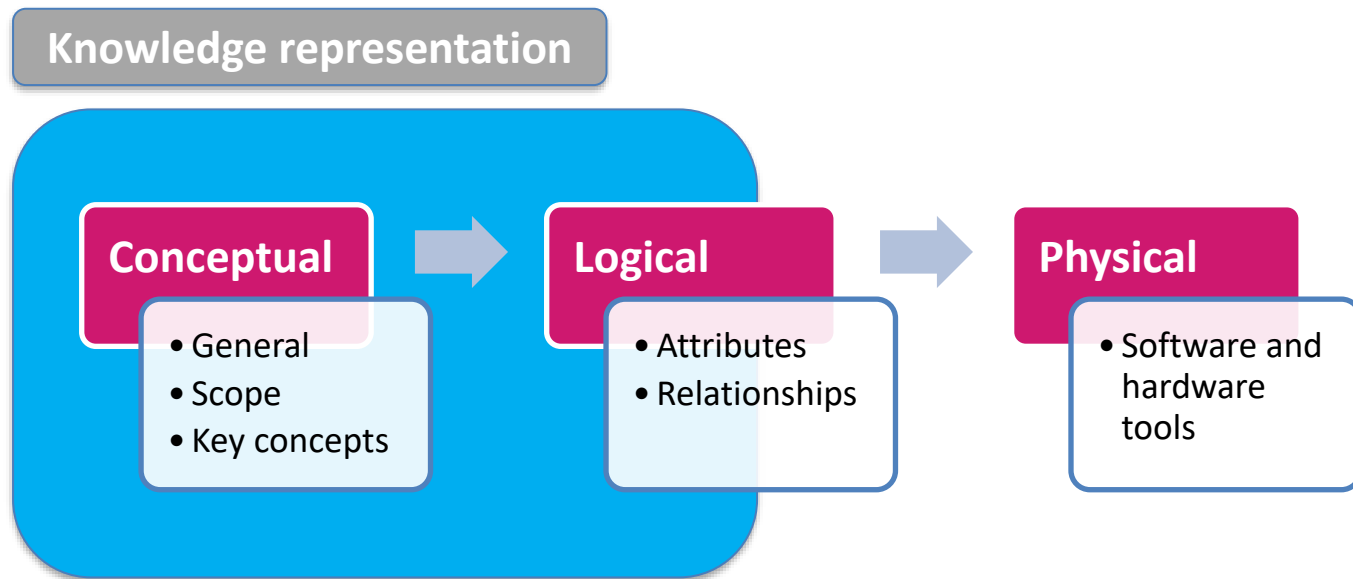


Figure 1. Knowledge representation





# METHODOLOGY

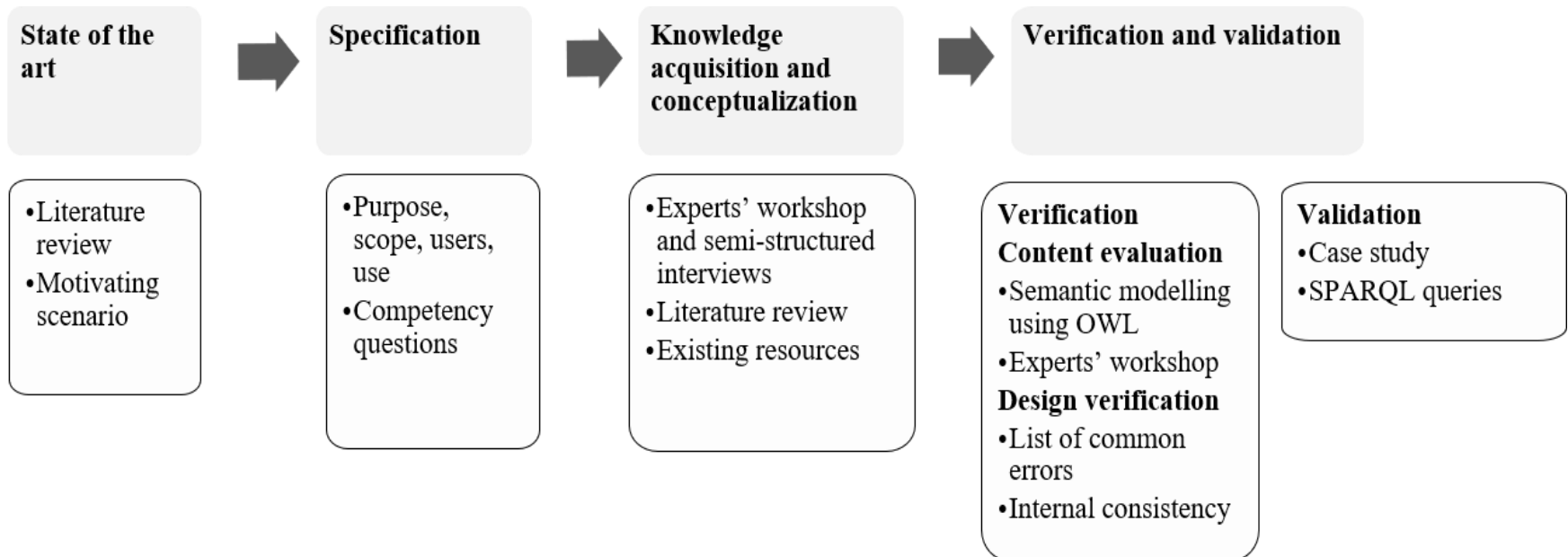


Figure 2. Methodology



# ONTOLOGIES

Renovation planning?

**Reno-Inst**

- Existing guidelines
- Expert's workshops and interviews

LCA/C analysis of potential alternatives

**LCA-C**

- Previous research initiatives
- Standards such as EN 15978

BEM model?  
...From BIM to BEM

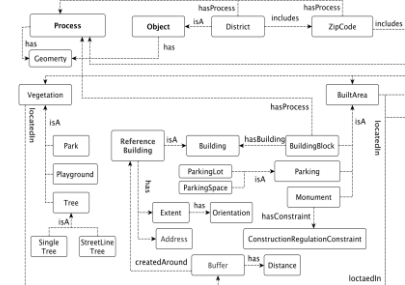
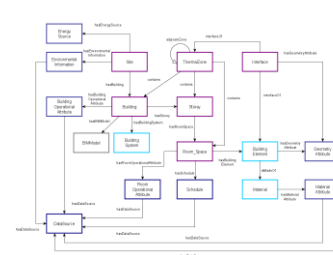
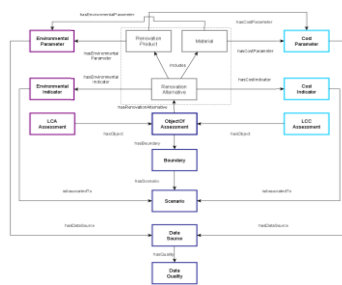
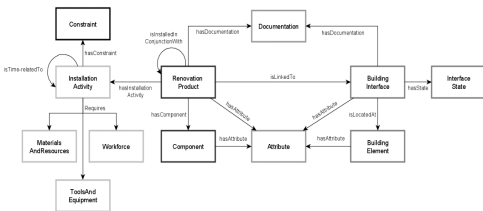
**BEM-Reno**

- Existing BIM to BEM workflows
- Previous research initiatives
- Existing ontological resources

Is it the surrounding relevant?

**GIS-Based**

- Use cases
- Related literature
- Existing GIS representations





# RENO-INST ONTOLOGY

**AN ONTOLOGY TO  
SUPPORT RENOVATION  
PROJECTS PLANNING AND  
RENOVATION PRODUCTS  
INSTALLATION**

# RENO-INST: SPECIFICATION

- ***What is the purpose?***

The Reno-Inst ontology is developed to represent concepts related to **requirements, constraints, and the installation of renovation products** to support planning and execution tasks in building renovation projects.

- ***What is the scope?***

The ontology covers concepts and relations regarding **the installation of windows, ETICS panels, and radiators**, which are common renovation products. The ontology includes information on **physical features, general installation procedures, constraints** that should be considered, and additional elements such as workforce, time, and tools requirements.



# RENO-INST: SPECIFICATION

- ***What are the intended end-users?***

The final intended users are **project managers, site-directors, and other stakeholders** which are involved in the **planning and execution** of construction activities in building renovation projects.

- ***What is the intended use?***

To assist stakeholders during the planning and execution phases of renovation projects, **facilitating the retrieval of installation information for different purposes**. For instance, a user can list **the tools and materials** required to install a window. A user can also verify whether a specific construction task can be performed in **the presence of occupants**.



# RENO-INST: OVERVIEW

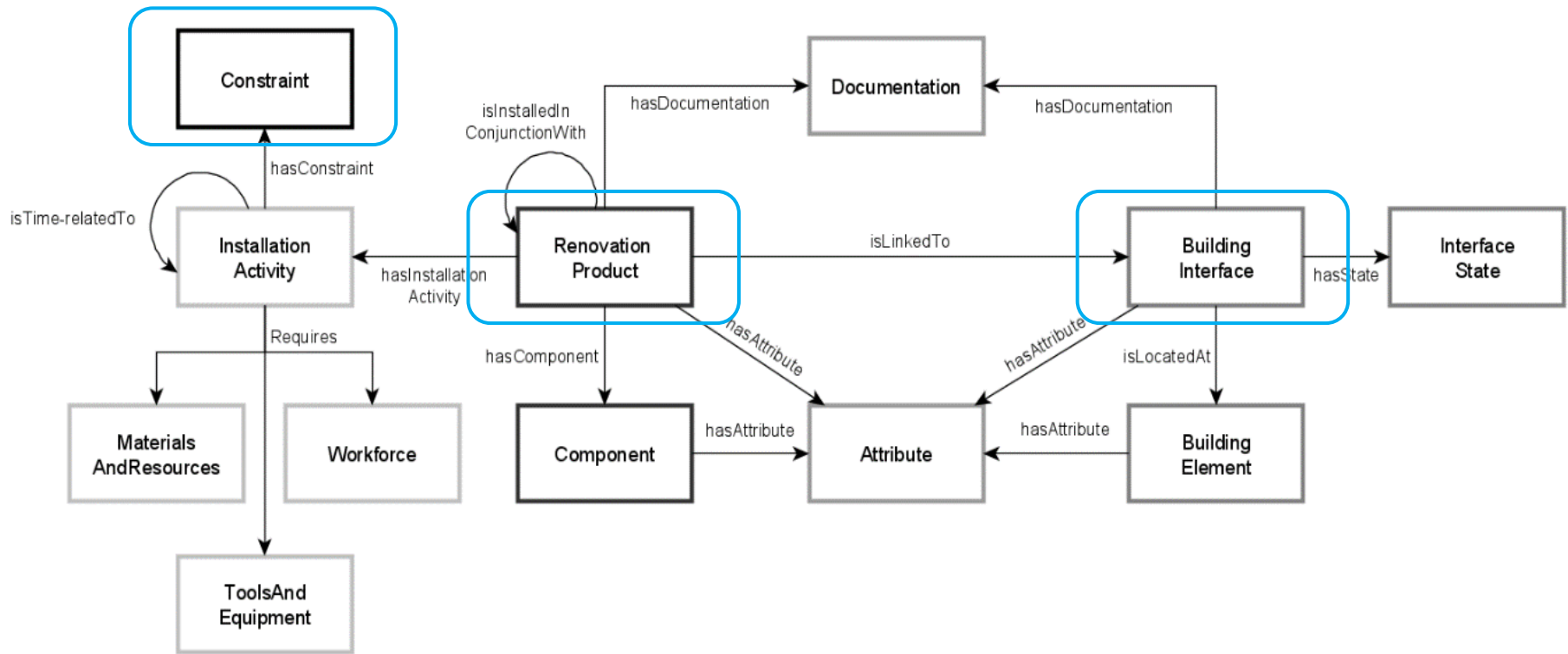


Figure 3. Reno-Inst ontology overview

J.A.P Amoroch, T. Hartmann, Reno-Inst: An ontology to support renovation projects planning and renovation products installation, Advanced Engineering Informatics, Volume 50, 2021, 101415, ISSN 1474-0346, <https://doi.org/10.1016/j.aei.2021.101415>.



# RENO-INST: SPARQL QUERIES



## SPARQL query:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX reno: <http://www.systemsEngineering.org/jersonpinzon/Reno-Inst.owl#>
SELECT ?ETICS_Panel ?RenovationProduct
WHERE { ?ETICS_Panel rdf:type reno:ETICS_Panel.
```

## SPARQL query:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX reno: <http://www.systemsEngineering.org/jersonpinzon/Reno-Inst.owl#>
SELECT ?ETICS_Panel ?InstallationActivity ?Constraint ?Description
WHERE { ?ETICS_Panel rdf:type reno:ETICS_Panel.
?ETICS_Panel reno:hasInstallationActivity ?InstallationActivity.
?InstallationActivity reno:hasConstraint ?Constraint.
?Constraint reno:hasDescription ?Description}
```

ETICS_Panel	InstallationActivity	Constraint	Description
thermal_classic_mineral_panel	Removal_gas_pipelines	basic_services_interruption	"When basic services such as water or gas are interrupted by an activity. A notification should be send to the occupants 48 hours previous the starting of the activity"

Figure 4. Reno-Inst ontology queries



# FINAL REMARKS

- Knowledge representations can be the starting point to formalize **information requirements** from the renovation domain, develop **dedicated tools** to support specific tasks within renovation projects, and **support interoperability** between the diverse information sources available in these projects.
- The description of the ontological models is available within **Deliverable 2.2** on the **BIM-SPEED website**
- Potential future research activities include:
  - Validating the additional knowledge models
  - Further development of the models' documentation and description







# COLOPHON



07.09.2022

**Sustainable places 2022**

Nice

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