

# Technical review of existing standards

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Innovate  
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# Short description

- This technical review examines the existing ontologies, standards, and data models in the AEC domain and explore how they can be reused for the purpose of automatic compliance checking.
- This technical review explores the resources from the open Zotero library of the project<sup>1</sup>

<sup>1</sup> [https://www.zotero.org/groups/3007408/semantic\\_bim/library](https://www.zotero.org/groups/3007408/semantic_bim/library)





# In which use cases it can be applied?

- Evaluate the AEC domain-related ontologies and propose suggestions on how they can be employed for the development of the AEC3PO Ontology.
- Compares the rule languages developed or used in AEC projects as well as the existing reasoners that could be useful to building permitting automatic compliance checking.





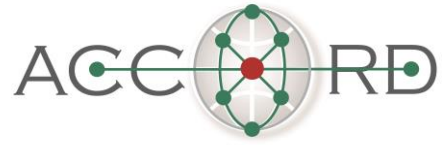
# Who can apply?

- The findings of this technical review will serve as a reference for other tasks within the project, which will:
  - Determine which ontologies can be reused, aligned, or serve as inspiration for the creation of the AEC3PO to be developed in **Task 2.2 of WP2**.
  - Determine the preferred rule languages that can be used in other tasks of the project (**T2.3** and **T2.5**).
  - Describe various reasoners and rule engines, this information will be particularly valuable for **WP4**.
  - Determine the standards that can be employed in various aspects of the ACCORD project in **WP2** and **WP4**.



# Content

- Issues
- Ontology Classification
- Ontology Metrics
- Ontology Assessment
- Conclusion



# Issues

- There are several ontologies in the construction domain.
- It is necessary to examine the work of working groups, organizations, and projects in the building sector.
- These ontologies need to be evaluated.
- There is no single ontology that can fully meet our needs.





How can we present the existing domain ontologies used in the AEC field, with a detailed explanation of their characteristics?



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# Ontology Classification

## **Classification by Application Domain:**

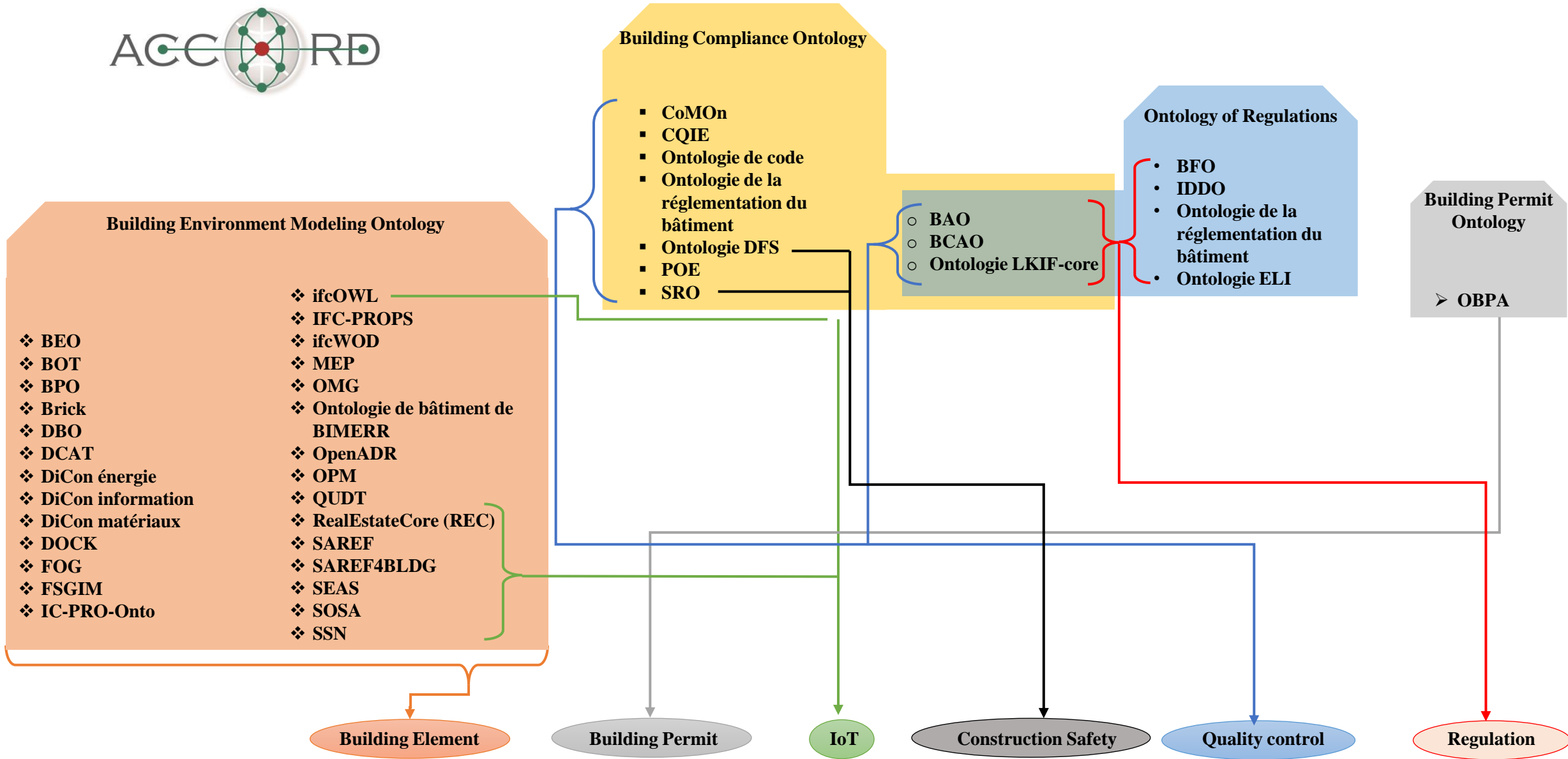
- Building Environment Modeling Ontology
- Building Compliance Ontology
- Regulations Ontology
- Building Permit Ontology

## **Classification by Ontology Characteristics:**

- Building Element
- Building Permitting
- IoT
- Construction Safety
- Quality Control
- Regulations





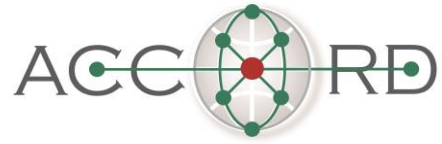




# Ontology Metrics

- **Statistical measures** describe the number of classes, individuals, and properties, as well as the maximum depth, the highest number of children, and the average number of sub-classes or sub-properties.
- **Quality control and assurance metrics** focus on the number of classes with only one subclass, classes with more than 25 subclasses, and classes lacking a definition.





# Ontology Metrics

- Some ontologies are very rich in concepts and individuals like **Brick** (with **1452** classes and **2566** individuals), **ifcOWL** (with **1326** classes and **1162** individuals).
  - Other ontologies contain fewer individuals and fewer classes like the **ELI** ontology (with **33** classes and **28** individuals), **QUDT** contains only **31** classes.
- This difference is explained by the nature of the data represented by the ontologies.

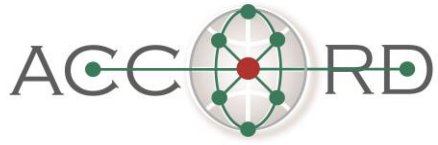




# Ontology Assessment

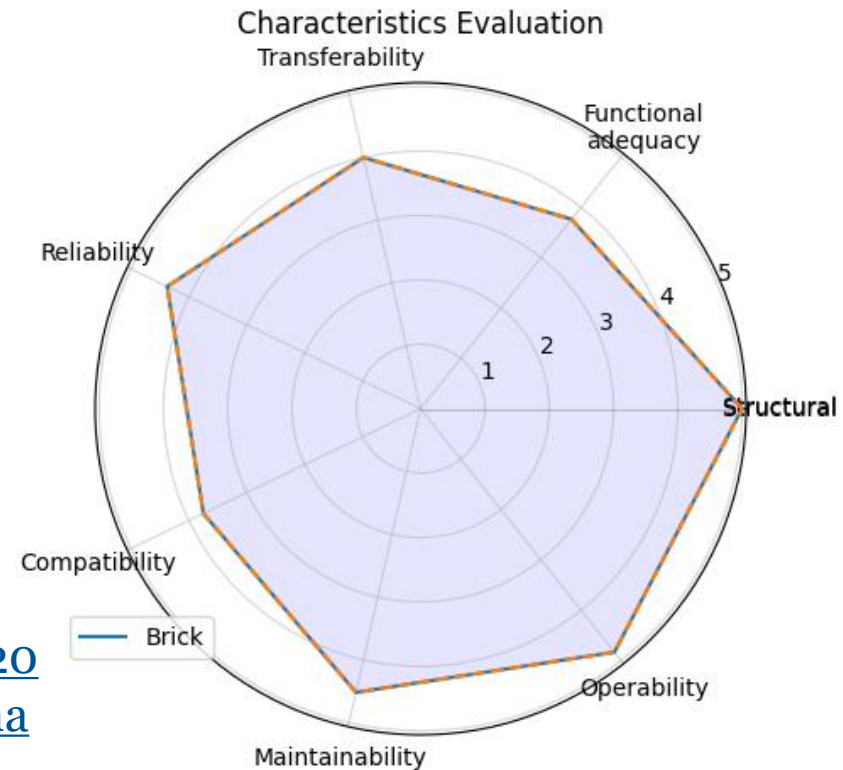
- **O'FAIRe** scores each of the four FAIR axes (findability, accessibility, interoperability, reuse).
  - **Ontology Pitfall Scanner! (OOPS!)** identifies the presence of bad practices and warnings in the evaluated ontologies.
  - **OQuaRE** scores each characteristic, including transferability, functional adequacy, structuring, operability, maintainability, compatibility, and reliability.
- The results indicate their commendable performance, making them suitable candidates for implementation in the context of ACCORD.





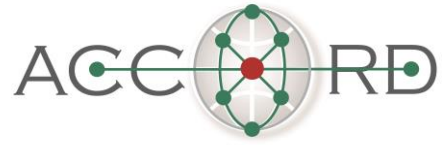
# Evaluation example

- Evaluation of BRICK with OQuaRE



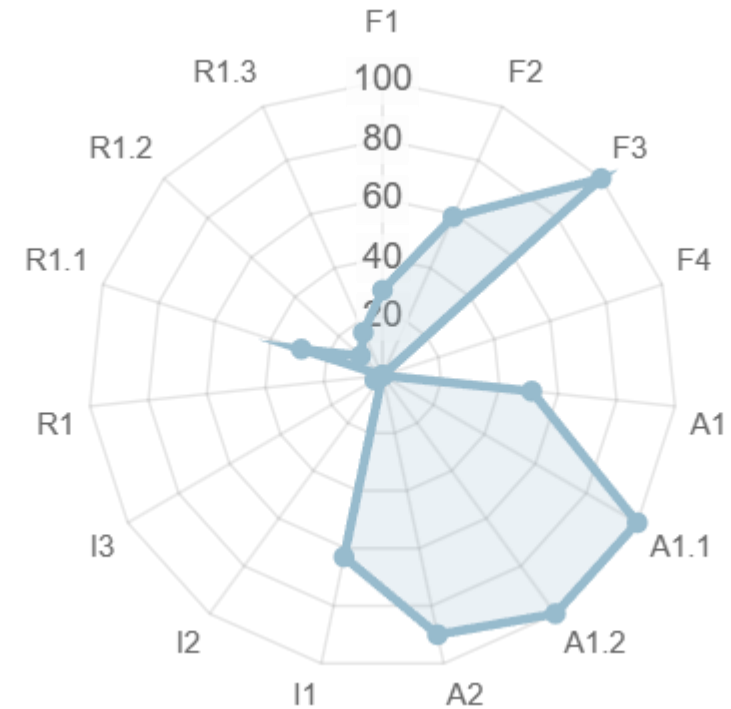
[https://github.com/ThamerMECHARNIA/EduBIM2023/blob/main/Evaluation%20OQuaRE/SummaryCharacteristic\\_Brick.png](https://github.com/ThamerMECHARNIA/EduBIM2023/blob/main/Evaluation%20OQuaRE/SummaryCharacteristic_Brick.png)





# Evaluation example

- Evaluation of BRICK with O'FAIRe



<http://industryportal.enit.fr/ontologies/BRICK>



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# Evaluation example

- Evaluation of BRICK with Ontology Pitfall Scanner ! (OOPS !):

Results	# case	Severity
Creating synonyms as classes.	115 case	Minor
Creating unconnected ontology elements.	8 case	Minor
Missing annotations.	126 case	Minor
Missing domain or range in properties.	48 case	<b>Important</b>
Inverse relationships not explicitly declared.	17 case	Minor
Using different naming conventions in the ontology.	Ontologie	Minor
Equivalent classes not explicitly declared.	3 case	<b>Important</b>

<https://github.com/ThamerMECHARNIA/EduBIM2023/blob/main/Evaluation%20OOPS!/Brick.csv>



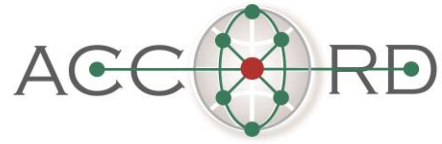


# Conclusion

- We analyzed ontologies related to construction, BIM, and regulations for the ACCORD project. This will enable the implementation of automatic compliance checking.
- According to our study of existing ontologies, none of the existing ontologies link the physical description of buildings with regulations.
- The findings from this study could provide valuable information for ACCORD and assist in selecting relevant ontologies for building compliance checking or general building modeling.







# Thank you!

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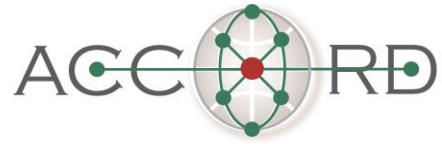
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# Partners



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