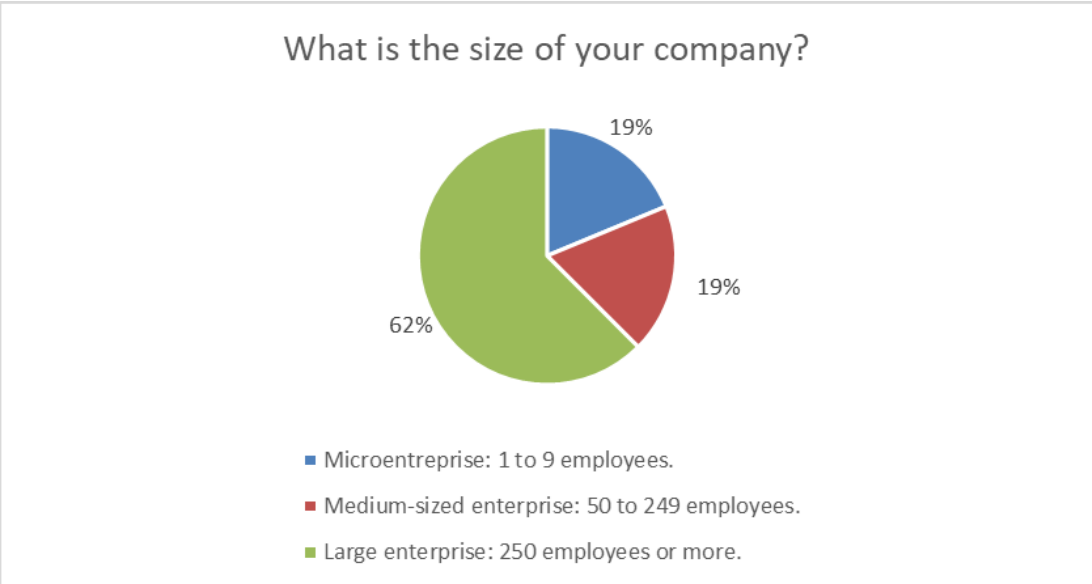
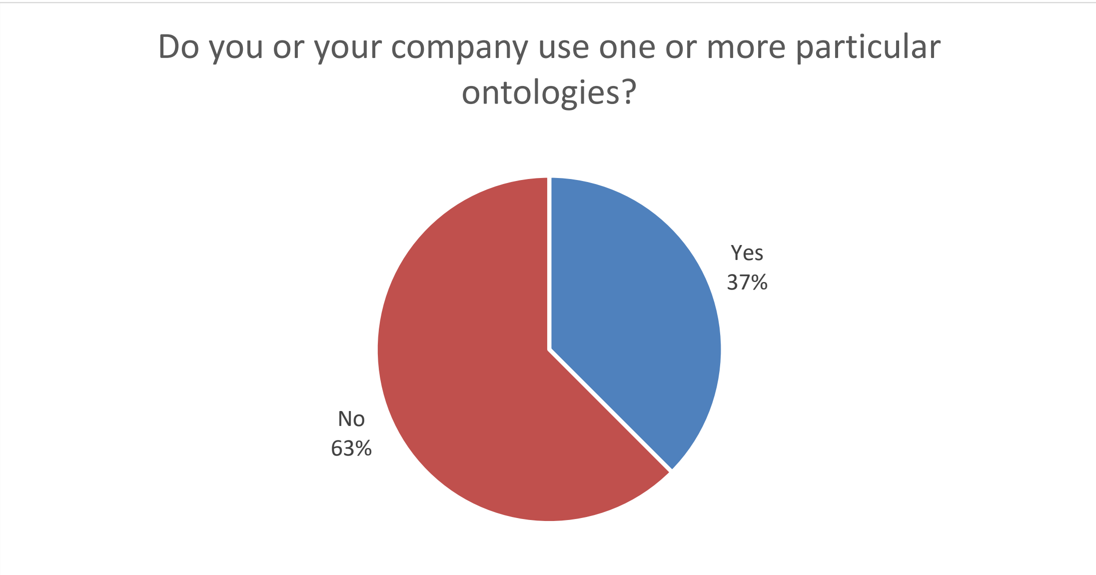
INFRASTRUCTURE ONTOLOGIES - Survey Results

Demographics

The scope of the survey was infrastructure ontologies used either in research or practice or both. Responses were collected in December 2020 and January 2021. Respondents represented a good breadth of infrastructure professions, sectors and sizes of companies. Over a third were proactive in the use of ontologies.





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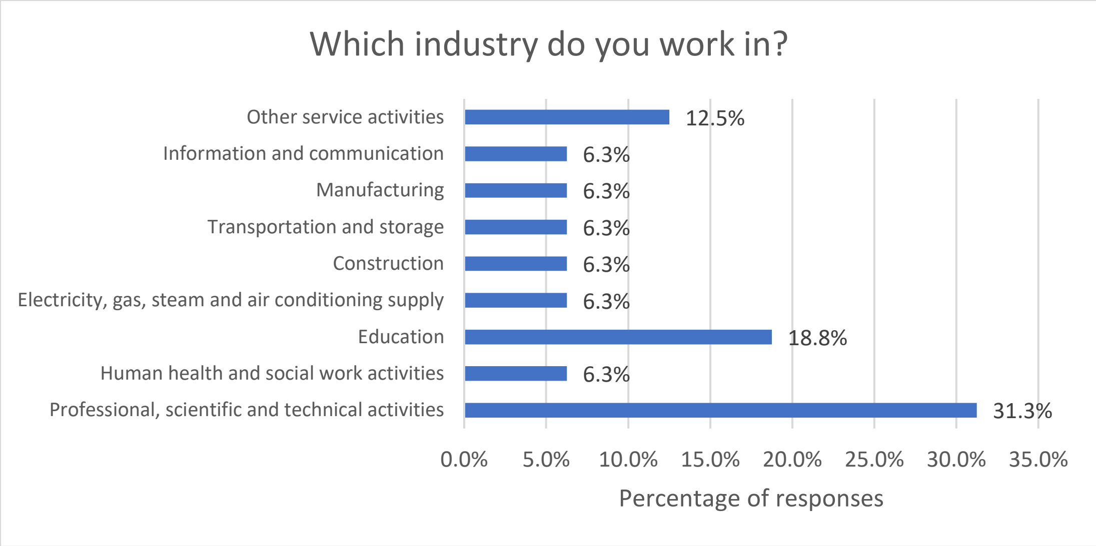
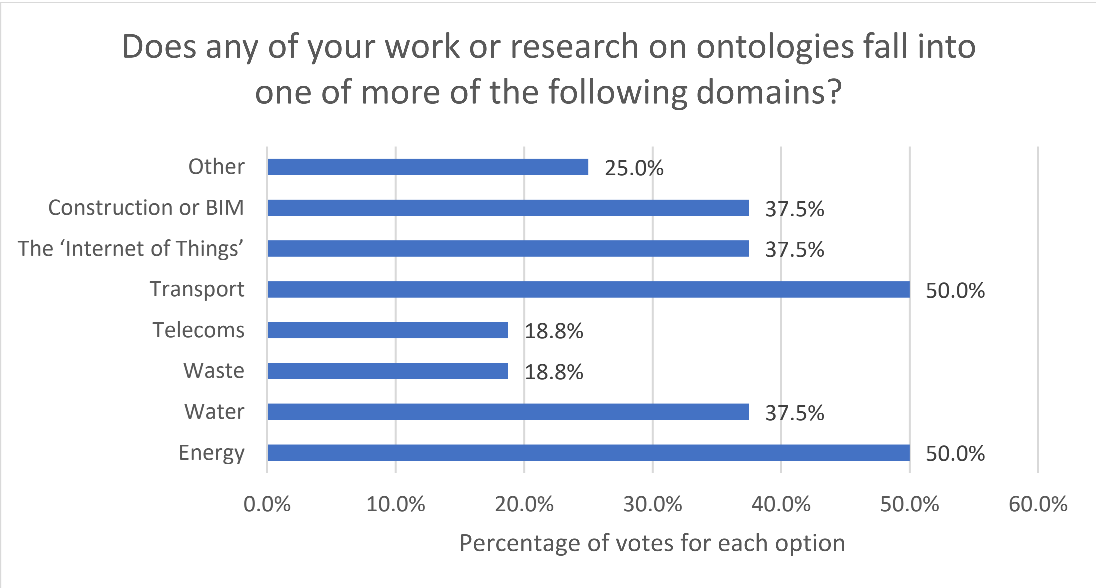
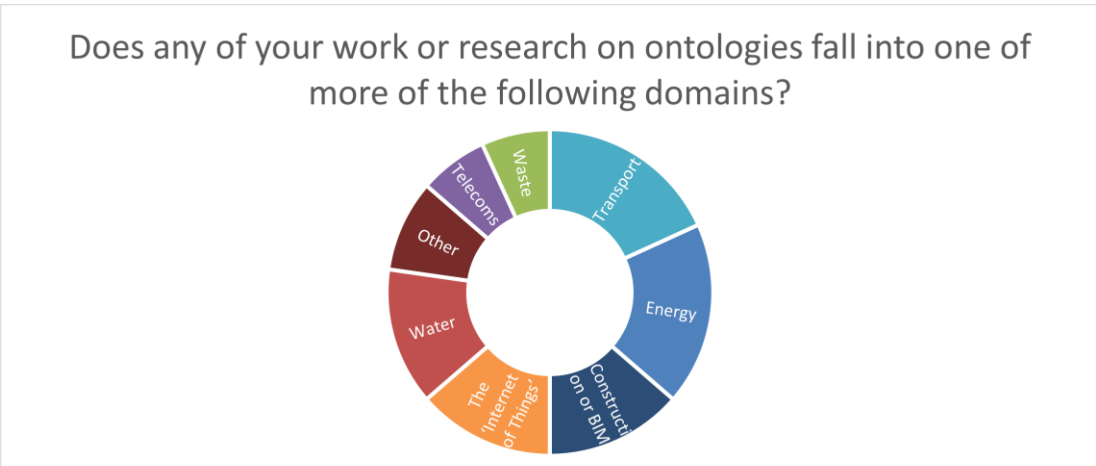

Which industry do you work in?
Other service activities 12.5%
Information and communication 6.3%
Manufacturing 6.3%
Transportation and storage 6.3%
Construction 6.3%
Electricity, gas, steam and air conditioning supply 6.3%
Education 18.8%
Human health and social work activities 6.3%
Professional, scientific and technical activities 31.3%
0.0% 5.0% 10.0% 15.0% 20.0% 25.0% 30.0% 35.0%
Percentage of responses


Does any of your work or research on ontologies fall into one of more of the following domains?
Other 25.0%
Construction or BIM 37.5%
The 'Internet of Things' 37.5%
Transport 50.0%
Telecoms 18.8%
Waste 18.8%
Water 37.5%
Energy 50.0%
0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0%
Percentage of votes for each option


Does any of your work or research on ontologies fall into one of more of the following domains?
Transport
Energy
Constructi on or BIM
The 'Internet of Things'
Water
Other
Telecoms
Waste

Survey findings

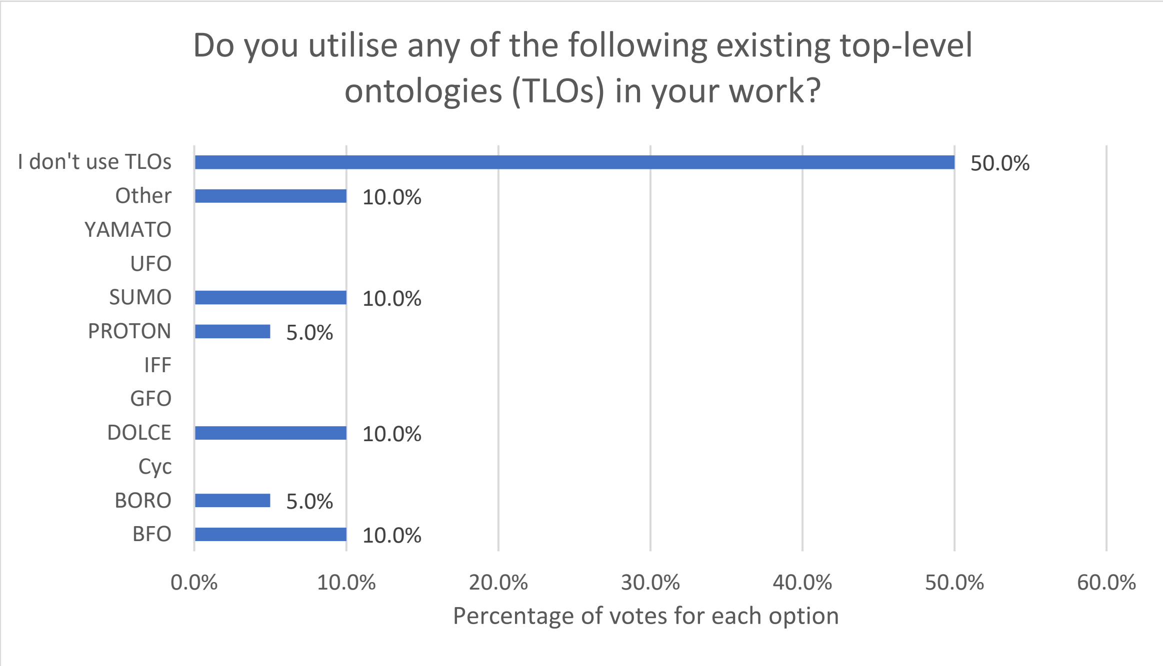
The purposes/intended outcomes for the use of ontologies fall into the following groups:

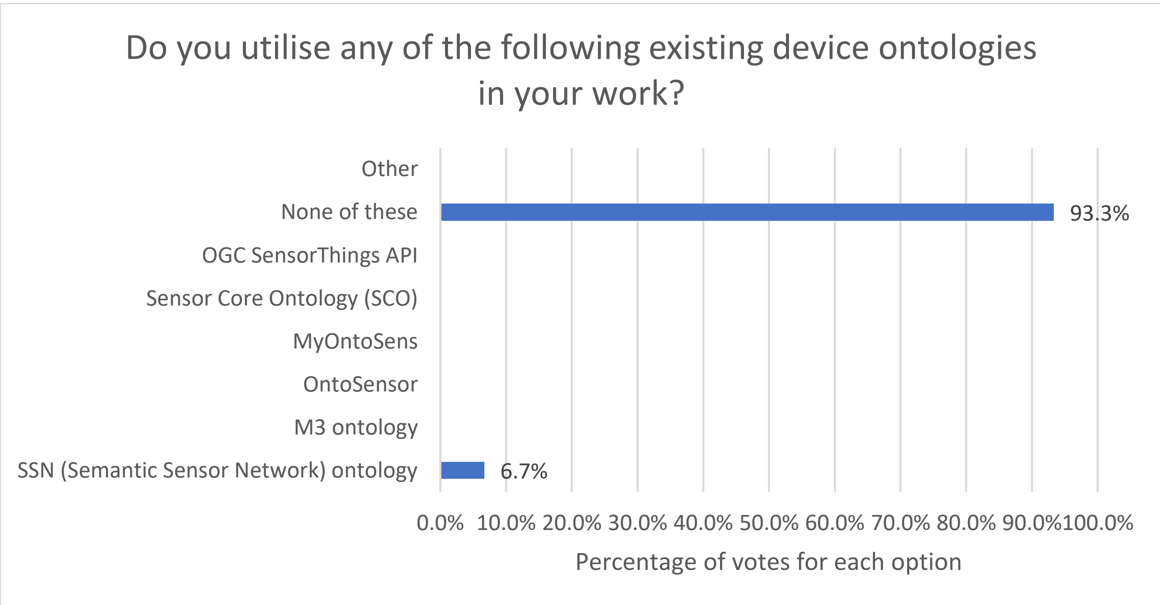
- **Knowing what there is:** Classification of data holding, cross-referencing, big data integration, data dictionary, data template, cross-searching, representing theories, sensing and data discovery
- **To identify gaps and vulnerabilities:** To direct and give focus to studies, system modeling, interactions; to use shared datasets and ontologies for dynamic approaches for urban analysis,
- **To target improvement:** asset management and monitoring (via a digital twin), through-life degradation for high-value systems (via top level ontology in a digital twin), improving sector efficiencies, behaviour change
- **For sustainability:** Carbon monitoring, reporting and verification, circular economy

The reasons for using ontologies specifically may be classified as follows:

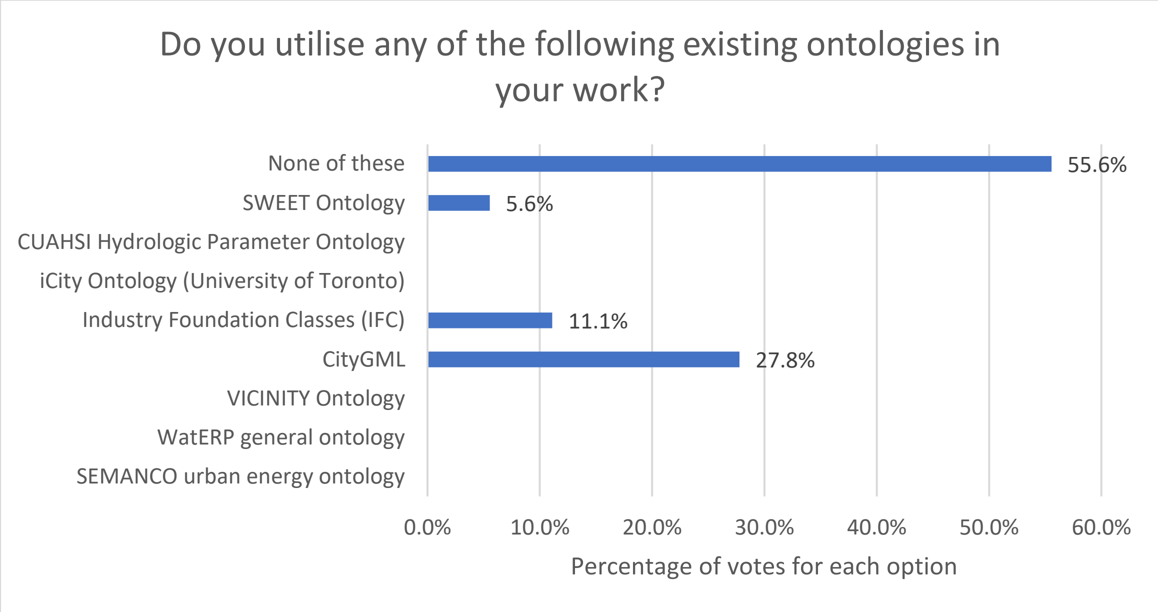
- **Data quality improvement:** To improve data standards for digital data archives; continuous improvement; to have clear definition of elements; Standardise concepts, improve data re-usability; structured metadata for hierarchy inference and topic inference
- **Interoperability improvement:** To enable better interoperable cross-referencing of data sets; improve interoperability between data exchanges in the industry; to build a better digital twin that can be easily interconnected in a future internet of twins. Uniformity (communicability); structured metadata for do-main and cross-domain data interoperability
- **Modeling and scientific rigour:** To describe simulation models rigorously; link theory and modeling; link models and data; to establish ontologies to improve models; (absolutely crucial) to the development of the science and its application.
- **Engagement:** To engage people working within those domains as it provides an existing language; Desire to find common ground for sharing data and unified APIs for consuming data; so that our users can understand what our data means.

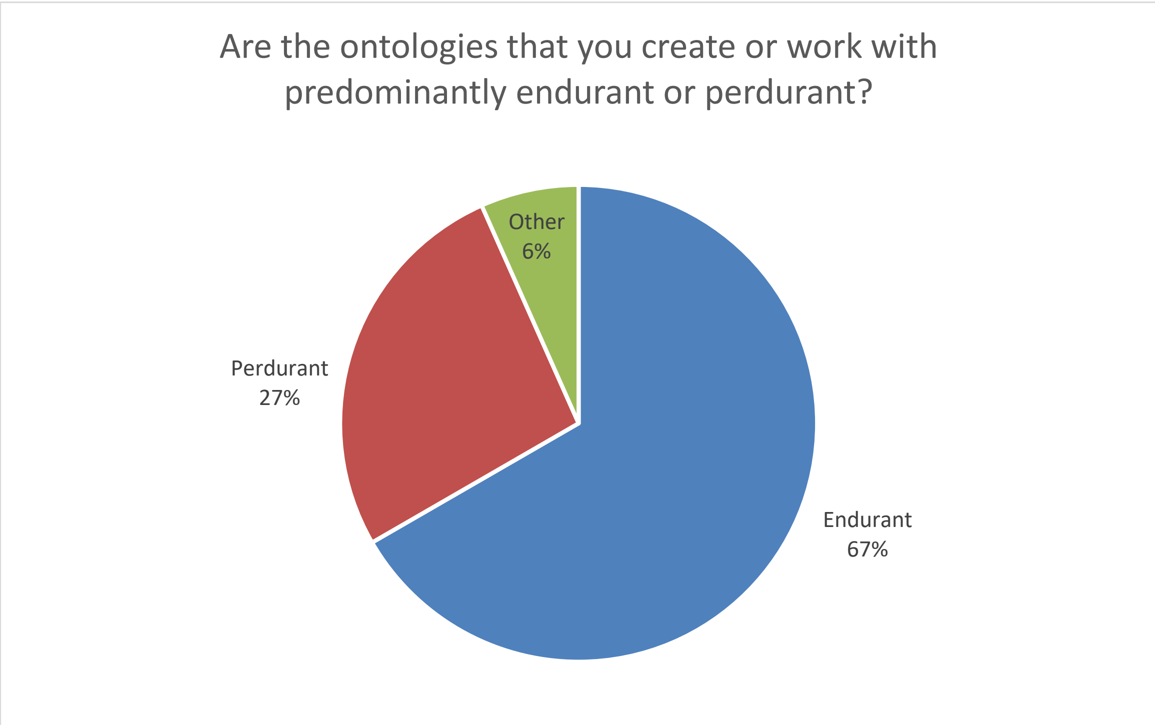
Nearly two thirds of respondents did NOT use top level ontologies; of the remainder the following were in use: BFO, BORO, DOLCE, PROTON and SUMO. Surprisingly usage of sensor network ontologies was negligible suggesting that the use of cyber physical systems with infrastructure is not considering ontological needs.



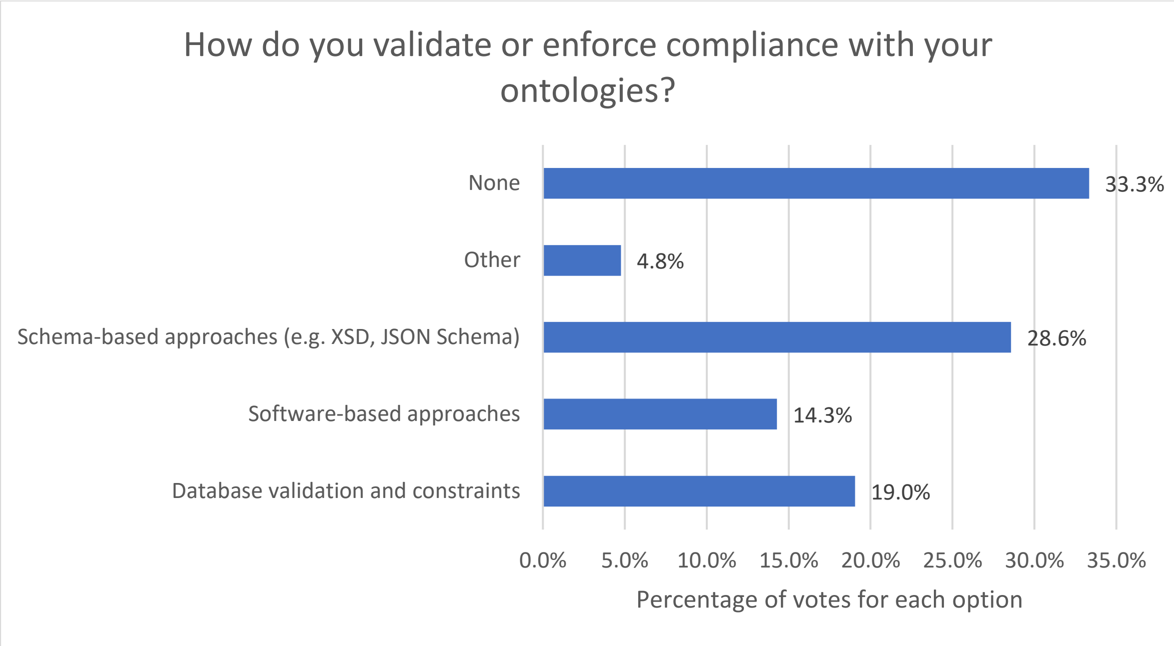


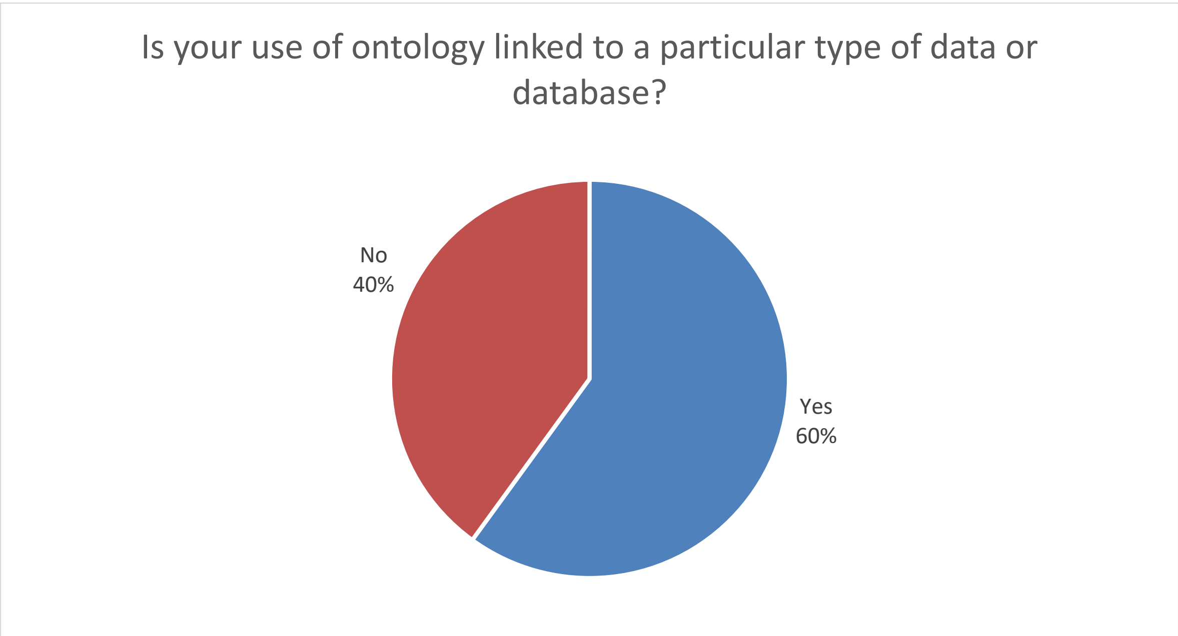
Nearly two thirds of respondents did not use domain or application ontologies, but those that did mentioned CityGML, Industry Foundation Classes (IFC) and SWEET. Two thirds of respondents use endurant (3D) rather than perdurant (4D) ontologies.





Compliance with ontology constraints is achieved by around half of respondents through database, software or schema-based validation. Just under two thirds of respondents use a database with their ontologies. Just over one third capture spatial or temporal details although just under two thirds stated their systems or processes had interactions across scale.





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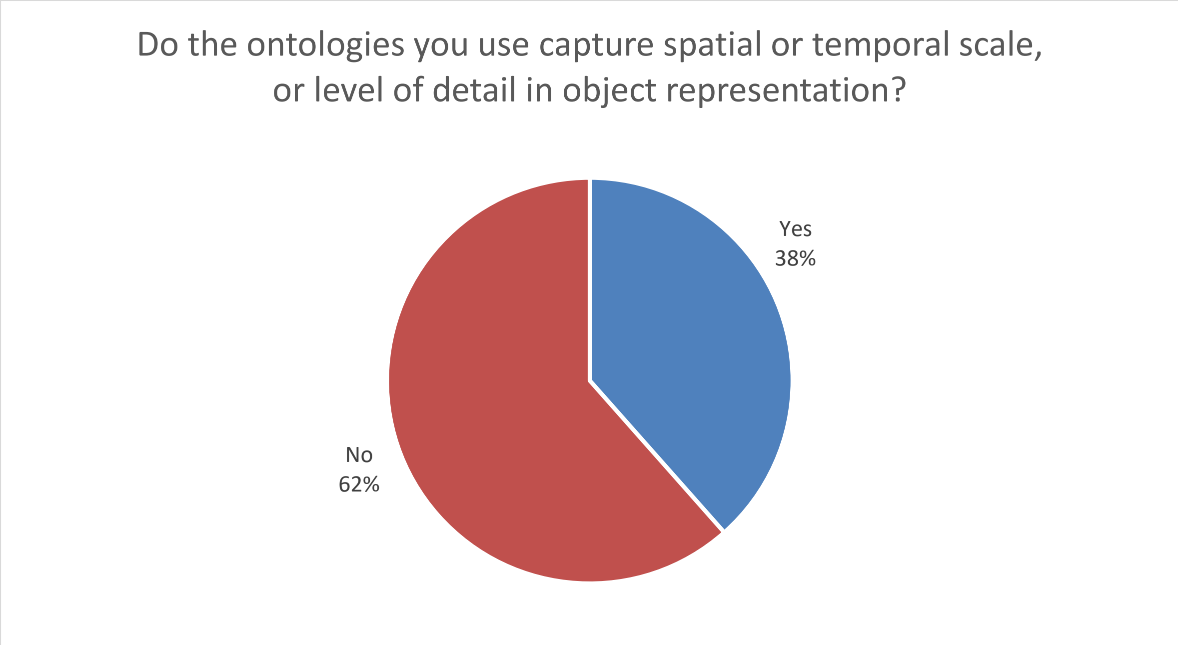

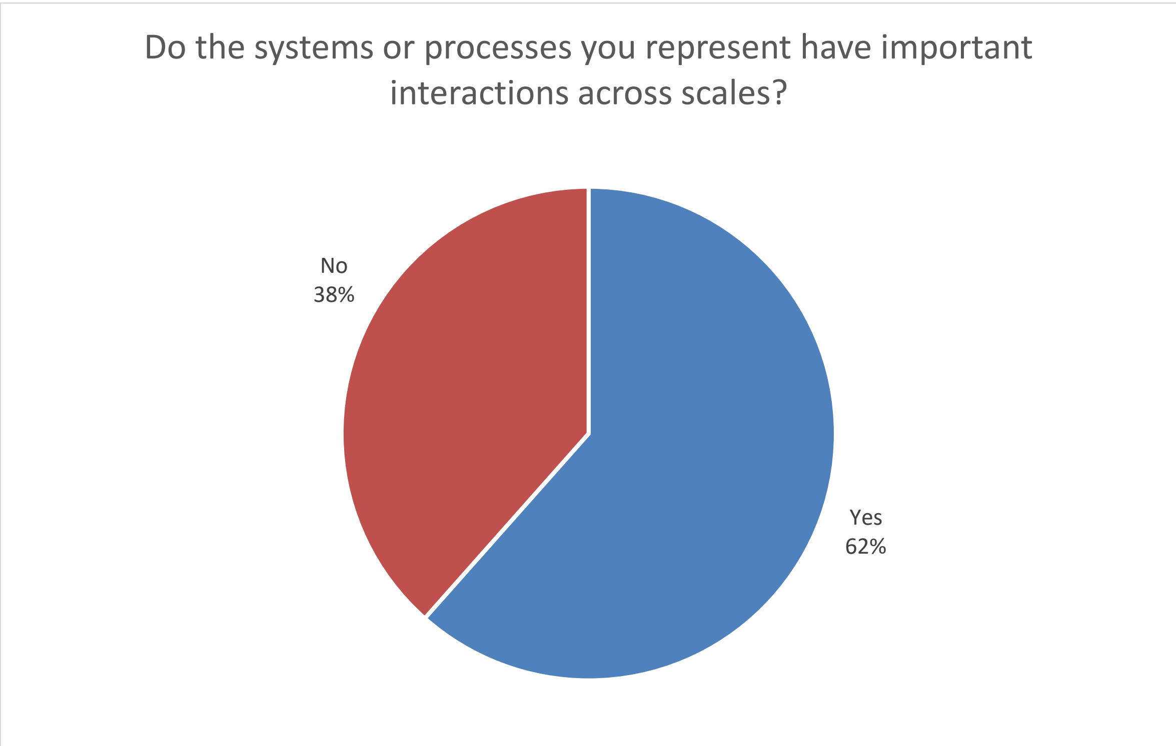

END OF SURVEY RESULTS