# 02.12.2020 Digital Twins and Data Ontologies Wider Ontologies in Infrastructure

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## "An ontology is a formal, explicit specification of a shared conceptualization" Struder et al, 1998

- A 'conceptualisation' is an abstract model of some phenomenon in the world by having identified the relevant concepts of that phenomenon
- 'Shared' reflects the notion that an ontology captures consensual knowledge, that is, it is not private to some individual, but accepted by a group
- 'Explicit' means that the type of concepts used, and the constraints on their use are explicitly defined
- 'Formal' refers to the fact that the ontology should be machine readable, which excludes natural language





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### Ontological commitments – energy, water and transport top level ontologies

	mereology	interpenetration	materialism	possibilia	criteria of identity	time	indexical: here and now	higher arity
BEO	no	allowed	adopted	actual world	intensional	eternalist	not supported	not assessed
BORO	GEM	not allowed	adopted	possible worlds	extensional	eternalist	supported	supported
DOLCE	GEM	allowed	not adopted	possible worlds	intensional	eternalist	not supported	not assessed.
GFO	GEM			possible worlds	extensional	eternalist	not supported	not assessed
HQDM	GEM	not allowed	adopted	possible worlds	extensional	eternalist	not supported	supported
IDEAS	GEM	not allowed	adopted	possible worlds	extensional	eternalist	supported	supported
ISO 15926-2	GEM	not allowed	adopted	possible worlds	extensional	eternalist	not supported	supported
KR Ontology	not assessed	not assessed	dot assessed	not assessed	not assessed	not assessed	not supported	not assessed
UFO	GEM	allowed	not adopted	possible worlds	intensional	eternalist	not supported	not assessed
YAMATO	GEM	oot assessed	not assessed	oot assessed	intensional	eternalist	not supported	not assessed

#### https://www.cdbb.cam.ac.uk/files/a\_survey\_of\_top-level\_ontologies\_lowres.pdf, p44



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- Digital Twins
  - SSN ontology for devices and actuators
  - Real time feeds bi-directional (automation and human in the loop) for better understanding enabling better decision making
  - Manage the evolution of the static ontological models
  - Manage the inter-play of scale



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### iCity Ontology for smart cities

Mark Fox, University of Toronto

iCity Ontology encourages those who shape policy to make decisions based on data.

Builds on Global City Indicators Ontology (Fox, 2013), Ontology of Transportation Networks (Lorenz, Ohlbach, & Yang, 2005) and Land Based Classification Standards (LBCS) Ontology (Montenegro, Gomes, Urbano, & Duarte, 2011).





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### **CCAV and Smart Motorways**

Automated driving systems would require an operational "world model" ontology:

- an holistic, real-time ontology of the domain of automated driving
  - Vs car centric, road-centric, route-centric, driver-centric, ...
- with context awareness using human-like reasoning
- addressing interdependencies

Brunner et al. "Ontologies Used in Robotics: A Survey with an Outlook for Automated Driving", 2017



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