ICT4SM : Z-BRE4K Ontology

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Z-BRE4K Ontology

- Application domain :
  - Industrial maintenance and knowledge regarding components and processes
- Purpose of our ontology :
  - To achieve predictive maintenance by enriching the information used for data analysis
  - To establish standards in order to foster interoperability
    - Ontologies help us add information through semantic meta-data in order to make data machine-understandable, and interpreted the same way across diverse systems of information
    - We rely on the relative stability of natural language to ensure interoperability between systems
- How we represent the world/what are our concepts in the upper level of our ontology :
  - Our domain-specific ontologies are built from BFO, which represents the world as a continuum. We use terms and elements rather than concepts.

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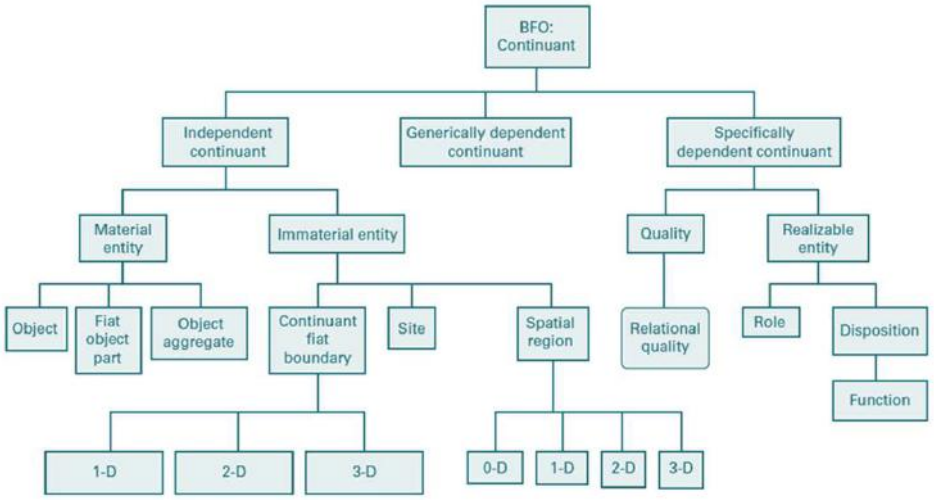
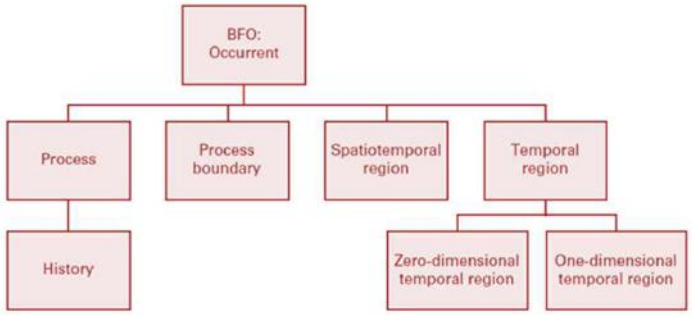
Z-Bre4k top-level ontology : BFO



BFO Continuant are the entities that continue to persist through time while maintaining their identity

BFO Occurrents are the events or happenings in which *Continuants* participate



Arp R., Smith B., and Andrew D. Spear.
Building ontologies with basic formal ontology. Mit Press, 2015.

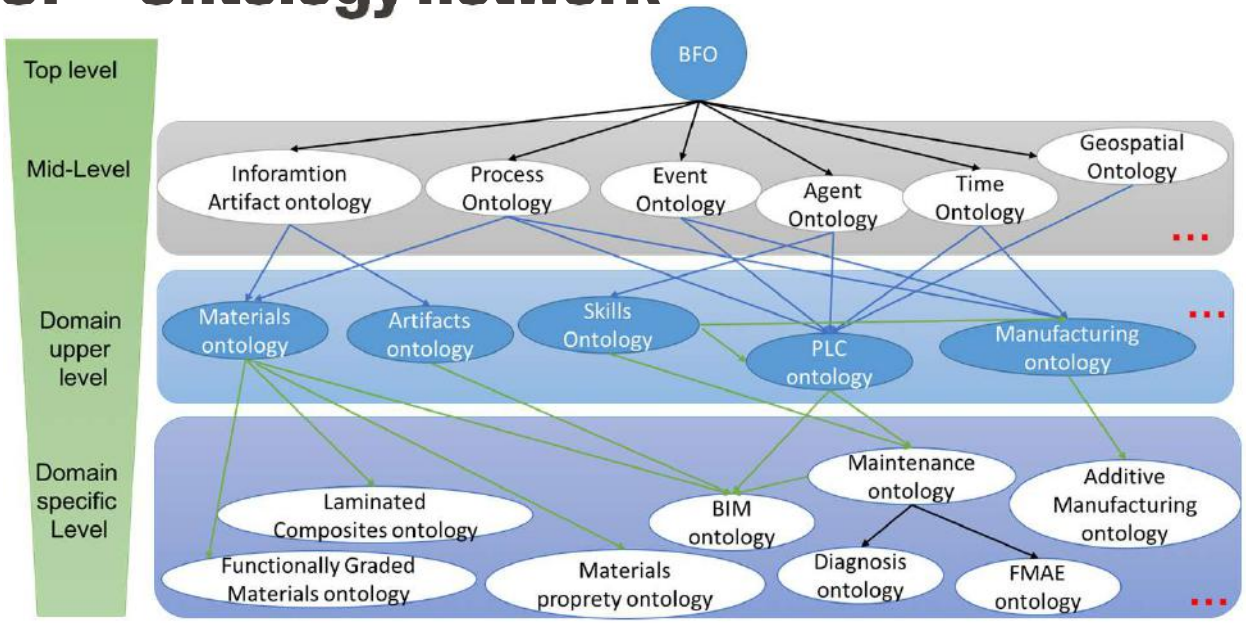
Z-BRE4K Industrial use cases

The GESTAMP-Autotech demonstrator will be linked to the demonstration of a Lighthouse manufacturing process FRAMETOP for the multi stage zero defect manufacturing of next generation automotive chassis.

As a complex demonstrator PHILIPS contributes a production line with cold forming tooling. On this tooling PHILIPS would like to move from preventive maintenance to predictive maintenance.

The SACMI-CDS use case will be related to the packaging industry. SACMI is planning to introduce a predictive maintenance service for the end user involved (CDS) within Compression Moulding machines.

Overlap with other ontologies: IOF – Ontology network

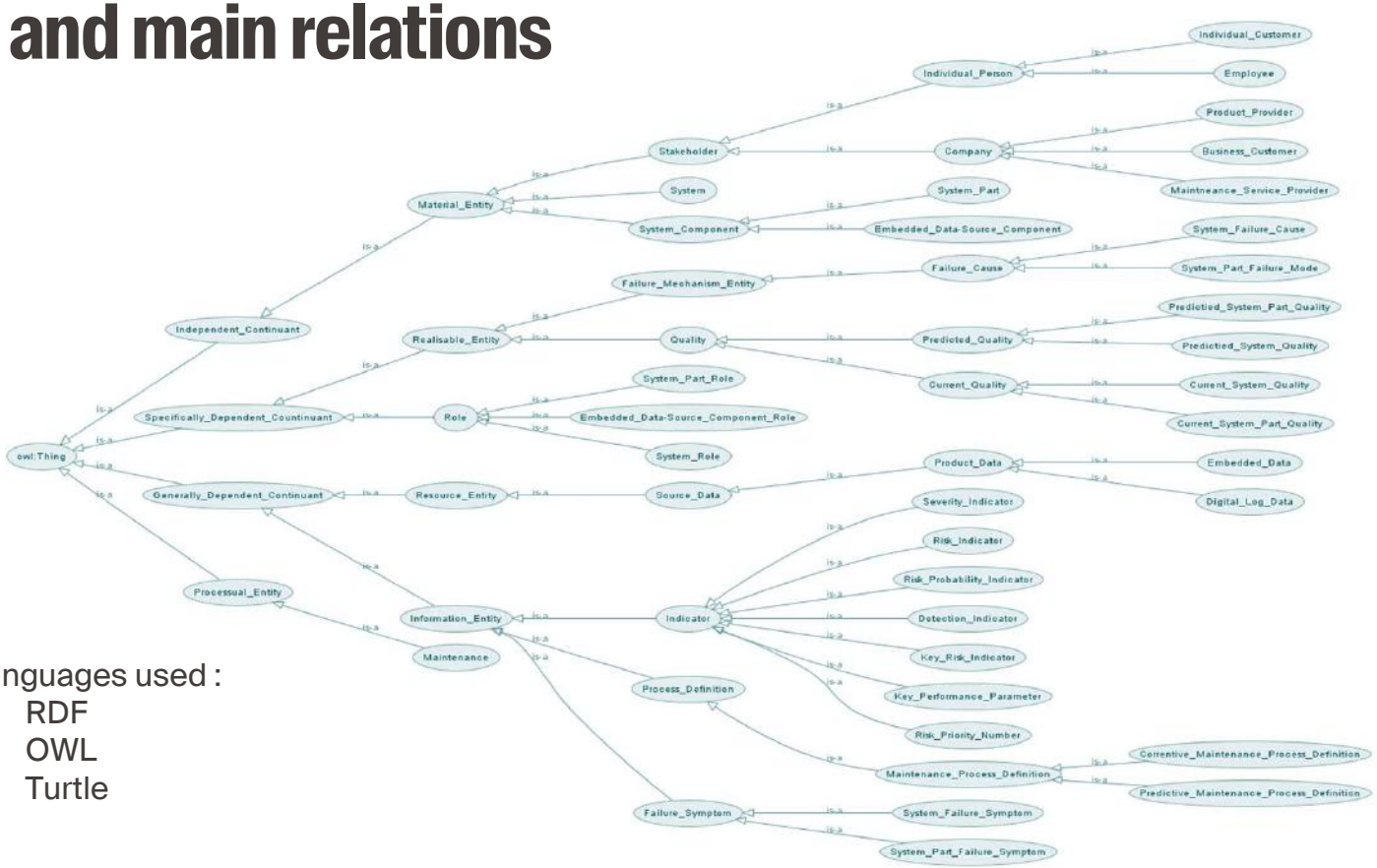


Drawn by Hedi Karray

https://www.industrialontologies.org

To foster interoperability, we re-use as much as possible IOF and other published ontologies

Hierarchy of the Z-BRE4K ontology and main relations



Languages used :

- RDF
- OWL
- Turtle

Diagram : Sang-Je Cho

Z-BRE4K Ontology

- The knowledge represented by our ontology :
  - The ontologies built from BFO provide a realistic view of the world, but since they are also domain-specific, they also offer a pragmatic description of current practices
- How our ontology represents the relations between different granularity views on the same object:
  - In BFO, most of the time, instances of continuants are different from instances of occurrents. Therefore, an object will only be represented according to one granularity view

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Z-BRE4K Ontology

- How our ontology represents materials:
  - Our ontology is aiming for discrete industries and therefore materials are not represented
  - If materials are referred as material entities, then, they are represented as independent continuants http://purl.obolibrary.org/obo/BFO_0000040
- The type of processes we address and how we represent them:
  - We represent mainly maintenance processes and failure mechanisms. They are represented as instances of classes
- How our ontology addresses the connection between properties and measurement:
  - The aim of our ontology is not to describe the materials flow, but to monitor the status and risk severity of a potential machine break-down. Therefore, there is a connection, but not a circular one, between physical properties and measurements
- Our representation languages:
  - OWL, RDF, Turtle

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Competency Questions

- What machines/equipment are considered in each use cases?
- What stakeholders/actors are considered for each use case?
- What is BOM for each machine (as a hierarchy diagram)?
- What component is critical for asset management in a specific use case?
- **What is the component scope?** → **We should consider a "component" and "scope" classes**
- What are the failure modes for each critical component?
- What are the effects of each failure mode?
- What is the criticality of each failure mode?
- What kinds of actions are required before the failure?
- What kinds of actions are required after the failure?
- What kinds of sensor is available/required for each critical component?
- What kinds of critical components are linked to a sensor?
- What type of signals are collected from a sensor?
- Which sensor/s is/are relevant to detect a specific failure mode?
- Which is the signal unit of measurement?
- Which is the minimum value of the signal?
- Which is the maximum value of the signal?
- How often signals are stored in repository?
- Which is the sampling frequency of the signal?
- In which working phase is included the control system?
- In which working phase it is excluded the control system?
- Which kind of mathematical elaboration is requested for the signal? (average, standard deviation, RMS, ...)

To be answered by Z-BRE4K ontology

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