Observations on Urgent Research Needs

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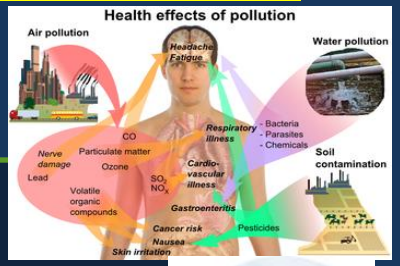
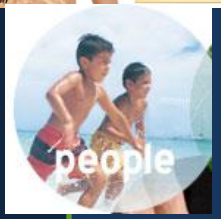
Sustainability – Macros and Micro level understanding is critical

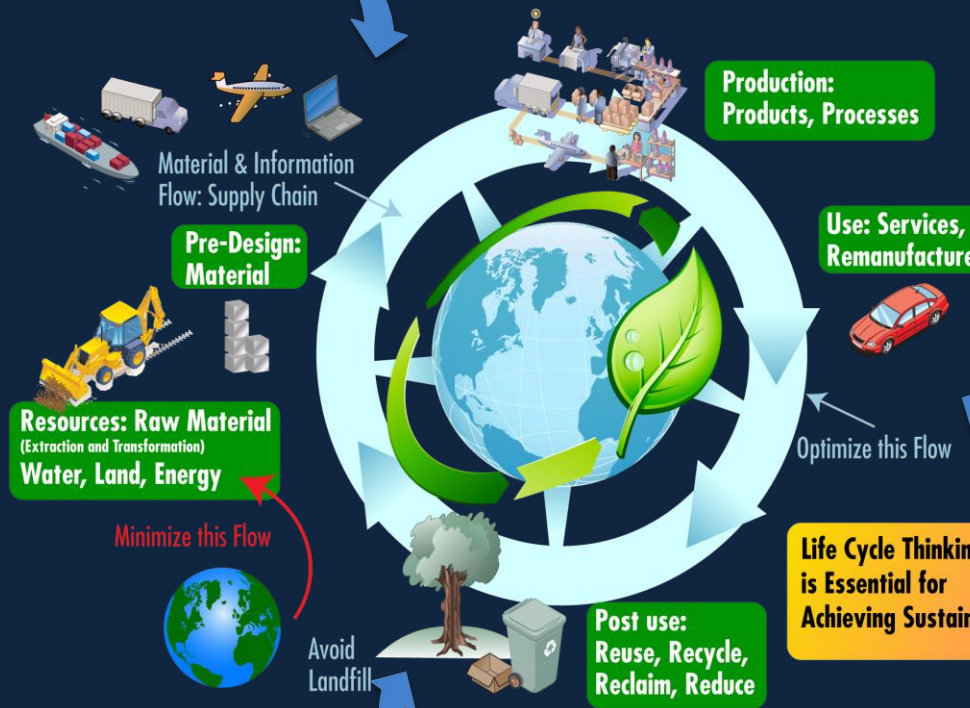
Macro level

View 1: "Triple Bottom Line"

View 2: Human Health



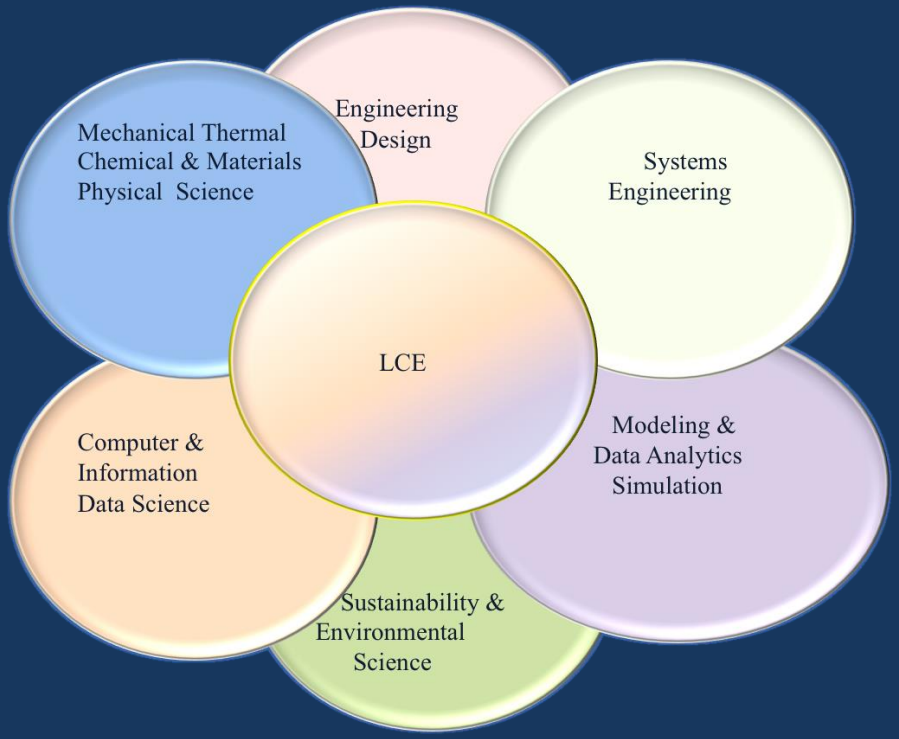




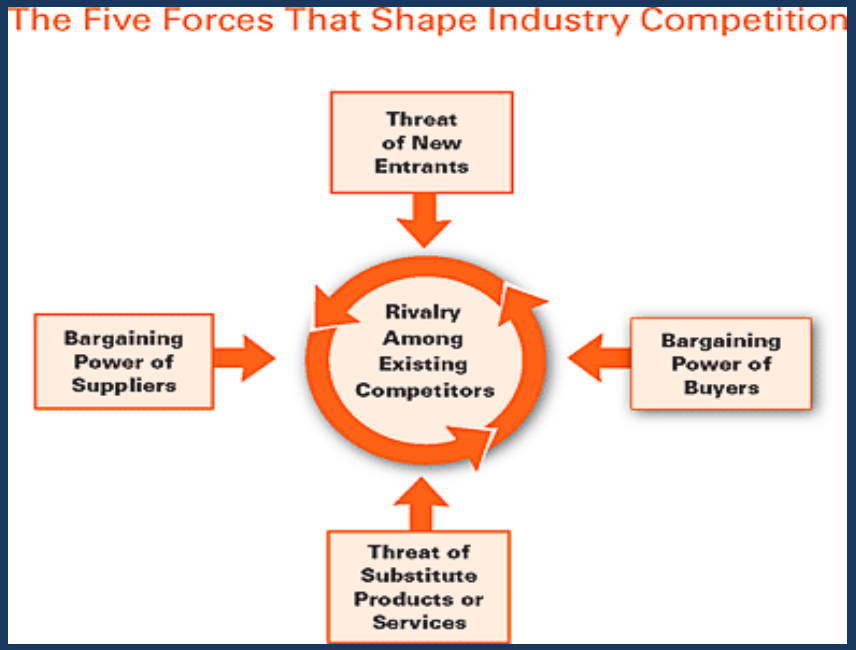
Micro level

View 3: Environment

Life Cycle Thinking is core to understanding sustainability



Mapping Sustainability to Porter's Five Forces



LCE is a multi-disciplinary approach and it is the core of sustainable manufacturing

Five forces of industry competition

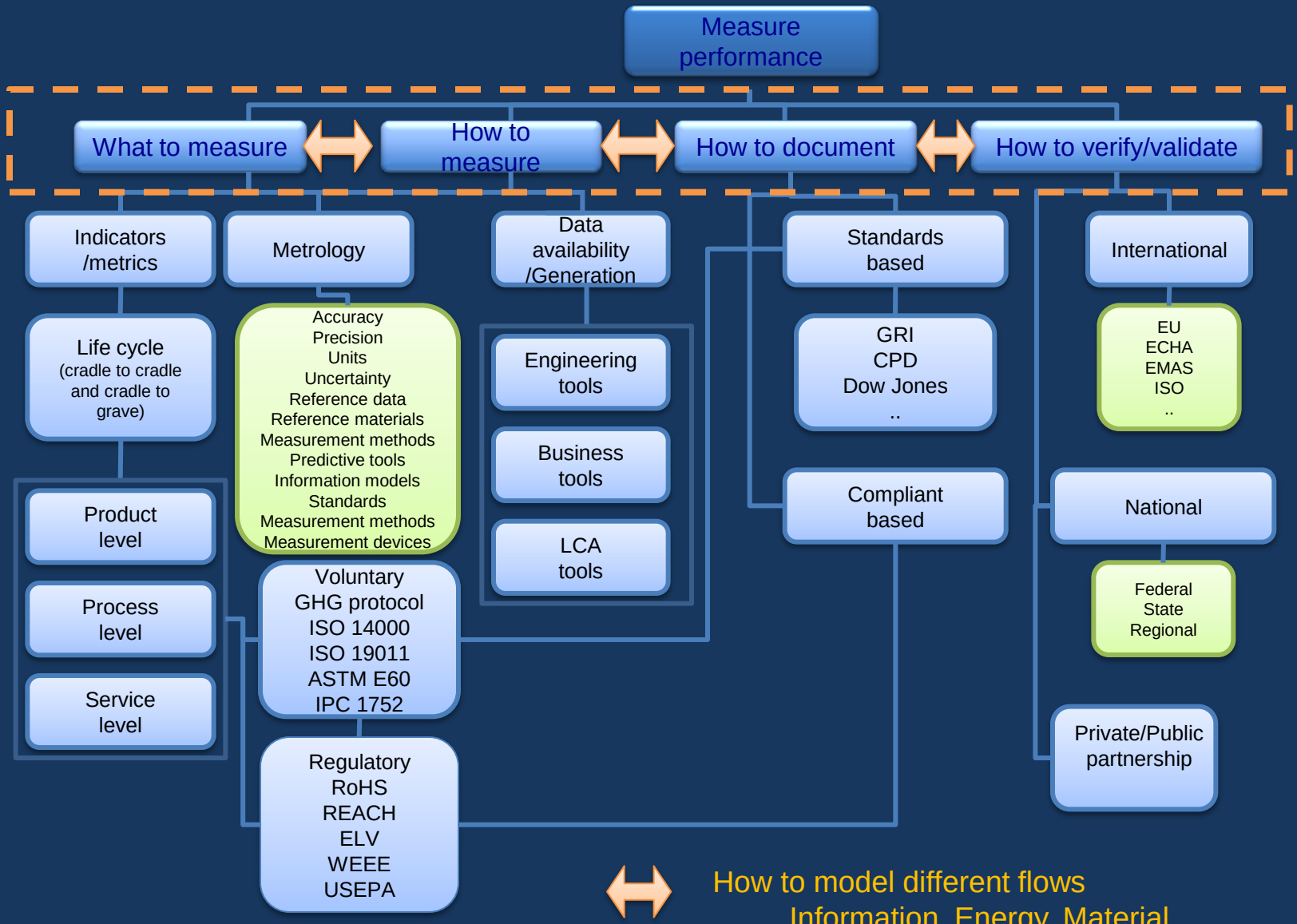
An engineer view on “Urgent” Research Needs

1. Performance of Sustainable manufacturing
   a. A framework for metrics and measurement

2. Aspects of measurement science
   a. Classification of metrics, resources, processes
   b. V&V and UQ of models

3. Smart interconnected devices and technologies
   a. Big data and Predictive analytics
   b. IoT and smart technologies

1) A Framework for Metrics and Measurements for Sustainability Performance

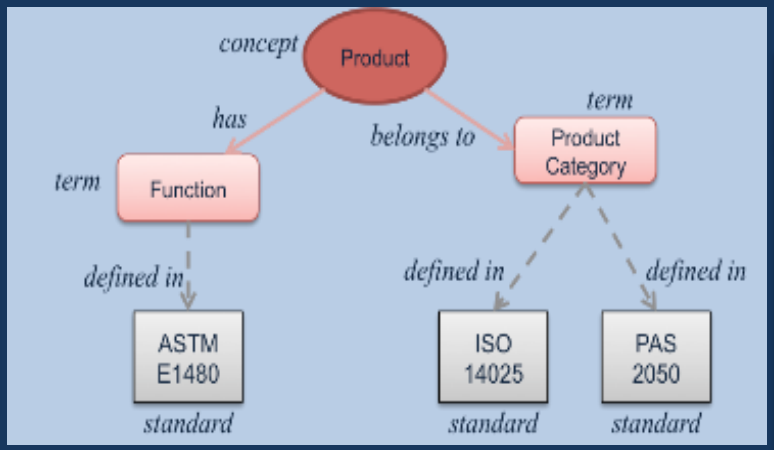


2. Aspects of measurement science

- terminology and metrics (ontology)
- resources (material) information model
- classifying manufacturing process (ontology)

Sustainable manufacturing terminology (ontology)

- extensible schema, to classify a wide range of terms
- terminology as an ontology, capturing relationships to other terms and concepts
- interactive visual interface



Interactive visualization of networked information

Intelligent querying

Search:

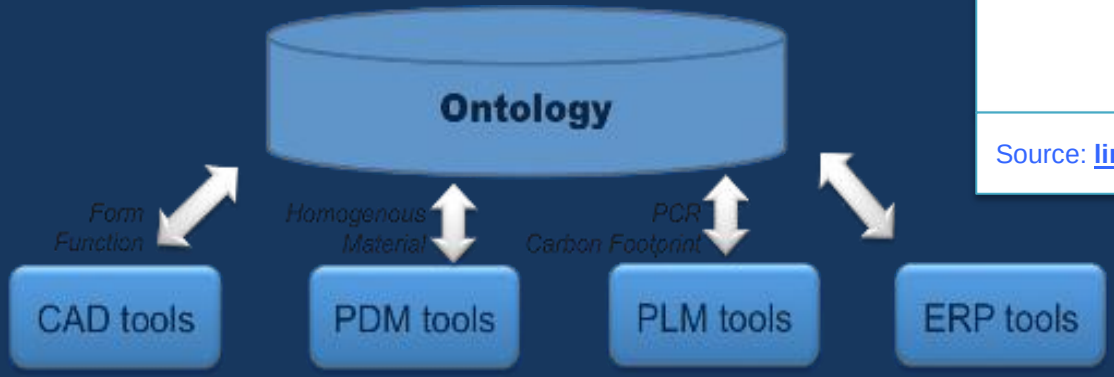
Product Category

Definition: Group of products that can fulfill equivalent functions.

Source: **link**

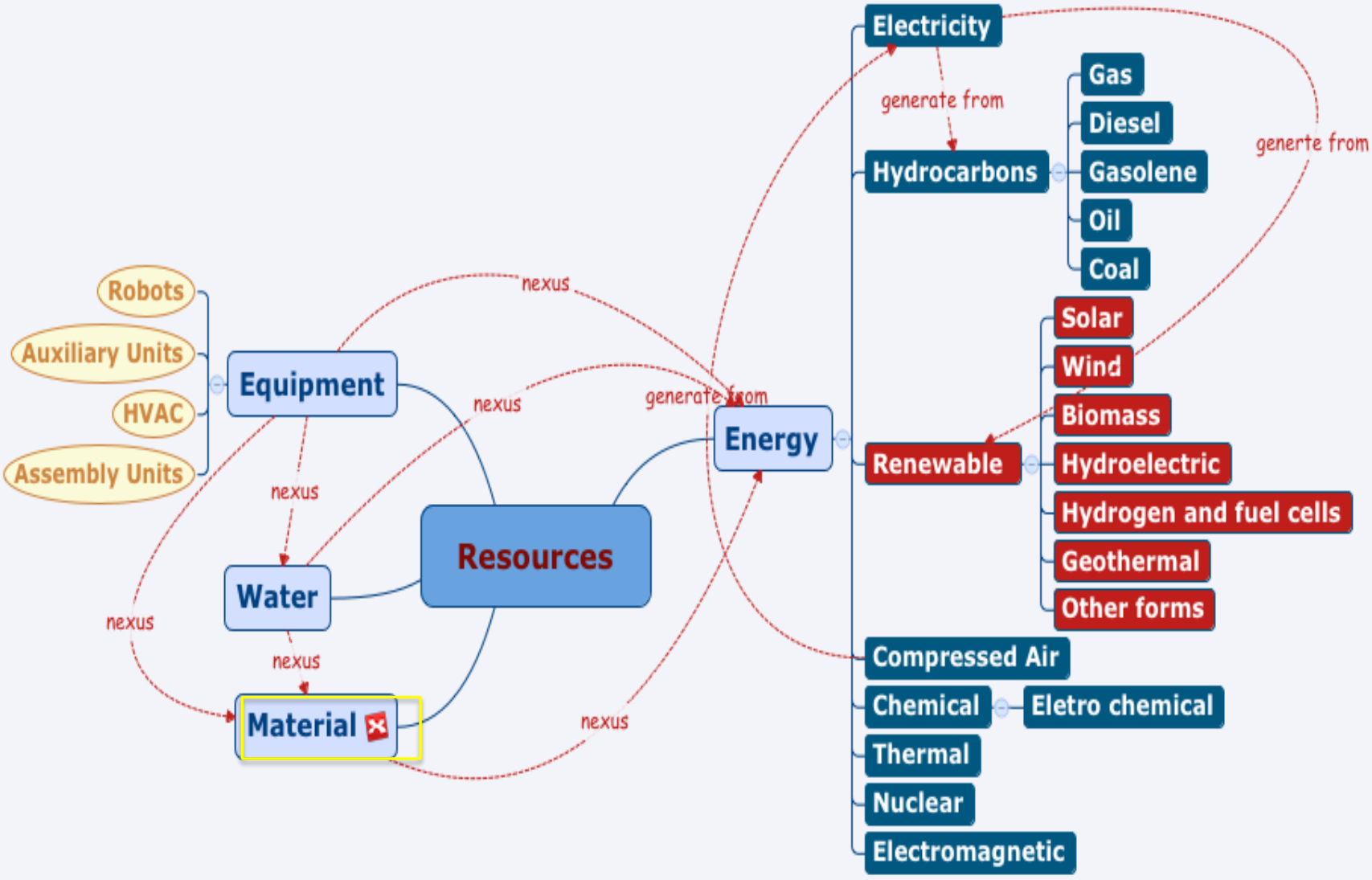
Detailed description of selected term, with links

Links to related documents

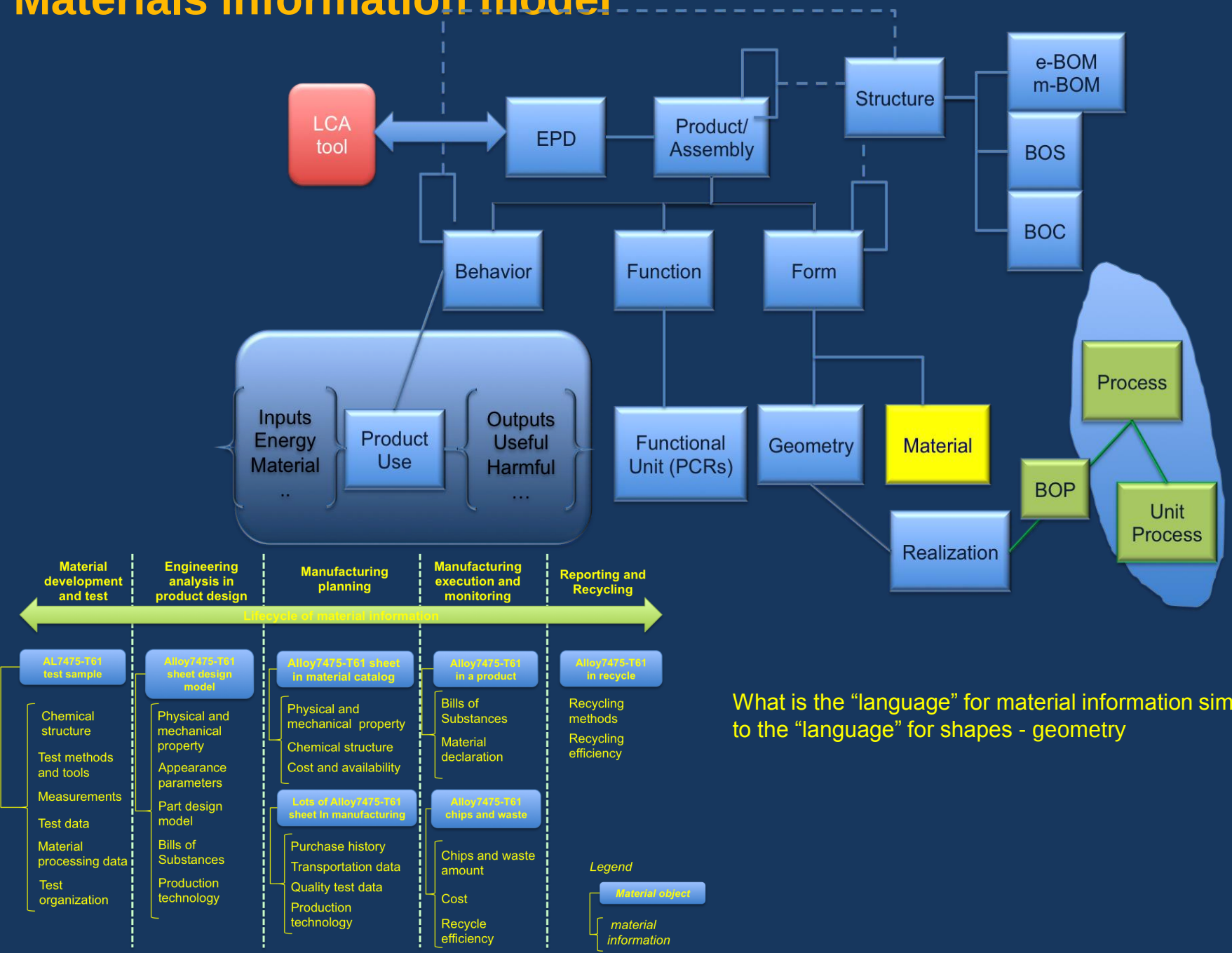


http://sourceforge.net/projects/novis/?source=directory

Typology of Resources and its representation



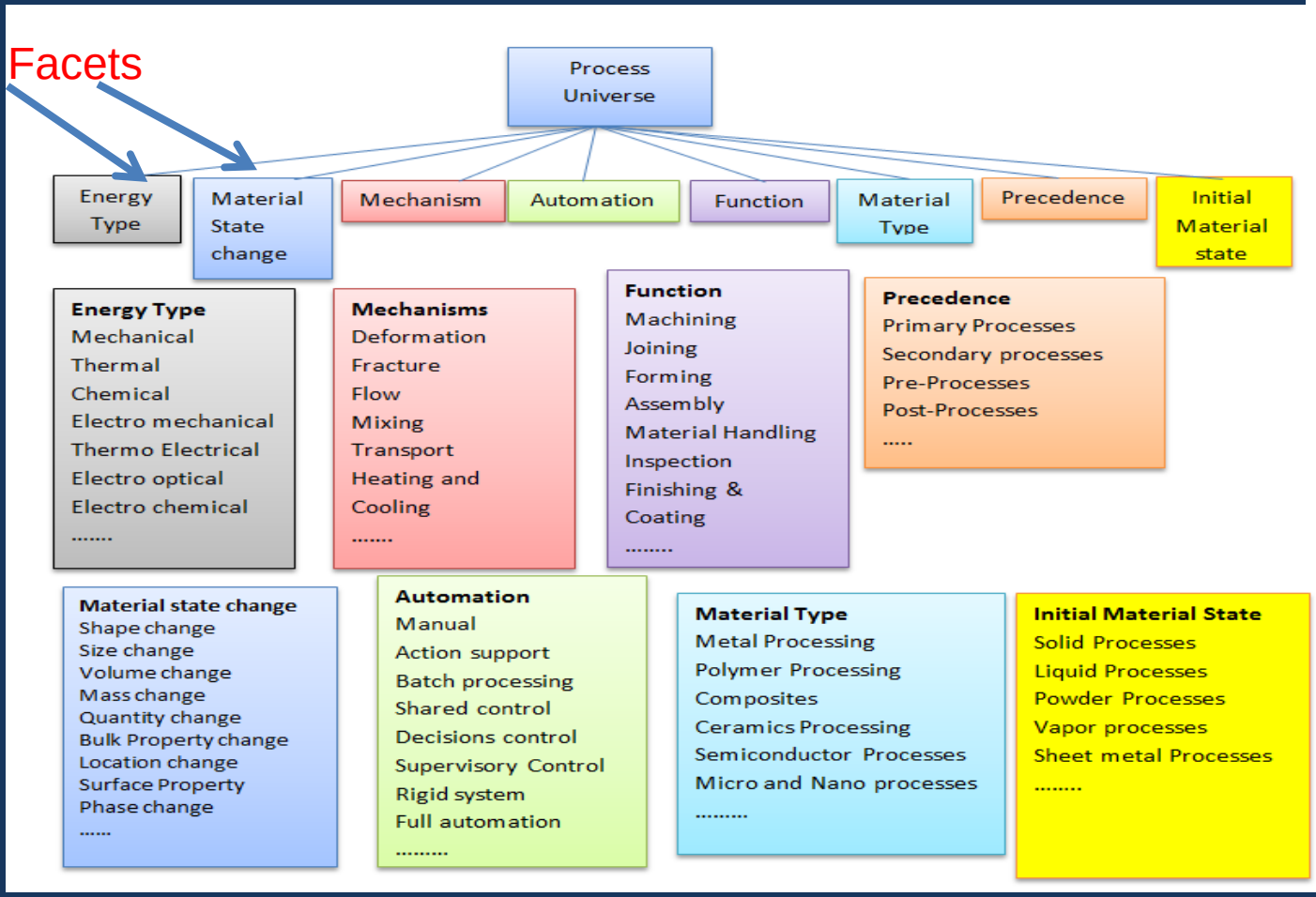
Materials information model

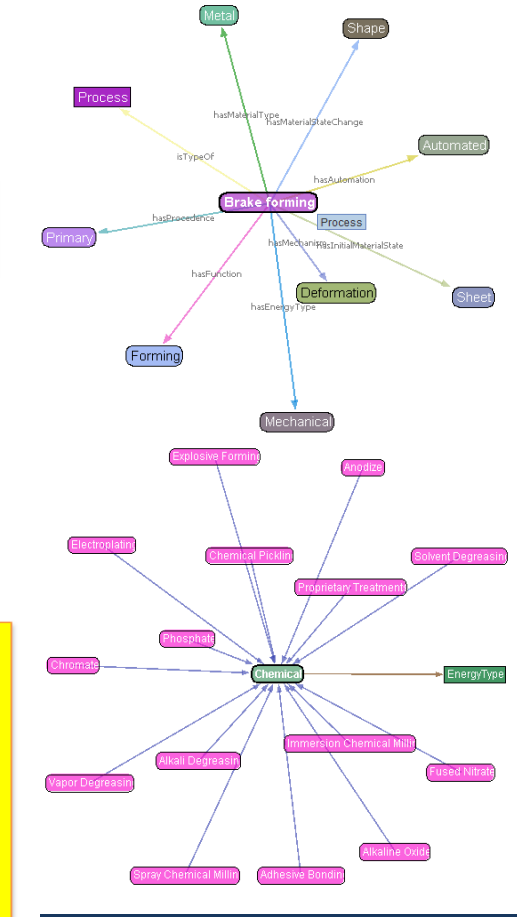


What is the “language” for material information similar to the “language” for shapes - geometry

We also need a good Manufacturing Process Classifications

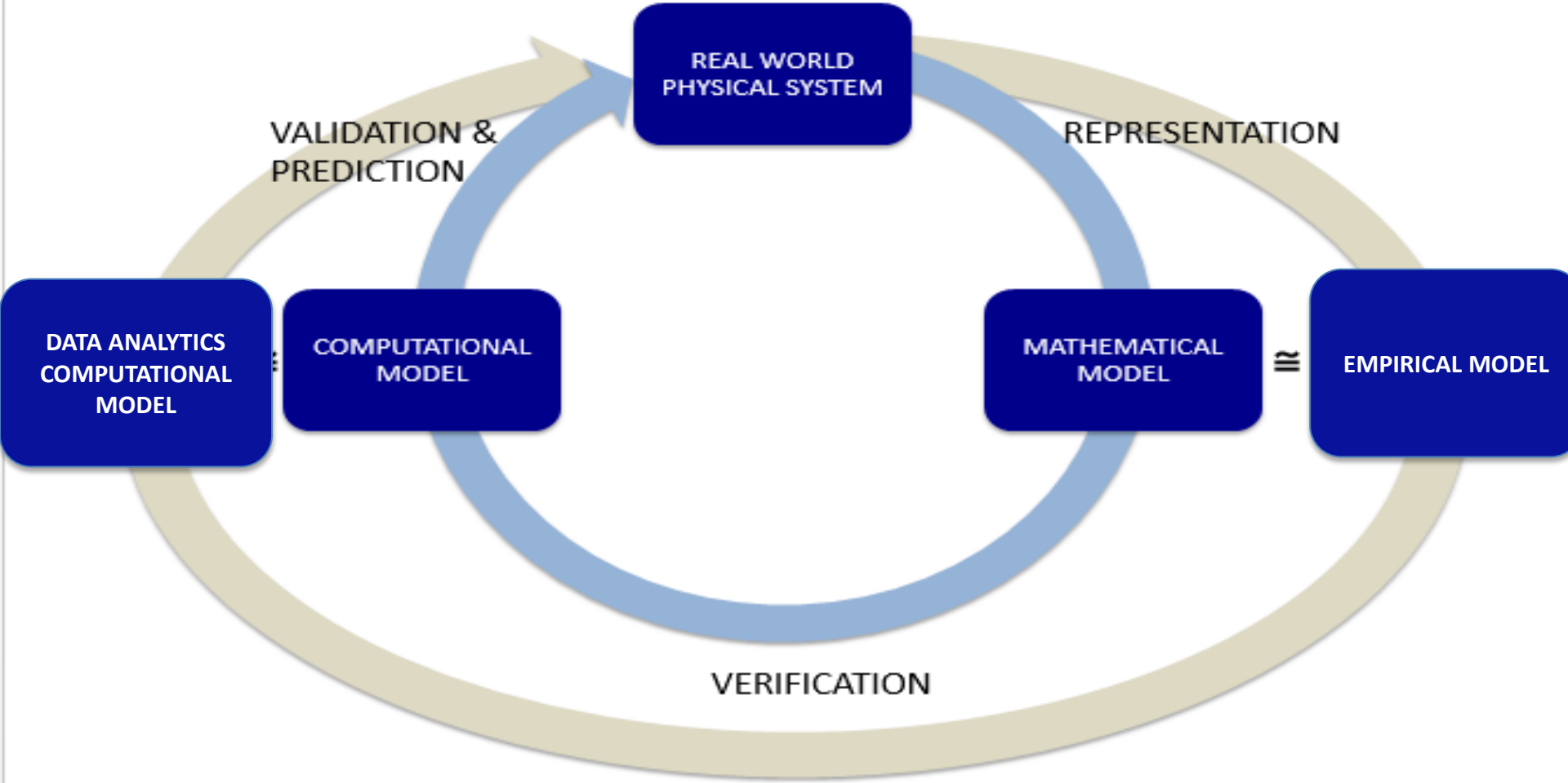
- Clustering of similar processes
- Easier grouping for purposes of analysis
- Sustainability characterization through understanding complex relationships



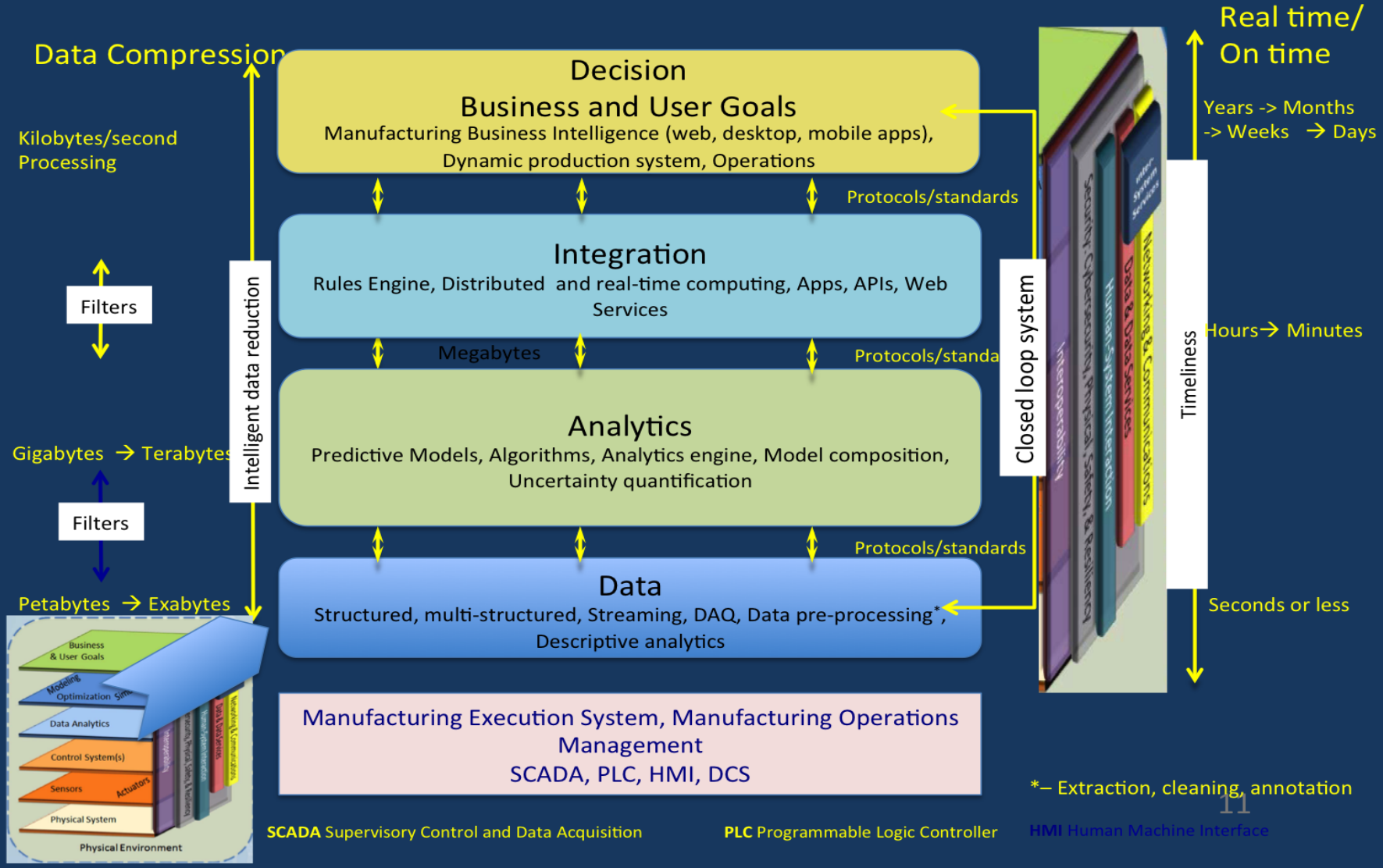


Faceted Classification of Manufacturing Processes, *Senthilkumaran Kumaraguru, Sudarsan Rachuri and David Lechevalier, The International Journal of Advanced Manufacturing Technology , (2014) 75:1309–1320, DOI 10.1007/s00170-014-6184-x*

V&V UQ of Models



Smart Technologies for deploying sustainable manufacturing



- Smart interconnected devices and technologies:
  - IoT, IIoT – Standards and protocols
  - big data analytics, smart sensors, mobile devices
  - cloud infrastructure, cyber security