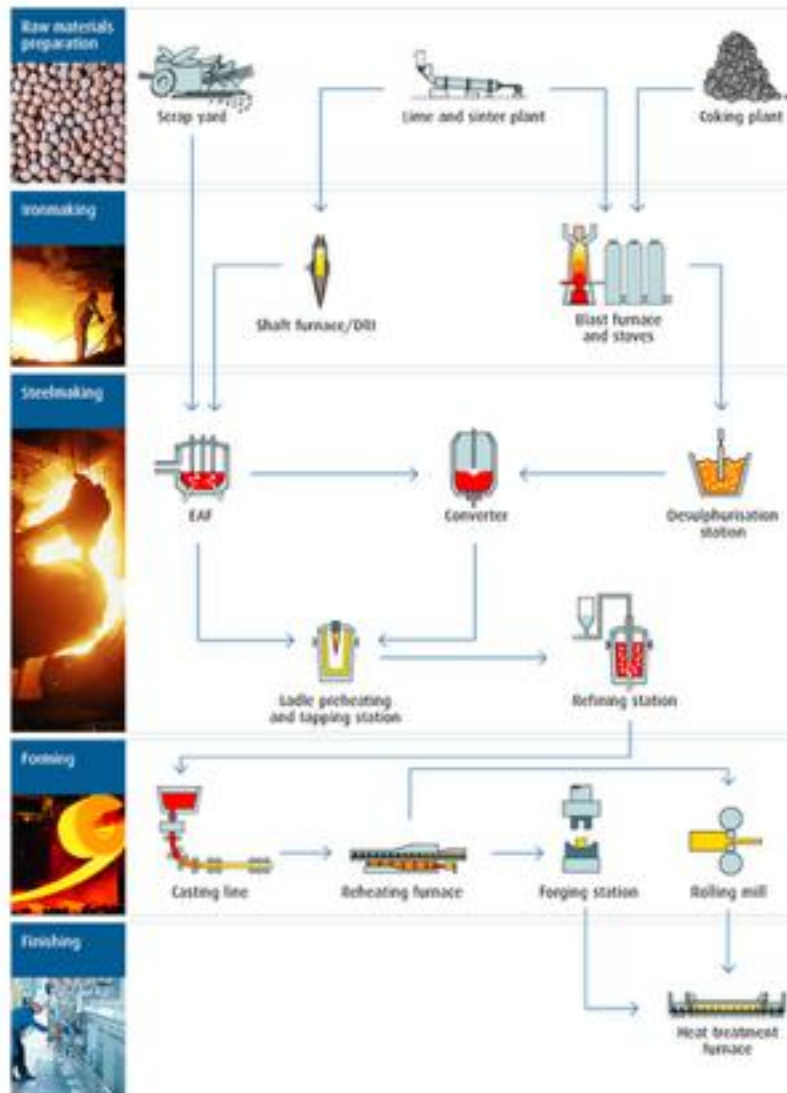


The urgent need for metals engineering ontologies

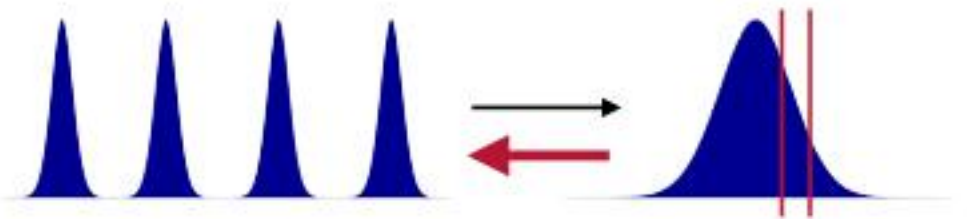
Lucio Colombi Ciacchi

15th September 2017

Process parameters ↔ Material Properties



$$\begin{Bmatrix} C_1 \pm \Delta C_1 \\ C_2 \pm \Delta C_2 \\ C_3 \pm \Delta C_3 \\ \vdots \\ C_N \pm \Delta C_N \end{Bmatrix} \times \begin{Bmatrix} P_1 \pm \Delta P_1 \\ P_2 \pm \Delta P_2 \\ P_3 \pm \Delta P_3 \\ \vdots \\ P_L \pm \Delta P_L \end{Bmatrix} \rightarrow M \pm \Delta M$$

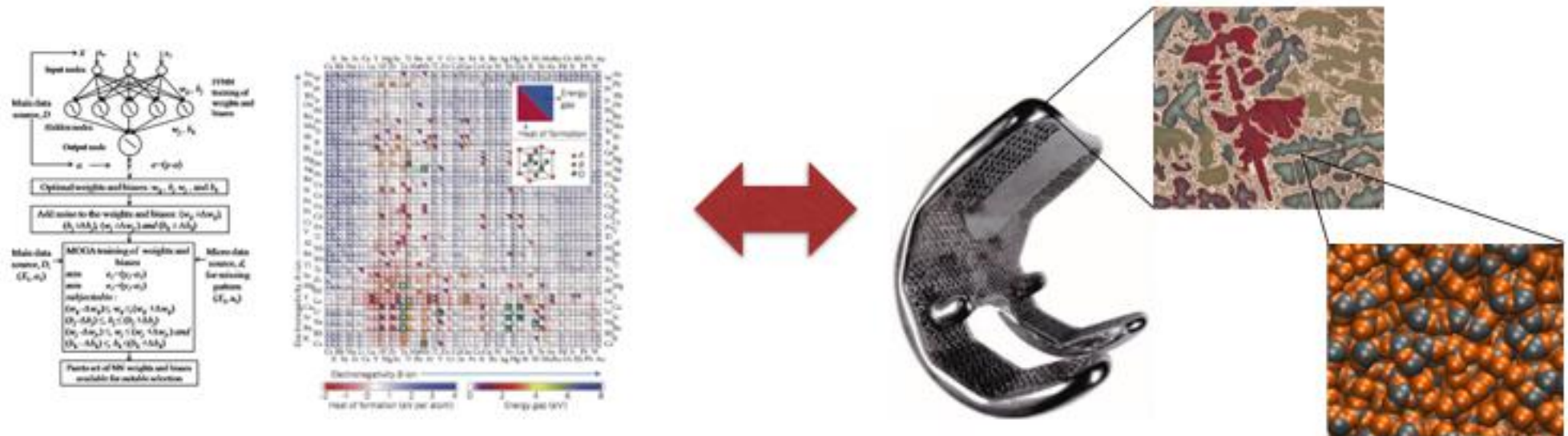


$$M_0 \pm \Delta M_0 \rightarrow \begin{Bmatrix} C_1 \pm \Delta C_1 \\ C_2 \pm \Delta C_2 \\ C_3 \pm \Delta C_3 \\ \vdots \\ C_N \pm \Delta C_N \end{Bmatrix} \times \begin{Bmatrix} P_1 \pm \Delta P_1 \\ P_2 \pm \Delta P_2 \\ P_3 \pm \Delta P_3 \\ \vdots \\ P_L \pm \Delta P_L \end{Bmatrix}$$

Bayes' rule:
$$P(f | \mathbf{D}, g) = \frac{P(\mathbf{D} | f, g)}{P(\mathbf{D} | g)} P(f | g)$$

Metals On Demand

Development of metallic materials with individually tailored and locally varying thermo-chemo-mechanical properties



Application of *artificial intelligence methods* for materials and process design

Beyond the 'Materials Genome' idea


The drawback of the material genome and related initiatives is that the *genome* alone does not tell you how the *cell* work.

“materials databases, especially if obtained via computational screening, tell very little on how potentially interesting materials can be synthesised, manufactured and perform in a complex environment”


Challenge: Modern Data is Incomplete and Heterogeneous

Answers to Queries can be Highly Incomplete

Using Multiple Data Sources Extremely Difficult



Emerging Approach: Ontology-Based Data Access (OBDA)

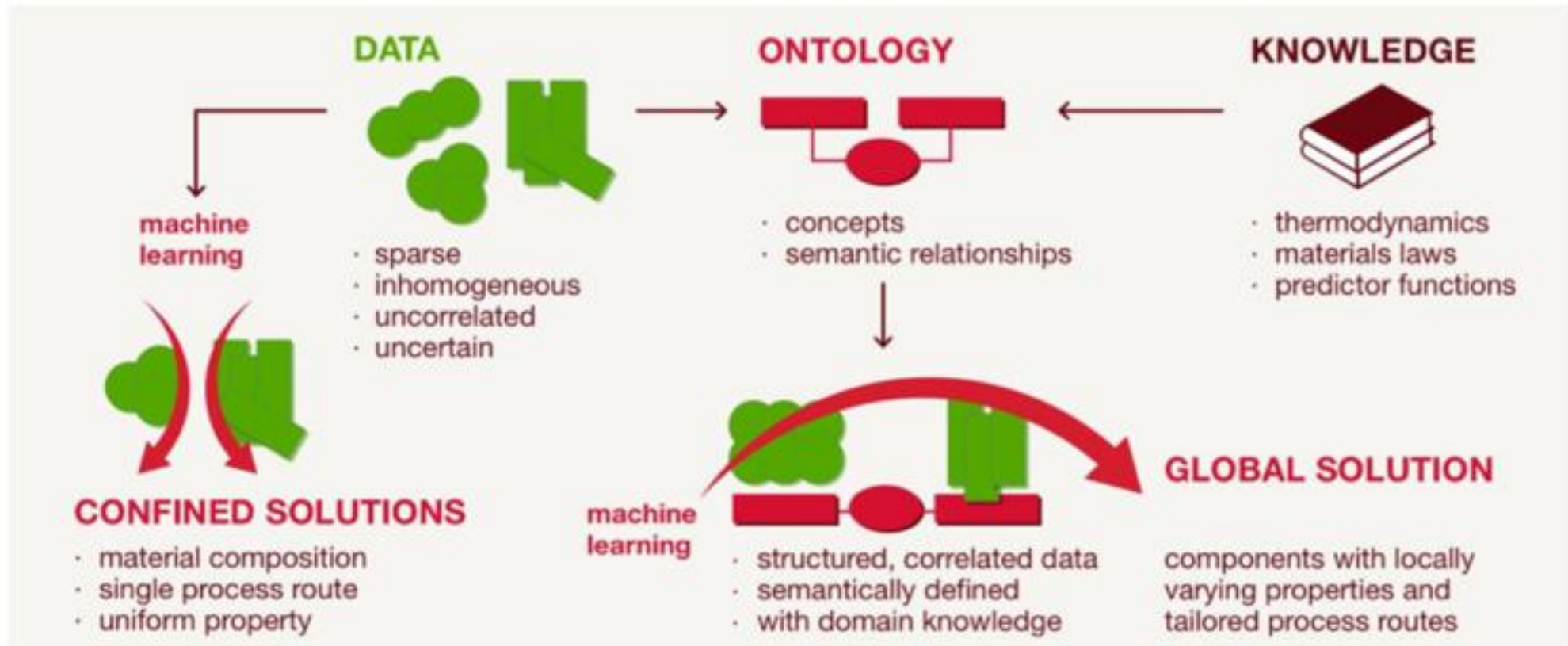


Ontology

- adds domain knowledge attenuate incompleteness
- relates vocabularies of data sources addressing heterogeneity

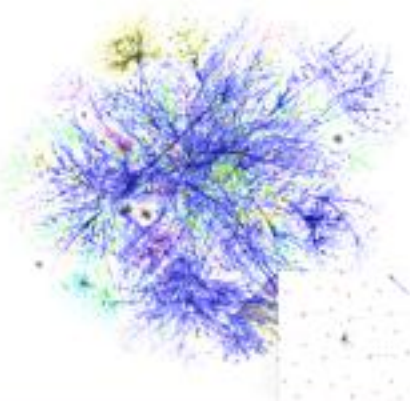
Carsten Lutz, Uni HB

An ontological approach to metals engineering

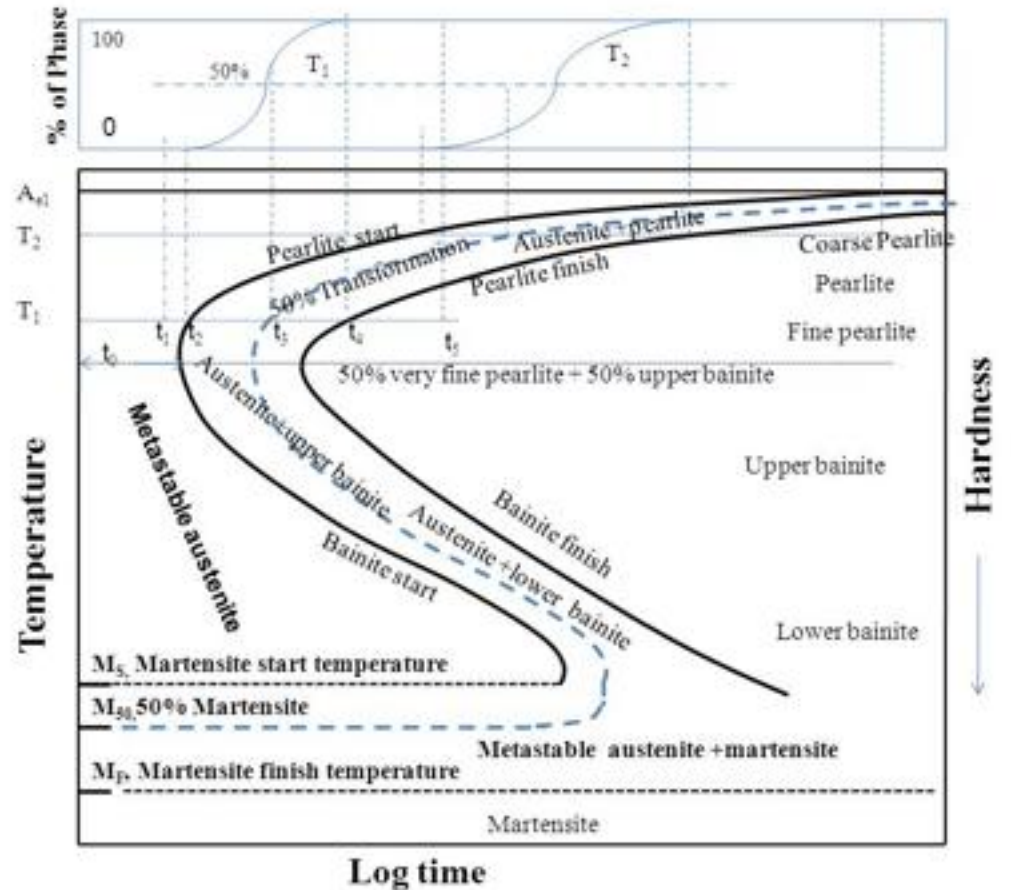
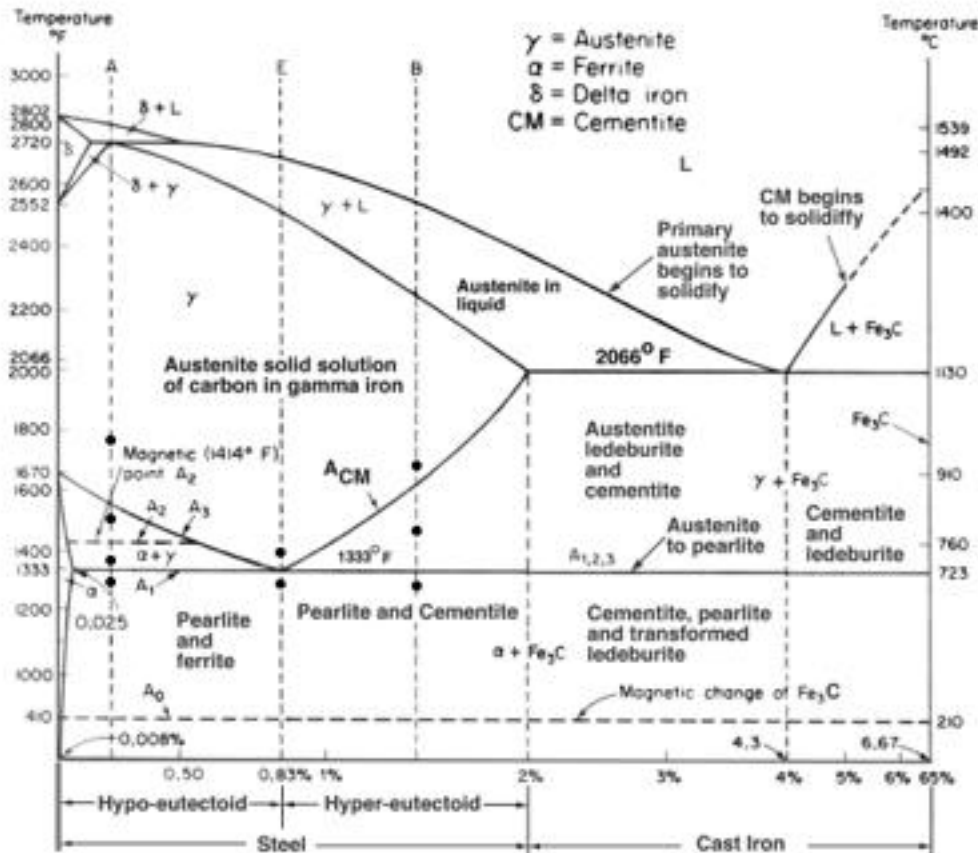


Requirements to metals engineering ontologies

- Inclusive** Interfaced with various materials and process databases
- Interactive** Enabling data reading; constructed from data reading
- Knowledgeable** Respecting / relying upon fundamental materials laws
- Local** Evolving in a piece-wise, divide-and-conquer kind of way
- Adaptive** Improving, revising or refining their structure where and when needed



Good luck with it.



Thank you!

