

# Multi-model ecologies for Industrial Symbiosis

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# Industrial systems are Complex Adaptive Systems

- Many social and technical components (Huges 1987)
- Parallel, distributed self organization with reflective downward causation (Holland 1996, Kroes 2009)
- Evolve over time (Dennet 1996, Dawkins )
- Require multiple formalisms to understand fully (Mikulecky 2001)
- Are value and emotion loaded. (Roesser 2012, van der Hoeve, 2012)

# Models of IS

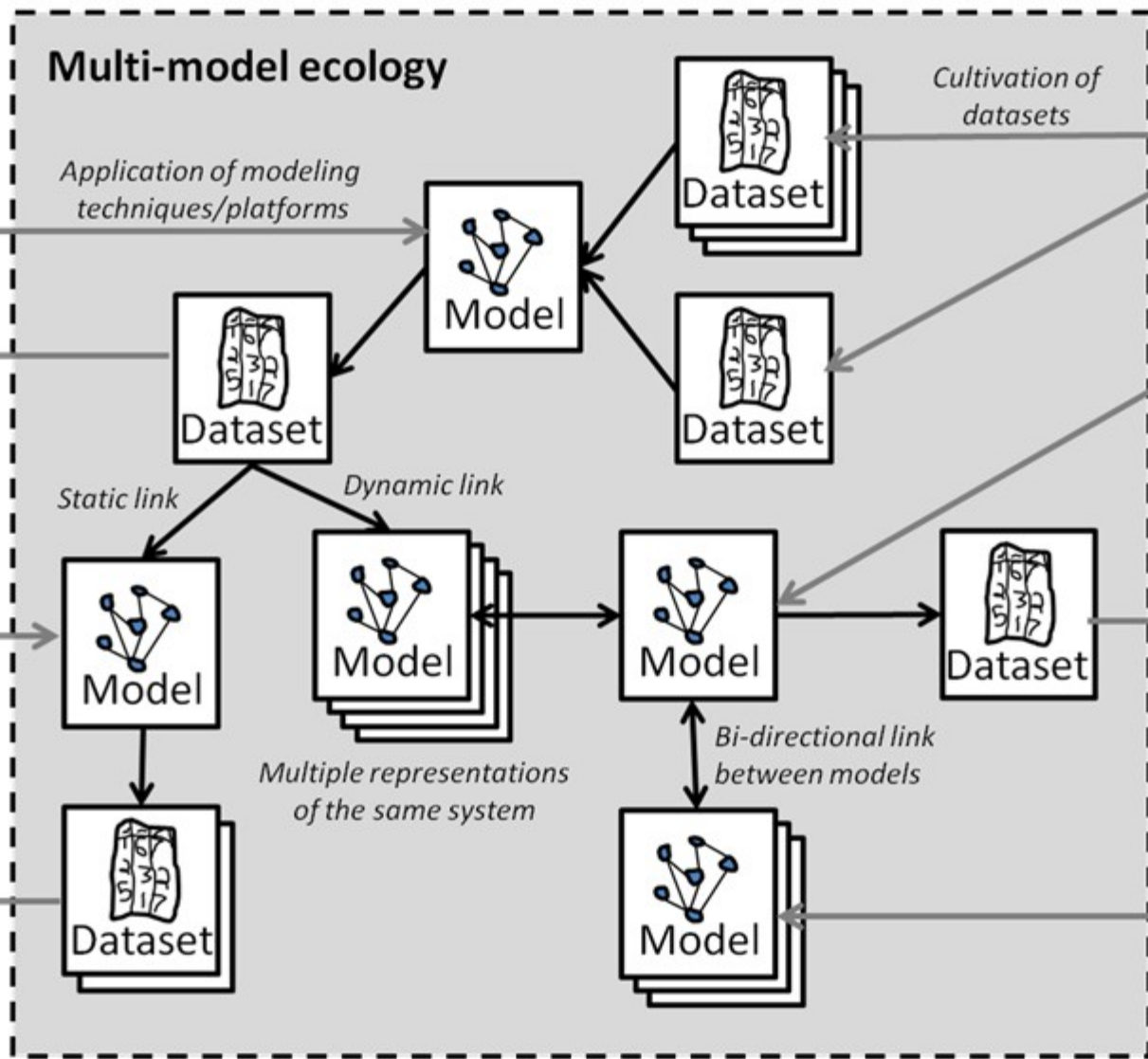
- Model = represents multiple valid epistemological and ontological perspectives
- A “leaky abstraction” (Spolsky, 2002),
  - subjective beliefs and choices
  - limited knowledge
  - skill of the individual modeler
    - And of course :
  - Simplification of the real-world system under study
- Should be as complex as IS itself! (c.f. Ashby’s Law of Requisite Variety)

# Models as memes

- Mental models
  - Neural connections in our minds
- Conceptual models
  - Mental models expressed as qualitative sets of relationships on paper
- Computer models
  - Conceptual model as logical configurations of electronic gates in a computer
- Information embedded in a medium => memes experiencing variation, replication and selection
  - Universal Darwinism!

# Evolving multi-model ecologies

- Groups of models and datasets co-evolving within a dynamic socio-technical environment.
- Variation
  - models modified, adapted
- Replication
  - Models used, published, copied
- Selection
  - Useful ones identified, rest discarded

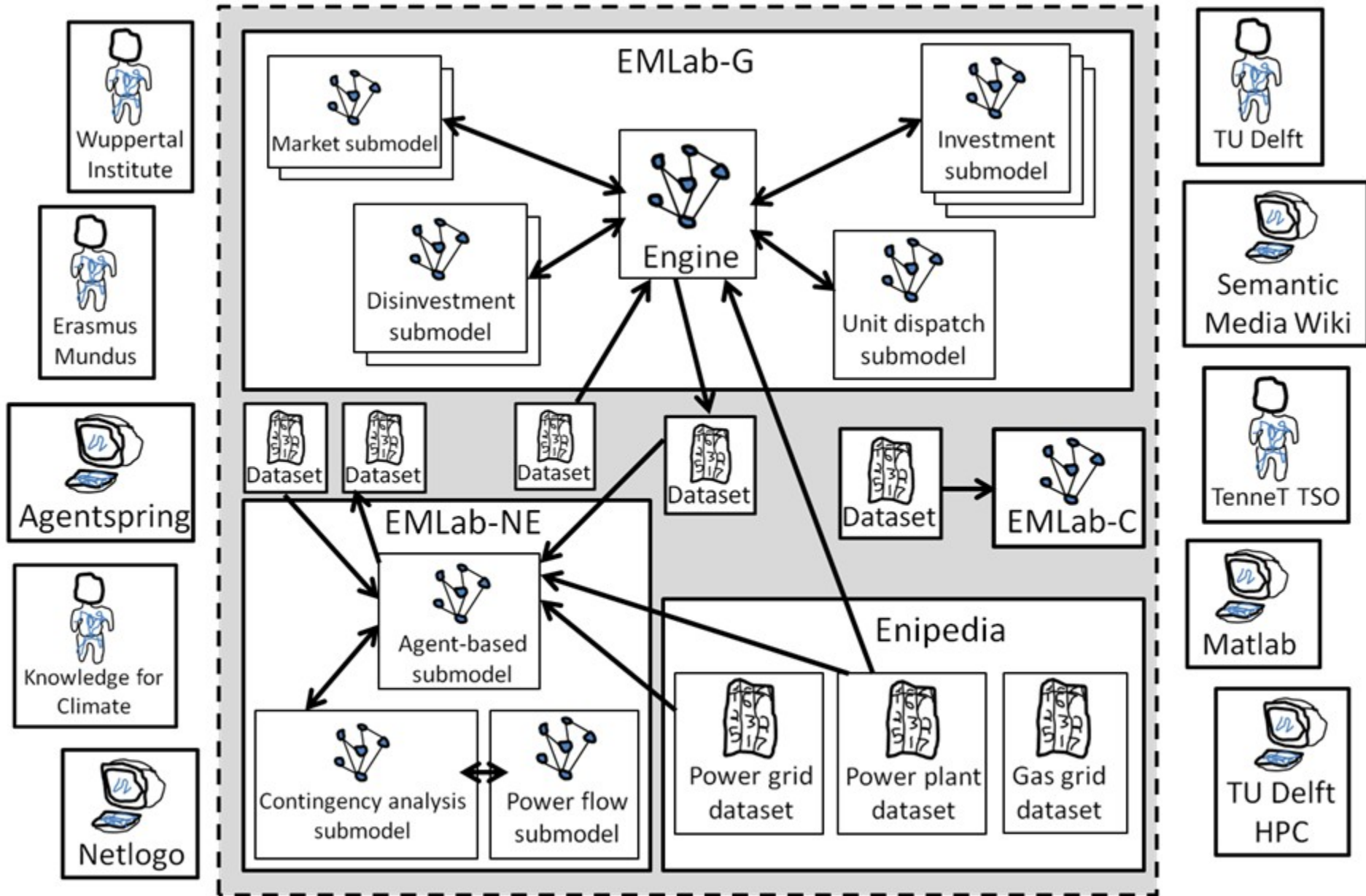


Socio-technical context

# Evolutionary perspective

- Ecosystem of tools creating
- an evolving series of locally optimal models
- using socially generated model mechanisms and
- distributed collection and curation of data, allowing for
- maximum transparency about assumptions and outcomes

# Example: emlab.tudelft.nl

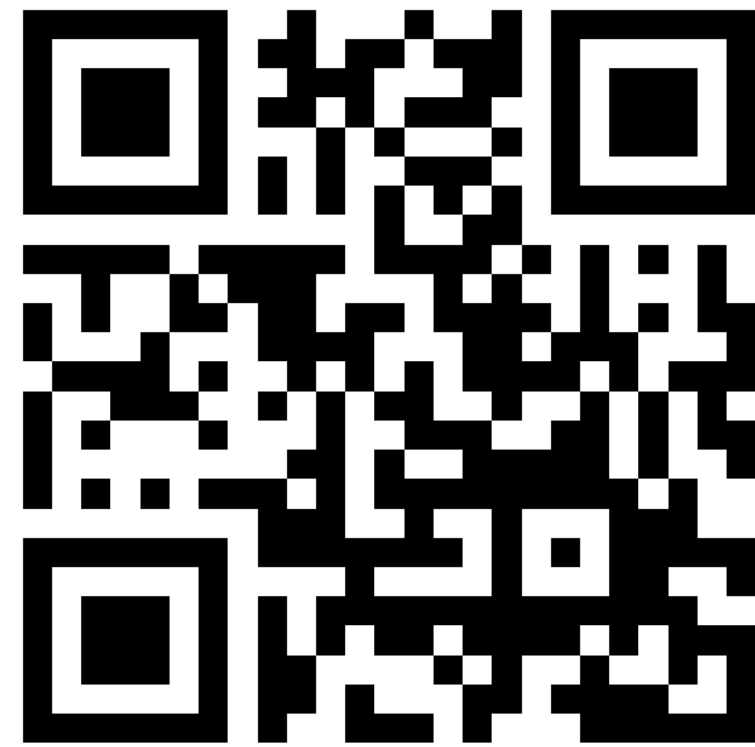




# Guidelines

- **Use open standards and open software**
  - Without “DNA” no evolution
- **Document, and use documentation standards**
  - “Data without context” > useless
- **Build simple components**
  - Modularity and ease of verification/validation
- **Leverage the Web, but recognize its limitations**
  - “Build it and they will come” = myth
- **Prioritize flexibility over completeness**
  - Able to adapt > “perfect” now
- **Borrow proudly**
  - “Not invented here” = waste of work
- **Acknowledge your role**
  - Framing, bias, skills, beliefs

Thank you!



<http://emlab.tudelft.nl/>

