

Evolving model of infrastructure evolution

Dr. ir. Igor Nikolic, L.A. Bollinger, MSc

03-04-14

Infrastructures 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 infrastructures

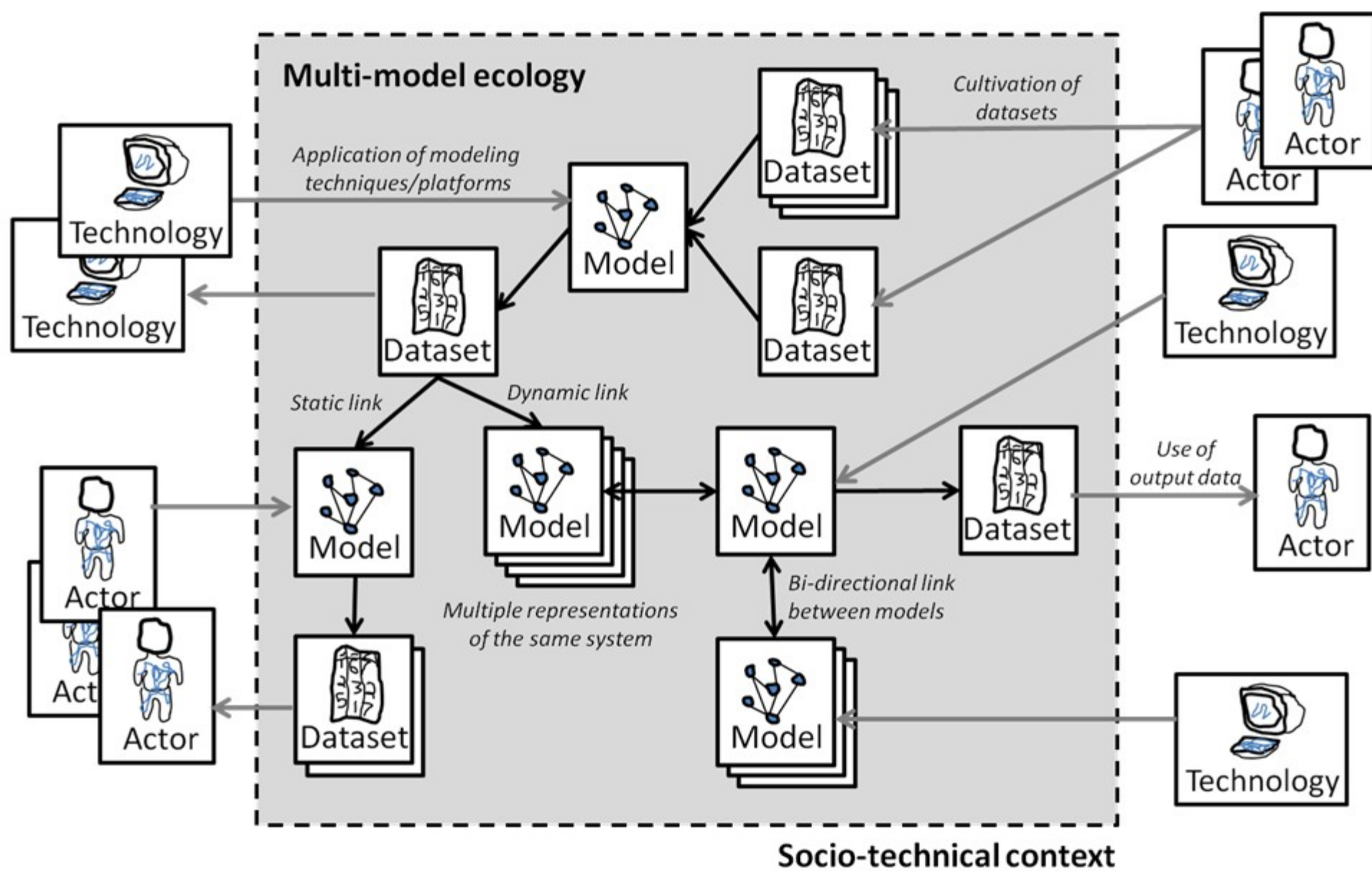
- Model = represents multiple valid epistemological and ontological perspectives
- A “leaky abstraction” (Spolsky, 2002),
 - subjective beliefs and choices
 - limited knowledge
 - skill of the individual modeler
 - And of course :
 - Simplification of the real-world system under study
- Should be as complex as infra 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

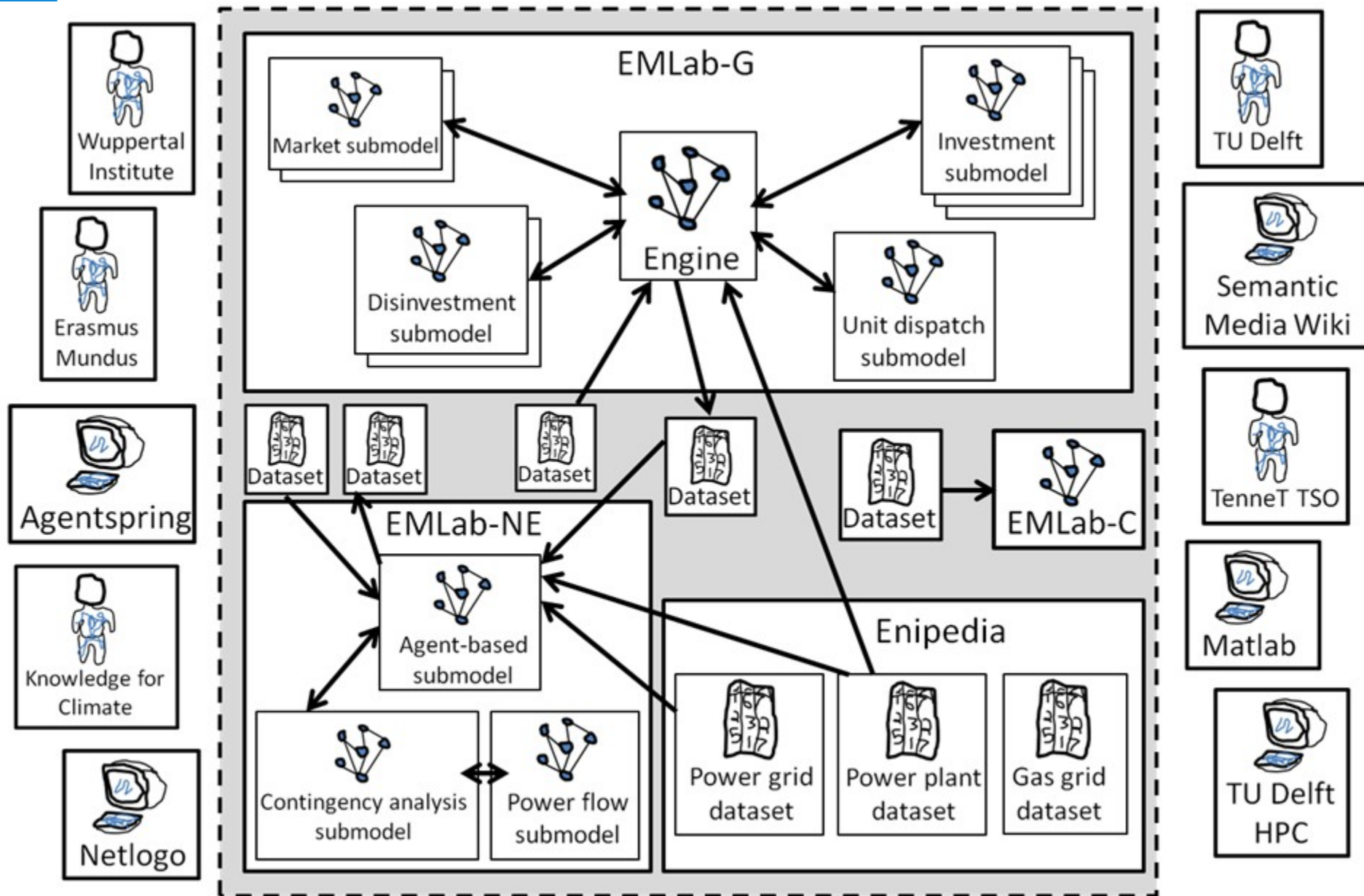
- Groups of models and datasets co-evolving within a dynamic socio-technical environment.
- Variation
 - models modified, adapted
- Replication
 - Models used, published, copied
- Selection
 - Useful ones identified, rest discarded



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!

