32nd Annual INCOSE international symposium
hybrid event
Detroit, MI, USA
June 25 - 30, 2022

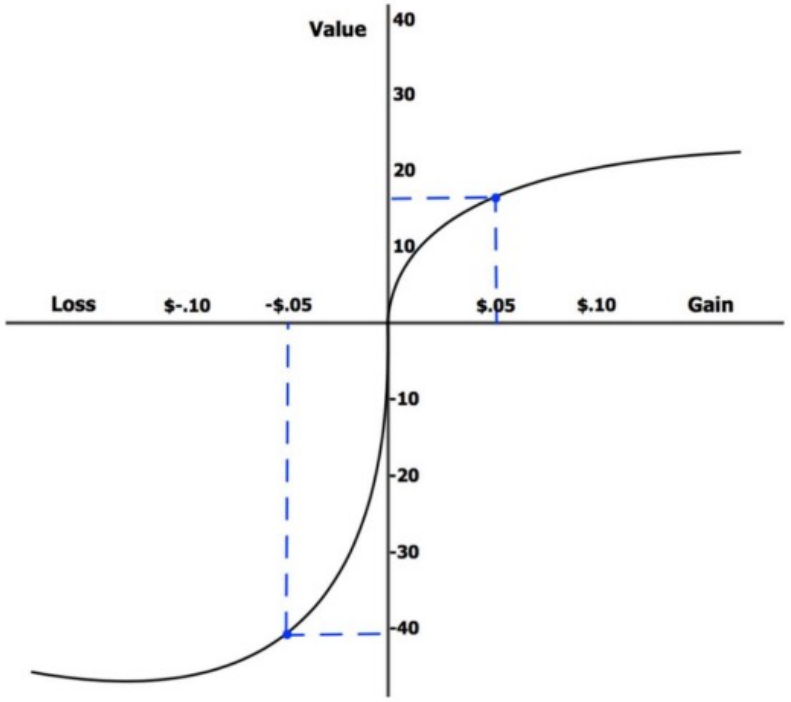
Logics of irrational design of rational systems

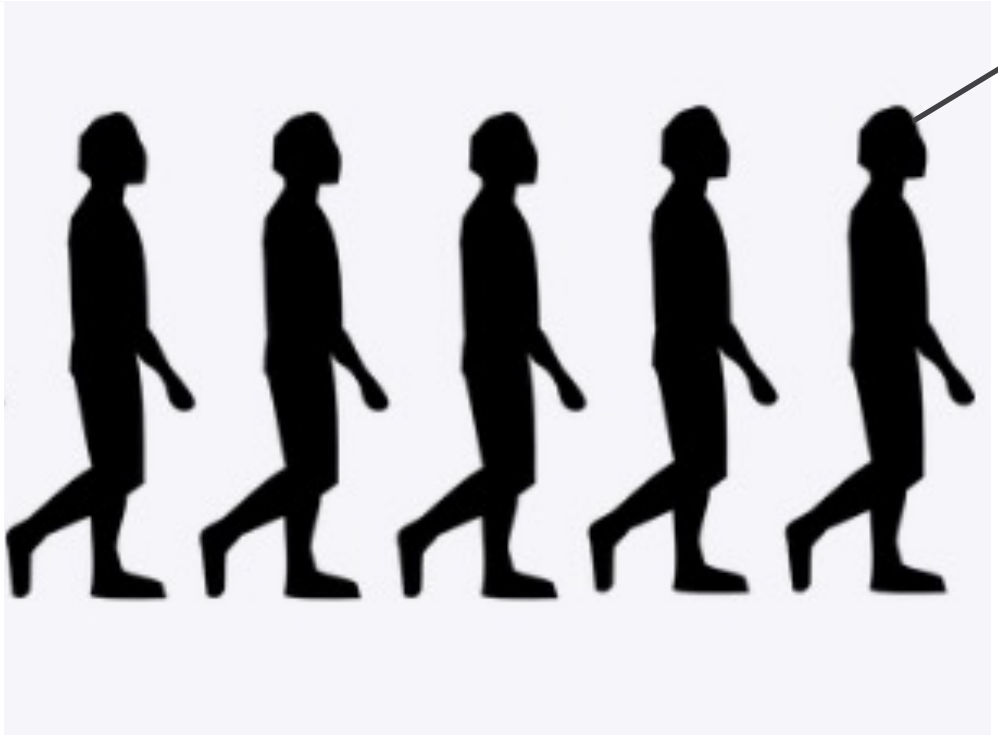
- Systems modelling and human decision making

Paper 120 – Robert Nilsson & Gary Smith

www.incose.org/symp2022

History of human decision-making research





1. Language
2. Abstract concepts
3. Gossip

Prof. Yuval Noah Yokul, *"SAPIENS"*

- **Heuristics, to be fast**
- **Ecological Models**

4. Year 1985-2000: Humans not victims to logic but actors in a constructive **system** aiming at positive outcomes

3. Nr 2 was proven not correct: "prospect theory" Kahneman & Tversky (2000) - new direction descriptive theory

2. Expected value: there is a "best" solution to the problem – normative/prescriptive, ""how you should do"

1. Logic and the world is known (research started about 1670)

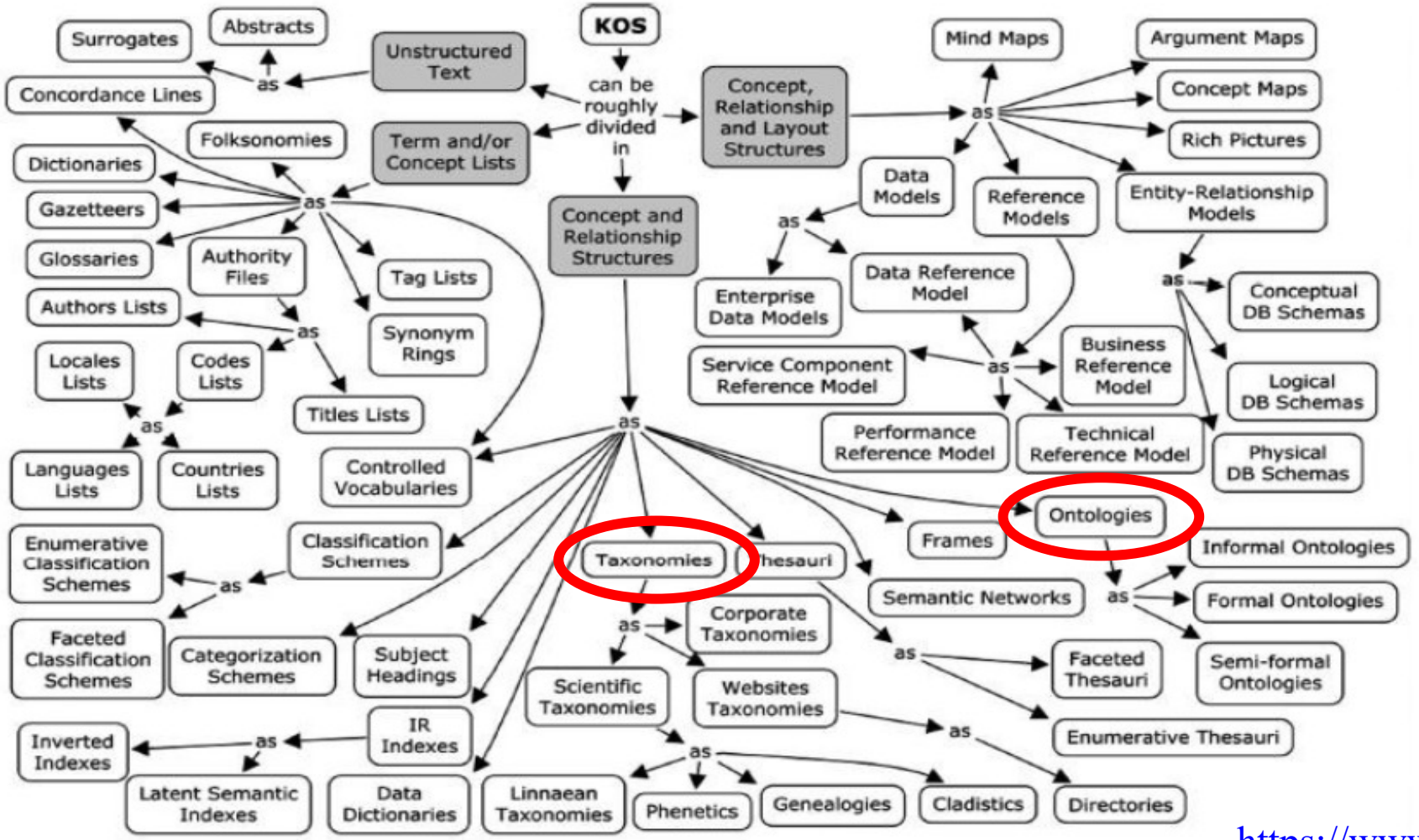
Example

Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.

Which is more probable?

A. Linda is a bank teller.
B. Linda is a bank teller and is active in the feminist movement.

Knowledge – a value proposition for model-based work



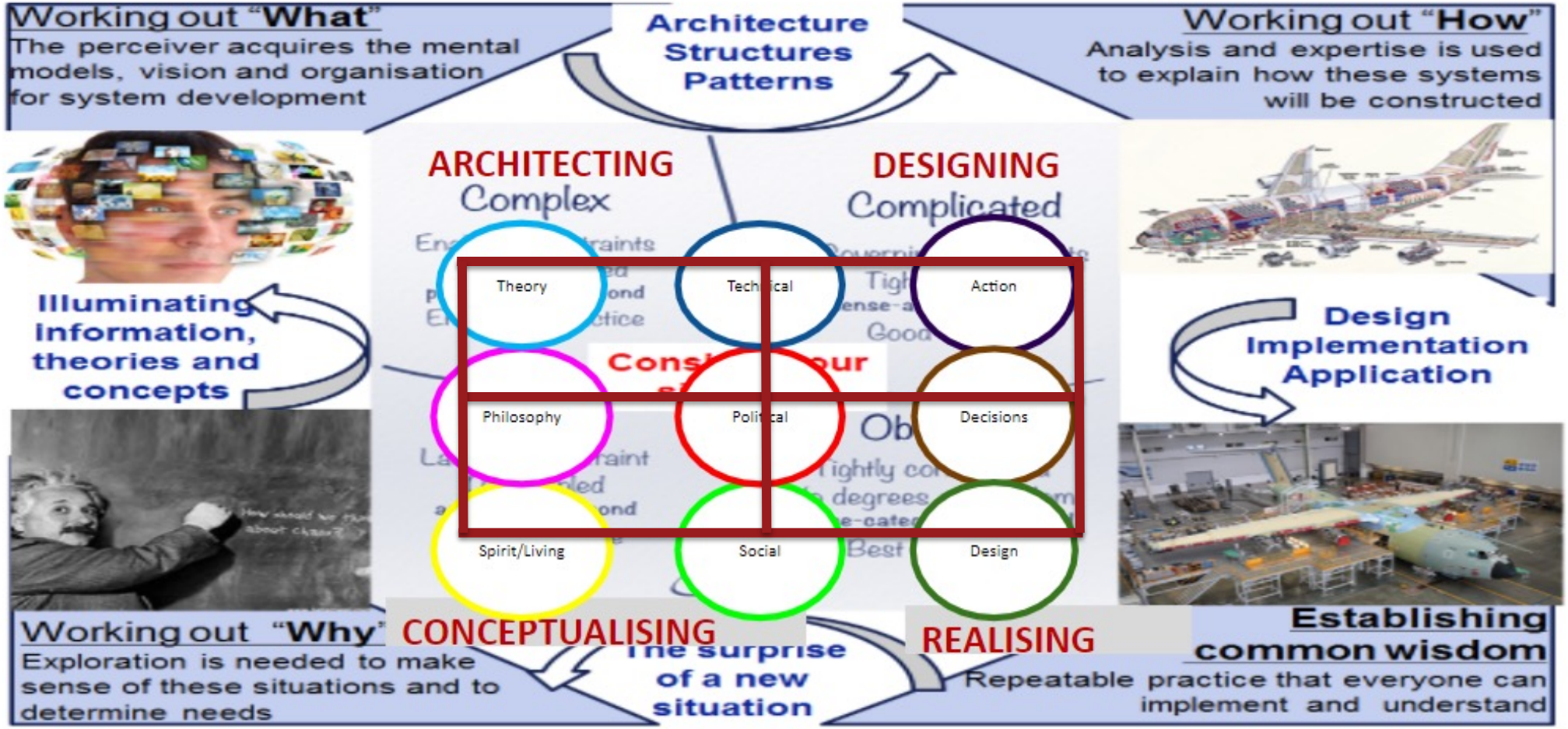
https://www.isko.org/cyclo/kos

Integrative Framework (Smith, G. 2021)

		Ideas - Concepts (for meaning and observation)	General Theories - Frameworks (for orientation)	Big Ideas - Principles (for deciding)	Enablers - Assets (for acting on)	The whole-Context (to realise)
Categories	**Identity of wholes** (togetherness of things)	Structure, Components, Boundary, Boundedness, Holarchy, Topology, Wholeness, Integrity, Network,	Theories of Identity and Togetherness	Simpler things combine into more complex things #1 have systemness #3 are networks	Taxonomy of togetherness (eg Volk)	Taxonomy of system types (eg Boulding)
FORM	**Behaviour of wholes** (processes of things)	Activity, Dynamic, Influence, Interaction, Dependency, Feedback, Source, Sink, Stock, Flow, Effect	Theories of Behaviour and Processes	Very different things do many things in the same fashion #2 are processes #4 are dynamic	Taxonomy of processes (eg Troncale)	Taxonomy of behaviours
	Cycles of wholes (phases of things)	State, Phase, Transition, Event, Tipping point	Theories of Cycles and Phases	Everything follows a lifecycle, even the universe #11 can be understood #12 can be improved	Taxonomy of phases (eg Troncale)	Taxonomy of cycles
FUNCTION	**Capability of wholes** (purpose of things)	Stakeholder, Responsibility, Role, Hierarchy, Autonomy, Environment	Theories of Capability and Purpose	Emergent Properties when things combine #5 are complex #8 have regulatory subsystems	Taxonomies of purposeful subsystems (eg Miller)	Taxonomy of capabilities
	Value of wholes (qualities of things)	Perspective, Use, Judgement, Condition, Circumstances, Benefit, Selection	Theories of Value and Qualities	Value increases when stakeholders are engaged #9 models of others #10 models of themselves	Taxonomies of qualities (eg Virtues - Rousseau et al)	Taxonomy of values
FIT	**Consciousness of wholes** (experience of things)	Awareness, Understanding, Empathy, Comprehension, Learning, History, Memory, Evolution, Adaptation, Anticipation	Theories of Consciousness and Experience	The more complex something is, the richer is its experience #6 are evolving #7 encode knowledge and exchange information	Taxonomies of experiences (eg Bloom)	Taxonomy of Consciousness (eg Jonkisz)

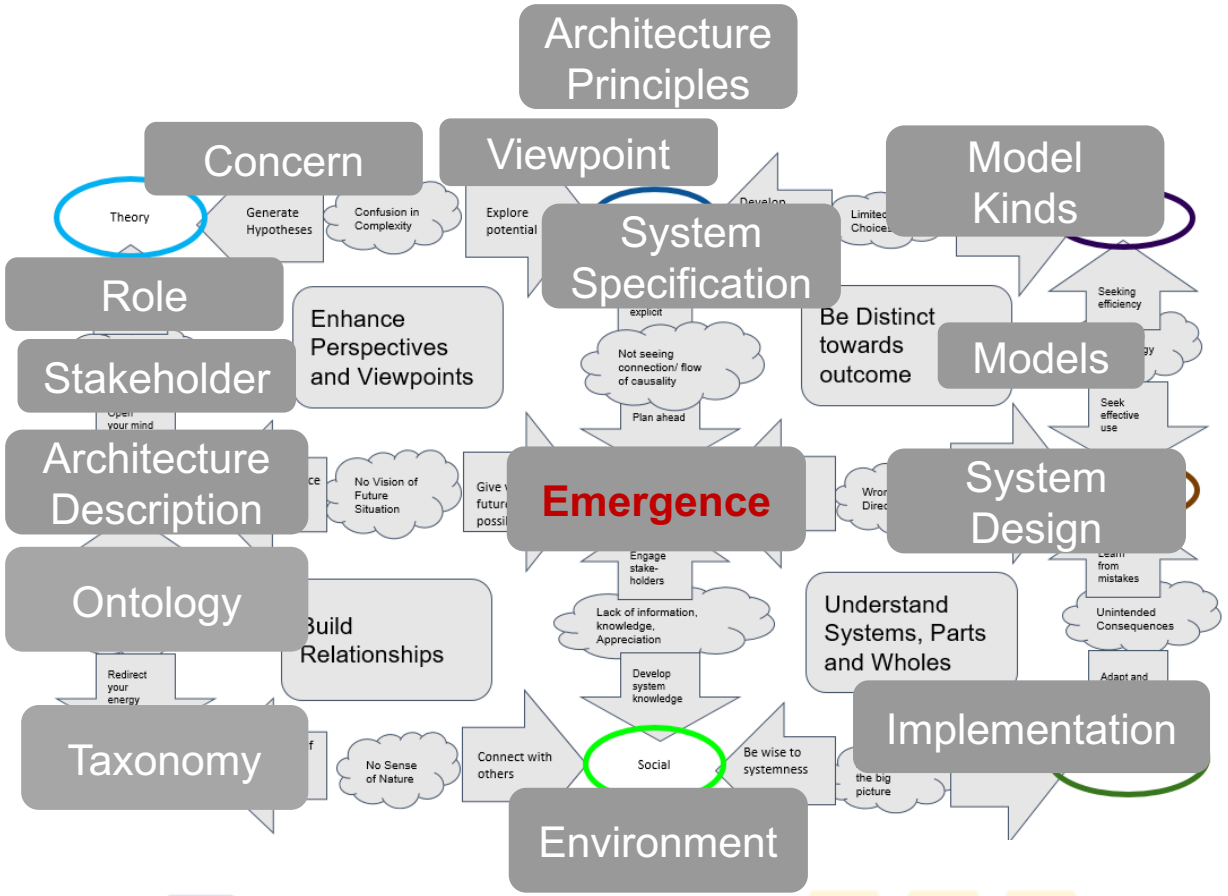
Transformational Powers connect theory to practice

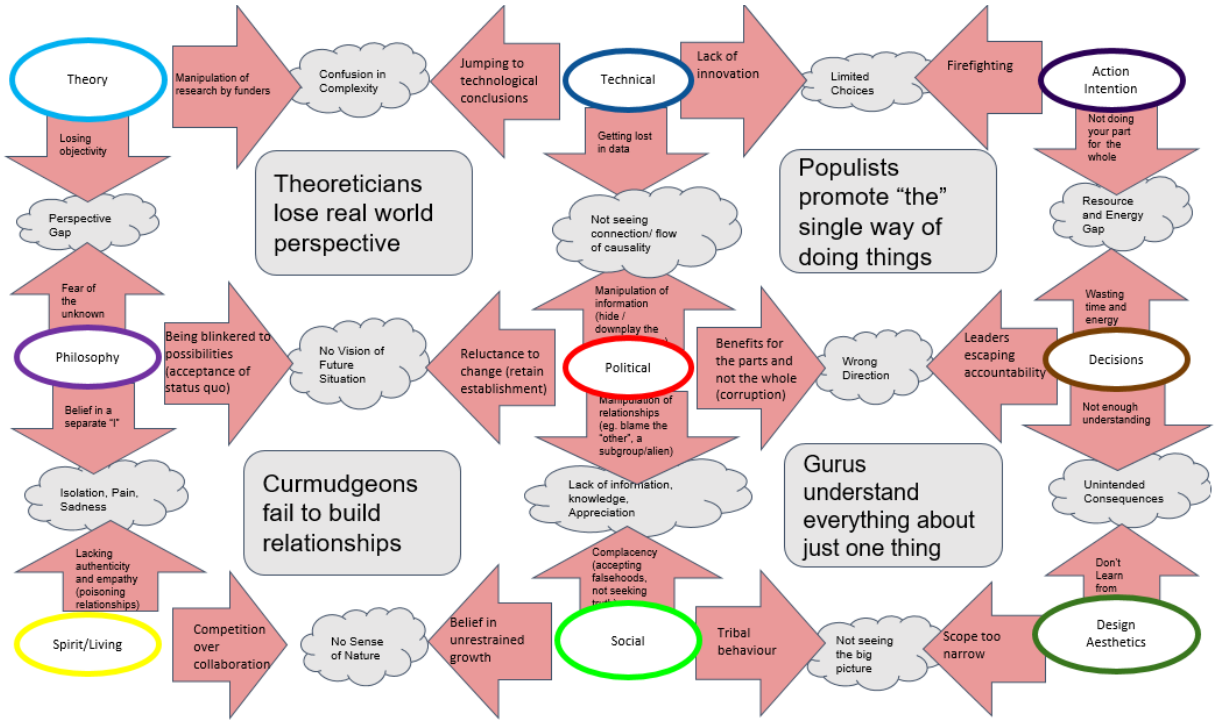
(Purpose and Power in the Evolution of Socio-technical Systems Design William E. Smith PhD



Gary Smith, *An architecture for system science*, INCOSE / IEEE, 2021

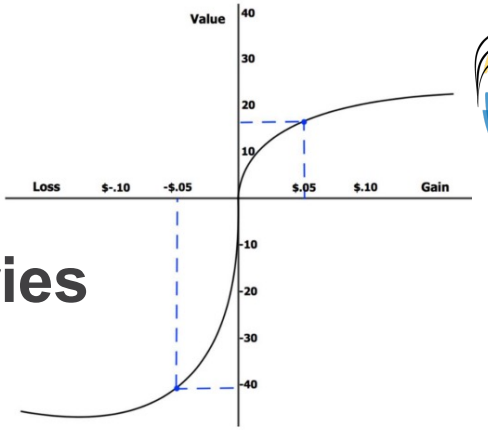
Systemness or Disorder





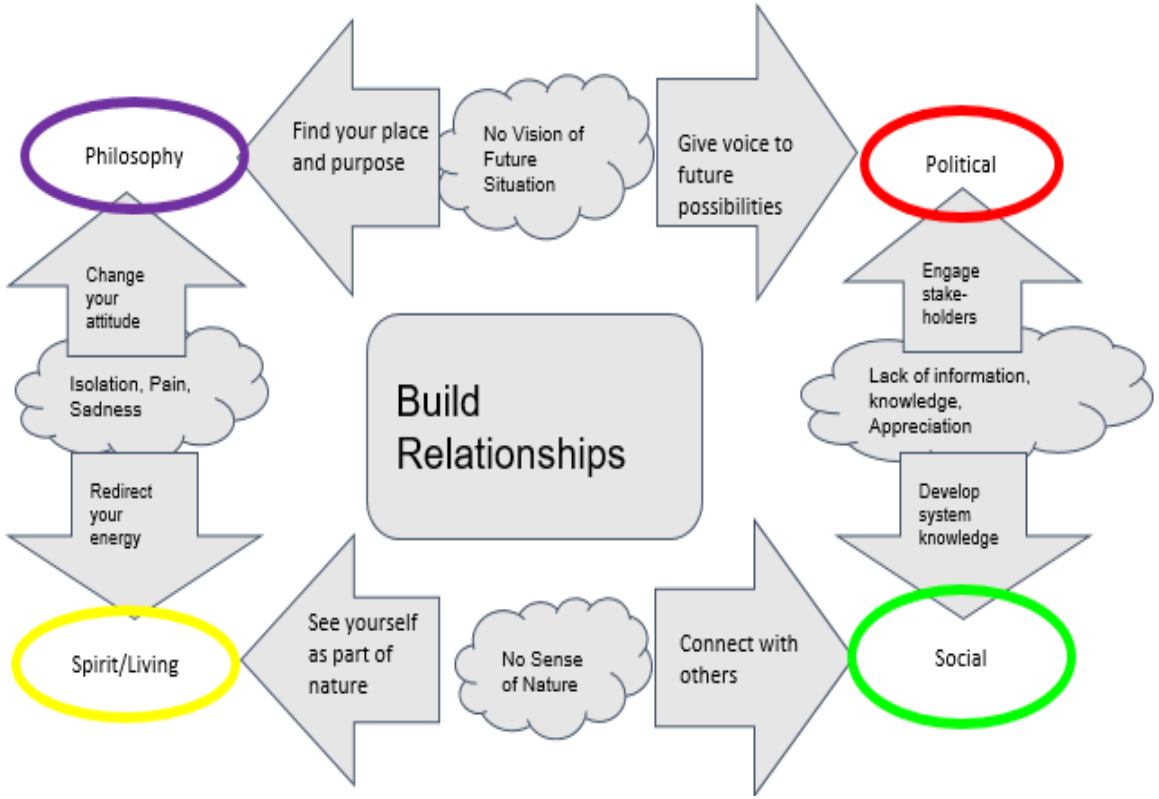
Impediments in modelling >50 years of modelling

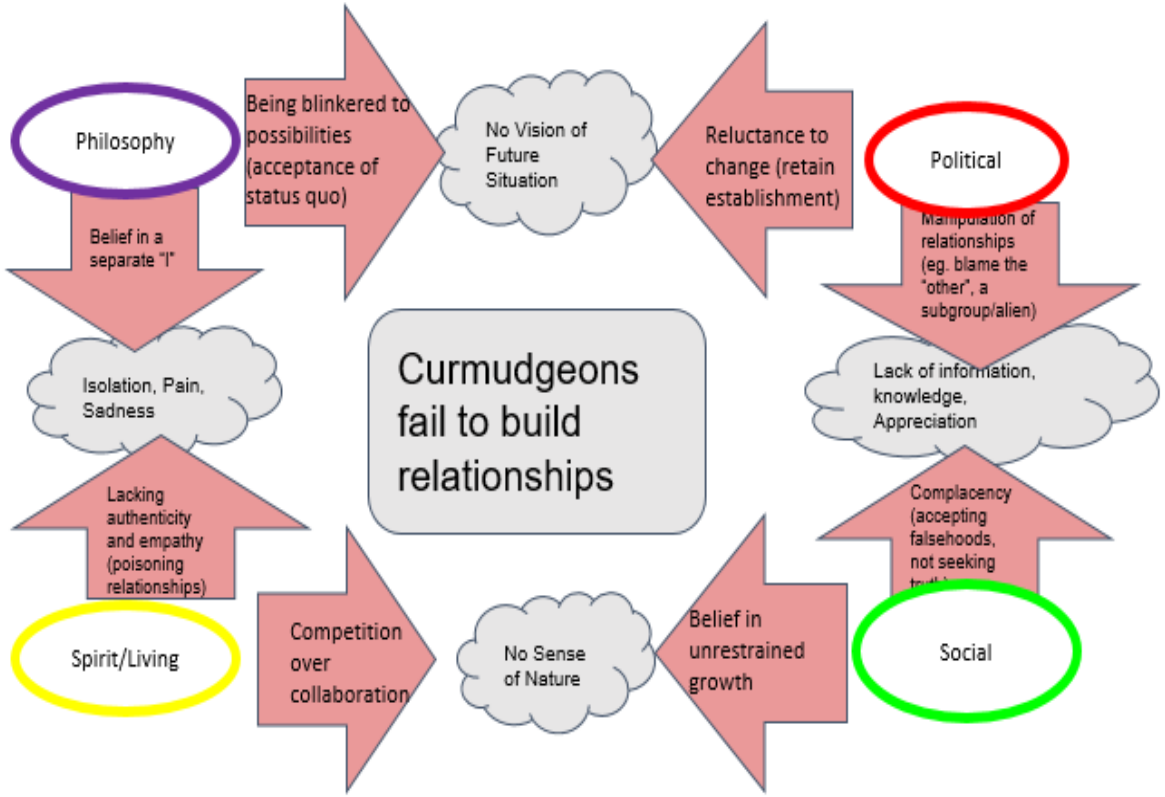
Impediment 1



Mixing system definition and/or interpretation of boundaries

- *inadequate definition of concerns*
- *variance in individual value (prospect theory)*

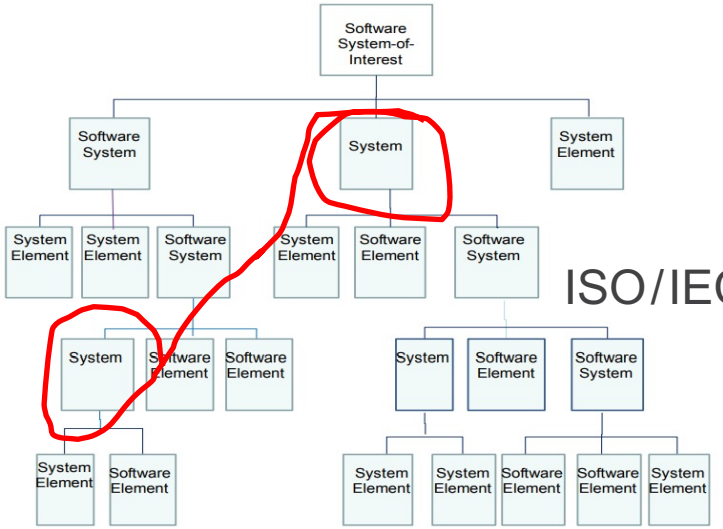




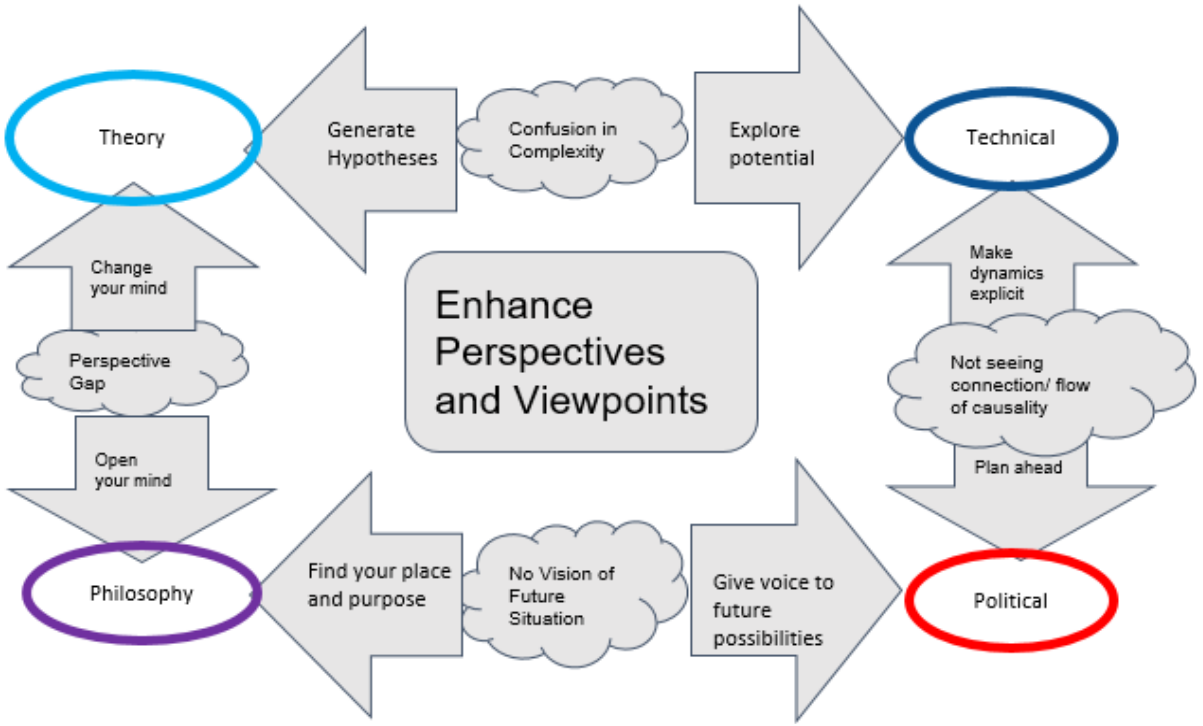
Impediment 2

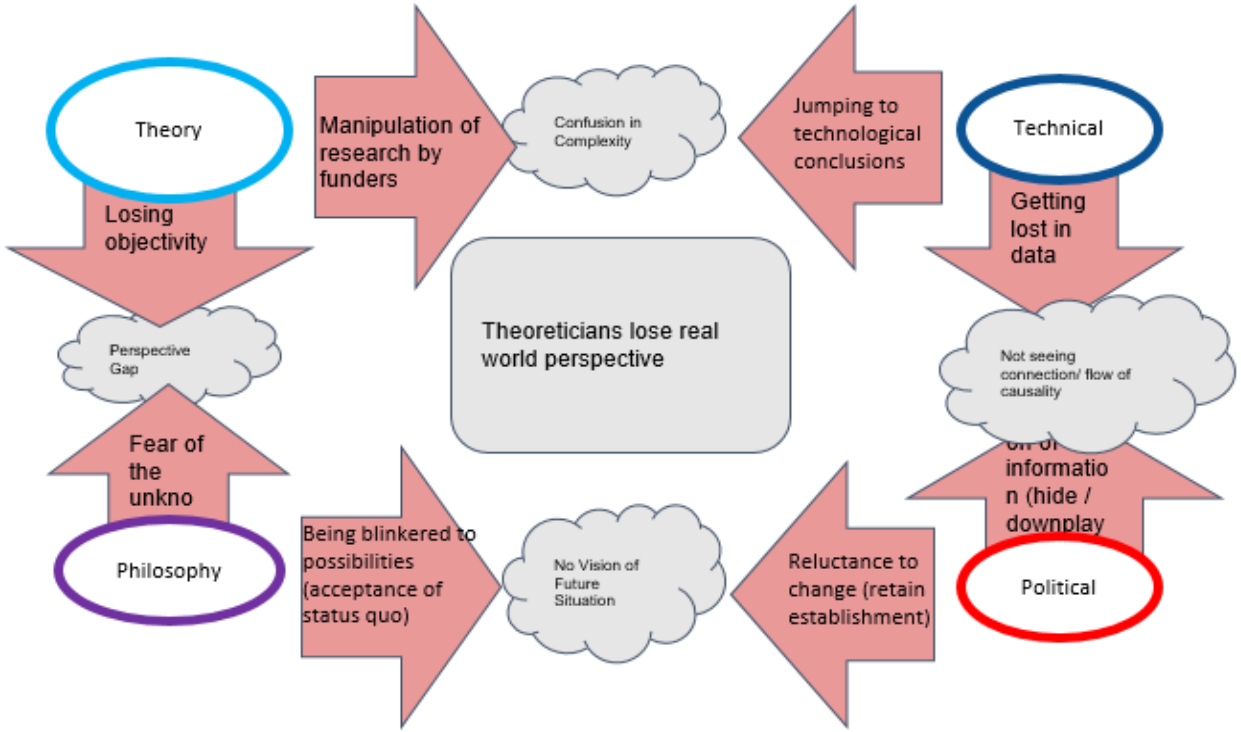
Mixing structure and abstraction

- *Unclear responsibilities*
- *System effects not stated / lack of viewpoints*
- *Confusing, not frugal or ecological*

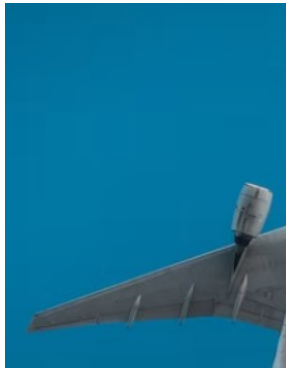


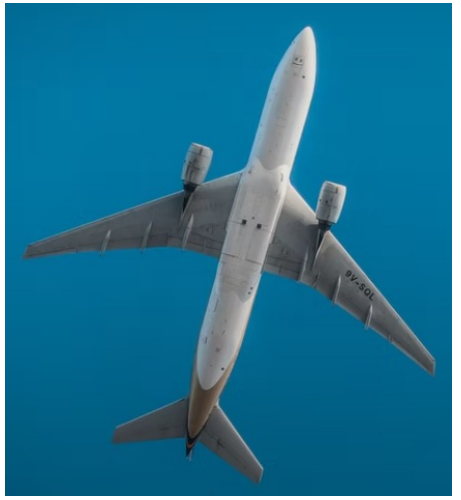
ISO/IEC/IEEE 12207 (2017)





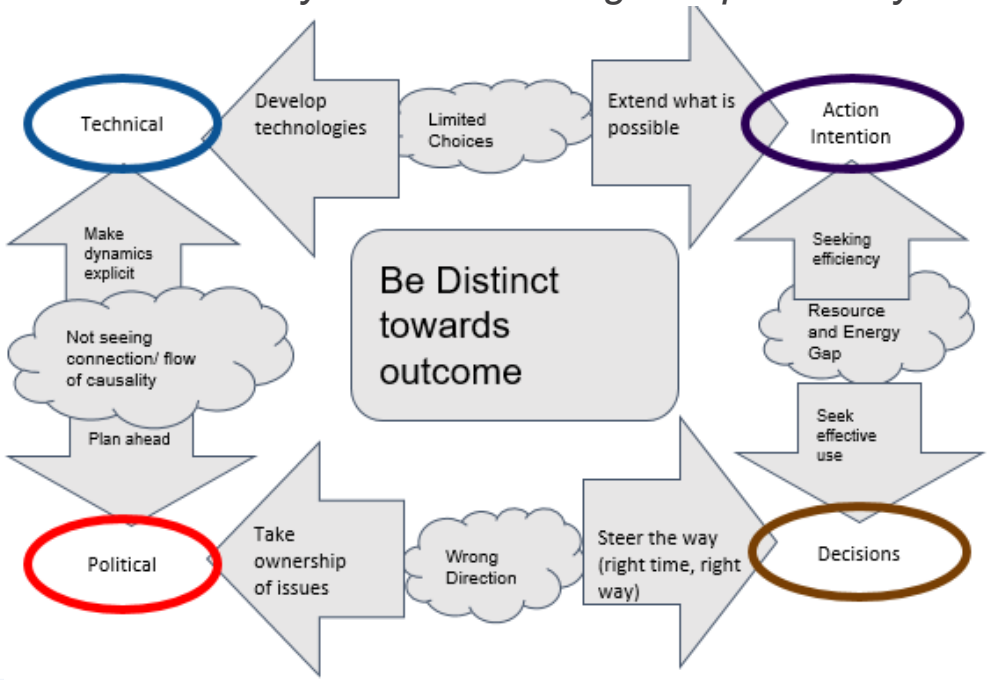
Impediment 3

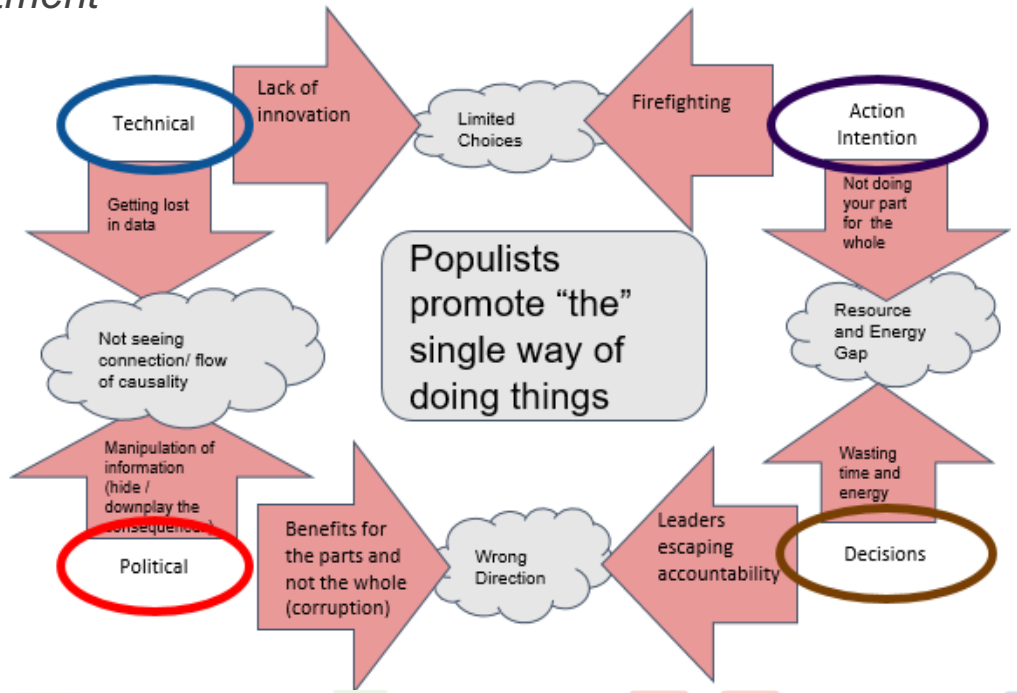




Uncertainty of what is modelled, current state or possible state

- *Typical when a smaller model grows in complexity*
- *A particular model kind is "overused", outside first purpose (architecture description "not in sync")*
- *Lack of rationality / understanding and potentially commitment*

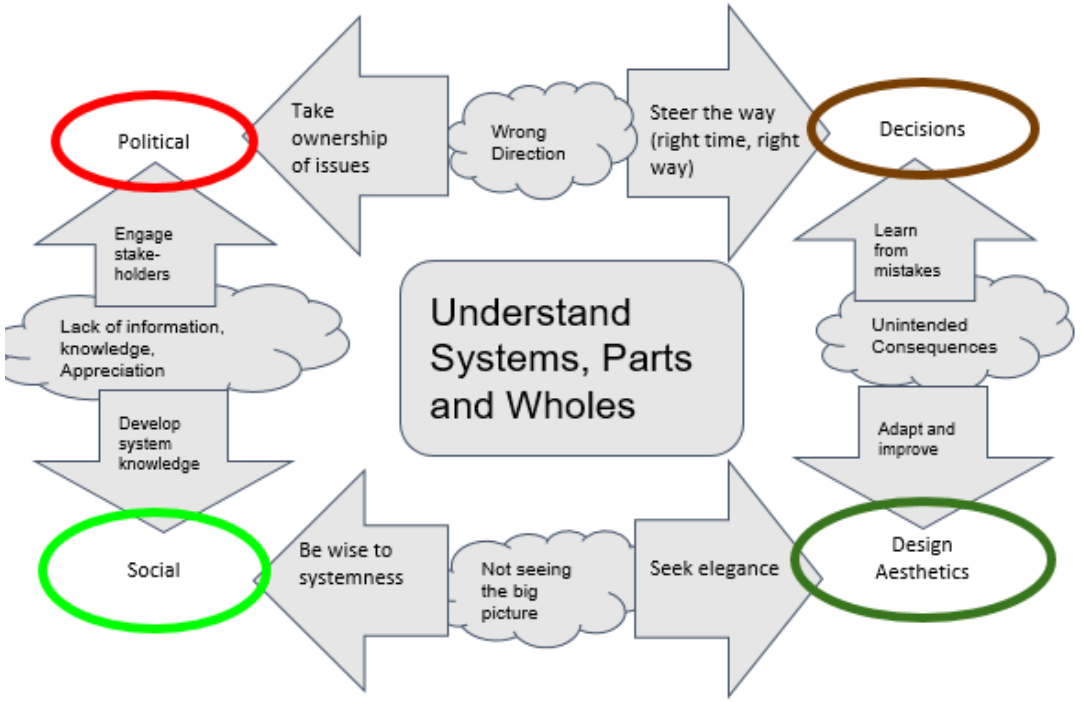


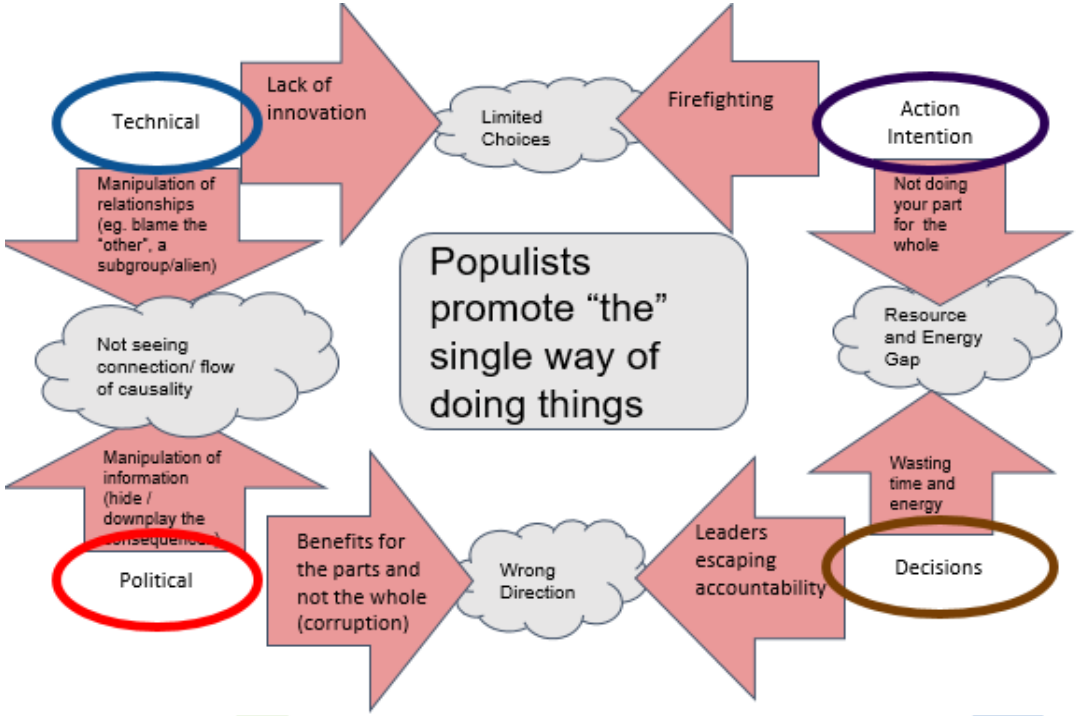


Impediment 4

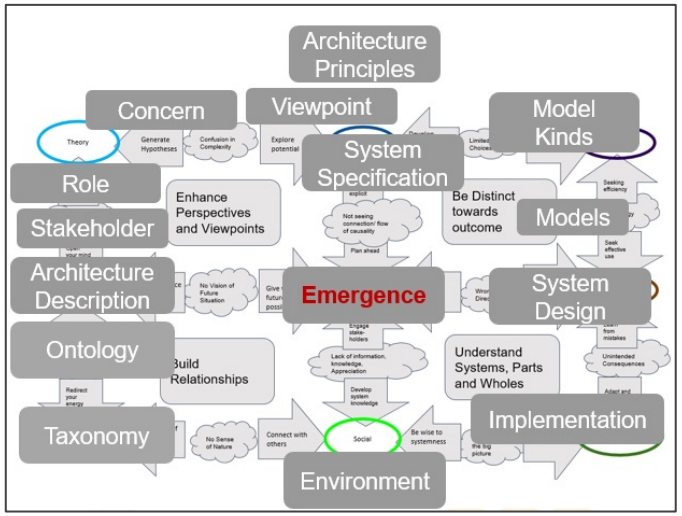
Reinventing the wheel

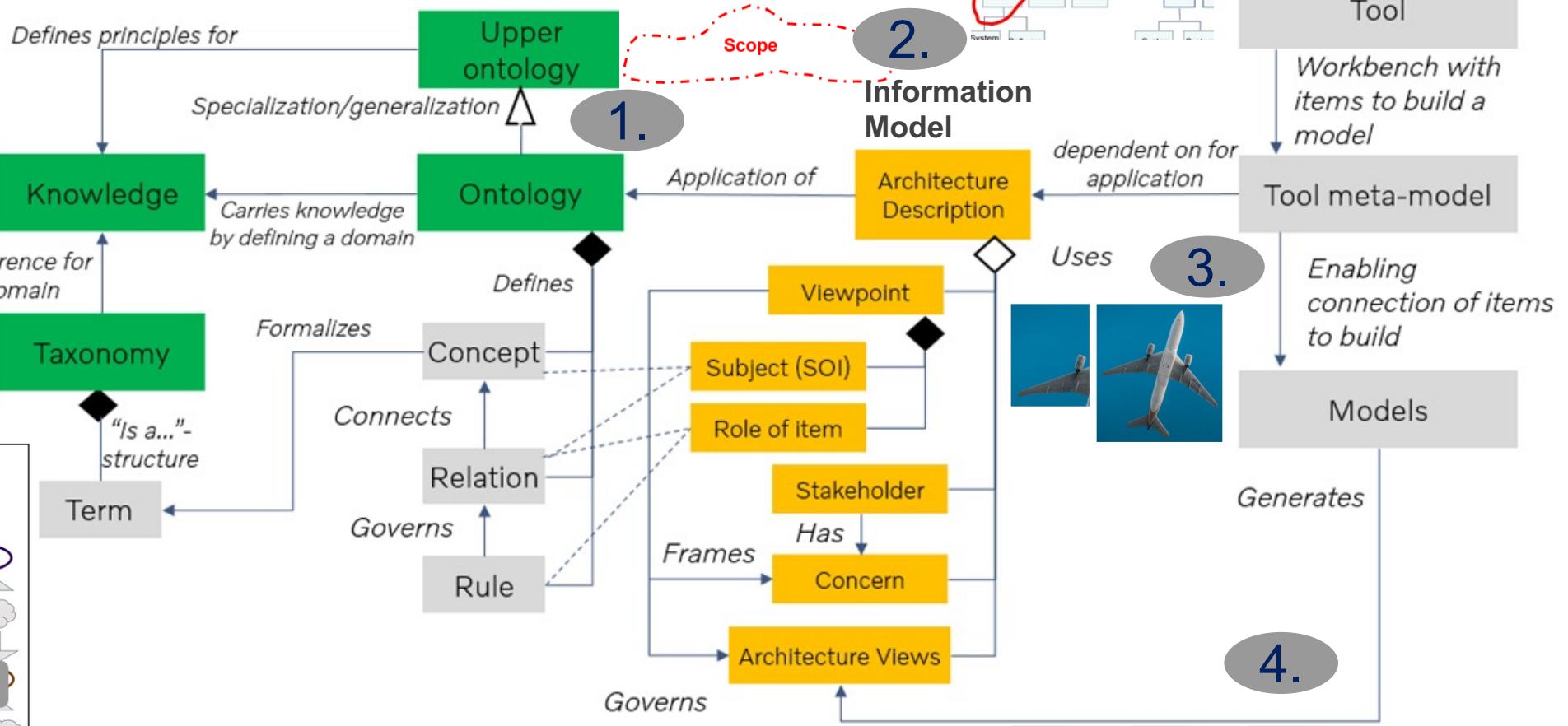
- *Moving fast not documenting solution*
- *Silos or hierarchies*
- *Ivory Tower or Misleading Framing*





A concept to model knowledge





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