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Self-* Systems and Special Systems Theory

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- Biography
  - Ph.D. [Econ] Philosophy of Science (LSE UK, 1982, Sociology)
  - Ph.D. in Systems Engineering work in progress SEEC UNISA AU
    - Title: **Emergent Design**
  - Satellite Systems Engineering Requirements and Verification Group
  - SE Process Team Lead (CMMI, AS9100)
  - Presented at INCOSE and CSER conferences
- Major fields of interest
  - Ontology
  - General Schemas Theory
  - Autopoietic Systems
  - Systems Design

Self-* Systems and Special Systems Theory

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How do we build systems that are . . .

- Self-Maintaining
- Self-Organizing
- Self-Producing
- Self-Designing
- Self-Adapting
- Self-Repairing
- Self-*

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Fundamental Problem

- The Systems that we build take too much thought, effort, and energy to create, build, operate, and maintain . . . etc. (*)
- Many of the errors that lead to disaster are human errors
- High Technology systems are fragile, lack resilience, and lack the ability to adapt to their changing environment

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Organisms have Autonomic Systems

- These are systems that self-regulate without conscious intervention and control. They adapt to changing circumstances allowing conscious attention to other matters beyond body regulation
- We know it is possible to have such systems because organisms, such as ourselves and other warm blooded animals exist with unconscious self-regulating systems

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According to Heidegger, this concerns the relationships between . . .

- Present-at-hand, Pure Being, Intentionality, Unity
- Ready-to-hand, Process Being, Viable Infrastructure, Totality

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Self-* Systems

- Move creation, production, and the operation of systems from the present-at-hand to the ready-to-hand modes of Being
- At present, most systems need to be supervised in the Present-at-hand mode to be used in the Ready-to-hand mode, in order to support present-at-hand concerns

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Types of Systems

- Alleo-* Systems
  - Present-at-hand = Users, Operations
  - Ready-to-hand = System Administrators, Logistics, Repair
- Auto-* Systems
  - Present-at-hand = Users, Operations
  - Ready-to-hand = System supports itself as much as possible rather than having human support

How far can we push Self-* properties?

- Very Hard
  - Self-Design
  - Self-Production
- Hard
  - Self-Organization
  - Self-Assembly (Building)
  - Self-repair
- Less Hard
  - Self-maintenance
  - Self-Adapting
  - Self-Resilience
- Easier … easy is still very hard for us . . .
  - Self-Control
  - Self-Navigation

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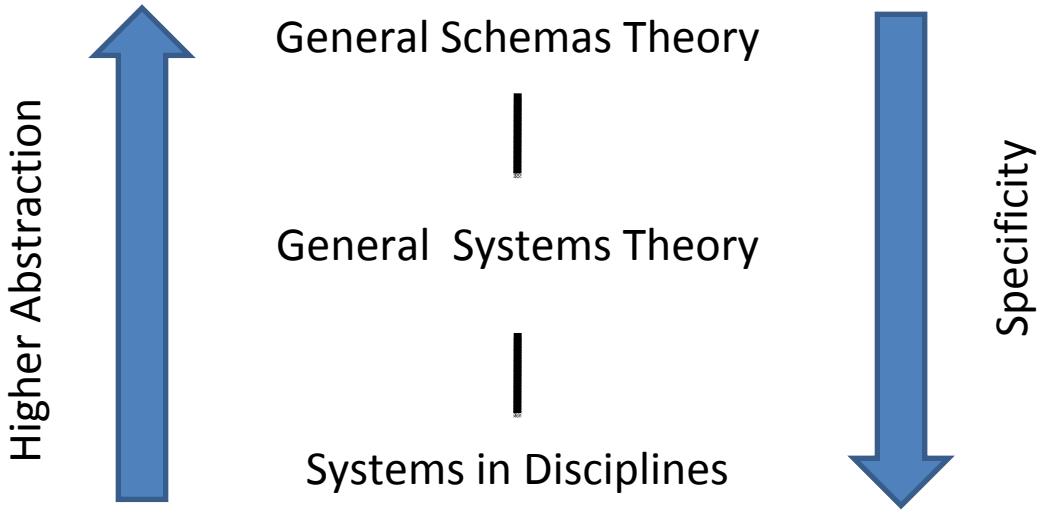
Change of viewpoint needed

- What is needed is a theory, which is fundamental to Self-* and autonomic systems . . .

Unfortunately, such a theory will have to be fundamental to systems engineering itself, i.e., a paradigm, or episteme shift, or possibly a deeper change in our way of looking at systems . . .

- An example of such a Fundamental Theory is developed in General Schemas Theory
  - General Schemas Theory extends to a higher level of Abstraction of General Systems Theory



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General Schemas Theory

- What is like a ‘system’, yet fundamentally different? What other organizational templates can exist at the same level of abstraction, although not necessarily at the same scale or within the same scope?
  - Form
  - Pattern
  - Monad
  - Domain
  - ??????

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S-prime Theory

- There are 10 Schemas
- They are nested
- They each have a different scope and scale
- Each has a fundamentally different organization
- They are templates of Pre-understanding
- They are projected embodied envelopes of spacetime

S-prime theory

- They are prior to determination of Kind (what), individual differences, and meaning
- Individual Schemas map to specific mathematical dimensions
- There are no gaps in the nesting of the schemas
- They are essentially different from each other at their higher meta-levels
- The hierarchy of schemas are Emergent based on supervenience to lower level schemas

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S-prime Theory Hierarchy

- Pluriverse
- Kosmos
- World
- Domain
- Open-scape (meta-system)
- System
- Form
- Pattern
- Monad
- Facet

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S-prime Theory Hierarchy

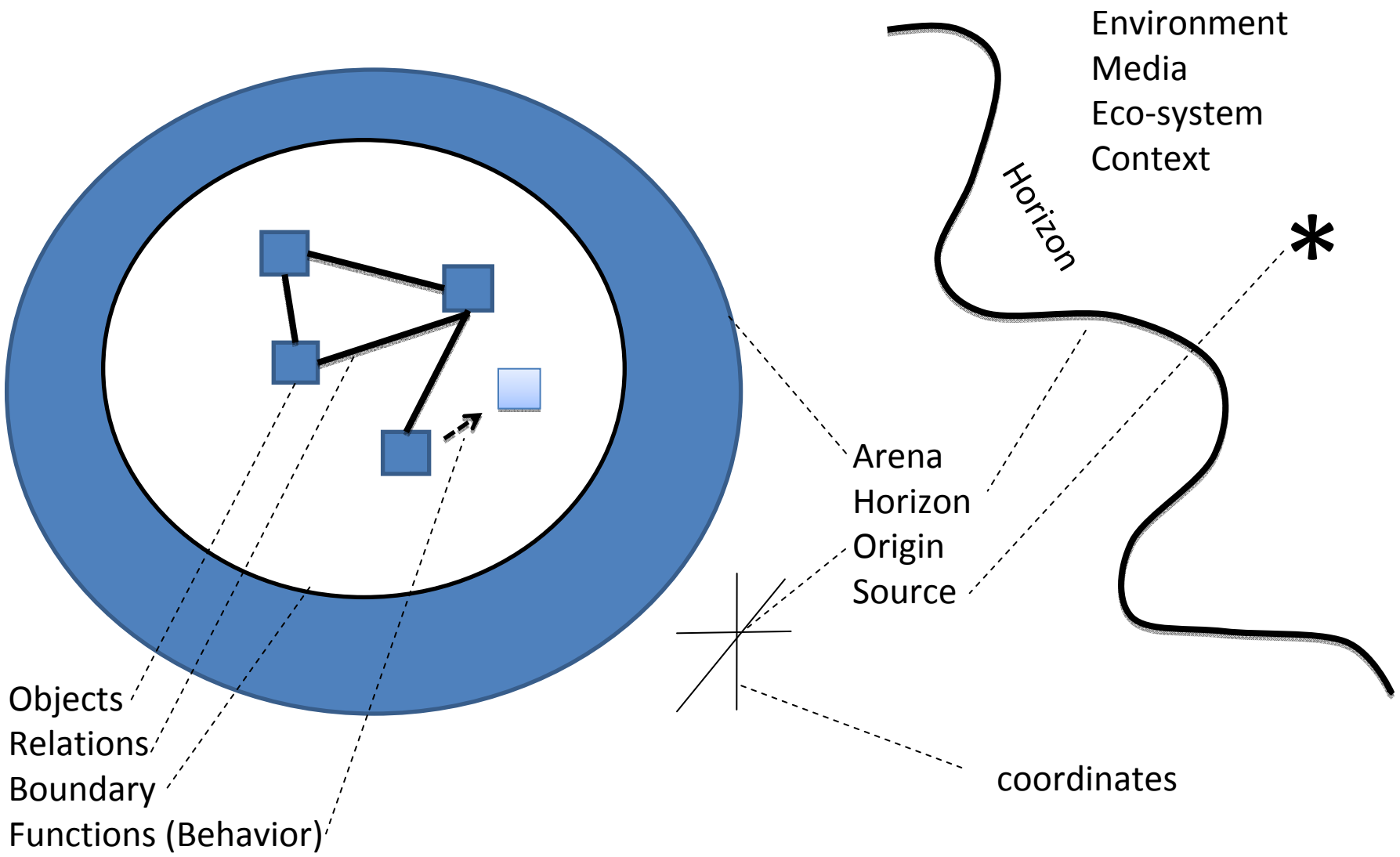
- 8-9 Pluriverse (beyond experience)
- 7-8 Kosmos (exceeds experience)
- 6-7 World (within experience)
- 5-6 Domain (within experience)
- 4-5 Open-scape (meta-system) (within experience)
- 3-4 System (within experience)
- 2-3 Form (within experience)
- 1-2 Pattern (within experience)
- 0-1 Monad (exceeds experience)
- -1-0 Facet (beyond experience)

Fold in hierarchy of schemas
DUALS

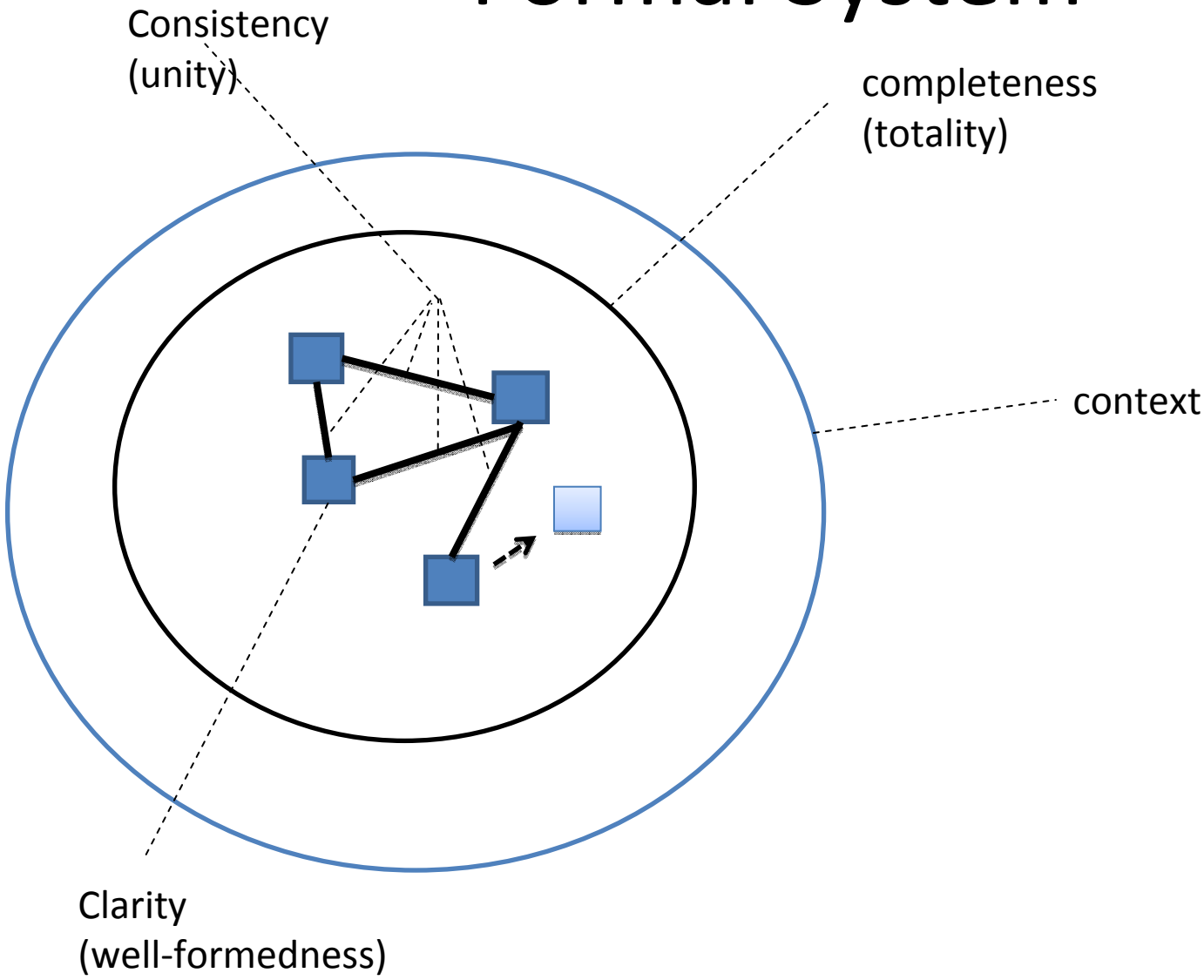
System	**Open-Scape**
Form	Domain
Pattern	World
Monad	Kosmos
Facet	Pluriverse

Duality

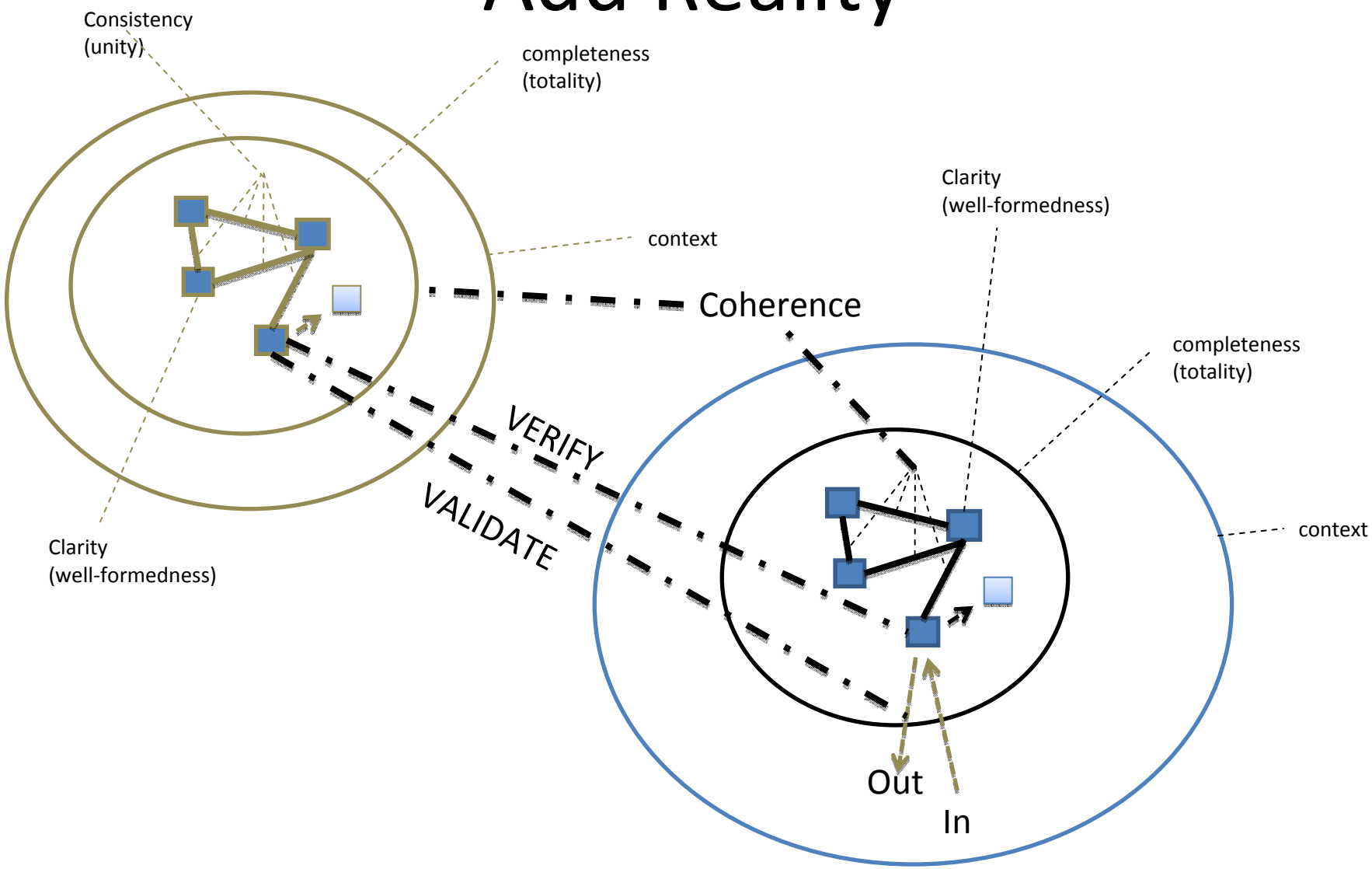
SYSTEM / OPEN-Scape [Meta-system]



Formal System



Add Reality


Consistency
(unity)
completeness
(totality)
context
Clarity
(well-formedness)
Coherence
VERIFY
VALIDATE
Clarity
(well-formedness)
completeness
(totality)
context
Out
In

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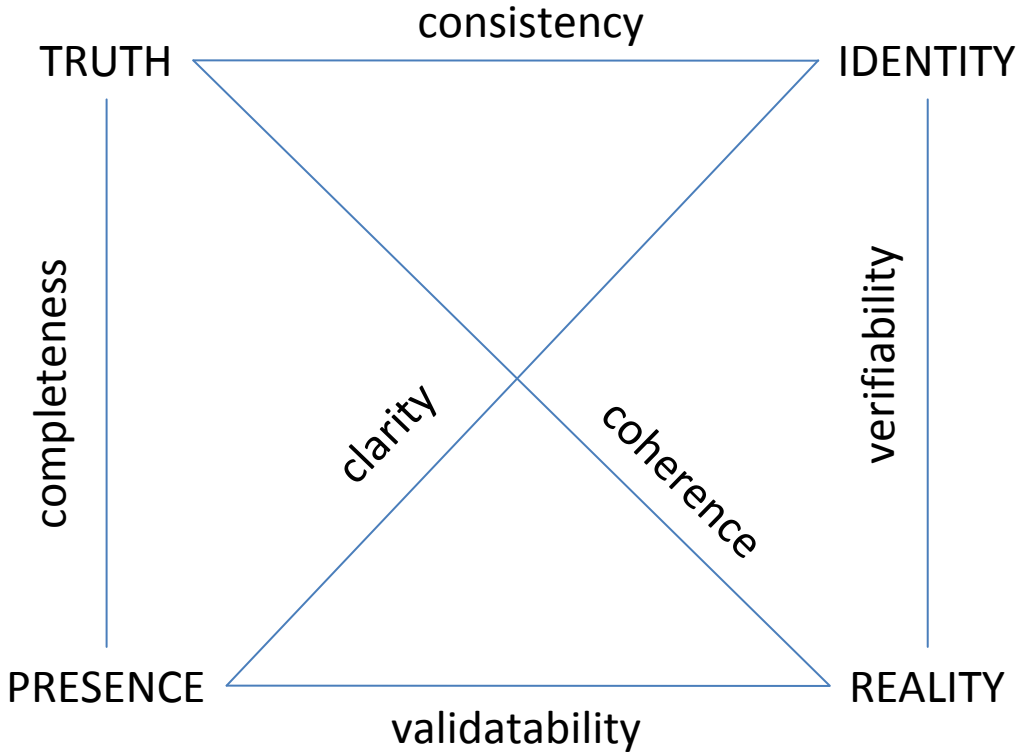
Aspects and Properties



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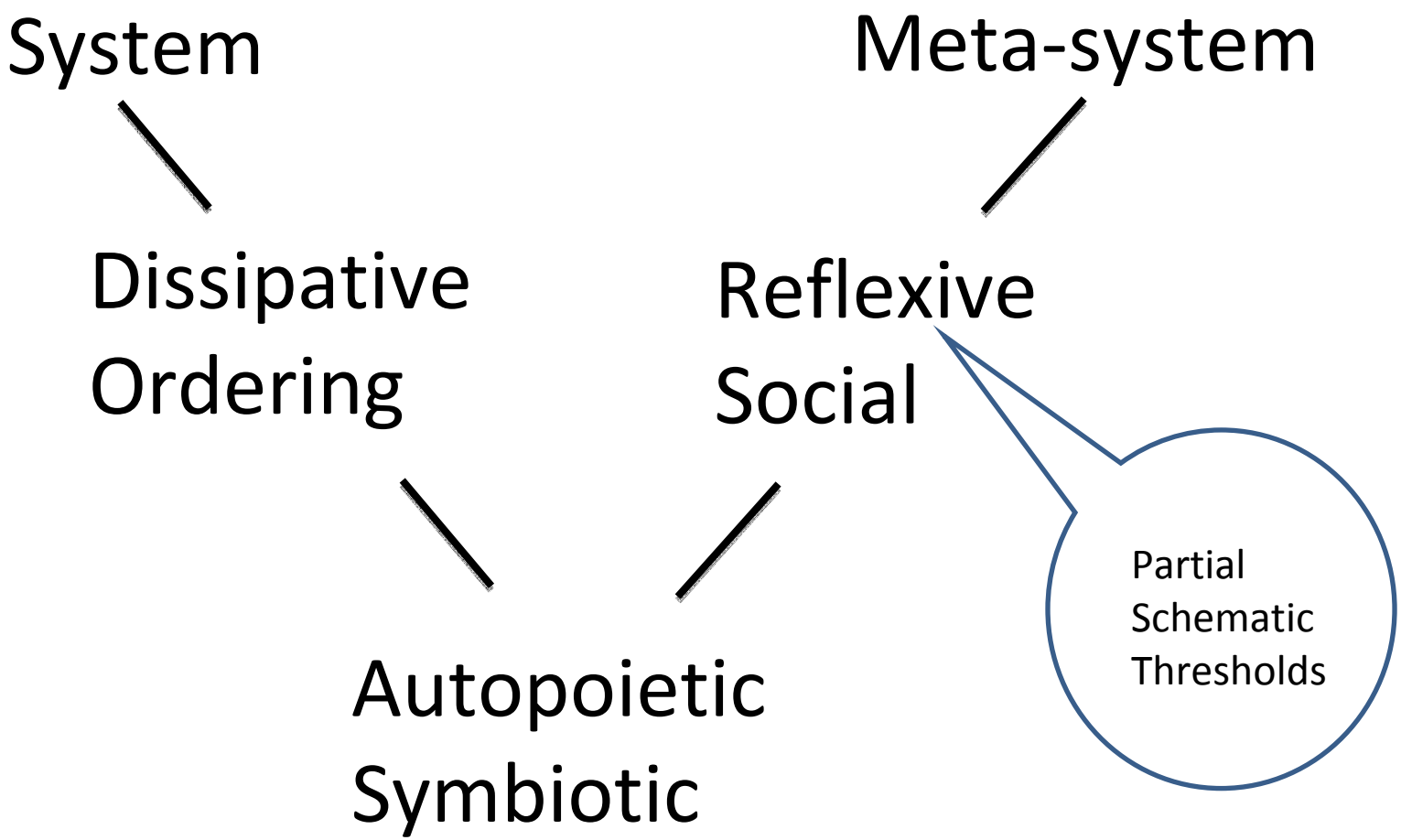
System/Meta-System

- System
  - Application
  - Turing Machine
  - Emergent
- Meta-System
  - ‘Operating’ system
  - Universal Turing Machine
  - De-emergent

Special Systems



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Holonomic Systems

- Meta-system – whole less than the sum of its parts
  - Reflexive Social
    - Autopoietic Symbiotic
  - Dissipative Ordering

Special Systems: Wholes exactly equal to their parts

- System – whole greater than the sum of its parts

Theorists

- Meta-system
  - Bataille, Plotnitsky, Baudrillard
- Reflexive Social
  - O'Malley, Sandywell, Blum
- Autopoietic Symbiotic
  - Maturana, Varella
- Dissipative Ordering
  - Prigogine
- System
  - Bertalanffy, Klir

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Analogies in Math Number Theory

- Meta-system
  - **Lacking number**
- Reflexive Social
  - **Sociable number**
- Autopoietic Symbiotic
  - **Perfect number**
- Dissipative Ordering
  - **Amicable number**
- System
  - **Excessive number**

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Analogies in Math Hyper Imaginary Numbers

- Meta-system
  - **Sedenion**
- Reflexive Social
  - **Octonion**
- Autopoietic Symbiotic
  - **Quaternion**
- Dissipative Ordering
  - **Complex(nion)**
- System
  - **Real**

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Analogies in Math Non-orientable Surfaces

- Meta-system
  - **Projective Space**
- Reflexive Social
  - **(Hyper Kleinian Bottles)**
- Autopoietic Symbiotic
  - **Kleinian Bottle**
- Dissipative Ordering
  - **Mobius Strip**
- System
  - **Leminscate (orientable)**

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Analogies in Physics Waves

- Meta-system
  - **Troughs**
- Reflexive Social
  - **(Hyper Breather)**
- Autopoietic Symbiotic
  - **Breather**
- Dissipative Ordering
  - **Soliton (Monopole)**
- System
  - **Wave**

Analogies in Physics
Anomalous Ultra-efficacious Phenomena

- Reflexive Social
  - **Bose-Einstein Condensates**
- Autopoietic Symbiotic
  - **Cooper Pairs of Super-conductivity**
- Dissipative Ordering
  - **Soliton (Monopole)**

Existence / Being

- **Ultra Being – no-hand**
- Meta-system – n mirrors distorted or separated
- **Wild Being – out-of-hand**
- Reflexive Social – 4 mirrors
- **Hyper Being – in-hand**
- Autopoietic Symbiotic – 3 mirrors
- **Process Being – ready-to-hand**
- Dissipative Ordering – 2 mirrors
- **Pure Being – present-at-hand**
- System – 1 mirror
- **Ultra Being – no-hand**

Special Systems are Unique and Rare

- Ultra-efficacious
- Based on conjunction
- Differentiated by Lost Mathematical Properties
- Simultaneously Emergent and Supervenient
- Appear as aspects of Pascal's triangle
- Configuration of Mirrors

Rare Phenomena take over
due to slight escape from entropy locally

- Meta-system
  - **Dis-unified and De-totalized awareness of Existence of Background**
    - Reflexive Social
      - **Society/Culture (intersubjectivity)**
    - Autopoietic Symbiotic
      - **LIFE (gendered species viable organisms)**
    - Dissipative Ordering
      - **Consciousness**
- System
  - **Unified and Totalized Projections of Intentions**

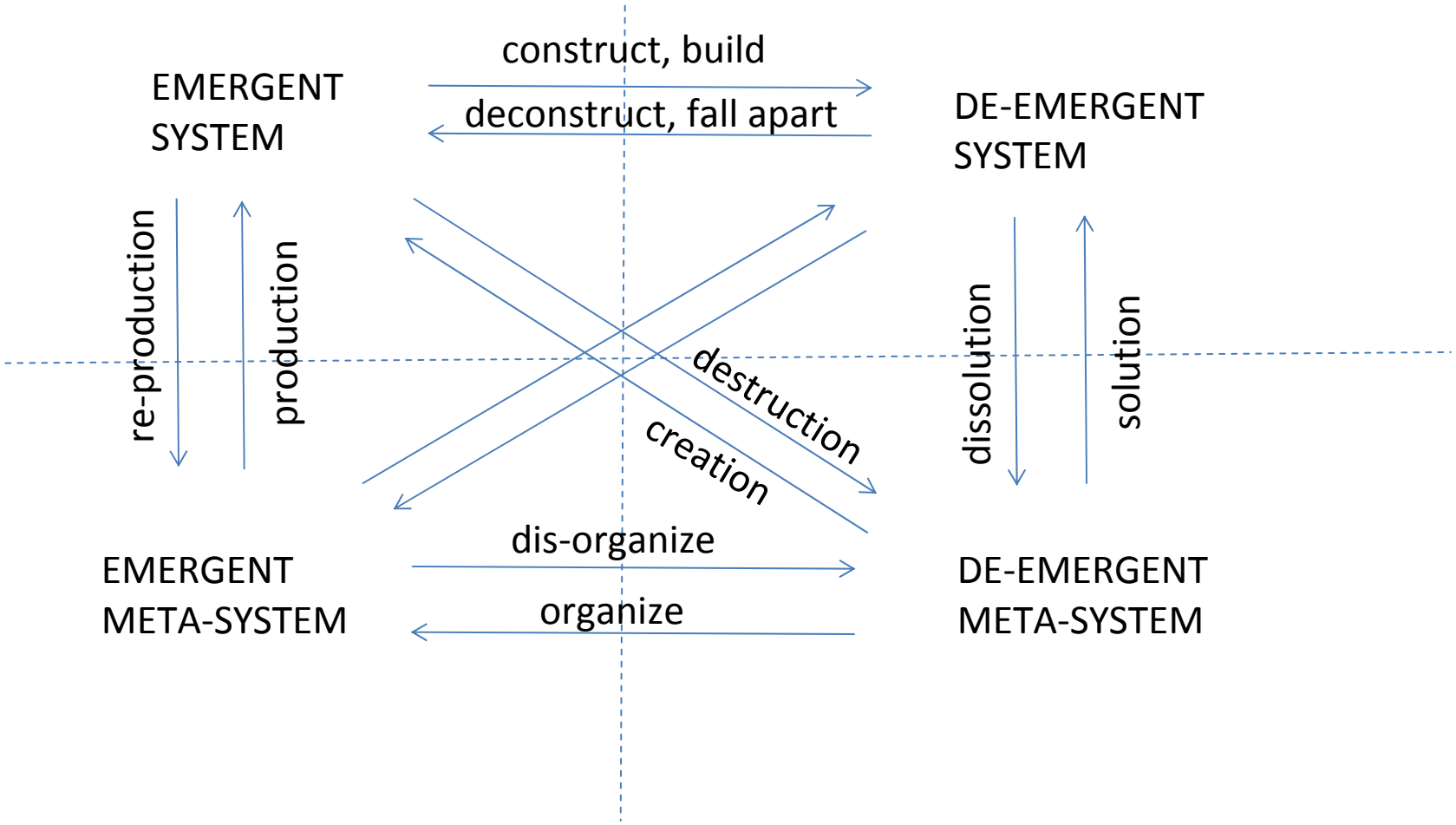
Mirroring Essential To Self-* Systems

- Closed reflective paths within configurations of mirrors are baselines for homeostatic behavior
- Hypercycles control the return to homeostasis
- Autopoietic Systems are Opaque and Closed Systems
- Reflexive combinations of Dissipative Ordering Systems give access to internal states
- Virtual Phase-spaces allow for self-representation and self-repetition of the Special System

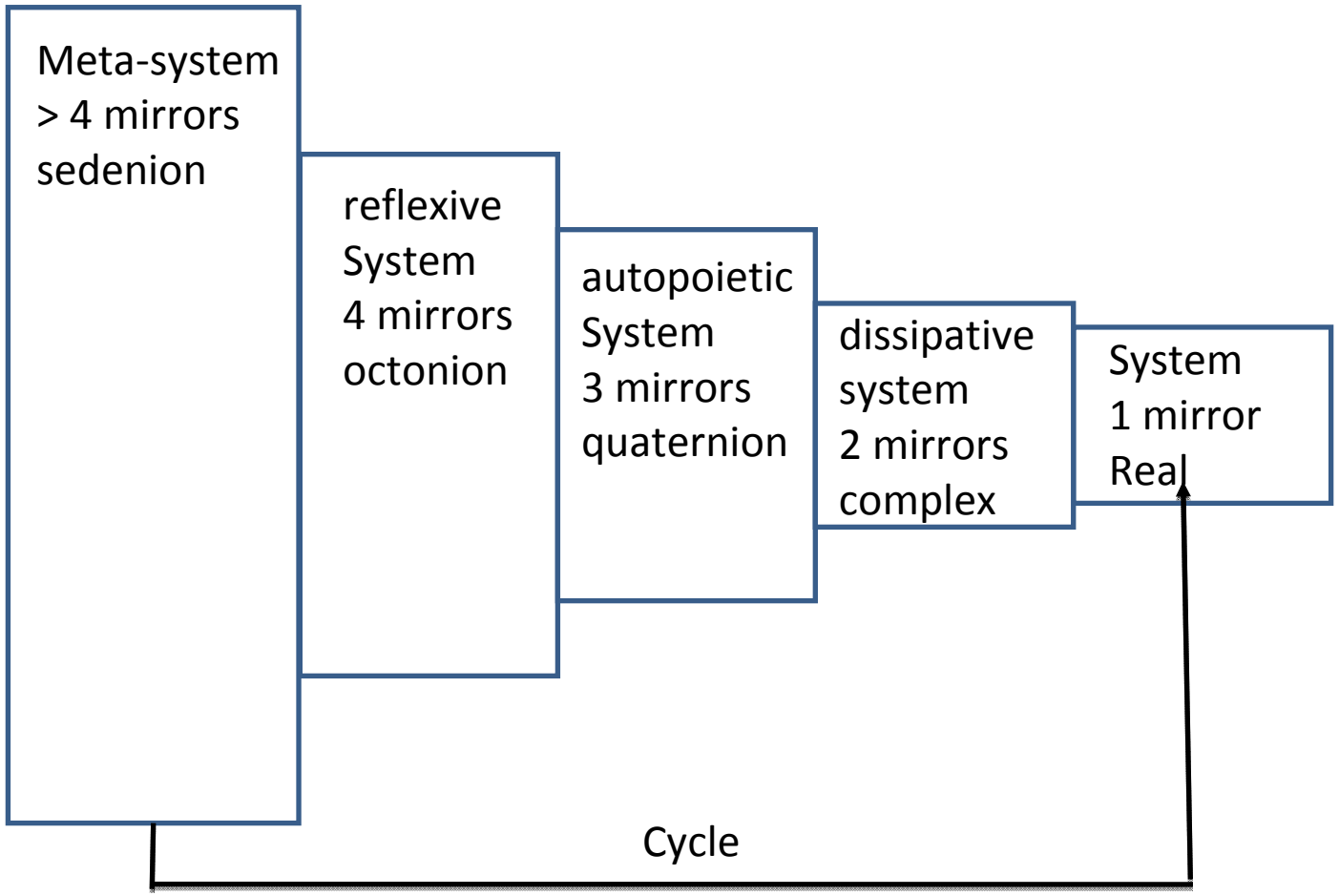
Basis of a Theory

- Special systems give us a fundamental theory of mirroring within a system embedded in a meta-system
- Special systems are partial systems and partial meta-systems, which are not part of the system itself where Self-* properties can be developed and expressed
- Special Systems plus a normal System give us an Emergent Meta-system

System and Meta-system combinations



Emergent Meta-system



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Conclusion

- Telescoping layers of mirror configurations provide a virtual space within which Self-* properties may be defined with regard to the different properties that are desired in a system in relation to its meta-system