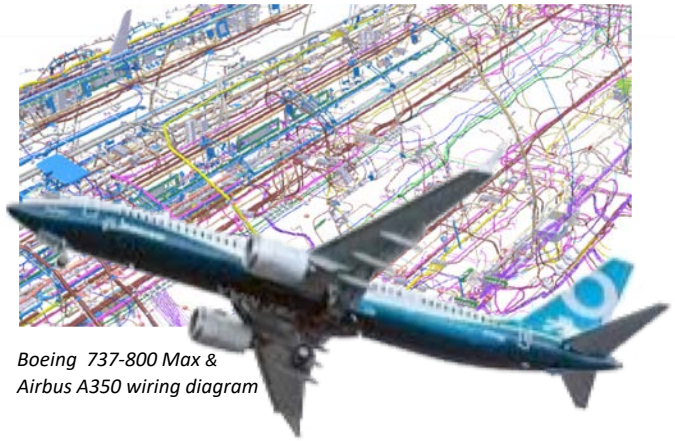
2020
Annual INCOSE
international workshop
Torrance, CA, USA
January 25 - 28, 2020

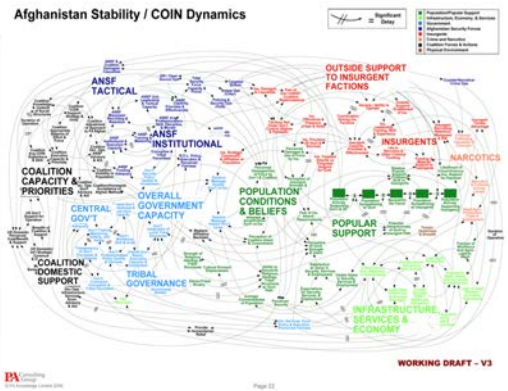
Pattern Literacy
in Support of Systems Capability

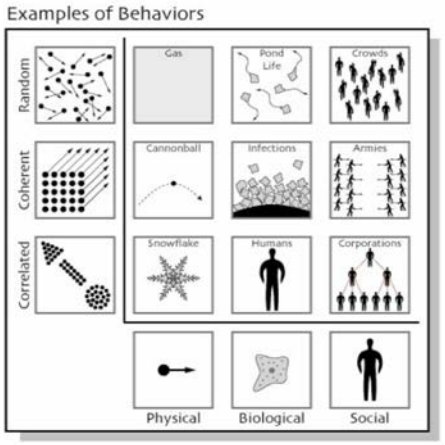
Helene Finidori

Increasing Complexity & Knowledge Fragmentation



Boeing 737-800 Max & Airbus A350 wiring diagram





Yaneer Bar-Yam (1997)

Engineers [and the world!] are confronted with:

An ever increasing detail and dynamic complexity and interactions among different types of systems, with different degrees of agency of their parts or wholes.

A high and increasing interdependence of multidimensional factors to make sense of and integrate; interactions ‘at a distance’ of biophysical, socio-cultural & technological ‘causes & effects’, without a higher order vantage point to look from; incompatible knowledges that aren’t curated and integrated fast enough.

In brief, we are faced with a greater intrication of the ‘problem’ field, and greater fragmentation and incommensurability of the ‘solution’ field.

Incose Vision 2025/2035

The development of a core body of systems engineering foundations also encompassing human and social sciences; defined and taught consistently across academia and forming the basis for systems engineering practice. Abstracts from the SEBOK:

- A more encompassing foundation of theory and sophisticated model-based methods and tools allowing better understanding of increasingly complex systems and decision making in the face of **uncertainty**
- A capacity to make sense of **elements of context that are 'not fixed'**
- An integrated approach of **different worldviews and skill sets**.
- An ability to grow and **adapt through iterations** over lifecycles.

Find an **Integrative Systems Science** to identify, explore, and understand **patterns** of complexity through contributions from the foundations, theories, and representations of systems science and other disciplines relevant to the "problematique". (SEBOK SE Foundations)

The Problematique

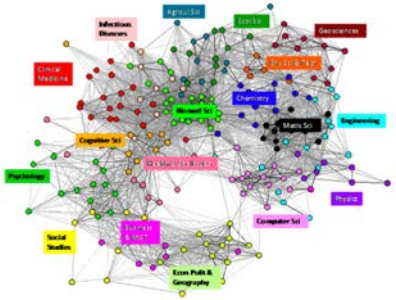
Systems Science suffers from the same fragmentation issues:

“No one branch of systems science or practice provides a satisfactory explanation for all aspects of a typical system “problematique” » SEBOK

“The set of “clouds” that collectively represents systems praxis is part of a wider ecosystem of knowledge, learning, and action. Successful integration with this wider ecosystem is the key to success with real world systems.” SEBOK

What needs to be bridged if not encompassed/integrated spans altogether across:

Loci, levels and dimensions of emergence



Disciplines and domains of specialized practice, dealing with the biophysical, the socio-cultural, the psycho-cognitive

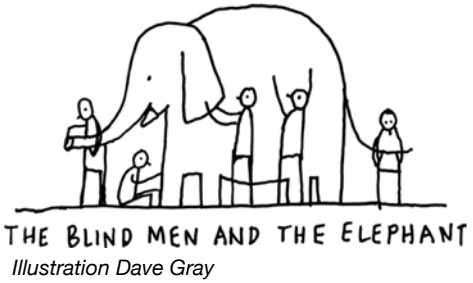


Illustration Dave Gray

Perspectives, worldviews, purposes

Multiple Systems Worldviews - Incose - Sillitto & al

Tacit assumptions not shared

S1: Formal minimalist based on mathematics and logic

S2: Constructivist - systems are purely a mental construct

S3: Moderate realist

S4: Strong and Extreme Realists

S5 – Complex, viable and living systems

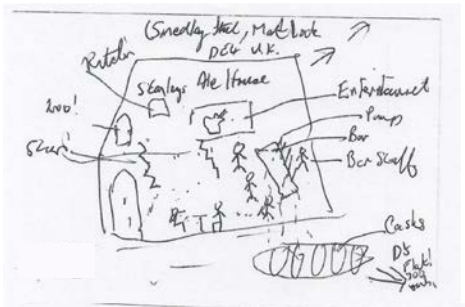
S6: Systems as a Mode of Description

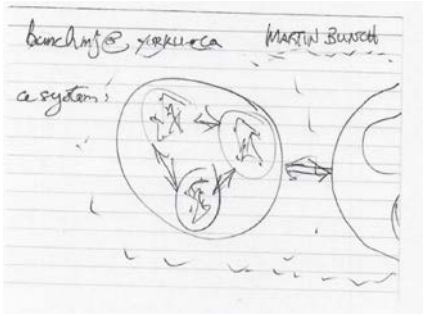
S7: System as a process

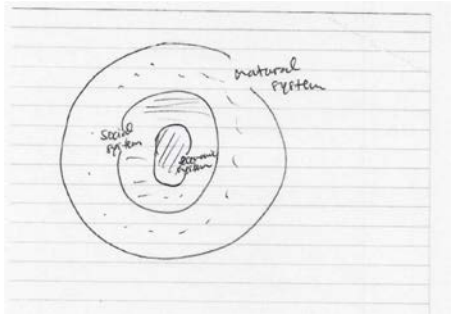
A Constructivist vs realist duality to overcome

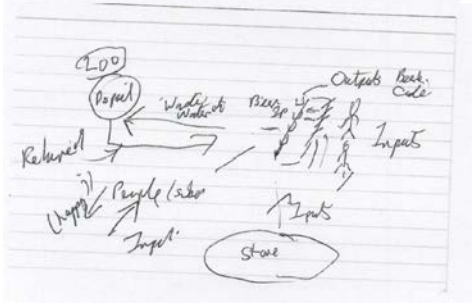
Sillitto & al (2018), *What do we mean by "system"? - System Beliefs and Worldviews in the INCOSE Community.* 28th Incose Annual Symposium. Washington DC July 2018

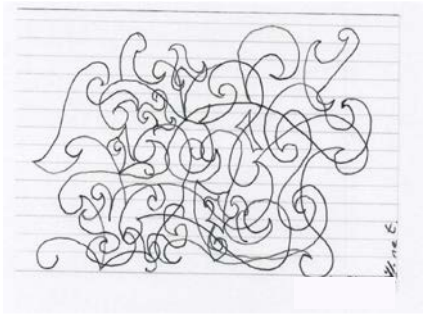
Multiple Systems Representations - Finidori & Tuddenham

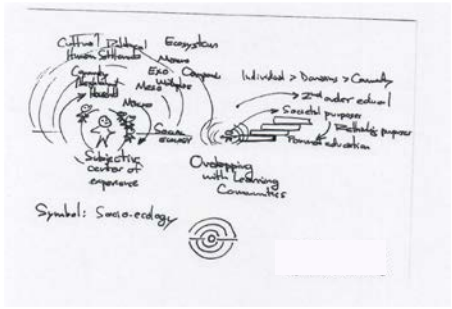


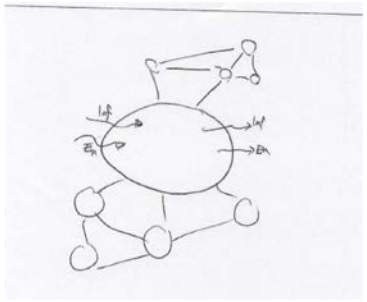


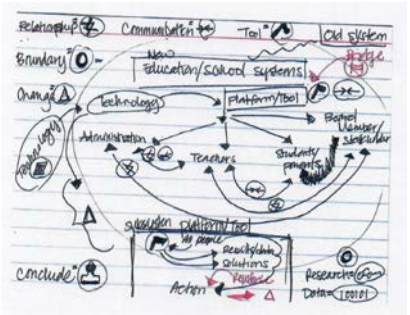


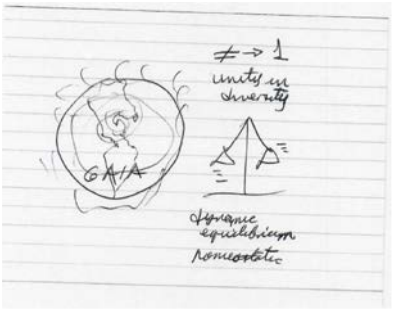


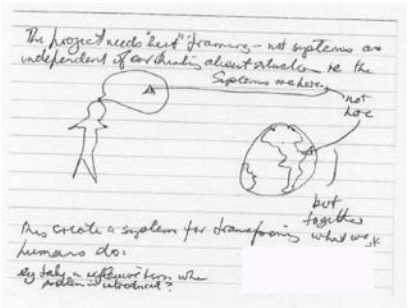












Sample systems representations collected at ISSS 2016. See Finidori, H., and P. Tuddenham. "Pattern Literacy in Support of Systems Literacy - an Approach from a Pattern Language Perspective." Paper presented at the 24th Conference on Pattern Languages of Programs (PLoP), Vancouver (October 2017), 2017.

Multiple Frameworks and Systems Streams

Methodological and sense making frameworks: Critical Systems Thinking frameworks such as Jackson's 'system of systems methodologies' (1987); Midgley's ontological complexity (1992) and systemic intervention (2000) approach; and Mingers's multimethodology (1997), as well as Derek Cabrera's DSRP model (2015), or Dave Snowden's Cynefin model (Kurtz & Snowden, 2003)

Principles: Rousseau's Systemology; dozens of sets of heuristic principles: Sillitto, Mobus & Kalton, Hitchkins, Senge referenced in Rousseau 2017

Patterns and archetypes, isomorphies: Len Troncale, Mobus, Volk…
Pattern based models: Schindel, Swami etc…

How can all this be integrated and or synthesized?

The Challenges of Systems Science

« An integrated systems approach needs to provide a [scientific] framework and a [common] language that allow different communities, with highly divergent world-views and skill sets, to work together for a common purpose » SEBOK

There are two specific ‘tensions’ to resolve –if not dissolve- in this endeavor!

- The soft vs hard; ‘heuristic vs scientific’ duality
- The unifying language and unity in diversity imperative…

As underlined by Schindel, all the hard sciences are based on the ‘systems phenomenon’, which systems science attempts to capture. And in this process, ‘soft’ elements are not to be considered in isolation, ruled out, or dealt with as a deficiency that needs to be fixed.

Humans are natural systems and key components of socio-technological systems, which they influence. The processes that lead to acquisition of knowledge, decision making and social consensus are essential to find ways to make models that are interoperable and that stakeholders can trust. Something Schindel captured in his Value Selection and Model Trust Phenomena. I will go deeper into this.

Focus on Science & the scientific approach

- Etymologically, scientia = knowledge
- A systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe;
- An inquiry that enables to make models that describe phenomena.
- A consensus thereof
- Testable laws based on consensual hypothesis

A key word is consensus…

- What type of consensus are we talking about here?
- How does it build up?
- How are these laws generated?
- Can a science be ‘designed’? What are the requirements to do so?
- Who is legitimate to legitimize hypothesis and validate theory?

Focus on Consensus

- Etymologically, con + sensus = feeling/sensing together, cooperatively
- Builds over time and a history of practice, with its associated language
- Stabilizes over time, with some form of ‘self-sealing logic’
- Within the specialization of a domain of consensual interaction = a context of shared experience and cooperation, around a shared object of focus.
- This is an evolutionary process; adaptive and goal seeking rather than goal directed.

→ Self sealing logics just like closed models cannot interconnect. They are ‘closed loops’, hard to get into, sometimes hard to challenge. How can the loops be ‘broken’, and ‘broken into’?

→ How can a ‘scientific consensus’ or a sustained ‘working consensus’ develop and persist across multiple points of focus? When there is no shared context, and no one actually has a vantage point on the whole? Could the attainment of ‘multicentric’ consensus follow a similar process? Or something totally different and new? And with which ‘evolutionary pressure’?

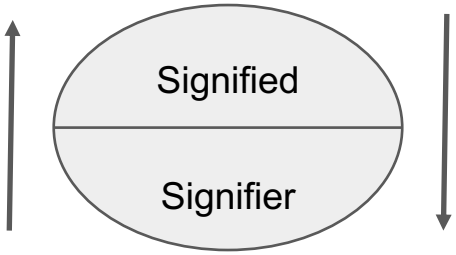
Biosemiotic Evolutionary Perspective

Cognition, communication systems and social practices have evolved in co-relation. The evolution of scientific paradigms and practices, follow the same recursive construction process than cultures and languages, via feedbacks between [co]operating individuals and their environment.

This same construction process interconnects Schindel's systems phenomenon, and his Value Selection and Model Trust Phenomena.

I will focus now on biosemiotics, the sign processes through which living organisms acquire the ability to optimally operate in their environment, by developing their modeling and learning capability. The principles listed here apply to social and socio-technological systems as well, and they are those upon which successful AI is built.

Semiosis > “Making” Sense for Effective Operation



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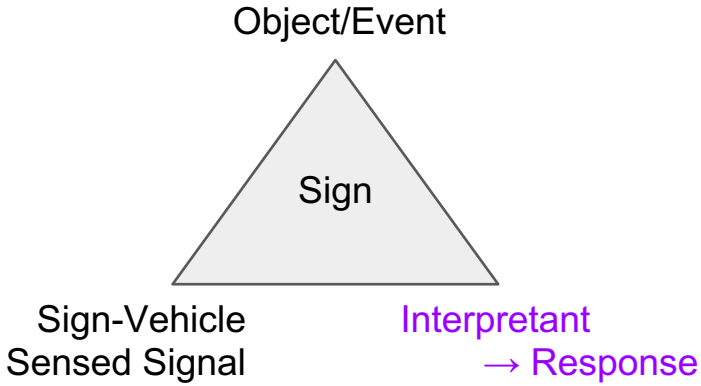


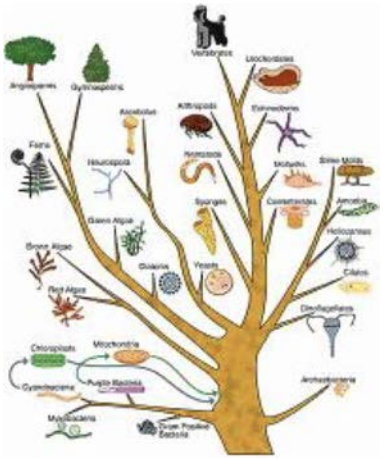
Saussurean Semiotics
Language/discourse focused

Peircean Semiotics
Cognition/action focused

- There is more to semiotics than Saussure and the signified / signifier relation
- With the Peircean interpretant, the ‘observer’ or ‘agent’ and therefore its cognitive frames and the way they are constructed are brought into the semiotic process, grounding human discourse into perceived reality and experience.
- Peirce extends the sign process to non-intentional communication, applicable to all living organisms. Peirce-based biosemiotics connect sign relations, meaning and teleology.
- From a biosemiotic perspective, semiosis is a sign process that allows an organism to operate effectively in its environment; it is linked to cognition (Sebeok, Maturana).

Figures: adaptations H. Finidori

Key Features of Semiosis in Living Systems



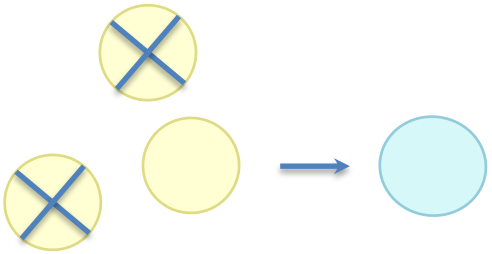
Living systems are sophisticated networks of semiotic controls whereby biochemical, physiological and behavioral processes become tuned to the needs of the system across various levels (Hoffmeyer).

- Semiosis mediates matter & energy exchanges through sensorimotor processes; it coordinates & orients behavior.

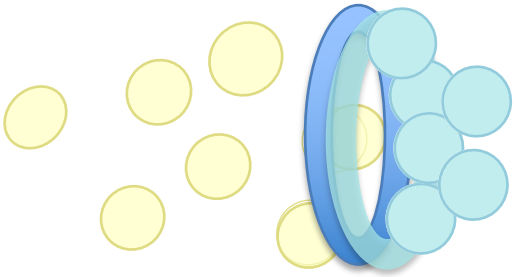
- Signals that an organism is structured to perceive, are possibilities for interpretation actualized into responses which become signs for next interpretations: a recursive / cybernetic process key to adaptation & evolution.
- Cumulative experience generates habits, making same or next signal anticipable, enhancing learning and fostering the emergence of new capabilities within existing structural boundaries. It both expands the scope and specializes systems of perceivable signs, but can also channel / format behavior…
- Congruence of habits among structurally coupled organisms fosters the formation of semiotic niches, where organisms co-adapt & co-evolve, constructing 'consensual cognitive domains' (Maturana), with their own systems of sign interpretation. Co-adaptations are eventually genetically integrated.

Image: NBII

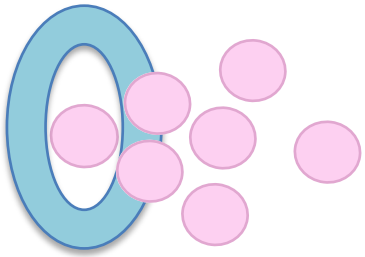
Sign System Specialization – Retention Processes



We only ‘retain’ the salient signs that we notice or recognize, consciously or not, from our experience of the world
(Primary retentions)



The aggregate of past primary retentions (memory, habits of mind) constitute the filters / funnel through which primary retentions are selected
(Secondary retentions)



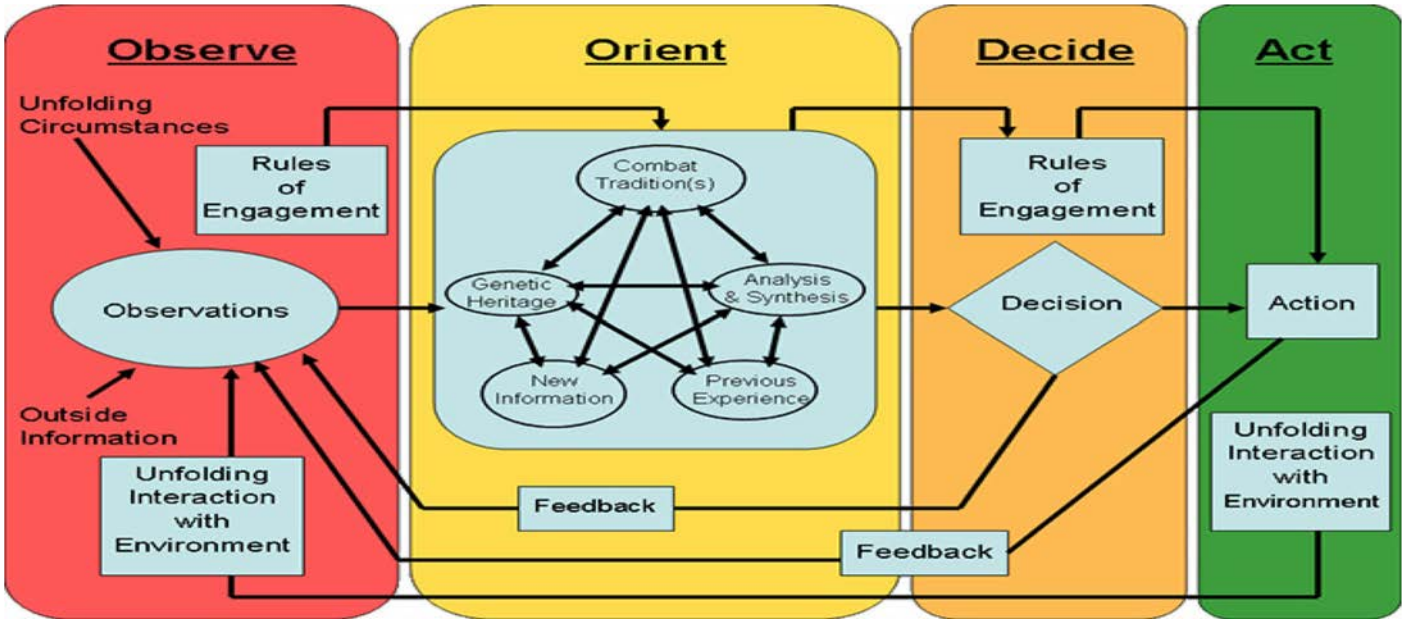
The tracks we leave in the environment for others to process (cultural artefacts) perpetuate and expand the process in the social sphere
(Tertiary retentions)

Husserl & Stiegler

So here come Patterns

- Le signs that trigger this activity can be understood as patterns.
- They are at the core of the process, which connects salient elements perceived in the medium/world (patterns 'out there'), with their expressions/representations (formalized/design patterns) and their interpretations/internalizations (mind/conceptual patterns), up to the (re)actions they trigger.
- This 'triadic' nature of patterns allows the adoption of an agnostic view on the nature of reality & systems, and to step out of the constructivist/realist debate
- The recognition and production of patterns and this triadic relation enable organisms to operate in their environment through a process of adaptive modeling (of which the OODA Loop is an illustration).
- The more varieties and instances of patterns an organism can [re]cognize, the more 'understanding' and 'semiotic freedom' he has, to operate in his world (to the limit of a complexity threshold).
- The idea I am exploring here is that developing pattern literacy and better understanding modeling processes using patterns could help make models and knowledge more inter-operable than our fragmented languages allow.

The prompting of patterns: Boyd's OODA Loop



Note how orientation shapes observation, shapes decision, shapes action, and in turn is shaped by the feedback and other phenomena coming into our sensing or observing window.

Also note how the entire "loop" (not just orientation) is an ongoing many-sided implicit cross-referencing process of projection, empathy, correlation, and rejection.

From "The Essence of Winning and Losing," John R. Boyd, January 1996.

Initially meant to act and change direction faster than the enemy in fighter jet situations, is now used at different paces

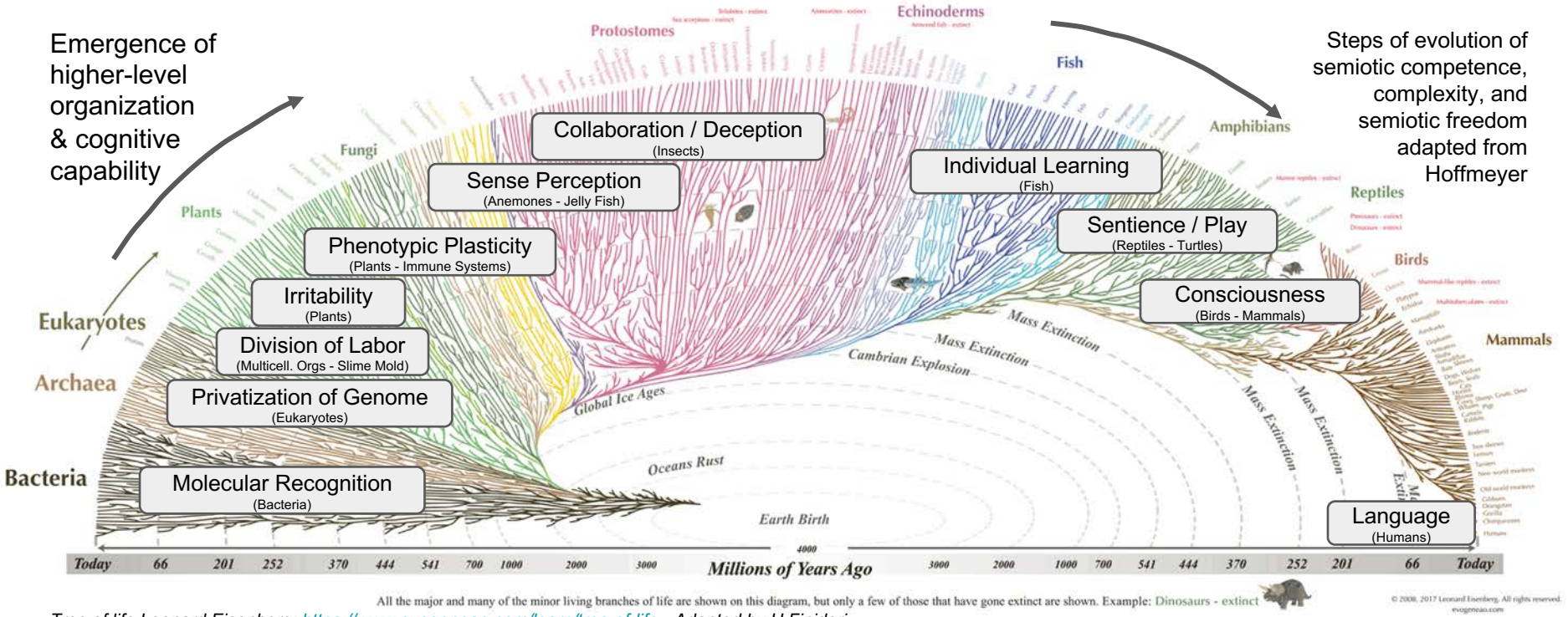
How Patterns are involved in cognition

- Pattern recognition is a basic function of the mind (Gee)
- Patterns are the material of the neural function (Bloom)
- Our neocortex contains pattern recognition circuitry (Kurtzweil)
- Each zone of the neocortex handles a specific type of patterns, in whole or part (Hawkins)
- As synapses are consolidated through repetition, we gain a clearer ‘sense’ of what is perceived, forming patterns.
- "All our conceptions are obtained by abstractions and combinations of cognitions (patterns) first occurring in judgments of experience (inferences). The thoughts that we can cognize present themselves as signs (Peirce)
- Re-cognition is the repeated cognition of similarities and differences that help us categorize, i.e. learn and retrieve, complex combinations.
- Andersen: patterns learnt through experience are at the basis of understanding and learning which supports model building
- Patterns act as “potentially structured”, scientifically, cognitively and socially recognizable units of meaning

Semiosis at the Basis of Evolution

Semiosis generates the capacity for a species to produce and comprehend the specific types of models it requires for processing and codifying perceptual input in its own way (Sebeok).

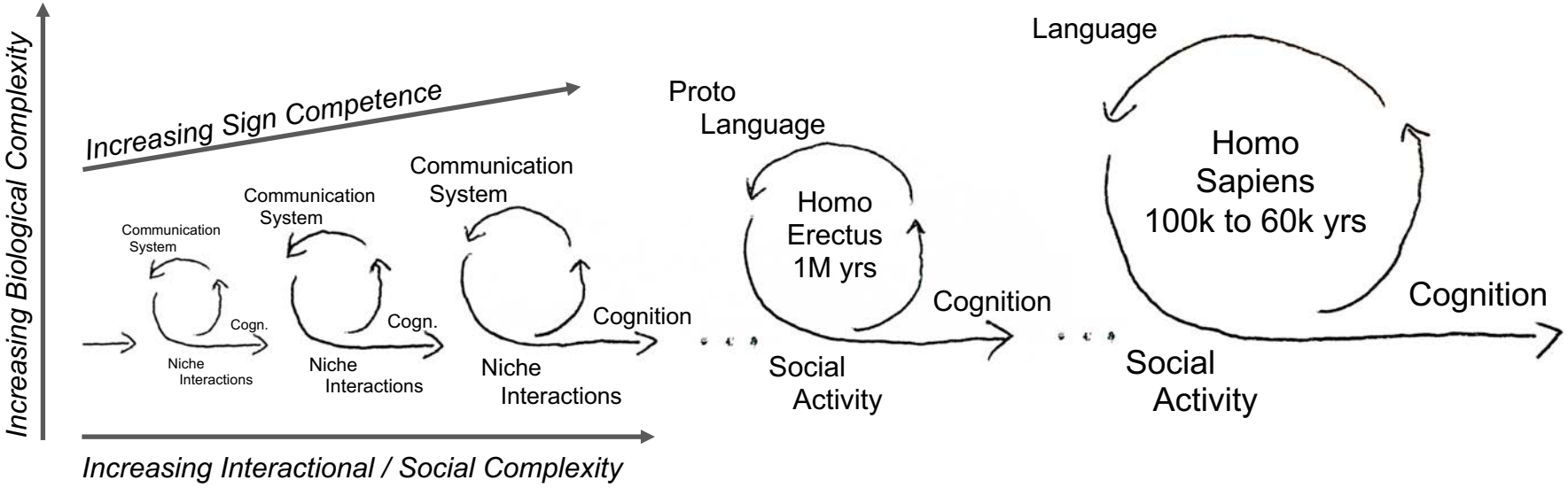
Evolution of species occurred by expansion of the limits of possibilitiies (Hoffmeyer) Kauffman's adjacent possibles…



Tree of life Leonard Eisenberg: https://www.evogeneao.com/learn/tree-of-life - Adapted by H.Finidori

Evolutionary Dynamics & Human Language

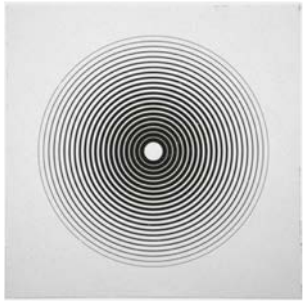
- Within each semiotic niche: increase in cognitive/semiotic competences (biology) enhanced sign systems (culture), enabling more complex interactions (social), generating out of equilibrium conditions and new evolutionary pressures, leading to further cognitive improvements at each generation, and further recursions, which were eventually epigenetically & genetically integrated (Dessalles, Bickerton).

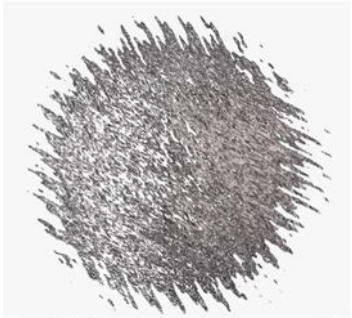


- Biosemiotics allow a bio-constructivist perspective that links nature and culture in a continuum of nested and/or forked micro and macro evolutions.
- Some consensus that human language appeared in two steps starting with Homo Erectus 1 million years ago.

Figure: H. Finidori

The 2 steps of Human Language Emergence





Step 1. A Symbolic System - ‘compression’ of signals:
A shift from pragmatic/inferential reference (gestures, calls, scenic signaling), to symbolic reference. Pressure: delayed accounts requiring to deal with longer thoughts and greater volumes of information (Dessalles, Bickerton) > Protolanguage.

Step 2. A Syntactic system - spatio-temporal ‘mapping’:
The addition of a digital mechanism based on a recursive combinatorial of discrete elements. Pressure: a need for argumentation and verifiability of longer more complex accounts (Dessalles, Jackendoff) > Language as we know it.

➢ Providing infinite creative possibilities and exponential learning, and pushing limits of interpretation, understanding & knowledge.

Images: Visualmelt, Cal Lomax/Bēhance, Adobe Stock

Focus on the Human Symbolic Sign System

Indexical reference

Iconic reference

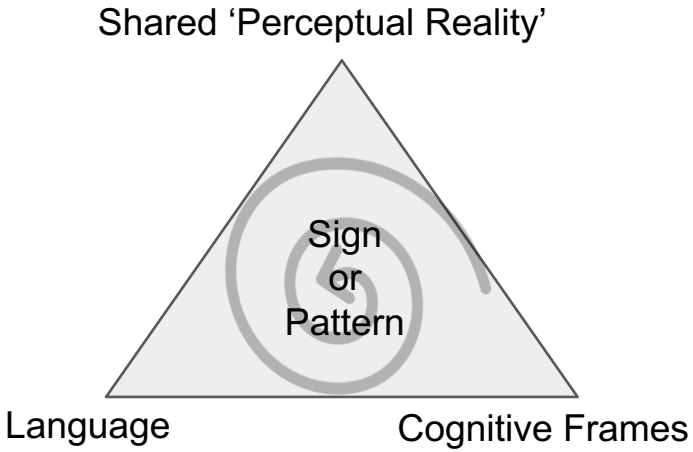
Three types of sign reference
Peirce

Buffalo

Symbolic reference

- With protolanguage, referential sign relations shift from indexical -denotative, pointing to- and iconic -figurative/analogical-, to symbolic –connotative-. The latter do not bear in themselves the ‘clues’, easily inferable, intrinsic to iconic or indexical references (Deacon).
- Freeing from the ‘here and now’, symbolic references allow multiple recursion and bring freedom to the thought process (Deacon, Kravchenko).
- But they are ‘detached’ from the “perceptual groundedness of language as an orientational activity in a consensual domain of interlocked conducts” (Kravchenko on Maturana).

The Construction of Worldview and Language



Tacit Symbolic Grounding

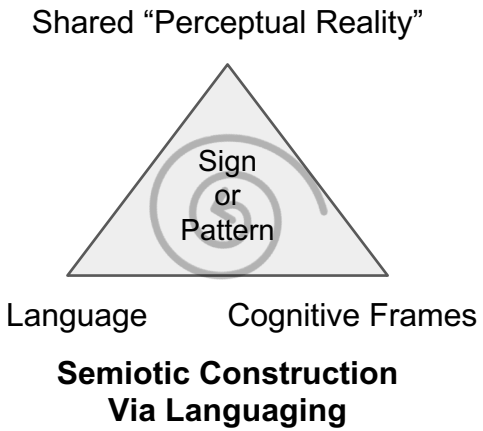
Cognitive Domain =
Domain of shared experience
and co-operation

Con-sensual =
Felt/sensed together
Not necessarily consciously and intentionally

- The symbolic system's form is socially acquired, in a given context / semiotic niche. Its 'grounding' into 'perceptual reality' is externalized in the collective memory, tacitly understood and reproduced through a history of personal and social experience.
- The tacit grounding that enables the detachment is operated during child development and social practice via successive construction of higher level indexical and iconic relations at multiple integration levels, which ultimately give place to the symbolic reference (Deacon).
- Interpretation is supported by an ongoing familiarity with symbolic semiotic relations, re-enforced through learning, recursively shaped by and shaping the frames through which interpretation is made, constructing the consensual cognitive domain.

Figure: adaptation H. Finidori

Languaging as Effective Coordination Mode



Semiotic Construction Via Languaging

For Maturana:

Language behavior is the *consensual coordination of action within a cognitive domain*,

Languaging, which focuses on language behavior as object of coordination, is the recursion of it, i.e. *the consensual coordination of the consensual coordination of action*

Within consensual cognitive domains:

- focus can be set on language behavior -the semiotic process in Peircean terms- as object of coordination
- languaging shapes and ‘perfects’ language behavior and shared systems of signs
- language can focus on itself as already grounded in a socially constructed shared reality that becomes ‘transparent’ to the observer / agent... Fish in water… Cultural ‘bubble’…
- languaging is or can be effective for coordination of action and various modeling and knowledge production endeavors: nuances can be worked out...

Figure: adaptations H. Finidori

Across Cognitive Domains? The Babel Curse...

Why can't we 'talk each other into' alignment or production of shared visions, values or languages across identity, experience, and knowledge domains? Across cognitive frames and language systems?

Two errors are usually made:

- Conflating language as human-wide semiotic capability (phylogenetically acquired), and language as context/milieu dependent (ontegenically acquired)
- Viewing language as representational and denotative, i.e. pointing out to an external world all can refer to (Winograd & Flores, Mingers)

➢ Outside of shared experience contexts there is no shared perceptual reality, no tacit 'grounding' of language, no support from historic shared experience, no ground for translation, no recursive habit that helps reflect, integrate and change. Languaging is not effective as factor of coherence transcending contexts.

➢ There is a need -an evolutionary pressure?- for reciprocal grounding across symbolic systems using human's advanced semiotic competences, processes and relations (patterning) in order to coalesce different forms of agencies and knowledges.

Photo: The Tower of Babel - Pieter Bruegel the Elder /Wikimedia

From Semiotic Competence to Systems Sensitivity

Five innate pre-linguistic core knowledges humans are born with:

Source: S. Carrey, E. Spelke – Cognitive Psychology Harvard

- Forms (and their relations of length and angles)
- Quantity / numbers (and their arithmetic relations)
- Objects (and their motions)
- Agents (and their goal directed actions)
- Places (and their relations of distance and direction)

Assembled by our plastic minds to make sense of (input) and create (output) increasingly complex structures and models as we develop and learn

→ An innate language of patterns of systemic nature? That I call “Patterning”, and Mobus calls “systemese”.

That helps us understand the world, describe it and design/construct it, even before articulating any language?

Chomsky’s “universal grammar”, at play at a pre-linguistic rather than linguistic level?

Patterns and Systems

“Our ability to conceptualize a system is thought to be built right into the human brain. We automatically (subconsciously) categorize, note differences and similarities, find patterns, detect interconnections and patterns, and grasp changes over time (dynamics).” (Mobus and Kalton 2015)

Mobus is even more into patterns with his new book presenting Systems Science as a Science of Patterns.

Definition of a Pattern, relation to Systems: a survey

Synthesis definition of a pattern:

An arrangement > at different scales, part/whole, more or less ordered, more or less generative
of elements > of different orders, more or less abstract, nested or not
repeated or repeatable in space/time > similarity or difference, stability or contingency
that is cognized or recognized > observable, anticipable, identifiable, recognizable, mobilizable
as manifestation of 'reality' or a system at work
that helps inquiry, meaning-making and design
key in the understanding and orientation of systems behavior and outcomes.

This definition and subsequent pattern features are an output of a Mapping the landscape of patterns across disciplines survey organized by the Systems Science and Pattern Literacy Research Group of the Bertalanffy Center for the Study of System Science (BCSSS) in the first half of 2018. The survey targeted systems thinkers/scientists, designers, activists, consultants, policy makers, and generated 140 responses.

An arrangement >

Aggregate
Collection
Set
Combination

Whole
Purposeful unity
Synthesis

Topology
Scales
Fractals
Kaleidoscope

Order
Hierarchy
Chain
Sequence
Steps
Process

Organization
Structure
Architecture
Composition
Configuration

Part
Unit
Monad
Module
Building block

Constellation
Network
Web
Interconnection

Loops
Recursion

> at different scales, part/whole, more or less ordered, more or less generative

Verbatim from the Survey: Mapping the Landscape of Patterns across Domains
BCSSS System Science and Pattern Literacy Research Group - 2018

of **elements** >

Entities
Components
Units
Things
Objects
Variables
Parts
Instances

Forms
Shapes
Numbers
Sounds

Chunks
Schemata
Distinctions
Perceptions
Signals
Signs

Concepts
Abstractions
Generalizations
Symbols

Dimensions
Levels
Scales

Information
Expressions
Aspects
Attributes
Features
Characteristics
Genetics

Competencies
Qualities
Forces

Phenomena
Events
Actions
Processes
Behaviors

Connections
Relationships
Interactions

Causes
Effects
Rules

> of different orders, more or less abstract, nested or not

Verbatim from the Survey: Mapping the Landscape of Patterns across Domains
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regular or **repeatable** in space or time >

Repeated
Iterated
Repeatedly
Persistent
Frequent
Invariant
Common
Occurring over & over

Rhythm
Resonance

Similar
Sameness
Convergence
Correlations
Co-variate
Symmetry
Mirroring
Rhyme

Irregular
Distinction
Differences
Variation

Substantial enough to be observed
Dynamically stable
Fixed
Consistent
Reliable
Proven

Signature
Predicted
Established
Ritual
Archetype

Predictable
Logical
Ordered

Recursion
Rule
Law

Reusable
Reproducible
Replication

> similarity or difference, stability or contingency

Verbatim from the Survey: Mapping the Landscape of Patterns across Domains
BCSSS System Science and Pattern Literacy Research Group - 2018

cognized or recognized >

Observable
Identifiable
Recognizable

Meaning making / cognitive units

Experience based understanding

Conclusion by the mind of 'something' in the background mess

Experienced
Distinction
Perception
Visual
Sensory
Appears
Distinguished
Re-cognized
Discerned

Intuition
Vibrational resonance recognized by the brain

Mobilized when a certain condition is sensed

Emerge from creative cognition

Way in which we speak, communicate, think, create, organize

Metaphor
Perceptual construct

Knowledge conceptually/semantically structured

> observable, anticipable, identifiable, recognizable, mobilizable

Verbatim from the Survey: Mapping the Landscape of Patterns across Domains
BCSSS System Science and Pattern Literacy Research Group - 2018

that helps **inquiry**, **meaning-making** & **design** >

Observe, study, analyze
Abstract & decompose

Provide context & difference

Describe transformation rules

Explain why phenomena are how they are, or predict how phenomena will be

Describe interrelating aspects of discrete things

See underlying, chaotic or chaordic flows of material, energy, or information.

Describe how historical and emergent energies interact to create reality

Study transformative emergent properties

Sense the world and make meaning

Enhance senses
Arouse cognitive perception

Widen circles of perception

Guide through and engage consciousness

Seed that builds complexity
Serve as scaffolding
Giving shape

Can be manipulated and changed while retaining their value

Design element that promotes vitality and wholesomeness

Reuse of design knowledge
Enhance stability of design

Prototypal design solution to a recurring problem

Resolution of 'forces' in a design problem

Verbatim from the Survey: Mapping the Landscape of Patterns across Domains
BCSSS System Science and Pattern Literacy Research Group - 2018

Making sense of, understanding systems

- Systems awareness
- See parts of complexity more clearly
- Make complex systemic relations explicit

- An identifiable pattern points to a system at work
- If there is no pattern there is no system.

- Everything recognizable is made of patterns
- Key to understanding the workings of systems
- Describe elements or characteristics of systems.
- Structuring messy situations; construction of sense
- Discerning the direction or nature or events

- Building blocks to define complex systems.
- Blueprint of a system

Verbatim from the Survey: Mapping the Landscape of Patterns across Domains
BCSSS System Science and Pattern Literacy Research Group - 2018

Connecting understanding & design

- A function both diagnosing and design
- Systemic aids for improved system evolution and optimization.
- Can help describe and understand systems and systems dynamics in order to take more informed decision
- Can also enable people to improve systems, because they enable analysis and understanding.
- Only by experiencing and trying to understand can we learn to compose
- An explicit methodology to capture the characteristics of overlap, ambiguity and web-network interrelatedness within systems that can be reused to generate designs
- Allow us to break out of binary thinking and applying ordered systems approaches to solve complex problems; enables systems to become more adaptive and agile in response to changing contexts.

Verbatim from the Survey: Mapping the Landscape of Patterns across Domains
BCSSS System Science and Pattern Literacy Research Group - 2018

The relationship of systems to patterns

- If there is no pattern there is no system.
- Systems are, at one level, nothing more than patterns within a context.
- Systems embody patterns, often recursive, nested, compound, composable, decomposable, fractal, etc. patterns.
- Patterns define Systems, Systems define patterns.
- To me, in the language sense of Hofstadter, a system is a pattern.
- I tend to use these two terms interchangeably (not a fan of defining system by function).

Verbatim from the Survey: Mapping the Landscape of Patterns across Domains
BCSSS System Science and Pattern Literacy Research Group - 2018

Crossing boundaries with patterns

- Patterns enable to visualize systems of high complexity and thus play an eminent role in knowledge transfer.
- Seeing patterns can help inform choices about transferring evidence from one place to another by understanding the links between units of activity
- The general language/tool that enables trans domain communication and comparison. The clear discernment and application of basic patterns enables transcendent design.
- Patterns are very important for meaning to be contextualized and outline the diversity of observed reality.

Verbatim from the Survey: Mapping the Landscape of Patterns across Domains
BCSSS System Science and Pattern Literacy Research Group - 2018

Patterns are foundational to systems

- The essence, sine qua non
- The critical stuff that underlies all systems knowledge.
- Pattern thinking is next generation systems thinking.
- The use of patterns in the implementation and practice of the work in the meta-framework will be essential.
- Purpose & identifying patterns that link purpose to practice or actions are foundational in the social sciences
- Pattern awareness will be core in meaning making, understanding systems and reality
- Much of cutting edge 21st century science will be about recognizing patterns as opposed to recognizing objects: our political domain is the area where pattern/systems thinking is most critically necessary and least apparent.

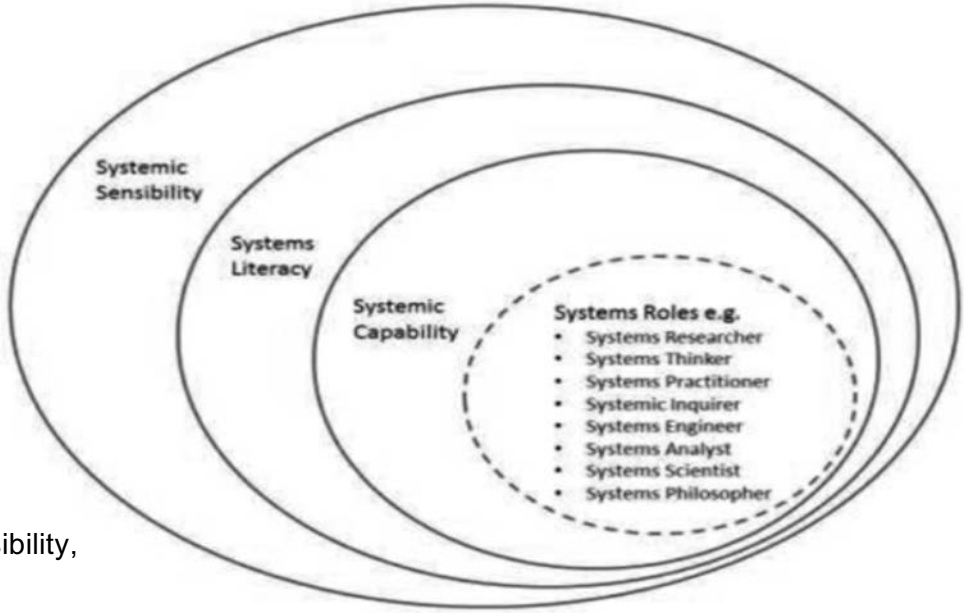
Verbatim from the Survey: Mapping the Landscape of Patterns across Domains
BCSSS System Science and Pattern Literacy Research Group - 2018

Systems Sensitivity & Systems Literacy IFSR 2016

An ISFR workshop explored the idea to work at the level of embodied practical capability and knowledge, enhancing human's "innate systemic sensibility" to support Systems Literacy

"Systems literacy engenders systemic capability in practice, and achieves this by developing innate talents people have.
...
Everyone starts out with "systemic sensibility", i.e. an innate, intuitive or tacit appreciation of systemicity in the empirical world (Mobus).
...

Systemology formalizes this tacit knowledge, so that education in Systemology provides persons with clear concepts and a common language that gives them the capability to articulate and reflect on this innate sensibility, and act on it in a considered way."



Quotes from proceedings of IFSR 2016 on Systemic Literacy

Ray Ison - IFSR 2016

Work with Peter Tuddenham, ISSS 2017

Pattern Literacy, introduced at ISSS 2017

This innate 'systemic sensibility' which must be transformed into systems literacy is underpinned by humans' **innate skills to discover / recognize / associate/mobilize patterns.**

Working at the patterning 'instinct'/ literacy levels can further enhance systemic sensibility and help it transform into systems literacy.

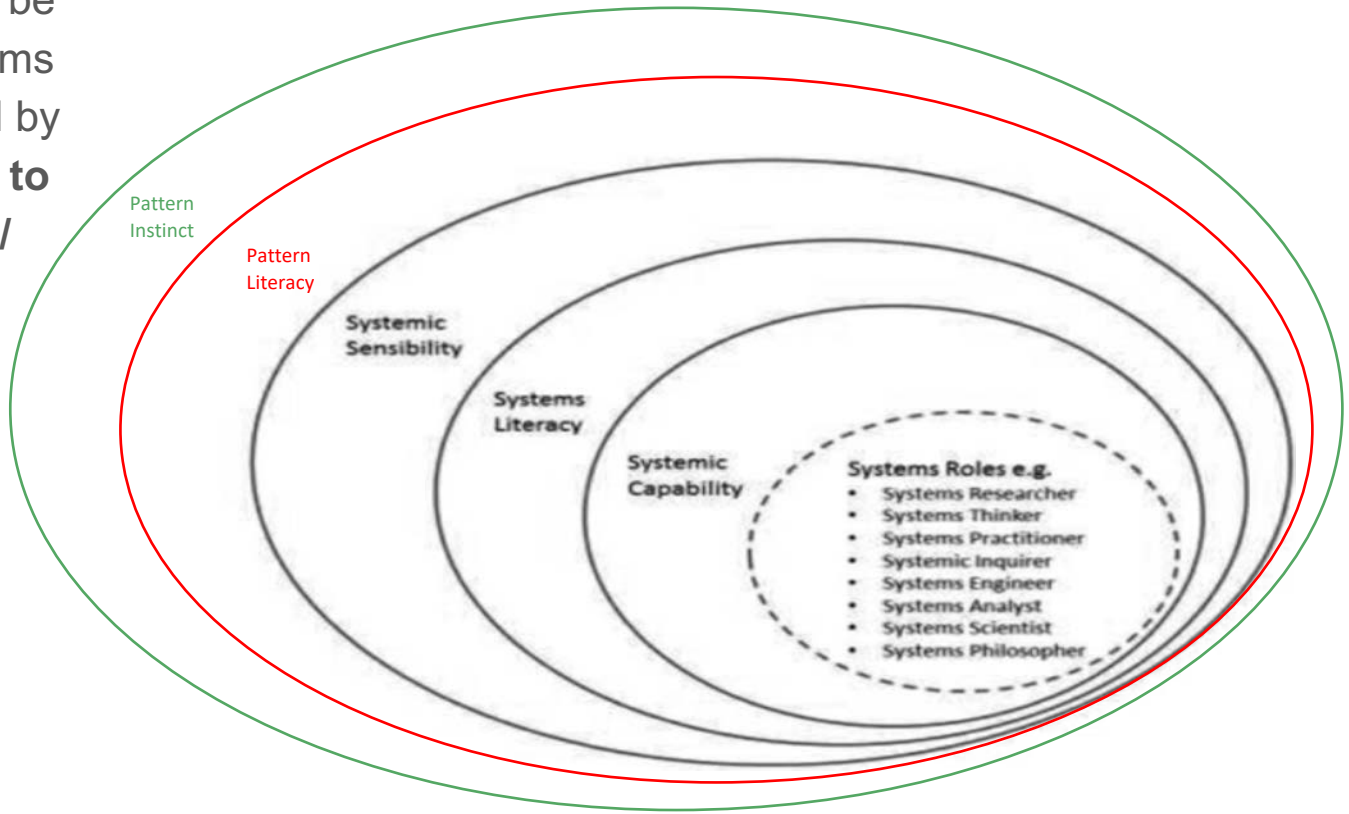


Image: Adapted from Ray Ison - IFSR 2016

Work with Peter Tuddenham, ISSS 2017

Applications of and for Pattern Literacy

- Using patterns as “mediators” between and among
  - Different aspects of systems / ‘dimensions’ of complexity
  - Different attitudes towards and representations of these aspects
  - Cybernetic feedbacks resulting from both observation and practice

- Leveraging the potential of patterns as semiotic signs to look at phenomena and associated problematiques in their multiple dimensions with multiple lenses. In particular, understanding which level of observation and design we and others are referring to and looking at. An inquiry, positioning and navigation system.

- Using patterns as ‘boundary’ objects [scientific objects of study?] to inquire and probe [dfferent] experiences of reality, interpretation, representation; and confronting ‘views’, to better cross different types of boundaries (epistemologies, ontologies and phenomenological interpretations), and tackle specific challenges. Could be used in on-going manner as trans-disciplinary tool.

Outcomes of Pattern Literacy

- Enhancement of the process of observing / recognizing / differentiating / categorizing / composing / decomposing, to support patterns based inquiry

- Enhancement of skills to perform the above across disciplines frameworks and methodologies, through joint discovery by comparing, confronting views (Johari Window)

- Manifested by new embodied probe / sense / think / act cognitive acuity and skills to better make sense of systemness / systems phenomena etc in their multiple expressions, at multiple levels.

  > Allows to systematize this without choosing a school of thought [philosophy] and without falling in the usual pitfalls (imperialism, positivism, relativism… abstraction, reduction etc...)?

Transcending the Heuristic vs Scientific Duality

Scientific inquiry starts with heuristics.

Pattern literacy works using heuristics to build an understanding and tacit practice bottom up.

It could be enhanced by promoting heuristics and hermeneutics as an interpretative exploratory approach more systematically Which could lead to some metastabilization into principles

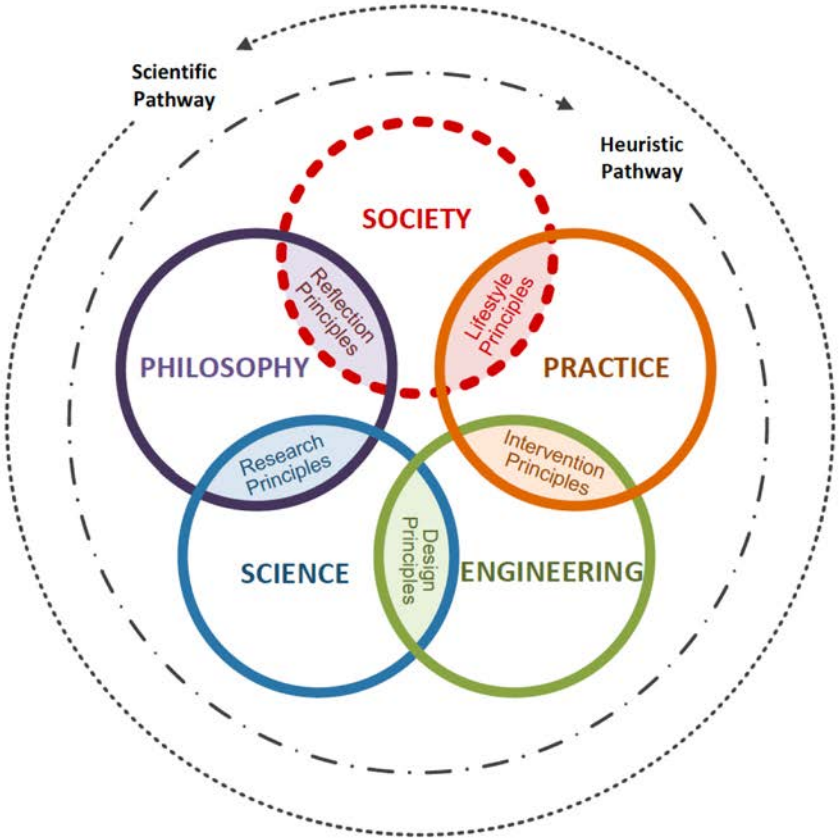


Fig. 10. Interplay of pathways driving the emergence and evolution of principles across fields.

Rousseau, D. (2018). *A Framework for Understanding Systems Principles and Methods.* Paper presented at the 28th Annual INCOSE International Workshop, Washington DC.

Crosscutting Concepts

In the Next Generation Science Standards' Cross Cutting Concepts unify the study of science and engineering through their common application across fields, and core ideas in the major disciplines of natural science. The role of patterns, first cross cutting concept is described as:

1. Patterns. *Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.*

These are systems characteristics

Crosscutting Concepts

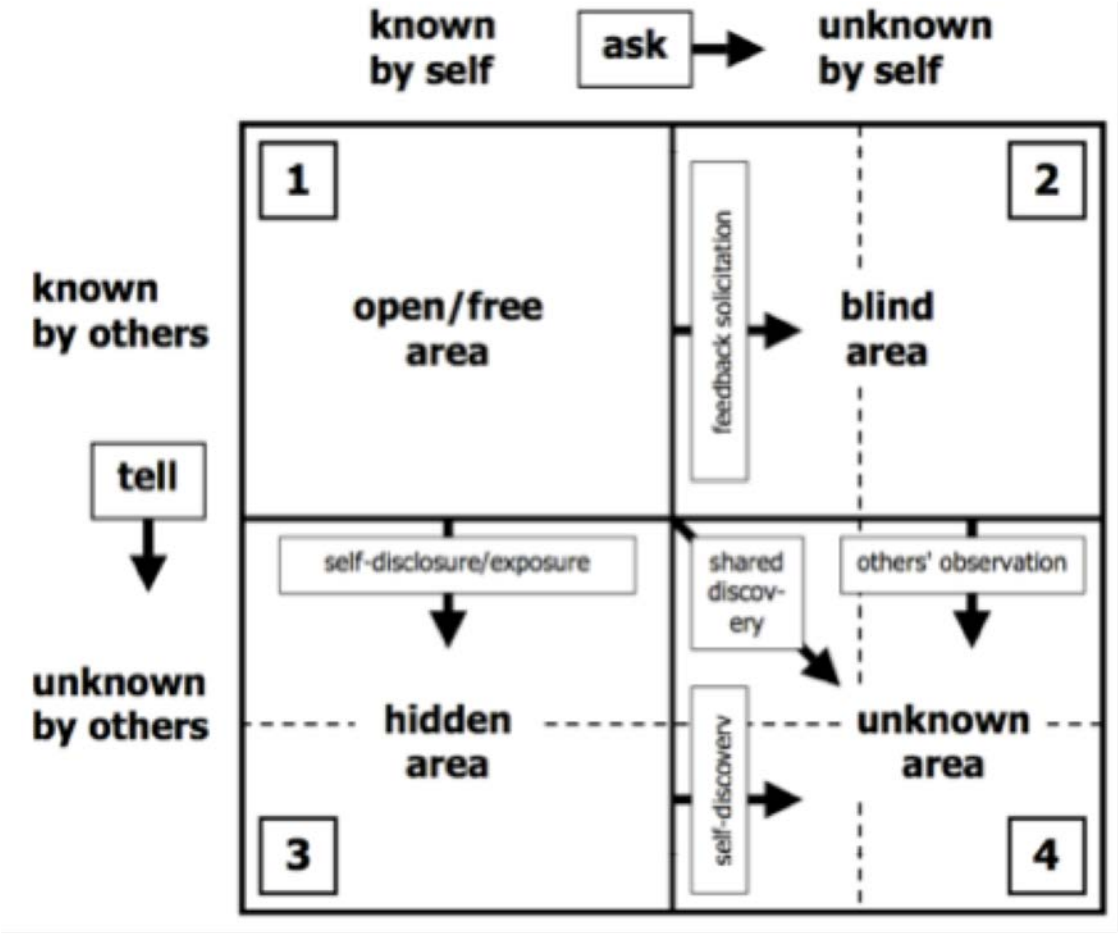
Other cross-cutting concepts can be expressed as patterns also!

- **2. *Cause and effect: Mechanism and explanation.*** Events have causes, sometimes simple, sometimes multi-faceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
- **3. *Scale, proportion, and quantity.*** In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
- **4. *Systems and system models.*** Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
- **5. *Energy and matter: Flows, cycles, and conservation.*** Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
- **6. *Structure and function.*** The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.
- **7. *Stability and change.*** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

➔ Looking at and expressing these cross-cutting concepts as patterns would allow to start in a simple manner.

Joint inquiry using Patterns as Boundary objects

Joint discovery of blind spots and the unknown
Using patterns

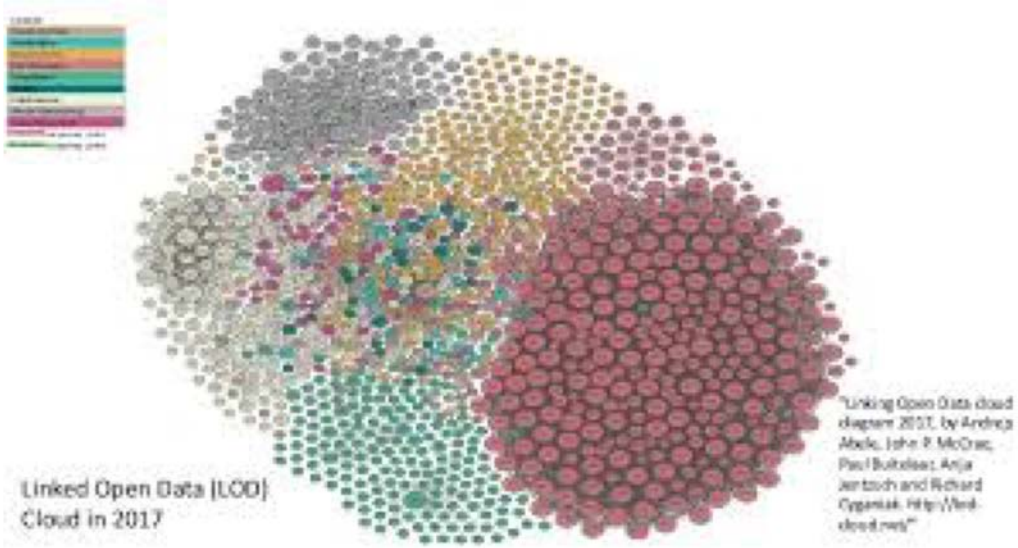


The Johari Window

A Web of Interconnected & Interoperable Patterns?

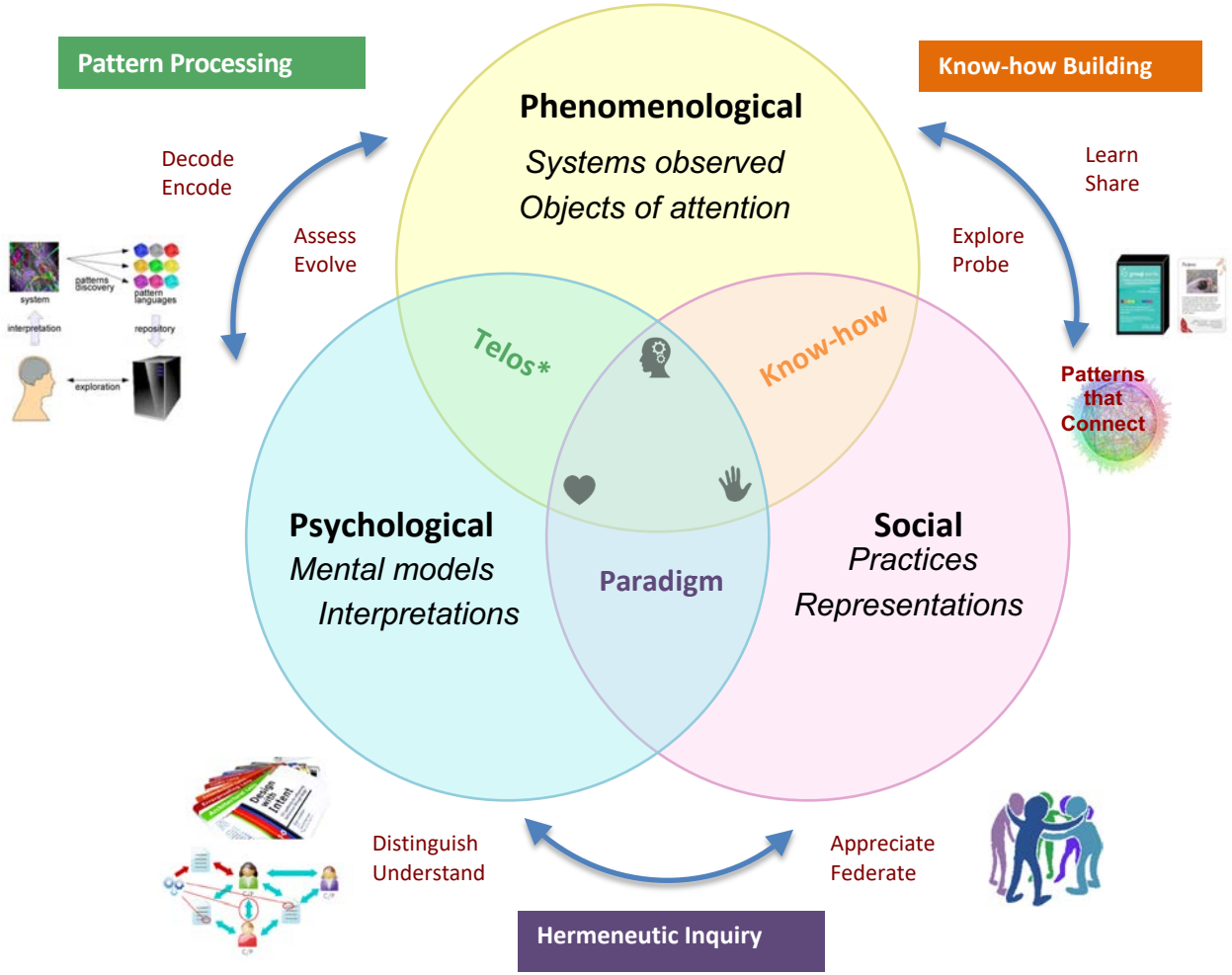
The world wide web is born from the unresolved quest to integrate information diversity through single centralized systems and format standards.

Instead Tim Berners Lee made information inter-operable through the hyperlink and communication protocols. Linked data preserves difference and contexts, and data that does not fit anticipated forms. It enables every nuance to be expressed.



Isomorphic and homomorphic patterns could be inter-connected into networks or clusters, meta-stabilizing around strong ‘centers’ -towards mediated universals...

A Pattern Literacy Operating System



Examples of Pattern Literacy in action

Visual tools / artifacts - to play, construct, deconstruct, probe
A Systemic Connective Language - the units to be combined
Collaborative sketching and annotation

Semantic capability - finding various ways to associate patterns
Formats and protocols for interoperability of patterns
AI deep learning systems to infer / suggest / simulate / play
Visual tools to navigate data and knowledge (anoptical, holoptical)

Systemic Interpretation Language Finidori

A Systemic Interpretation Language
Bridging the Systemic & the Semantic Spheres

Domain Related Contexts

Systemic Interpretation Grammar
(Elementary Components)

Dynamics
(Movement)

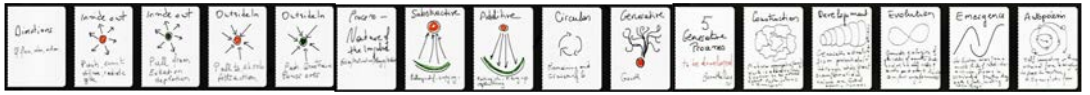
◆

Statics
(Space - Structure)

◆

Heuristics
(Inflexions – Limits – Angles – Switches)

Systemic operators - Variables – Principles for combination – etc…



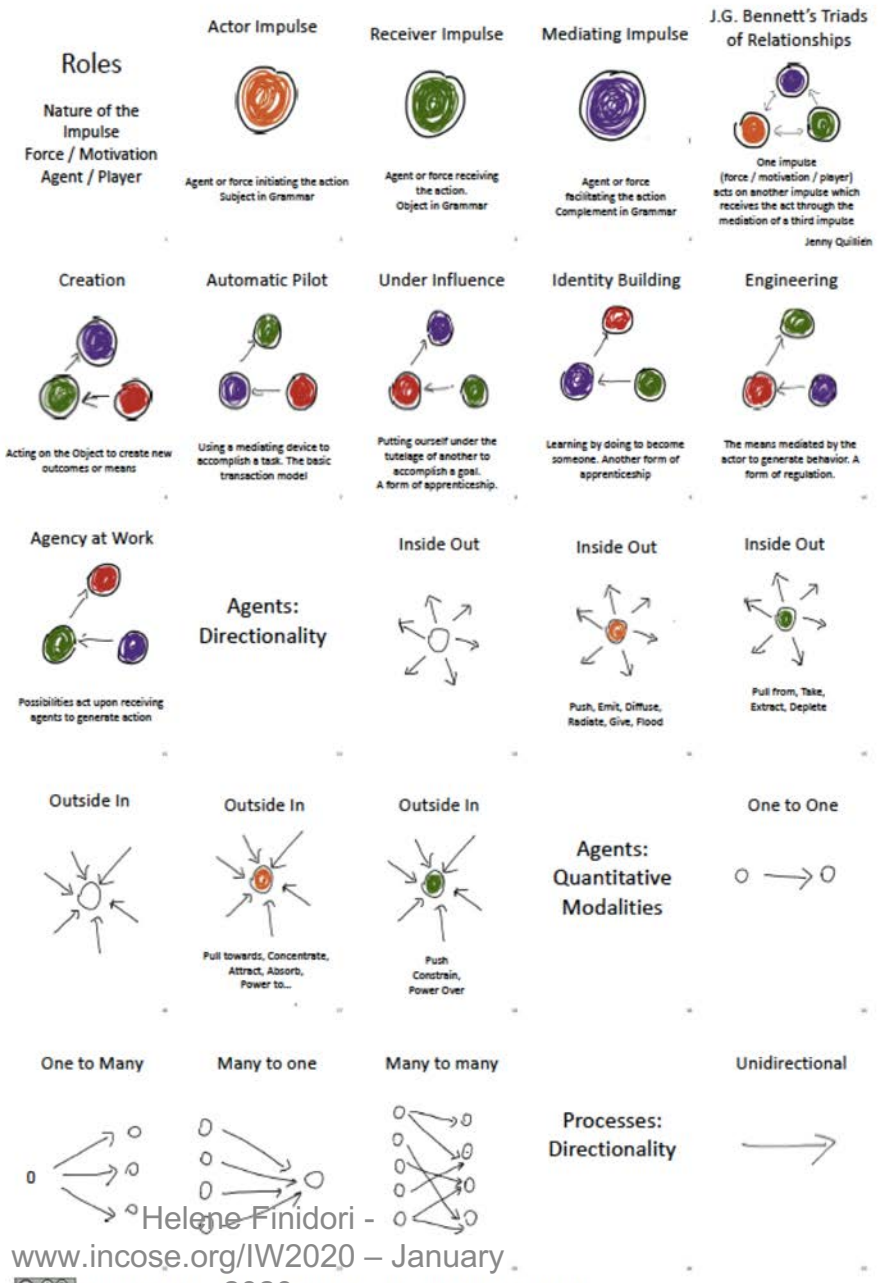
Generative processes - Nature of movement – Direction – Rhythm – Effect of time & scale etc…

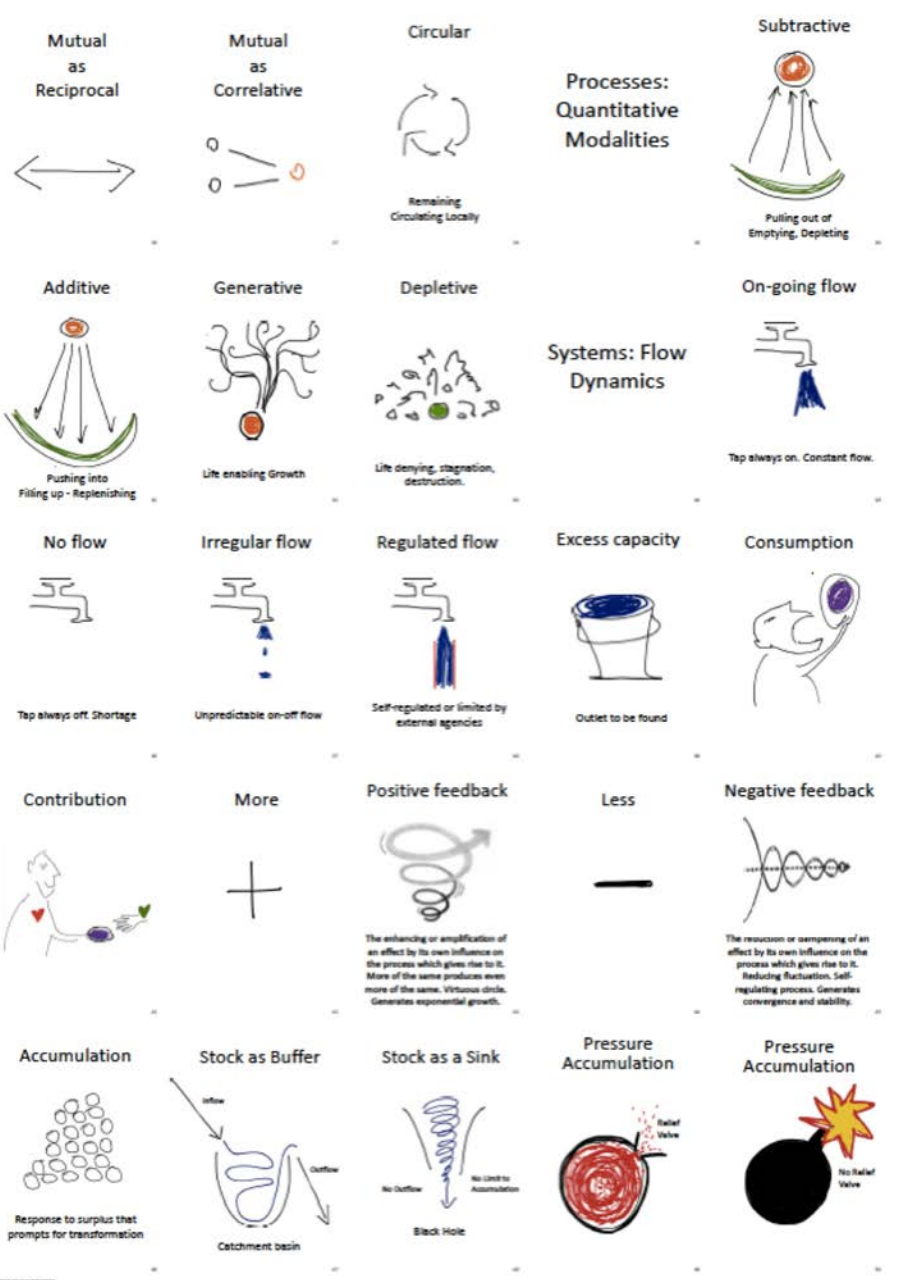
Function - Relationships – Proximity – Mutuality – Boundary - Position – feedback etc…

Logics of Change - Cognitive Processes (Jung) – Learning Styles – Process Narratives (Roy) – Inference (What/what/how, Aristotelian ethics) – Pharmakon/window of viability (Stiegler, Lietaer) – One level up/down – etc… - Switches (DNA)

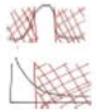
Systemic Patterns
Generic

Pattern Languages
Domain Related





Entropy



Elimination of Variance
More of the same
Non renewal of the system

Negentropy

Fostering diversity
& confrontation
Letting the new emerge
within the old

5 Generative Processes

Bonnitta Roy

Construction

Infusion of Design
Produces aggregates (heaps)
Work is added to the system
by an external agent.
Form follows function

Developr

Intentional pr
Generates Actu
Potentials (holarchi
whole/part transf
Holons are central ag

Boundary

Inside

Outside

Inclusion

Exclusion

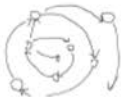
Evolution

Natural progress
Generates ecologies of
plurasities of agents that evolve
on different scales and levels
and adapt through complex
engagements, generating diversity.

Emergence

Synergetic combinatories
The system arises from a
multiplicity of simple interactions.
Agency is distributed.
Status switches back and forth
creating neguentropy

Autopoiesis



Circular interdependent agency
ceaselessly producing itself.
Simultaneously autonomous and
dependent processes.

Pace

Linea

Change at a cons
with constant acc

Enclosure

Distribution of Responsibilities & Agency

Subsidiarity Principle

Nothing should be done at a
higher level that could be done
as well or better at a lower level

Ascend

Elevate to the nearest above
level with the necessary skills
and resources

Descend

Delegate to farthest below level
with the necessary skills and
resources

Exponential

Accelerated pace of change
i.e. increasing acceleration

Incremental

Change in segmented additions

Sporadic

Change in sudden
irregular bursts

Inflection points

Inflection

A point in ti
where the directi
curvature che

Distribute

Distribute excess concentration
over network of peers

Concentrate

Concentrate diluted operation
from network of peers

Change Paradigms & Engagement Logics

The dominant
perspectives from which
change is seen

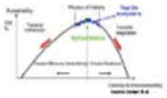
Symbiotic

The source, Mother Earth,
attunement, honoring all beings,
ecosystemic integration

Agentic

Self-determination and
actualization, distributed nature
of change at the individual level

Window of Viability

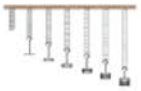


Complex natural ecosystems
invariably operate within a fairly
narrow range on each side of an
optimum point

Window of Opportunity

Period surrounding an inflection
point during which action must be
initiated to remedy foreseeable
negative effect or to harness
foreseeable positive effects

Efficiency



Do more with less.
Extend resource productivity

Resilience

Capacity to adapt
or recover initial shape
after transformation

Combinat

Politic

Change through law and
institutions, ethics and
governance

Technic

Change through new strategies
and mechanisms, tools and
metrics

Relational

Change through social practice
and community learning
and sharing

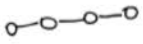
Systemic

Change through systems dynamics,
polycentric approaches

Cosmologic

Change through experiencing
wholeness of existence, deep
sense-making and awareness,
and evolutionary phenomena

Linear

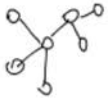


Elements assemble or function
in sequence

Parallel

Elements assemble or function
alongside each other

Network



Swarm

Agent Syste Inclusiv

Known Effects & Laws

Snowball Effect

Domino effect

Winner Takes All

Also known as Matthiew Effect

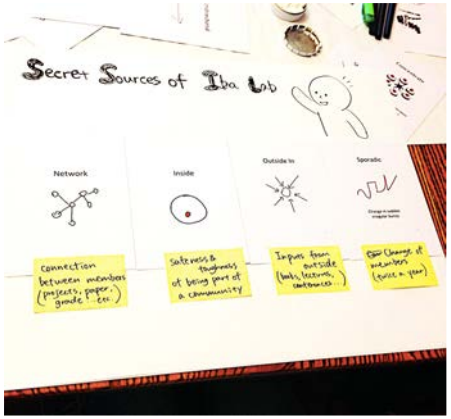
Preferential Attachment

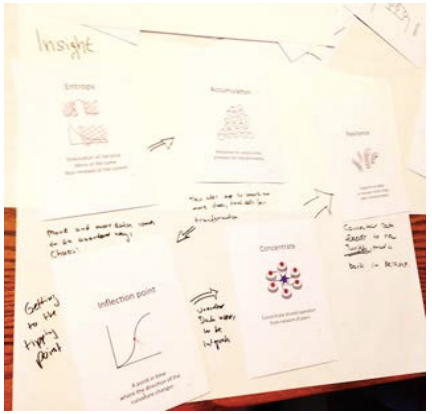
Those who already have
receive more

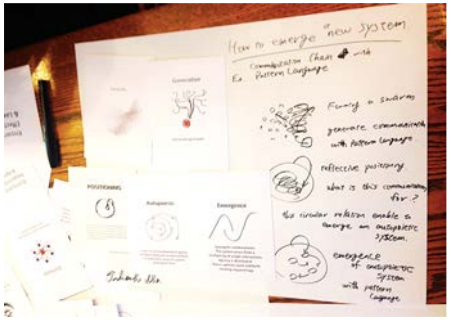
Finidori, H. (2014). *Systemic Interpretation Elements.* Presented at Purplsoc 2014 & 2015, PLoP 2016

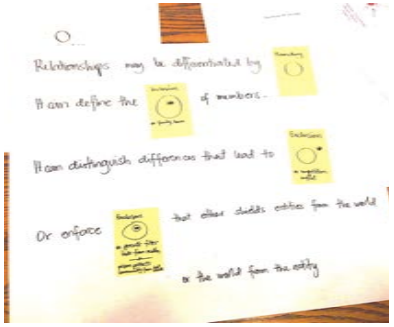
Cards used to tell ‘systemic stories’ at Purplsoc 2015

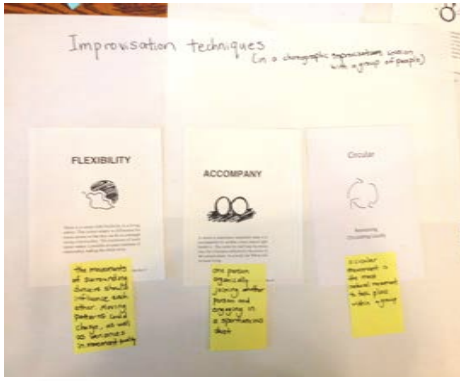
Cards used to tell ‘systemic stories’ at Plop 2016

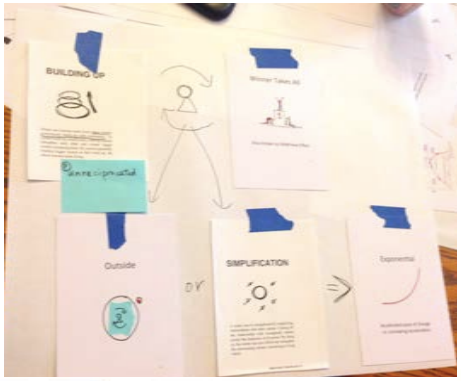








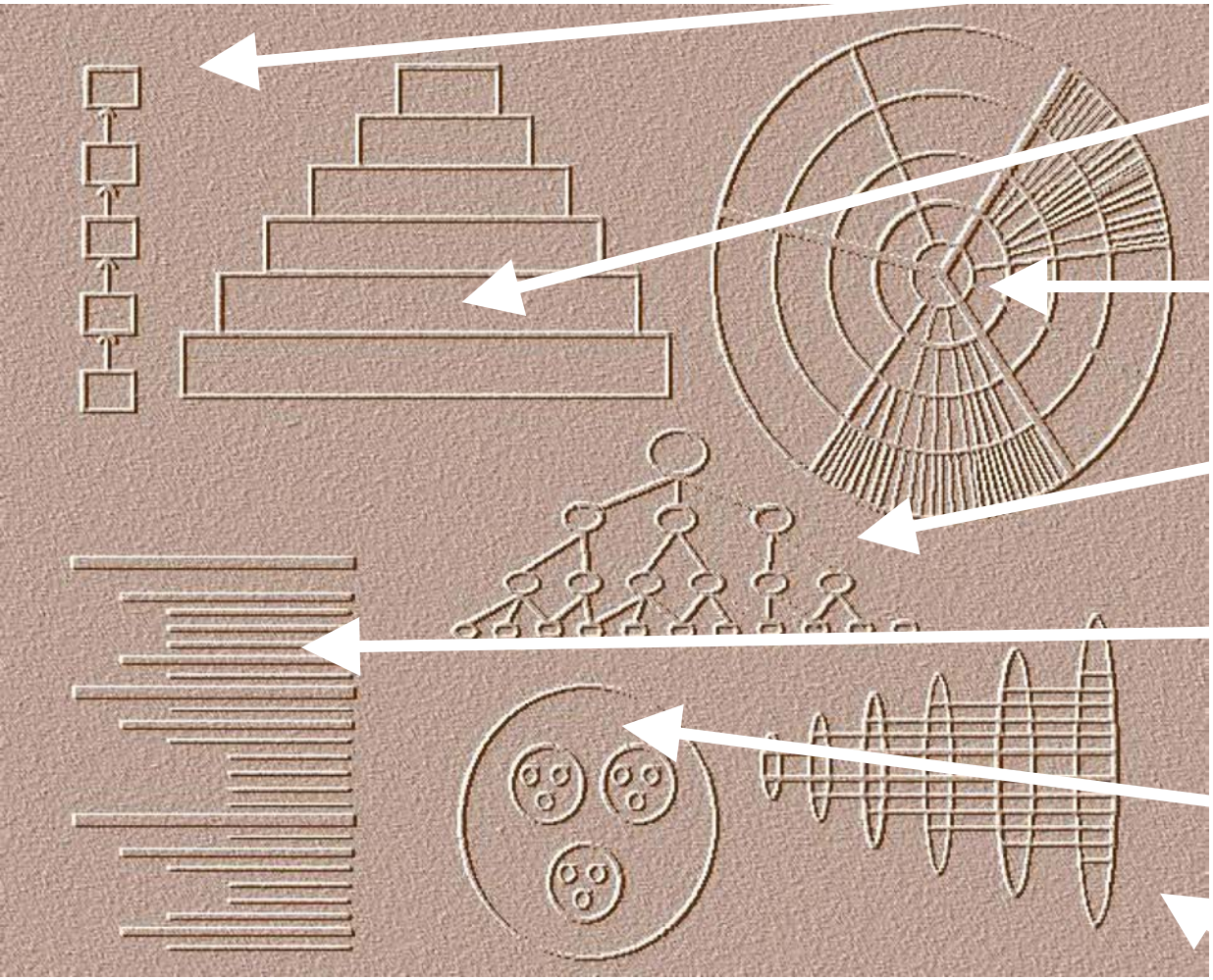




Isomorphy & Systemic Interpretation
Languages & Representations

Systems Sciences: Len Troncale - Icons for Hierarchy

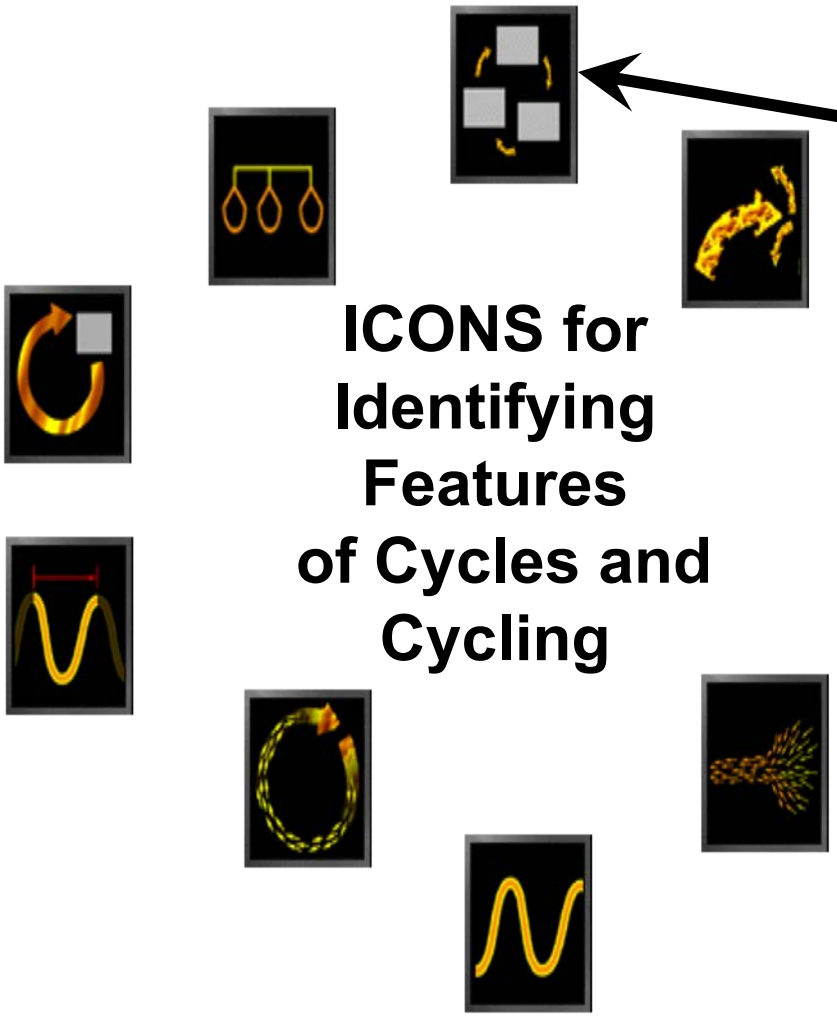
Icons represent the essence of an idea in abstract; simplify (all-at-once)



1. A series of stages or layers
2. Series showing changes in magnitude
3. Circle showing separation in divisions
4. Pyramid showing parts to wholes, subunits to units
5. Outline showing subheadings at several levels
6. Circles showing clustering and inclusion
7. Series showing subsumption

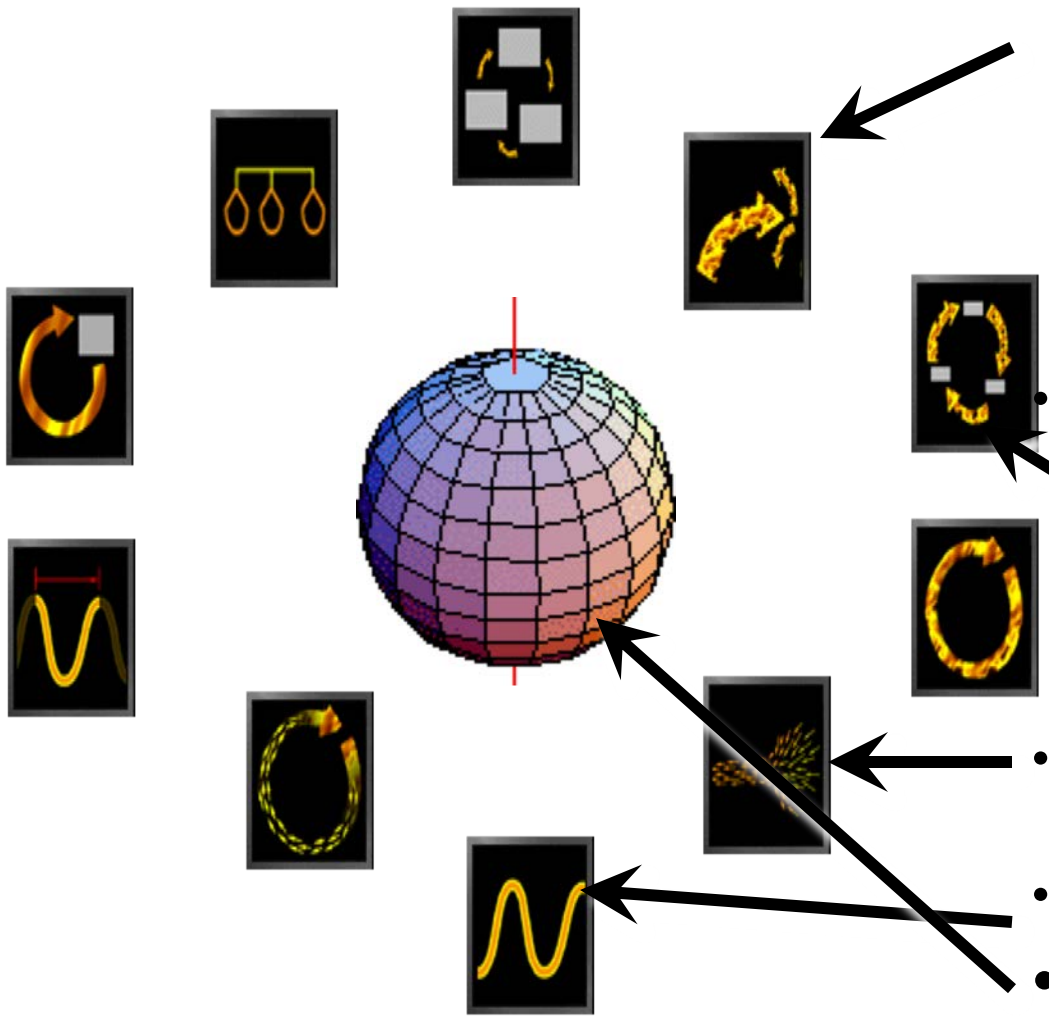
ALL SHOW COMMON ID FEATURES OF LEVELS,GAPS, CLUSTERING, HETEROGENEOUS SEPARATION, ETC.

Systems Sciences: Len Troncale – Features of Cycles I



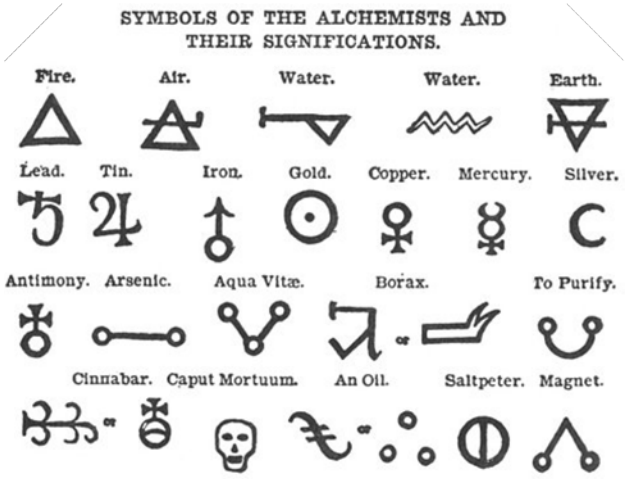
- ✓ From “cyclus” (Gr.) = circle, wheel. Some key features are:
- ✓ Stages of a cycle
  - Steps in a process
  - A cycle may seem like a smooth transition; not; very specific intermediates
- ✓ Obligate sequence
  - Transformation of one stage into next
  - Next stage requires previous stage
- ✓ Return to beginning
  - Oscillations
- ✓ SO NEED TO KNOW THE SEQUENCE & STAGE NAMES

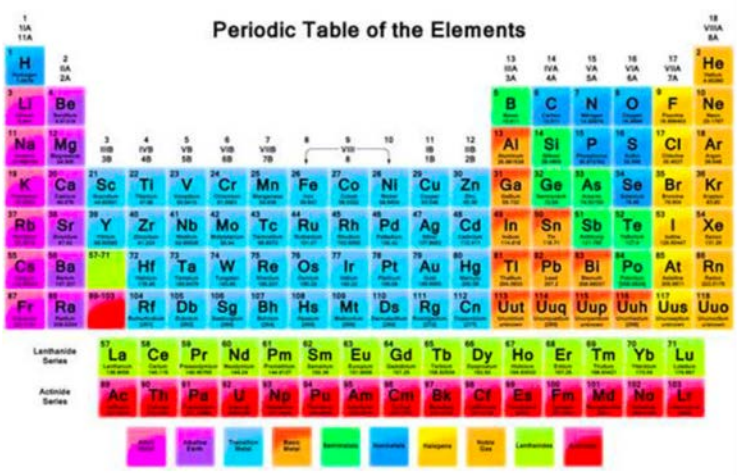
Systems Sciences: Len Troncale – Features of Cycles II



- Importance of Initiating Conditions
  - Steps in a process
  - A cycle may seem like a smooth transition; not; very specific intermediates
- Control of Stages
  - When one starts; when one ends
  - Source of embedding cycles in net context for a function
- Entrainment (all cycle)
- Periodicity
- Spin /or/ Rotation /or/ angular momentum

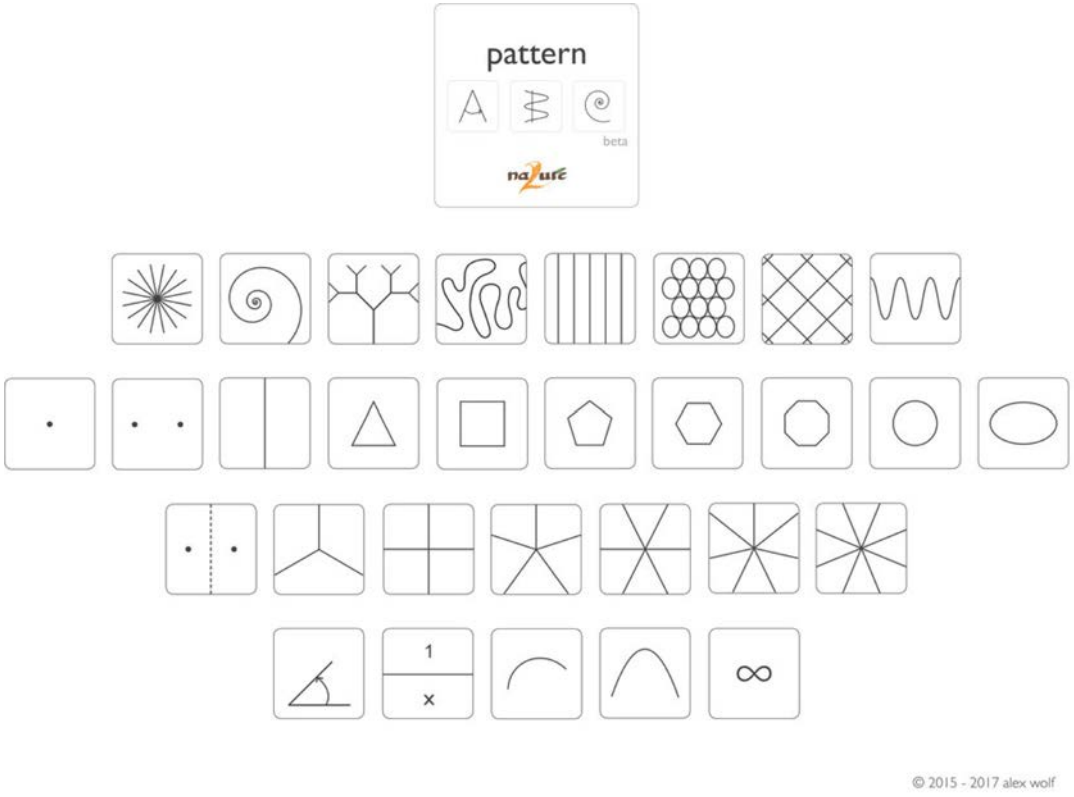
Alchemy to Chemistry



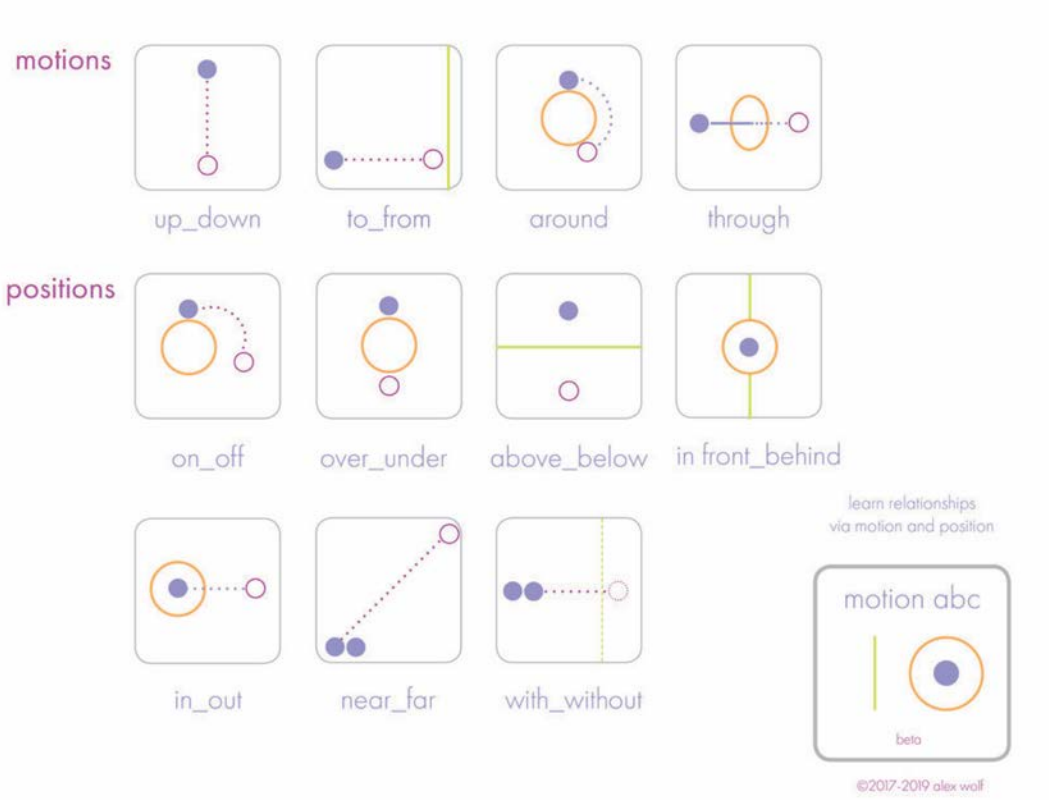


Concept Gary Smith (check)

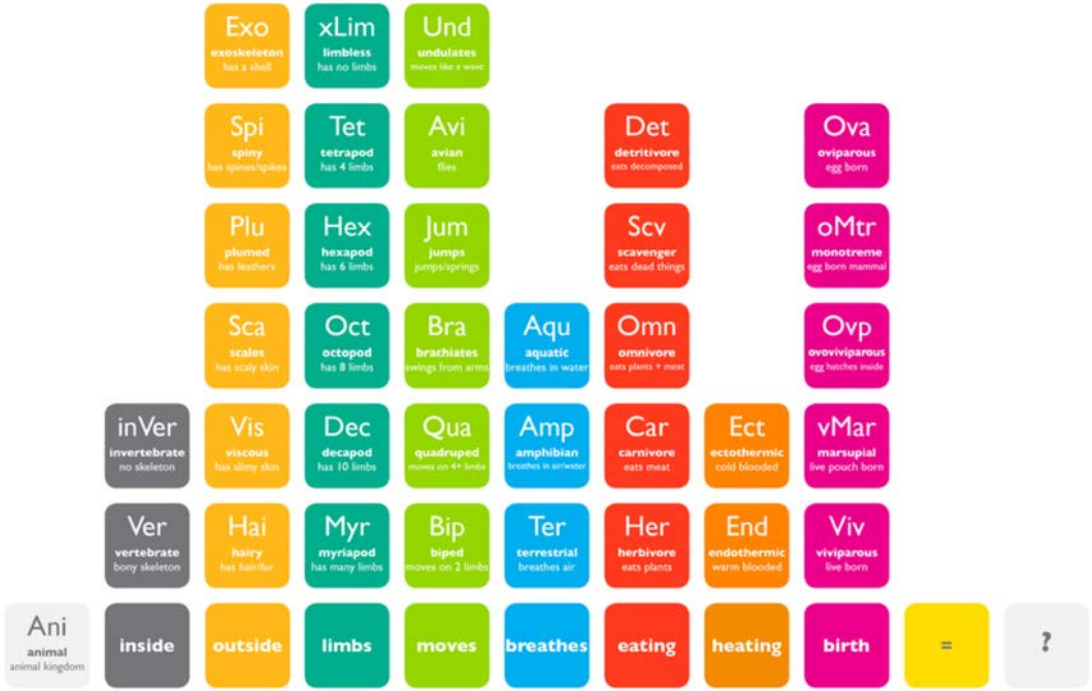
Na2ure – Pattern ABC



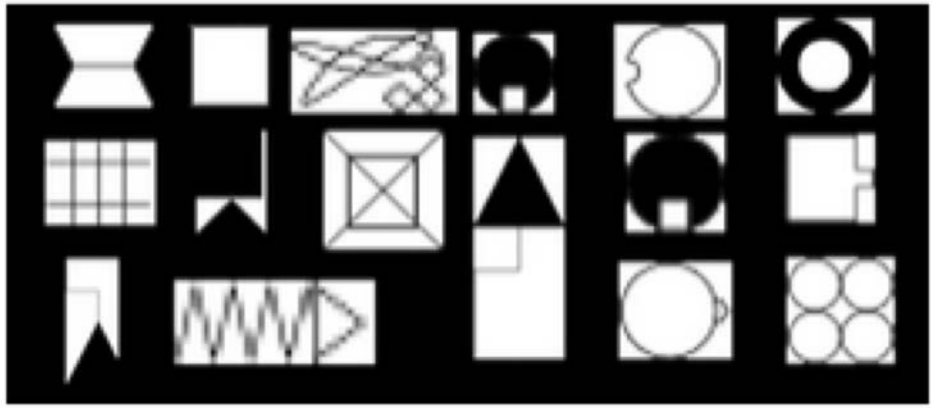
Na2ure – Motion ABC



Na2ure – Periodic Table for Biology



Ilan Riss' Living Systems Symbols



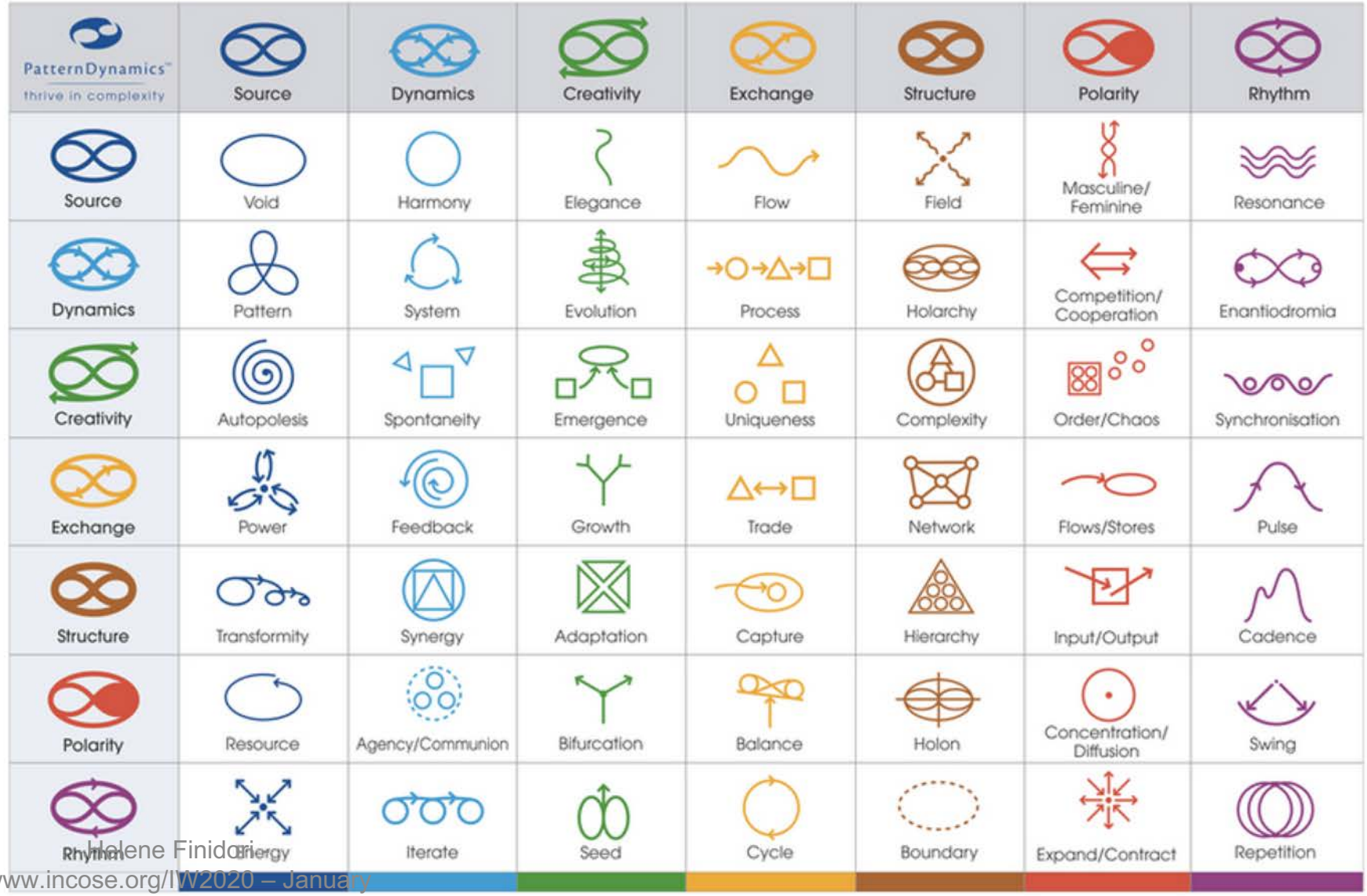
LEGEND of SYSTEMS SYMBOLS and FUNCTIONS

Symbols	Mnemonic shorts	Subsystems (critical)	Functional character features & qualities
△	S 1	Input transducer	sensor, sighting, receptor, detector, perception, receiving
⧖	H 2	Internal transducer	coordination, inside monitor, feeler gage, harmonious correlator, home-base sensing
▭	D 3	Decoder	diagnose, designation, distinction, interpret, translation, categorize, synoptic labeling, construe, situation-control, identification
◇	P 4	Associator	projective planning, prospect vision, assemble, relate, strategic intelligence, anticipation, presage, decision switch
⬭	G 5	Decider	goals & objectives-keeping, purpose guidance, motives, drive, policy, steering-control, impeller
⤭	N 6	Channel & Net	net (work), communication, circulate, relaying,
▯	M 7	Memory	remember, message-retainer, filing & retrieval, retrospect
▭	E 8	Encoder	explicate, external translation, expression-former, outcoding, public report
▽	A 9	Output transducer	action, activator, actuator, exploit, deed, implement, sending, effector,
◷	T 10	Timer	time-keeper, cycle-setter
⋗	J 11	Ingestor	injector, jet-entry, intake, reception, job-entry
⊓	F 12	Supporter	foundation, firmament, ground, substance, sustain, maintain
▭	C 13	Converter	conditioning, prepare, transform, rework, refinery
▱	K 14	Producer	maker, generator, facture, repair, mending
⊛	Y 15	Motor	move, motility, mobilize, ambulate
⇄	L 16	Distributor	pipeline, transport linkage, route, line entrenchment, liner fairway
◇	Q 17	Storage	supply store, stockpile, queue, cumulation, reservoir, depot, deposit
⊠	X 18	Extruder	exit, outlet, exhaust propulsion, remove, discharge, unload
▭	B 19	Boundary	border, shield, fence, wall, enclose
◿	Z 20	Reproducer	replicate, template, zoon, remake

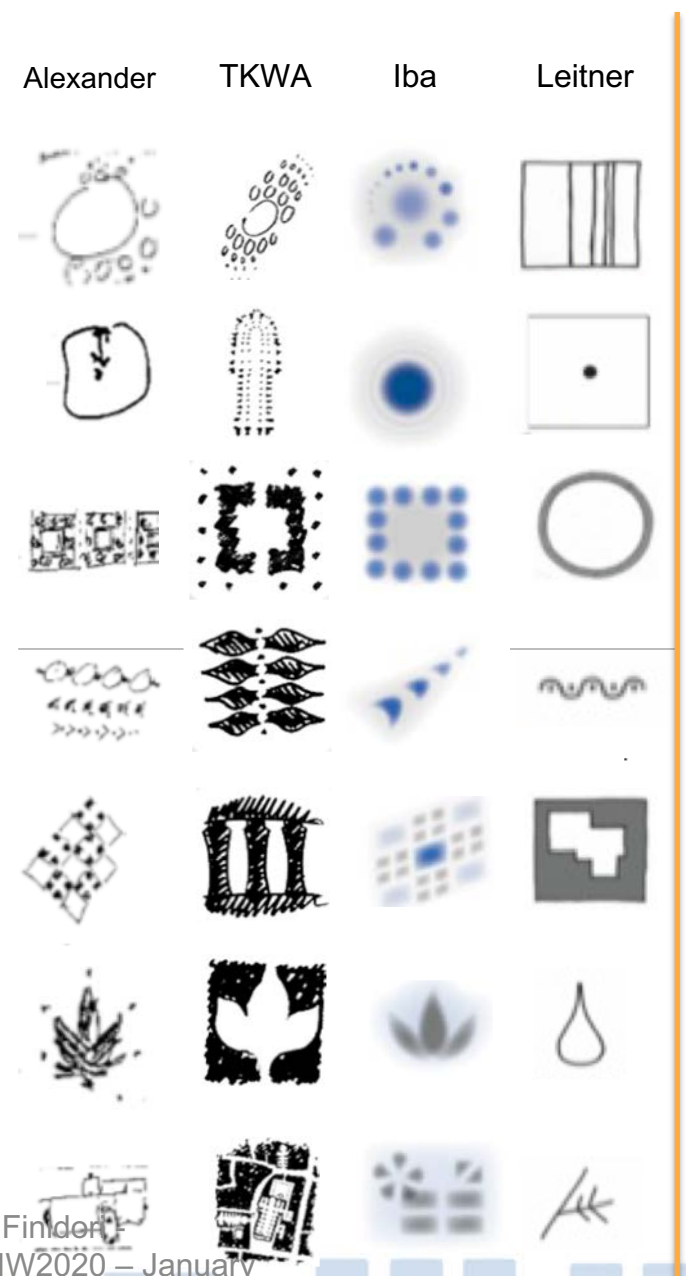
Pattern Dynamics consulting practice

www.patterndynamics.net

PatternDynamics™ Matrix Chart



Alexander's 15 Fundamental properties



Iba Lab's 24 Fundamental Behavioral Properties

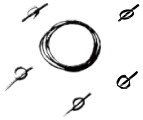
1. BOOTSTRAP

2. SOURCE

3. SPREADING

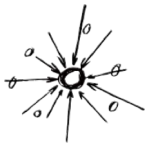
13. SELECTION

14. SIMPLIFICATION



15. CONSISTENCY

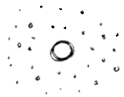
4. ATTRACTION



5. INVOLVING

6. TOGETHERNESS

16. ROUGHNESS



17. FLEXIBILITY

18. ABUNDANCE

7. BUILDING UP

8. GROWTH

9. REFLECTING

19. AIMING

20. CONNECTING

21. POSITIONING

10. ACCOMPANY

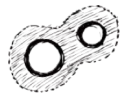
11. ENHANCING

12. EMPATHY

22. DIFFERENTIATING

23. OVERLAPPING

24. CONTINUATION



Adinkra Symbols

It seems they have
- different representations
- and signification

Tao and I-Ching

1. Ch'ien (The Creative)
Creative power and energy of the universe.

2. K'un (The Receptive)
Involves the feminine part of your self that is gentle and devoted to others.

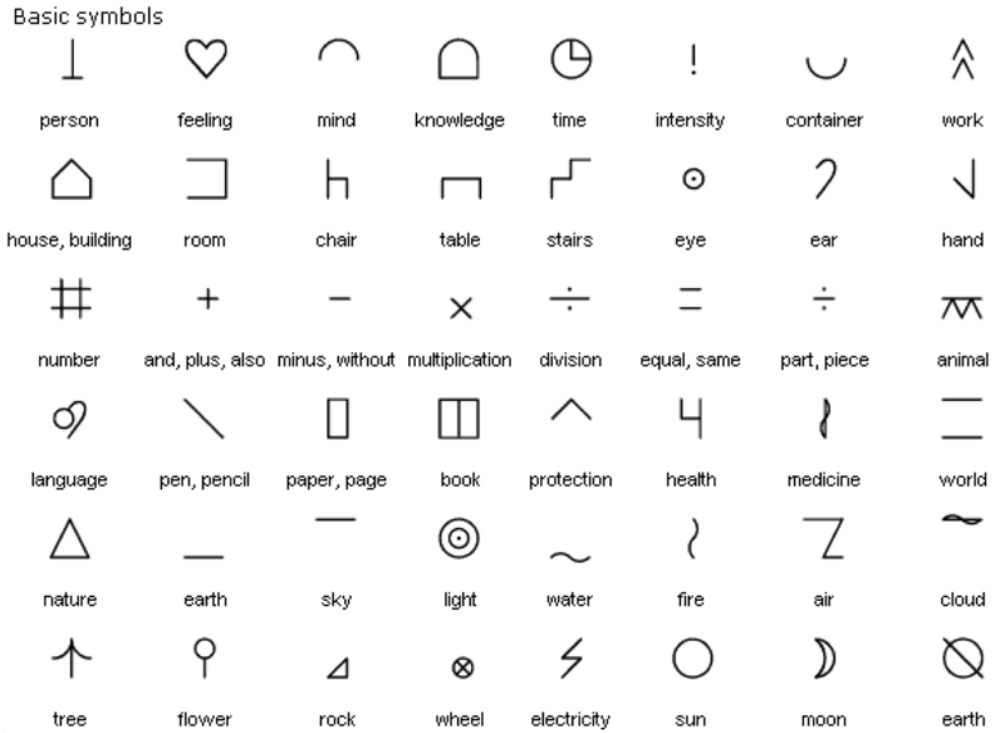
3. Chun (Difficult Beginnings)
At the beginning of any new venture there is struggle.

4. Meng (Youthful Folly)
The inability to foresee the consequences of your actions can sometimes lead to disater.

5. Hsu (Waiting)
Certain situations call for immediate action however it is important to know when to wait.

Bliss Symbolic

To compose words

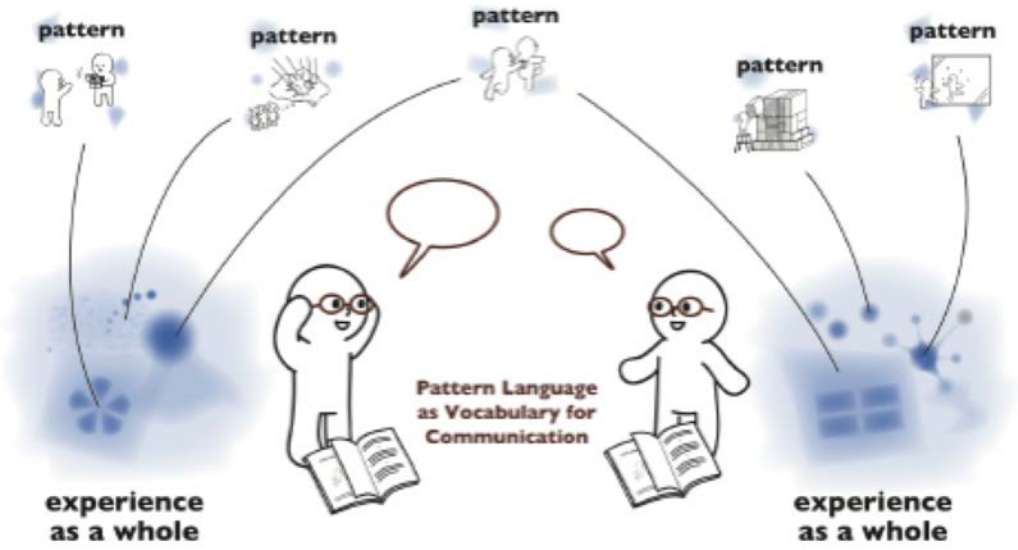


Play - Inquire - Learn

Boundary Objects

Discussing patterns as boundary objects (Bowker & al 2016): Learning at the boundaries, finding interoperability, interfacing diversity.

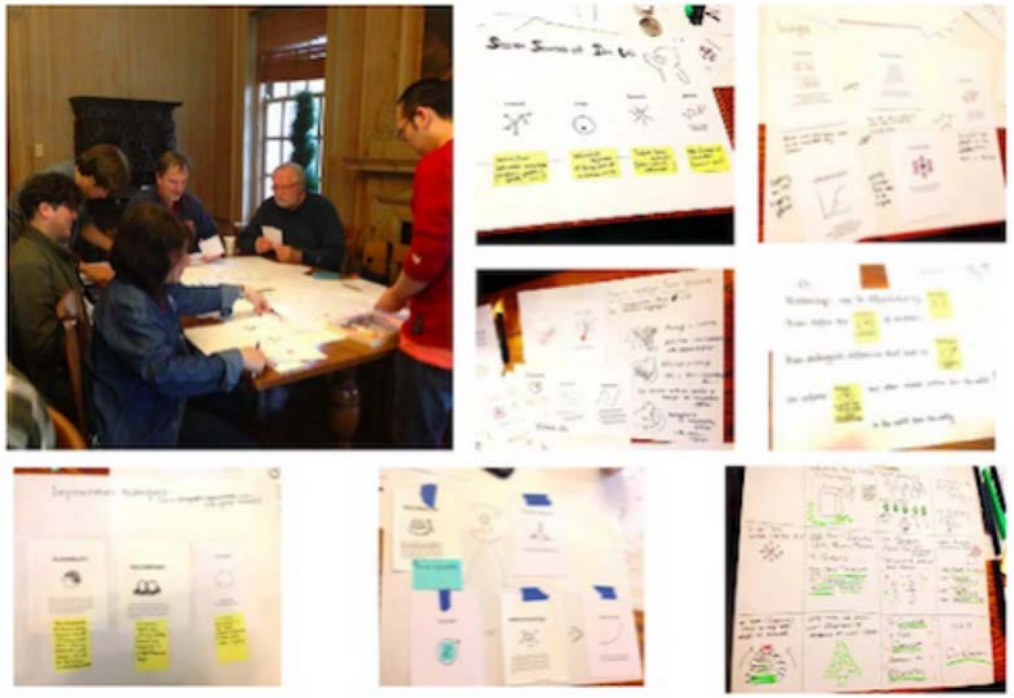
Here: Exchanging about experience through dialogue via patterns and pattern language (Iba)



Composition

Telling each other systemic stories with patterns as unit of micro-narrative.

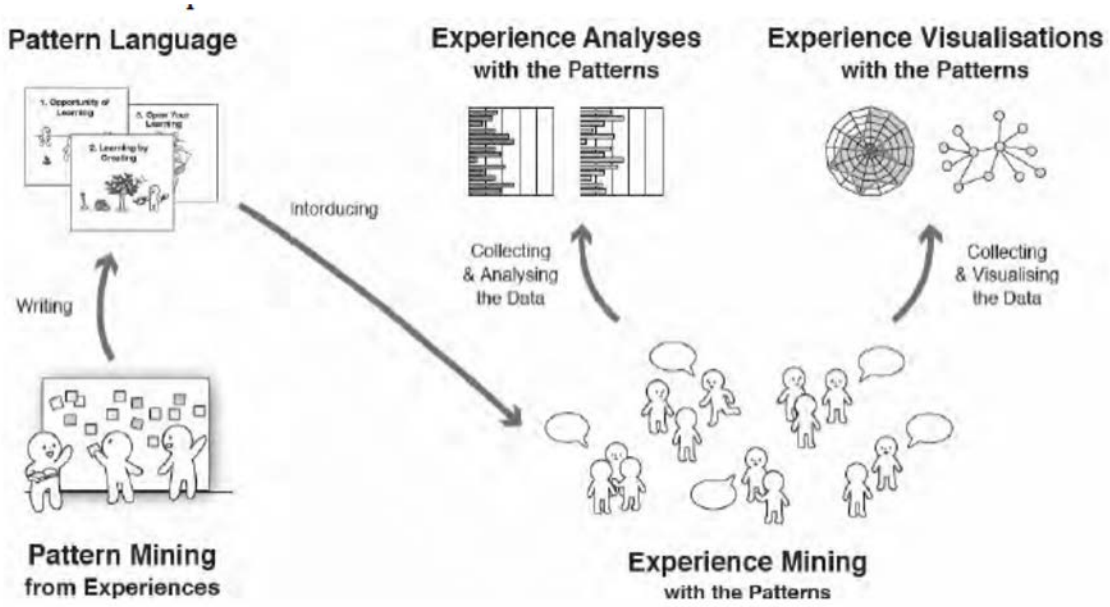
Here at Plop 2016, using cards with symbolic representation.



Cycles of learning

Acquiring new skills for observing & ‘sensing’, for sense-making & [adaptive] modeling

Here: The overview of experience mining, experience analysis and experience visualization with patterns (Iba 2014)



Real Time Learning

Learning to observe our individual and collective thinking as it is happening.
Using hermeneutical inquiry (Kinsella 2006) and joint discovery methods to learn together (Johari Window, Luft & Ingham 1955).

Here: Dialogue Workshop with Learning Patterns at Keio University (Iba 2016)

Cards

A Pattern Language for bringing life to meetings and gatherings

http://groupworksdeck.org/

Visualizing Structure & Movement
Individual & Collective

Games and Action

Constructing and deconstructing with our heads and hands. The 'hacker's approach

Here: Hands-on construction - Lego Serious Play © - Source Avea Partners.

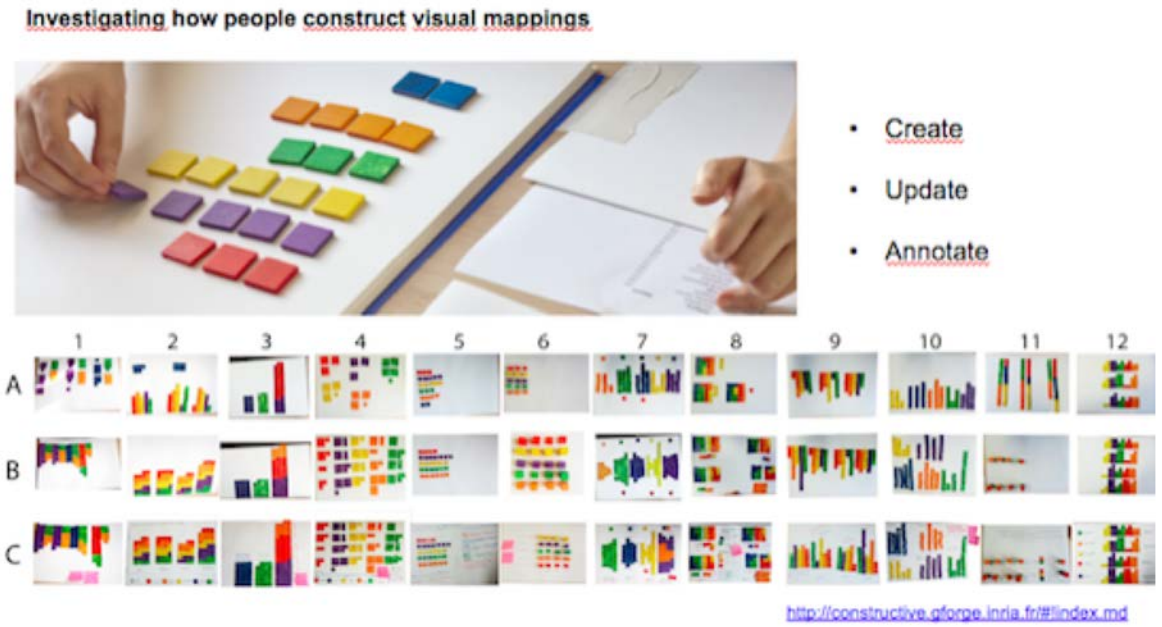
Lego 3D models used a shared language for group discussion, knowledge sharing, problem solving and decision making

- Based on creative imaginations & metaphor
- Learning to 'think with one's hands'

Building Visual Systems

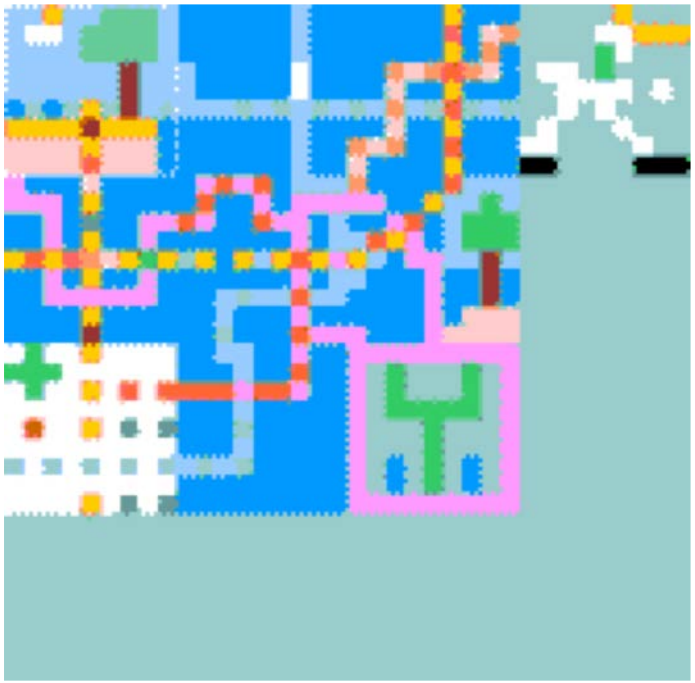
Investigating how people create visual representations.

Here: Visual Construction Tools: Tangible Tokens - S. Huron Inria



Emerging Patterns

Seeing the changes, where they are coming from, where they are going, adapting in real time.



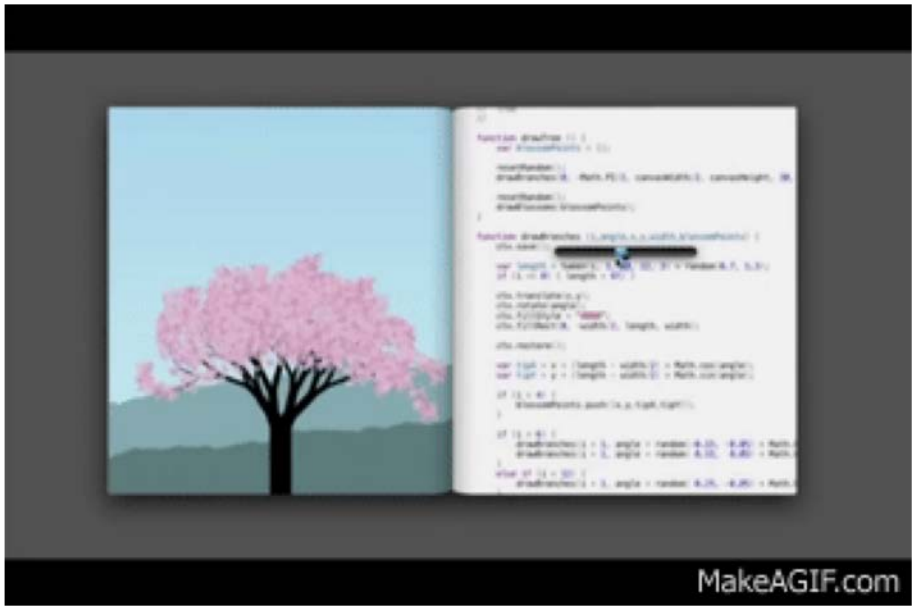
Each player draws on a small part of a global mosaic that each can see evolve as they draw

By OlivierAuber - Own work, FAL, http://commons.wikimedia.org/w/index.php?curid=19849563

Living presence

Learning to see the picture as it emerges

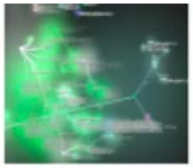
Here: an illustration of adaptive modeling: Real-time coding feedback. B. Victor



The image moves as the code variables are changed

https://www.youtube.com/watch?v=I8F7tzc1Tco

Applying Energy



The movement (pattern) is different for each verb (Finidori 2012)

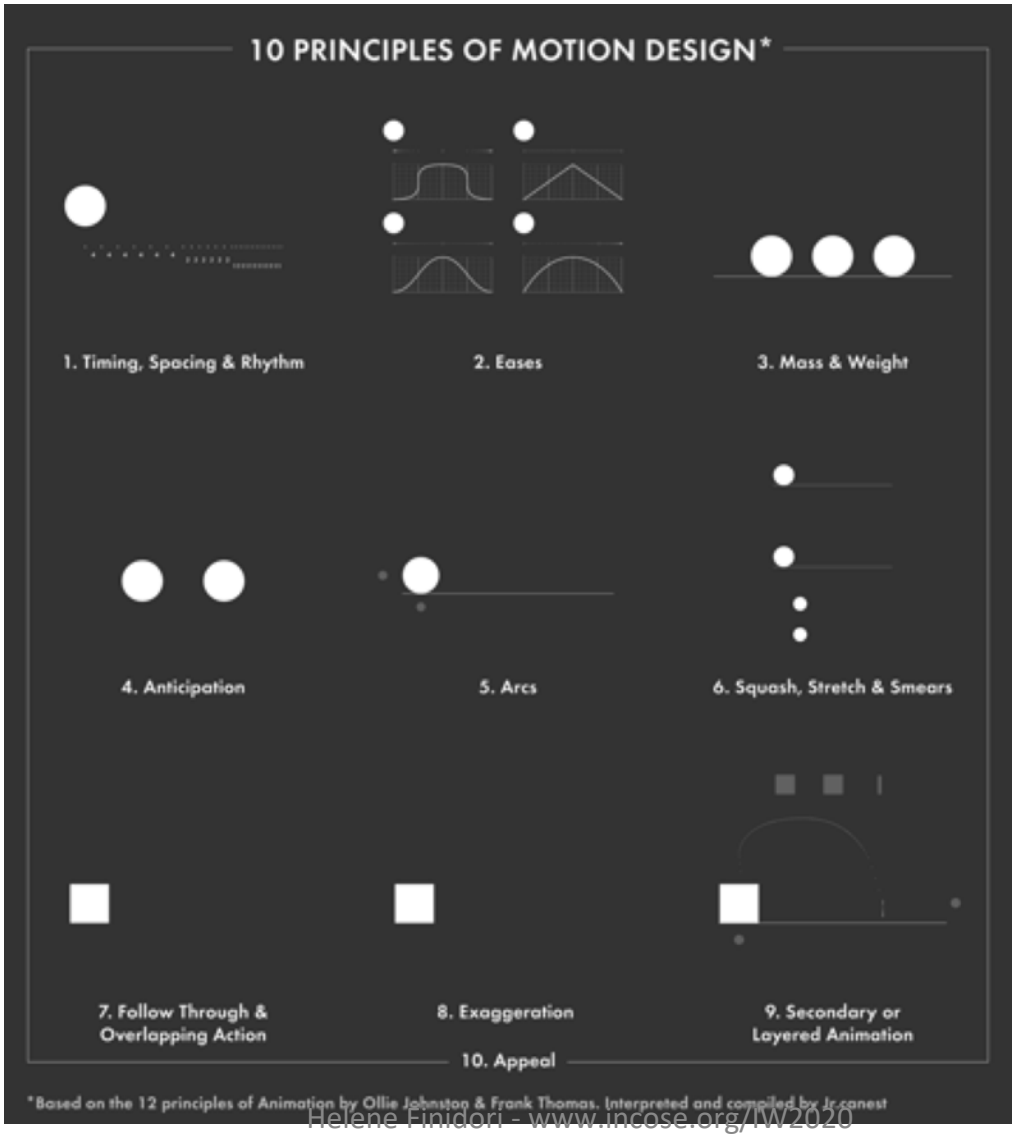
Initiate & fuel
viral transmission, meme propagation, osmosis
chain reaction, snowballing, virtuous circle

Radiate
collide, swarm, hive, burst, explode, buzz, humm

Leverage
pressure, push, channel, funnel, occupy, spur

Engage
be the change you want to see...
envision, embody, enact
inspire, empower, enable

Adapted from the 12 principles of Motion Design- Olie Johnson & Frank Thomas



Emerging Patterns (2)

Gource Vizualization:
seeing additions to
software code over time.

Thank you

2020
Annual INCOSE
international workshop
Torrance, CA, USA
January 25 - 28, 2020

www.incose.org/IW2020

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