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■ *Research Paper*

Augmenting the Collective Intelligence of the Ecosystem of Systems Communities: Introduction to the Design of the CI Enhancement Lab (CIEL)

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The quality of collective intelligence flowing in and across systems communities of various disciplines, and the fragmentation or connectedness of their mental models of the world, shape their capacity to assist decision-makers and social movements in defining, mapping, and addressing the world problematique, by identifying policy options and anticipating their outcomes. In their current state of fragmentation, the systems sciences' epistemic communities cannot provide that assistance. Upgrading their collective intelligence is a vital imperative. This paper is suggest the prototyping of a Collective Intelligence Enhancement Lab and describes its core idea as a platform with an innovation architecture that integrates social, electronic, cognitive, and inner technologies and processes. Copyright © 2014 John Wiley & Sons, Ltd.

Keywords collaborative design inquiry; intelligence; evolutionary guidance systems; evolutionary learning communities; innovation architecture; intentional evolution; knowledge ecosystem; learning expedition; systems communities; systems ecosystem; systems movement

In the opening speech at a systems conference in 2004, Russell Ackoff declared that the state of the world is a mess and went on to saying

> "*Reform will not do it; transformations are required, two kinds. First a transformation of the way nations and international institutions handle global affairs and second, a transformation in the way systems thinkers collectively conduct the systems movement. The second must come first if we hope to have any effect on the global mess.*" (Ackoff, 1)

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MOTIVATION: GEARING UP TO FACE TO AN EPIC DANGER AND OPPORTUNITY

If humanity has never created a problem that it could not solve, let us not break that brilliant track record. Nevertheless, the clear and present danger to do just that is growing every day. The world is facing a myriad of wicked, interwoven problems. We know that they cannot be solved by any one nation or international institution. They are driven by what the Club of Rome termed the 'global problematique', a set of global systemic issues that include governance, environmental protection,

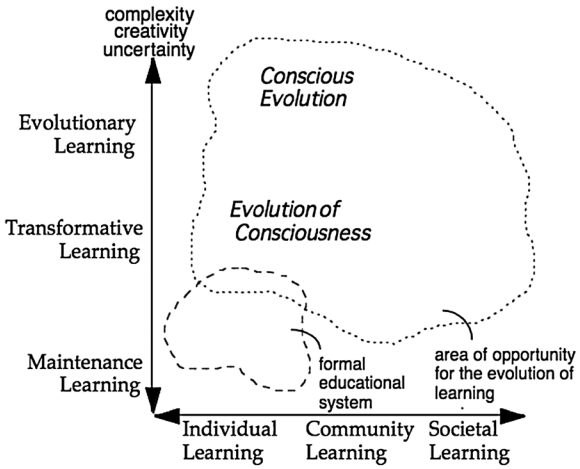

Figure 1 Evolutionary learning enables intentional, conscious evolution (image source: Laszlo, 2003)

socioeconomic development, and demographics, among others (Figure 1–6).

Combined with the rapid technological advances with incalculable consequences, those issues generate the VUCA world of volatility, uncertainty, complexity and ambiguity. The common usage of the term VUCA began in the 1990s and derives from military vocabulary (Stiehm & Townsend, 28). That VUCA is also a pivot, and the opportunity is to turn it into vision, understanding, clarity, and agility. To realize it, a transformation needs to take place 'in the way systems thinkers collectively conduct the systems movement' (Ackoff, 1).

Designed generatively, that transformation can become a key enabler of upgrading the capabilities of our social institutions to the requisite level to match the complexity of the global problematique. We admit that this is a hypothesis but a hypothesis worth testing. The motivation of building a Collective Intelligence Enhancement Lab (CIEL) is to jumpstart the process of testing it.

SYSTEMS COMMUNITIES, MOVEMENT, AND ECOSYSTEM

The engines of humankind collective intellect are the 'epistemic communities' defined as a transnational network of experts and practitioners, who share a common discipline. For example, the epistemic communities of systems sciences include

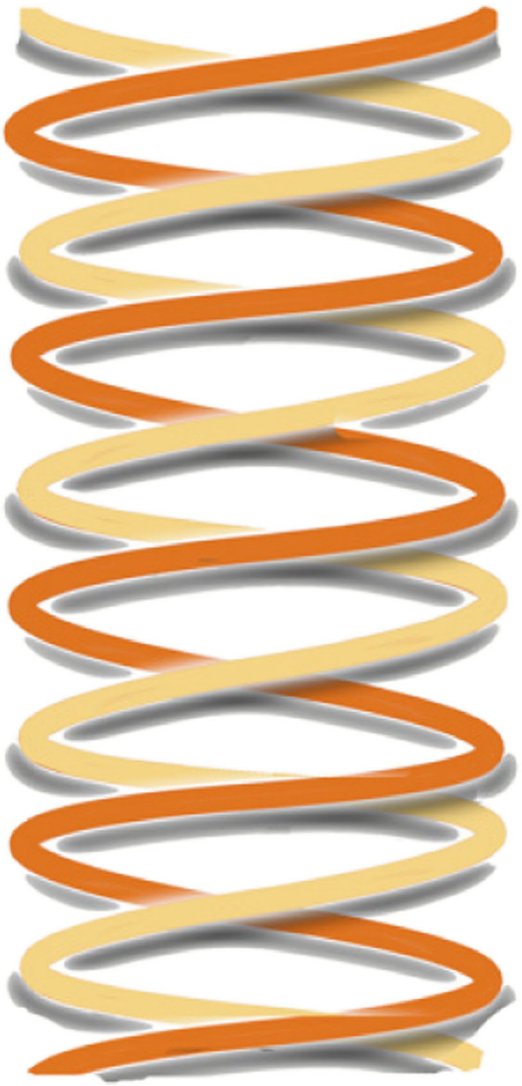

Figure 2 Double helix of co-evolving individual and collective intelligences (Pór, 23)

systems biology, systems dynamics, systems ecology, systems engineering, etc. The quality of collective intelligence (CI) flowing in and across those communities, the fragmentation or connectedness of their mental models of the world shape their capacity to assist decision-makers and social movements in defining, mapping and addressing the problematique, by identifying policy options and anticipating their outcomes. In their current state of fragmentation, the systems sciences' epistemic communities cannot

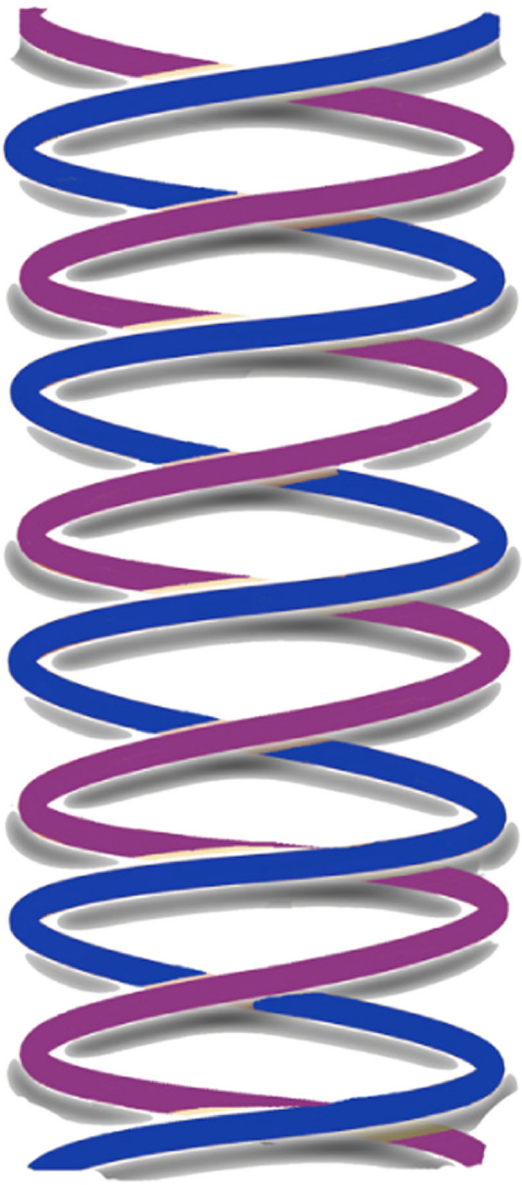

Figure 3 Double helix of human systems co-evolving with the system of available communication tool (Pór, 23)

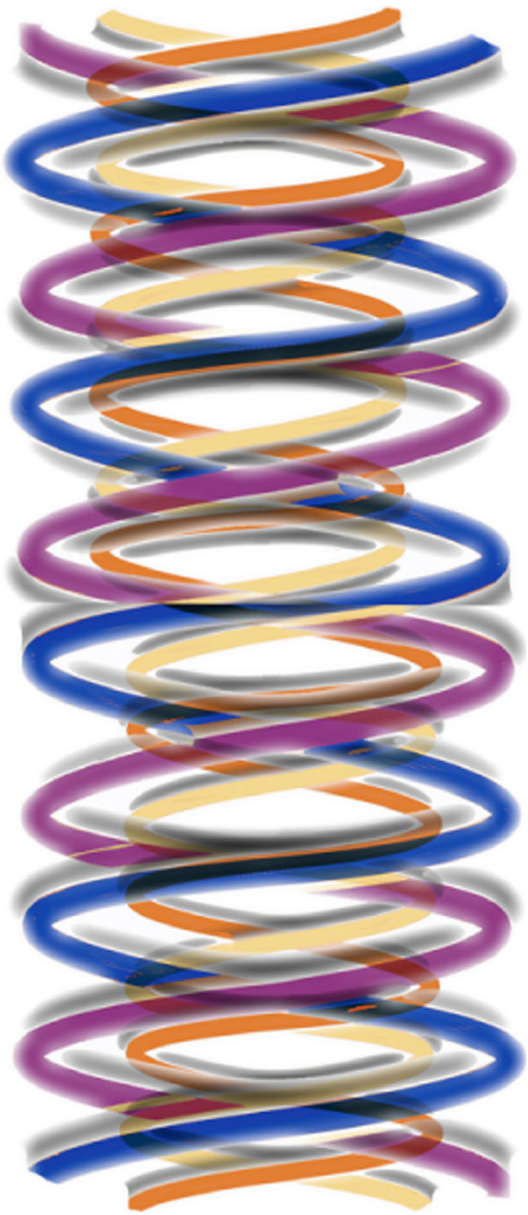

Figure 4 Co-arising quadruple helix, the engine of organizational/social evolution (Pór, 23)

provide that assistance. Upgrading their CI is a vital imperative.

Some authors, such as Ackoff, Checkland, Hammond, Laszlo, and others, talk about 'systems movement'. For example, "What are the patterns and processes currently alive in our world that intimate the possibility of co-creating a global eco-civilization? And how, and in what ways, must consciousness transform to propitiate such an evolutionary paradigm shift? These are some of the challenges posited by this paper in the hope that the Systems Movement in general, and the ISSS in particular, will take them up over the coming year and into the future." (Laszlo, 17)

The scale and scope of consciousness transformation required may necessitate to revisit the concept of 'systems *movement*' and eventually replace

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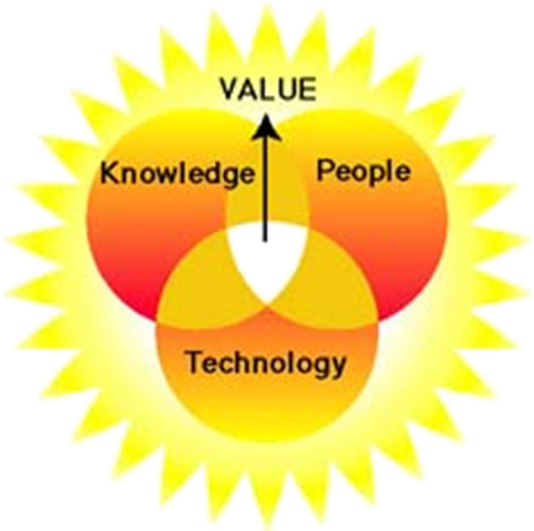

Figure 5 The triple network of the CIEL knowledge ecosystem

it with an enlivened 'systems *ecosystem*'. We all know the feeling of being more enlivened, more full of life, where we are intimately connected with another human being in a meaningful, inspiring relationship. Similarly, a social/intellectual movement is more *enlivened*, vibrant and dynamic when it is connected with other movements holding a similar vision and values and facilitating the information flow across their adjacent domains of inquiry and action. Together, they form a social/intellectual ecosystem of movements. The great variety initiatives and worldviews present at the ISSS conference makes me think that what we call a systems movement is more like an ecosystem of many movements, an ecosystem of ideas and desires, networks and commitments to change.

We embrace the concept of 'enlivenment' that adds a new quality to the scientific discourse. "Enlivenment is not an arcane historical or philosophical matter but a set of deep ordering principles for how we perceive, think and act. If we can grasp enlivenment as a vision, we can begin to train ourselves to see differently and approach political struggles and policy with a new perspective. The political consequences of adopting such an approach, which I call 'policies of enlivenment,' are far-reaching. Embracing a

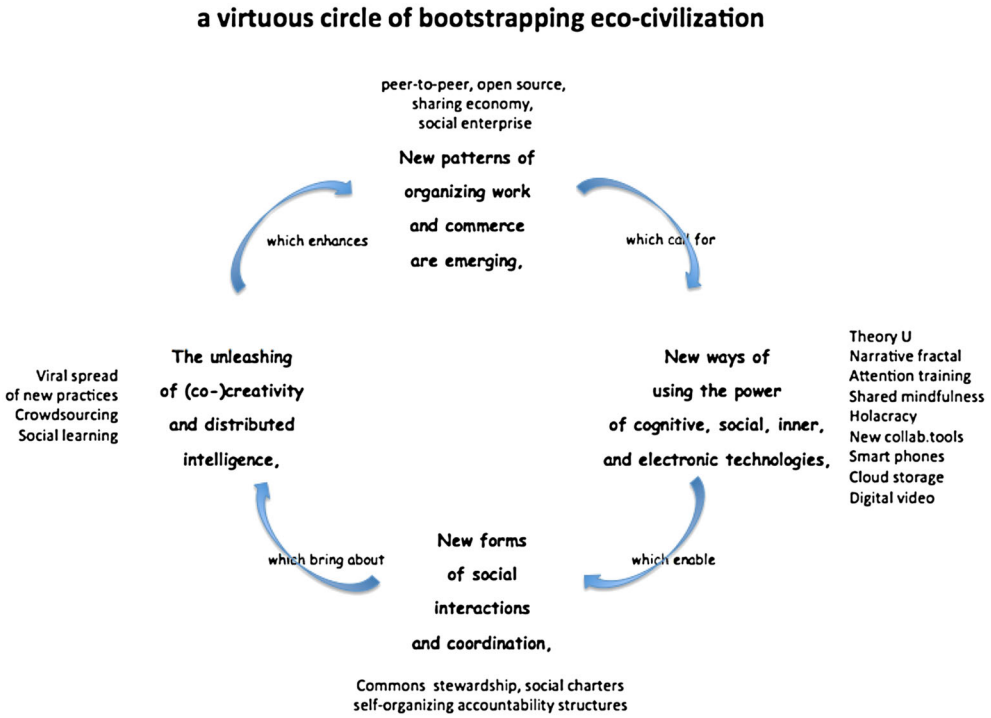

Figure 6 The virtuous circle (positive feedback loops) of bootstrapping an eco-civilization

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non-dualistic viewpoint allows for more inclusion and cooperation because there is no disjuncture between 'rational theory' and social practice; the two are intertwined." (Weber, 31)

THE PARTS AND RESPONSE ABILITY OF THE SYSTEMS ECOSYSTEM

The systems ecosystem includes the various systems science organizations and their conferences, the systems-oriented virtual communities, distribution lists, journals, academic programs, learning laboratories, books, and more than half million webpages referencing 'systems science'. Even this incomplete list reflects that this is a socio-technical-knowledge ecosystem, a complex whole with co-evolving parts.

What are the qualities that the systems ecosystem needs to possess if it is to become one of the enablers of evolutionary transformation in the larger ecosystem, the planetary patchwork of civilizations itself? Not assuming that the systems ecosystem already knows what those qualities are, we stipulate that the first of them is the capability of evolutionary learning. It is defined here as learning what it takes to augment its CI, a condition of being capable to contribute to the CI augmentation at the scale of the humanity itself.

Thus, the first response ability of the systems ecosystem lies in the bootstrapping its own collective intelligence. 'In its simplest terms, *bootstrapping* means *use what you build to boost your own effectiveness*—it's is expectation that anyone working on an important aspect of boosting our collective IQ capability will seriously push the envelope through their own experimental usage of their work products (Engelbart Institute, 11). Hence, the systems ecosystem's best starting point for contributing to the transition to a sustainable and thriving world is in prototyping evolutionary learning communities, capable to bootstrap their own CI.

For any systems community to collaboratively learn from the future, which is already present as potential in today's evolutionary trends, it must develop the capacity for collective self-reflection and meaning-making, which are pre-requisites for collective intelligence. That calls for the design of an 'evolutionary guidance system' (Banathy, 3).

INTENTIONAL EVOLUTION AND EVOLUTIONARY GUIDANCE SYSTEMS

> "Most systems of learning focus on teaching students how to make a sword, and maybe showing them how to use it. A school whose intention is Transformative Learning teaches students to be the kind of person *who can be trusted* to wield a sword" (Omer, citation to be inserted).

Transformative learning is a developmental process, in which individuals (or collective entities) gain a broader view of reality and grow capacity to sense, think, and act from a higher coherence with it. There is a specific form of transformative learning, which could be termed as 'evolutionary learning'.

> "Evolutionary learning empowers us to anticipate and face unexpected situations. It will help us to progress from unconscious adaptation to our environment to conscious innovation and coevolution with the environment and the development of the ability to direct and manage change" (Banathy, 4).
> Complex adaptive social systems (including the systems ecosystem) that aspire to accelerate their evolution need to create an evolutionary guidance system for facilitating the shift. "Evolutionary guidance systems are structured arrangements and operations, built into the human activity systems at all levels of society, that manifest evolutionary consciousness and enable the purposeful and guided evolution of human systems toward the realization of better futures for all." (Banathy, 2)

How to grow collective organs of sensing, thinking and coordinating to realize the potential of such guidance systems? Engaging that inquiry is particularly urgent in times of such rapid mode transitions as systemic bifurcation (Laszlo, 16) or punctuated equilibrium (Eldredge & Gould, 9), also popularized as 'jump time' (Houston, 13).

What is already clear is that in such times of acceleration, the guidance system needs to be built

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on an 'innovation architecture' (Pór, 25) that is capable to absorb the complexity of co-evolving with the co-arising strands of a quadruple helix. Refer to next section for explanation.

COLLECTIVE INTELLIGENCE, ITS CONTEXTS, AND THE QUADRUPLE HELIX

The exponentially growing number of research papers on CI indicates that it is an increasingly hot research topic. It is not a surprise if we consider the conditions of the VUCA world explained in Section 1.

CI is an emergent property that expresses the capacity of groups, organizations, and social systems to evolve toward higher order complexity and harmony. It is an emergent property resulting from the operations of such evolutionary mechanisms as variation-feedback-selection and differentiation-integration-transformation of insights, knowledge and inspiration. (Pór, 26)

In an operational context, CI frequently refers to "a software supported collaborative design process that allows a group of individuals with a vested interest in understanding complex issues to reach a consensus about system interdependencies among sets of ideas such as problems, barriers, obstacles, goals and strategic objectives. CI enhances the collaborative power and action potential of groups who seek to work together toward the resolution of problems and the realization of possibilities." (Hogan & Broome, 2013) That description of CI is derived from the "interactive management" philosophy of John Warfield. (Warfield & Cardenas, 1993)

Looking at CI in its organizational dimension (between the evolutionary and operational context), it can be defined as "as the capacity of a collective to: sense its needs and those of its environment (stakeholders); generate choices that will satisfy those collective needs; anticipate the consequences of those choices; make choices that best serve the well-being of those affected by those choices; and learn from the consequences of those choices" (Veltrop, 30)

A CI-boosting system, as part of the evolutionary guidance system, must be functional in all three scales or contexts: the evolutionary, the organizational, and the operational. It should be designed for seamlessly bridging them, thus allowing a full-spectrum user experience.

As any multi-disciplinary distinction, CI has a large number of definitions. For some, it is the 'wisdom of crowds' (Surowiecki, 29); for others, it is that intersubjective field that manifests when people interact from a beyond ego space, just to refer to two of the popular branches of CI. Nevertheless, other contexts that can bring valuable contributions to the design of augmenting CI is the cognitive, techno/computational and economic. For more, refer to Collective Intelligence and Collective Leadership (Pór, 26).[1]

CI is also described as relational intelligence, "integral, non-siloed systemic intelligence that conveys the capacity to engage a higher consciousness that synergizes the various forms of intelligence, exemplified by recent studies in consciousness and related fields, into one holistic engagement with experience." (Laszlo, 17) Emphasizing the relational aspect of CI, we can enhance the meaning of the term referred by its defining, technology-focused question: "How can people and computers be connected so that, collectively, they act more intelligently than any individuals, groups, or computers have ever done before?" (Malone, 21)

Each of those disciplines, in which CI is interpreted, can be thought of as a particular lens, through which different meanings can be accessed and enhance each other. In one interpretation of intelligence, it can be measured by the number of perspectives that one can simultaneously embrace and act from. If so, the CI-boosting socio-technical system should facilitate the access to all of the perspective sketched out here, and doing that facilitate the co-evolution of individual and collective intelligence.

As organizations and other human groups become smarter about making their pool of shared knowledge and CI more accessible to all members, the more capable and intelligent those individuals can become. As individuals become

[1] Pór, G. (2008) Collective Intelligence and Collective Leadership: Twin Paths to Beyond Chaos. PrimaVera Working Paper Series, University of Amsterdam http://academia.edu/982516/Collective_Intelligence_and_Collective_Leadership_twin_paths_beyond_chaos Retrieved on 1 September, 2014.

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smarter about learning to learn and sharing their knowledge, the more capable they will be to enhance our distributed, CI.

> "To the extent that we design our social institutions and practices well, we have better connection to that whole intelligence. To the extent that we are fortunate to participate in these 'better designed' social systems, we are more intelligent. And the whole is in a positive feedback cycle, where socially and individually we can get more intelligent - and maybe the whole will also get more intelligent if we go beyond threshold points." (McMaster, 22)

The speed of this positive feedback cycle spiralling up depends, among other things, on the sophistication of the tools available for symbol manipulation, in terms of the volume and complexity of meaning that they can convey in a given amount of time.

Human systems include our organizations, symbols and language, our various ways of knowing, etc. The system of available communication tools includes hardware, software and protocols for linking and using them.

The needs of human systems for better communication, collaboration, and coordination of action push the evolution of the symbol manipulation tools. The capabilities offered by new and better symbol manipulation tools pull the evolution of the human system. The two spirals drive on one another's spine.

> "If it is easier to update any part of your working record to accommodate new developments in thought or in circumstance, you will find it easier to incorporate more complex procedures in your way of doing things." (Engelbart, 10)

Nobody has moved the edge of deep knowledge about the co-evolution of human and tool systems more dramatically than the late Douglas Engelbart, the principal source of inspiration behind the suggested CIEL.

> "How we work together now emerged through centuries of gradual Human-Tool Co-evolution, changes in one side having a reverberating effect on the other. The Human System is generally much slower to adapt than the Tool System, and accounts for a much greater percentage of the challenge of pushing the capability envelope. Today we are witnessing the Tool System evolving at unprecedented speeds, while the Human System is evolving faster than ever but still lagging way behind what's possible in the Tool side." (Engelbart Institute, 12)

CI, as a socio-technical system thrives on the dynamic interaction between its two components, the social and the technical. The development of the CI of an organization or in fact humankind itself hinges upon how the human/tool systems' co-evolution may interact with the co-evolution of our individual and collective intelligence.

The two co-arising double helices represent the co-evolution of human and symbol manipulation systems on one hand and the co-evolution of individual and collective intelligence on the other hand. The engine of organizational evolution is fuelled by the dynamic interaction between these intertwining double helixes.

Organizations can put a break on or add fuel to that engine. Entrepreneurial organizations tend to free the flow of those interactions; bureaucratic organizations tend to refrain them.

The quadruple helix as the engine of organizational and societal evolution provides a framework for the development of both analytical/descriptive and design-optimizing/prescriptive indicators. Further research into and a resulting intimate understanding of the nature of dynamic interactions between the four spirals will allow organizations and social ecosystems to identify the key drivers and hindrances of that dynamism as well as what intervention can trigger the highest leverage movement forward across all spirals.

THE CORE IDEA AND FUNCTIONS OF THE SUGGESTED CI ENHANCEMENT LAB (CIEL)

A core idea any collective undertaking is at the source of why a group of individuals came together to do something. That can also be a strong call from their core of being to be useful, to serve, to create, and to evolve.

The core idea of the CIEL initiative is to prototype an 'emergent platform' that integrates social, electronic, cognitive, and inner technologies and processes for augmenting the CI of

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evolutionary learning communities, and the systems ecosystem, as whole.

When the prototype is implemented and put to use, it will have a built-in bootstrapping effect on the dynamic interaction between the four spirals of the quadruple helix. It may also alter the way in which system communities organize themselves, by enabling the collaborative and intentional stewarding of their membership's CI.

The specific functions that CIEL prototype is designed to serve are 3-fold:

- To create a testable alpha version that implements the basic elements of the CIEL concept. It should also serve as the kernel of the online R&D environment for hosting the team that works on its public beta version.
- To support the experience-based refining of a conceptual architecture for the web-enabled, evolutionary guidance systems of epistemic communities. Thus, CIEL should contribute to the development of such a guidance system, enabling the next stage in the evolution of co-intelligent human networks and organizations. That system will be indispensable to curating the conditions for a thrivable planet (the central theme of ISSS57).
- To lay foundations for convening an interdisciplinary community of CI practice, comprised of researchers, practitioners, software developers, students, technology architects, social innovation leaders, artists, etc., which could also serve as a "vehicle for enabling dialogue and collaboration among diverse and geographically dispersed individuals and institutions with a shared identity around innovating learning systems for sustainability" (IFSR, 14).

THE CONCEPT OF CIEL AS A KNOWLEDGE ECOSYSTEM

CIEL could also be thought of as a knowledge ecosystem comprised of three layers. It is a complex, self-organizing system of people interacting with each other, their knowledge, and technical environments for growing CI and capabilities.

Knowledge ecosystems are comprised of an integrated triple network of

> a PEOPLE network of conversations that is producing
> a KNOWLEDGE network of ideas, information, and inspiration,
> supported by a TECHNOLOGY network of wikis, forums, videos, blogs, and other infrastructure elements, which generate VALUE to their members, stakeholders, and the evolution of social systems.

In large organizations, a knowledge ecosystem is maintained by teams of information architects, learning facilitators, web developers, and cybrarians, who support the tools and practices for developing, capturing, organizing, portraying, sharing, and using knowledge. When building an evolutionary guidance system and its socio-technical infrastructure for self-organizing epistemic communities, we need to recruit talents serving similar functions.

Only then can we reach the requisite capacity to absorb the level of complexity that such guidance systems have to master. Only then can we bring the full power of bootstrapping to adding momentum to the co-arising spirals of the quadruple helix.

That bootstrapping idea referenced here is visualized in the diagram below, the original version of which appeared first in the paper on "Nurturing Systemic Wisdom through Knowledge Ecology" (Pór, 24).

> "A positive feedback is a process in which the effects of a small disturbance on a system include an increase in the magnitude of the perturbation, That is, *A produces more of B which in turn produces more of A*." (Wikipedia)

In the cyclical feedback loop pictured above, any improvement in the patterns of organizing work and commerce calls for new ways of using of our various technologies. The key words describing the nature of the forward-moving dynamics between the cycles above are shown on the arrows between the four nodes.

BIOMIMICRY-INSPIRED DESIGN OF THE CIEL KNOWLEDGE ECOSYSTEM

> "Biomimicry follows Life's Principles. Life's Principles instruct us to: build from the bottom

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up, self-assemble, optimize rather than maximize, use free energy, cross-pollinate, embrace diversity, adapt and evolve, use life-friendly materials and processes, engage in symbiotic relationships, and enhance the bio-sphere. By following the principles life uses, you can create products and processes that are well adapted to life on earth." (Biomimicry Guild, 7)

Until recently, biomimicry has been used primarily in industrial design and the development of new materials. Its application areas are now expanding from product to process design, which opens the possibility to use it in the design of social, knowledge, and technological ecosystems. That raises the following question: What can we learn from nature's ecosystems, which would allow for the rapid upgrade of the cognitive and technical ecosystems of organizations and communities, who face unprecedented challenges? What biomimetic principles, metaphors and models would most likely to prove useful in designing CIEL as a tool for that upgrade?

One direction of using biomimicry in the design of CIEL is provided by systems biology. "Systems biologists expect progress in the field to yield explanations of biological systems exploitable for applications in ecology, ethology, medicine, agriculture, business, the environment and technology—and to a considerable extent it has already done so." (Bruggeman & Westerhoff, 8)

Our search for integrating biomimicry methods in the design framework of CIEL gave rise to the following research questions:

- What essential patterns of differentiation and integration of thoughts, mental models and whole disciplines are common with the corresponding evolutionary mechanism in nature?
- What can be the implications of the 'neurons that fire together, wire together' process of memory formation for the design of system features and functions that support communal memory formation in the knowledge gardens of CIEL?
- What are the implications of the natural ecosystems' "edge effect, the changes in population or community structures that occur at the boundary of two habitats," (Levin, 20) for the principles, strategies, and functional requirements for having CIEL accommodate a collection of knowledge ecosystems stewarded by a constellation of diverse epistemic communities?

DESIGNING CIEL IN A COLLABORATIVE DESIGN INQUIRY: THE LEARNING EXPEDITION

The design of a design inquiry in systems science corresponds to what is known in software engineering as 'meta-modelling' or 'method engineering'. This is the domain on which we clarify the epistemological foundations of the research and specify the knowable requirements of its process. When this phase is overlooked or omitted, the design inquiry risks to be ineffective or inefficient, or both.

The design of CIEL calls for interdisciplinary collaboration and the self-organization of an evolutionary learning community. "The community of designers seeks; high ethical qualities, sensitiveness toward the impact of design on future generations and on those who are affected by the design, taking responsibility for the design they create, and diversity in membership. Members of the Community accept and respect each other, they aspire to become a learning system and aim to develop their own design culture. They regard having a shared worldview a quality of the highest order." (Banathy, 4)

It will take an evolutionary learning community using first, second and third person (personal, interpersonal and scientific) lenses to do justice to the complex task of designing CIEL. The overall process will be built on Banathy's Social System Design, the starting point of which is generative dialogues, the source of authentic communities, which will precede our more technically focused conversations.

We call our method of the design inquiry a 'learning expedition' and have implemented it in various organizational, and interorganizational settings in business, education, and government. We use that term both as metaphor and a model for a specific genre of inquiry.

The main *metaphoric function* of the learning expedition term is to "render comprehensible a complex set of elements and relationships…

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It is the peculiar strength of metaphor that it can convey the essential without excessive oversimplification, preserving its complexity by perceiving it through a familiar pattern of equivalent complexity." (Judge, 15) While an expedition typically unfolds in physical space, the learning expedition unfolds in conceptual and space.

The learning expedition *as a model* refers to an activity system of collaborative inquiry that includes such subsystems as seeking shared meaning and purpose, designing and improving the expedition community's communication and knowledge-creating systems and practices, and pursuing three types of outcomes:

- learning outcome—the development of new or enhanced individual and collective competences;
- research outcome—contributions to the evolution of knowledge and better maps of a particular knowledge landscape
- design outcome—a knowledge product, for example, the CIEL prototype.

The learning expedition model is supported by a complementary set of metaphors and processes, which includes 'scouting parties' (self-organizing, special-focus discovery teams) and 'base camps' (periodic, face-to-face gatherings of the scouting parties). In the context of the suggested research, the base camps will be our periodic, in-person meetings to complement our online exchanges.

Depending on the funding constraints, the design inquiry start-up process will include the following steps.

- Form a 'CIEL' learning community of researchers attracted by the approach presented in this paper and align individual talents and aspirations with the common intent. That group would work in close collaboration with similar initiatives is the systems ecosystem.
- Establish relationships with organizers of selected global events, with an eye getting CIEL's prospective stakeholders involved early with the design process.
- Jointly outline the 'innovation architecture' (Pór, 25) of CIEL.
- Develop and agree on a broad-brush methodology for carrying out the design inquiry.
- Take deep-dive journeys of practices worth replicating in the design and use of collaborative knowledge systems.
- Draft high-level design requirements for the CIEL platform's affordances
- Engage agile implementation in iterative cycles responsive to user feedback.
- Celebrate the launch of the systems community's CIEL.

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