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Evaluating the Impact of Preconditions for Systemic Human and Non-human Communities

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Abstract[1]

This paper discusses and examines the concept of preconditions and their possible impact on any systemic supporting structures related to human and non-human ecological communities. Preconditions are defined and discussed in this work as phenomena that exist, seen or unseen, as part of the initial stages of a developing community system (for both human and non-human). Recent evaluations of cases and models have highlighted how preconditions may enhance or weaken developing support structures of any ecological community system. These observations and outcomes were based on several previous cases, with targeted literature reviews and field work. The research spans across several different disciplines, with a common emergent thread, based on insights afforded by an interdisciplinary approach. The impact of preconditions within systems of sustainable ecological community structures, are essentially virtual with emergent physical properties and outcomes.

The practical and ecological community implications of this work lie in the provision of better insights into the how, why, and what are the existing, dynamic conditions towards sustained, future community development. The impact on dynamic community evolution involves countless dynamic relationships. This work presents reviews, based on evaluations on a range of approaches to capture a sense of what occurs within these complex environments and the abilities we need to visualize and communicate these actions. These virtual, and ultimately physical, transitional states are very relevant when considering the impact of what are essentially, bottom-up relationships. This work highlights the importance and impact of preconditions within an ecological community, and the dynamics involved with achieving a sustained state or "equilibrium", whilst attempting to absorb new conditions that the community may be encountering.

Keywords: *interdisciplinary fields; ecological sustainable communities; systemic biological structures; social dynamic phenomena; hybrid methodological approaches*

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1. Introduction

It can be said that relationships (biological and human) support preconditions that in turn, support the possibility for sustainable ecological communities, which are complex, to say the least (Nousala & Hall, 2008) (Nousala & Marlowe, 2020). For the purposes of this paper, except where explicitly specified, "precondition" will be used to mean a pre-existing condition that permits, facilitates, or enhances the likelihood of some following action, state, or condition. Therefore, this meaning can be understood in a broader sense, in contrast to the relatively narrow meaning derived from the formal sciences, where a condition must hold for a specified action or state to occur.

There are many aspects to consider, but one aspect is key. Ecological communities are dynamic (and dynamical) systems that begin both virtually and physically, and are influenced by how preconditions interact and initiate (this concept relates to systemic aspects of the building of an ecological community). These preconditions evolve and impact future individual and group relationship interactions. This paper focuses on the elements and characteristics of such preconditions (within systemic conditions of ecological communities), and discuss examples that impact them and introduce newer concepts that have emerged from previous evaluated work. Preconditions and their impact are embedded within the complexity of a system. In turn, the system's dynamics can be informed by both positive and negative constraints, which in effect, shape by informing the very nature of complex systems structures. It is essentially multiple layers of feedback loops.

On an individual level, humans or other individual actors within a system (or community) do not retain the capability for clear constant systemic predictability. Larger groupings of organisational structures with human or other biological configurations may also develop relationships that are unpredictable, even statistically, including outcomes and behaviours. These outcomes will exhibit non-linear relationships (when viewed individually, hierarchically, and recursively). The behaviours of complex systems cannot easily be reduced to any precise descriptions, including particular behaviours of any components at a lower level of the system. However, it is also these same complex behaviours that exhibit emergent actions based on the properties exposed during examination of preconditions, that help us to simplify (for communication) our understanding of the complex system as a whole (towards a holistic overview) (Holling, 1973), (Hutchins, 1994), (Hutchison, 2014), (Nousala & Hall, 2008).

When looking at the emergent aspects of complex systems from a "biological" point of view, it is important to evaluate the behaviours of organisations as well as their individual members. These emergent aspects are relevant with regard to governance, policy, and practical application. The difficult business of translating theory into field "practice" or policy implementation requires the integration of multi-focal awareness. In particular, more importance needs to be placed on why the knowledge flow exists in the first place. Looking deeper into the process of the development of such informal networks across boundaries can highlight the structures and scales of knowledge flows and their influence as geographical emergent phenomena.

In general, with regard to the virtual or the physical layers of communities, their individual processes can be difficult to isolate and define. In particular, there can be difficulties defining the dynamic movements and oscillation of multiple relationships involved, including their interplay (Hall & Nousala, 2010b). Nousala and Marlowe (2020) highlight the range of dynamics between different fields and states within communities, constantly creating on-going processes that may or may not be highlighted and/or identified as "… interactive sets of evolving actions" (Nousala & Marlowe, 2020, p.176).

These processes are of particular interest as they may provide hints and insights into the nexus of "... interdisciplinary breakaways …" (Nousala & Marlowe, 2020, p.176). These breakaway, emergent phenomena have the possibility to evolve and go on to create (within the virtual) various sets of distinct, ecological community structures (Nousala & Marlowe, 2020). These new sets of "... community adaptations …", (Nousala & Marlowe, 2020, p.176) have the ability to develop into stable structures in their own right, ready to seek the relevant resources and forge new pathways and directions. This includes the eventual giving of birth to new emergent phenomena of their own, alone or in combination with other communities.

To investigate such dynamic phenomena is a difficult task, since much of this type of behaviour is hidden, or to an outside entity, indecipherable (Hall et al., 2012), (Hall et al., 2007), (Nousala, 2014). It is, however, still possible to unearth the processes for future development of an ecological community. There are discussions and previous interdisciplinary field work that have applied rigor via longitudinal investigations involving community, ecological processes, and biological structures (Curtin & Allen, 2019), (Ing, 2016), (Marlowe, 2011), (Nousala et al., 2005).

It is conceivable that the Interdisciplinary approach and known (and also yet untested) interactive methodologies can support the equilibrium for the community to achieve an ability to balance a communities' processes

(Nousala & Davidova, 2021). However, much depends on the multiple layers of contributions both internally and externally. Much of the groundwork for these processes lay with the longitudinal precondition impacts, which play an important part of the community system dynamics, regardless of the perspective or approach (Holling, 1973).

2. Background for Context and Framing in Examining the Precondition of a Community

Looking at different perspectives through the lens of an interdisciplinary approach, it is important to take time to examine the role of context, framing and what relevance these elements have on the virtual and physical behaviours of the complex, ecological community. The typical questions regarding what is within or out of scope for any investigation is important, but with the investigations of biological multilayered structures, context, scoping and framing matters (Nousala et al., 2020), (Nousala & Hall, 2008).

The difficulties of investigating any moving target within virtual spheres maybe seem obvious. However, there have been some very important discussions regarding what is relevant, achievable, or adequate (Nousala et al., 2020), (Nousala & Hall, 2008). The concept of "bounded rationality" and the limits to human problem solving were coined by Herbert Simon (1982), by the term "satisficing", for example, captured by the mathematical term "satisficing", in contrast to "optimising" a solution that satisfies the constraints, and meets a threshold objective value". Simon (1982), (1962) argues that humans have limitations, and that humans aren't always rational. It is conceivable that the rational agents within a given process, within a system (a community for example), can experience limits in formulating and solving complex problems and in processing and handling of information.

When approaching complex systems and viewing the processes involved, it is important to clarify (by identifying the range or scope as discussed by Herbert Simon, the boundaries of rationality), the linked collaborative relationships, as far as that is possible. This approach could provide an understanding to the elements involved, the limits that will most likely be reached and/or experienced. These limits may also include the ecological communities' ability to define their experiences both human and non-human. However, this doesn't mean that these constraints are either good or bad, positive or negative; these constraints are just that, states that exist for the biological entities, both internally or externally, with many levels at play (Nousala & Hall, 2008), (Nousala, 2017), (Sucic et al., 2019). As Herbert Simon, paraphrasing Chester Barnard (1938), said, the decisions that an

individual makes as a member of an organisation are often quite distinct from his personal decisions (Nousala, 2017, p.118).

2.1 Unintended Consequences

In the context of aiming for systemic equilibrium (necessary for sustaining critical community processes), it is important and relevant to expand discussions and investigations beyond the internal actors and community systems themselves. The ecological communities and their networks have emergent elements and processes that may indeed have "unintended social consequences". However, these may or may not be positive or negative since the virtual emergent outcomes are essentially non-human in nature and are consequences of constraints (both positive and negative). The wider context within human systemic communities is that the co-evolution of individuals and group actors need to collaborate for cohesive social outcomes, this is not necessarily something that materialises in practice.

In contrast (but not mutually exclusive), ecological communities set off and operate on differing levels of social interactions to achieve higher scaled impact more aligned to dealing with the wider effects of initial local actions. Human communities continue to suffer from largely inadequate realisation of collaborative efforts and interactions among biological actors, ecological community balance, and the longitudinal effects of technology (OECD Directorate for Science, Technology and Innovation, 2013). As Nousala (2017, p. 119) states, "Whilst systems seem to be local when we design them, they have wider effects".

3. Background to the Longitudinal Approach for Creating Sustainable Support Structures

The processes involved with striving for ecological community equilibrium is something that takes time. The investigation into the development and growth of this community support structure topic is ultimately influenced by longitudinal approaches. Vaidhyanathan (2018) suggests that, viewed from a societal focal point, access to the multiple layers of ubiquitous, virtual, digital service ecosystem (over time) has only increased cognitive social isolation. This has been backed by the financial markets' linear range of applications with ICT for ever increasing amounts of ownership and control, which has left little room for sustained diversity. Diversity is relevant for balance regardless of the nature of the ecological community, and takes time to develop. Depending on what level of the system is in focus at the time

(from the individual to the group), it requires the realisation/reification of ever evolving skill sets. These skill sets are also developed over time and are not available to all. Without a longitudinal approach, it is relatively easy to throw off balance any hidden (tacit) processes of community connectivity.

This brings us to the investigations into longitudinal and cyclical, spiral thinking. Huesing and Selhofer (2002) have argued that the concept of the "digital divide" had immediate ties to the idea of an unbalanced "spiral" (or cyclical), which in turn, impacted the access but also the usability of information. Huesing and Selhofer (2002), have argued that the ICT sector and its associated applications and technical infrastructures have and continue to evolve at a pace, without the development of the relevant skill sets to match. This however, this argument was put forward two decades ago, with the gaps between technological impacts and the community developmental equilibrium (sustainability). Since then the barriers or the boundaries that have evolved have not only impacted the development of many ecological communities, but have also skewed critical hidden relational processes. This has meant that many emergent processes that go on to form new "preconditional" groundwork for new communities that are initially relatively balanced, but then are later excluded from critical resources (over time) and essentially become unbalanced.

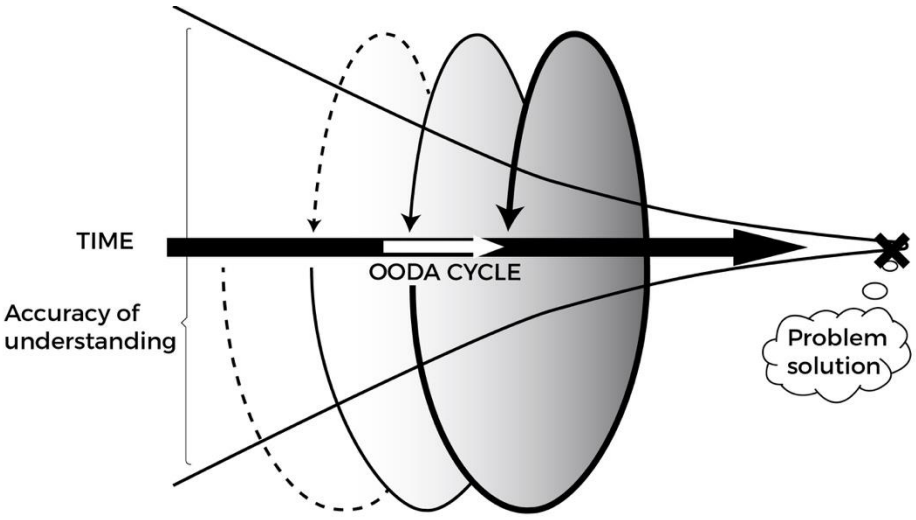

Figure 1. Hall and Nousala (2010b) Longitudinal "balanced spiral" (Hall et al., 2012), (Hall et al., 2007) where arguably there is an opportunity, over time, to revisit through the layering of OODA (Orient, Observe, Decide, Act) actions to arrive at possible, better integrated outcomes.

4. An Interdisciplinary Approach Review of Different Case Studies and Their Perspectives

The question of the impact of the relationships between the technical and the social within the context of the biological ecosystems (Nousala, 2017), (Nousala, 2014), is one which is still playing out and with mixed outcomes (Nousala et al., 2020), (Nousala et al., 2005), (Nousala et al., 2008), (Nousala et al., 2014). A lack of understanding between the technical and social, whether intentional or not, informs our relationships between the behaviours of all actors. In the context of investigating systemic preconditions, the consequence of bypassing these pre-existing conditions or attempting to overlay new conditions (out of ignorance or intentionally), will have long-term ranging effects for the ecosystem in question. An interdisciplinary approach offers some possibility to afford differing perspectives with a view to creating larger and more holistic understandings that in turn, could underpin better informed virtual and physical "ongoing" outcomes.

4.1 The Computer Science Perspective

The development of information science and the computer is something that (simplified) has evolved into specific areas of research and practice. The computer sciences and informatics began with the interactions (relationships) between investigations of logical foundations, along with applied mathematics implementing algorithms for application and so forth. These investigations (linked to engineers, and scientists) needed to work with large amounts of data, and built control processes to monitor applications for the related systems. Handling all this data also required specialists related to other disciplines, including technical librarians and the like.

Computer science was considered a branch of mathematics, but differences began to emerge. So as a community, computer science began to evolve in a different direction. This directional shift was mostly practical since the applications, techniques and approaches differed to that of the mathematics community. This break away could be considered as "allopatric speciation", a move into its own territory, where activities continue until the breakaway group activities are recognisably distinctive. These distinctions have continued to attract others to form this sub-field within an ecological community (of computer science), both virtually and physically (Nousala & Marlowe, 2020), (Nousala & Davidova, 2021), (Wilson, 1975).

This is an interesting nexus where the preconditions might be viewed (simplistically) in action so to speak. As Nousala & Marlowe (2020, p. 177)

stated, “This process has in turn resulted in the creation of still more interdisciplinary fields and communities, and of specialisations or new focus in existing areas: mathematical investigations that place greater emphasis on the representability of a problem and the complexity of its solution, data science and data analytics, agile management, and other uses of lean and agile methods beyond software development, a rebirth and transformation of artificial intelligence, and more”.

4.2 A Social/biological Complex Adaptive Case View

An ecological community case that was informed by an interdisciplinary approach (land use, biology, ecology, social complex adaptive systems and systemic design), focused on the preconditions of an ecological community, within the scope of sustainable development (Dongjin et al., 2015b), (Garduño et al., 2015), (Nousala et al., 2020). The community in question was the pre-Hispanic community of “Xochimilco” located at the Southern edge of Mexico City. These investigations aimed at identifying possible “markers” to indicate elemental preconditions for showing different ranges of equilibrium (for the precondition stages and the later stages) (Folke, 2006), (Holland, 2006), (Hutchins, 1994), (Nousala & Hall, 2008).

The in-depth study showed an interesting range of interactions that represented the diversity on which a community with pre-Hispanic roots had managed to survive into the 21st century (Nousala et al., 2020). This study was also an example of longitudinal emerging processes that supported the balancing of the intangible dynamics of the human and non-human ecological community. The interdisciplinary, action research, quantitative data collection and other hybrid methodological approaches, highlighted key potential markers that also showed the different stages and phases of the community’s (as there were several layers involved) emergence. In this instance, the resilience displayed so far could be described as a living, social complex adaptive system (Bateson, 1973, 1979), (Bredo, 1989), (Dynes, 2005), (Nousala & Hall, 2008).

These phenomena displayed the effects of social complex adaptive systems adjusting to their surroundings and creating new conditions, through new iterations of adaptation (Nousala et al., 2020), (Nousala et al., 2014), (Nousala, 2010), (Folke, 2006), (Holland, 2006). In a sense, these were extensions from preconditions that have inform new protocols, to achieve and maintain new environmental equilibrium. Contextually, this nexus informed interdisciplinary thinking as it continued to evolve (Nousala et al., 2020).

Many examples exist showing various combinations of tacit (virtual) phenomena which have impacted the initial preconditioning stage, towards the emergence of a "no return" point. These emergent states also develop their own sets of protocols along the way. These protocols continue to impact the newly evolved community, setting it on a path to achieve its own set of balanced and sustainable (equilibrium) on-going processes (Folke, 2006), (Holland, 2006), (Hutchins, 1994).

Many previous top-down investigations essentially failed to grasp the nature of the longitudinal holistic processes on which many ecological communities are based (but may not be aware of this themselves). Many complex adaptive systems are essentially best investigated in the context of holistic, bottom-up entities (Hall & Nousala, 2010a), (Nousala et al., 2020), (Nousala & Hall, 2008). Ecological communities are striving for balance but also effectiveness. However, the interpretation of what is meant by effectiveness can differ, according to initial and ongoing perspectives, as there are always elements of the emergent, holistic and longitudinal within any ecological community, knowledge-based process (Aguirre et al., 1998), (Nousala et al., 2020), (Nousala & Hall, 2008), (Tosey, 2006), (Hutchison, 2014).

4.3 The Living Labs Approach

Building Action Based Learning as Action Research within Living Labs is an approach that is considered as a dynamic learning system. To understand the various approaches towards different learning experiences for a range of environments, the application of longitudinal investigations and development are necessary. Several approaches have been previously applied to develop, build, and observe longitudinal, action-based community activity. Earlier examples of these approaches were introduced in the 1940s, informed by Revans (1982, 1998). Revans (1998) continued to work towards "... advocated group participation, programmed instructions, spontaneous questioning, real actions, and experiential learning in a constant and dynamic way in different social and organizational contexts" (Dongjin et al., 2015a, p. 49), (Dongjin et al., 2015b).

From the inception of "action-based learning", the application by individuals, groups, teams, and organisations, has assisted with defining and solving a range of bottom-up complex problems. As a "self-developed learning agenda" this approach has been applied within businesses, governments, and educational institutions (Dongjin et al., 2015a). The concept of action-based learning has been defined as a cyclical or iterative process through which groups of real-world individuals can assist one

another by learning and sharing experiences, including reflection, to resolve (not solve) complex issues.

5. Discussion and Analysis

The current approaches to systemic and complex learning an understanding are still linear and more aligned with instruction and compliance, which supports the institutional matrix. Systemic approaches focused on the human-centric ecological views are typically based in economic, political and other societal external pressures. The educational sector also adds to societal pressures through economic funding policies, forcing those within to comply regardless of where the research is leading. Unwittingly, and out of necessity, this has led to a range of ever larger emergent outcomes in the form of interdisciplinary self-organising groups and communities that are in themselves displaying behaviours of emergent ecological sustaining communities.

These are also examples of preconditions that have led to unintended consequences for continuing the existence, and/or development. Both human and non-human have undergone (and will continue to do so) forms of allopatric speciation, where self-creating formations continue to evolve in response to external or internal constraints. Our world boundaries (on many layers and scales), continue to morph into various ubiquitous or autonomous classifications, pushing the understanding of what, how and why preconditions impact community behaviours. The physical and virtual including big data, social and digital networks, biological diversity, and much more are oscillating between multidisciplinary and interdisciplinary domains. As such it's important to show the differing perspectives through various visuals and modelling (where possible) to enhance understanding towards the virtual (intangible) dynamics of the behaviours involved with the preconditions of ecological communities of all types. Most of all, it is necessary to highlight the importance and the range of dynamics of the relationships (including the emergent and evolving) involved with these phenomena.

The protocols (see Figures 2 and 3) that are involved are highlighting the possible different questions regarding the evolutionary developments on multiple levels for newer ecological communities. These protocols also show the possibility for what has been happening within and outside our worlds of the meta-scientific, meta-linguistic nature, and the developmental cross-fertilisation of behaviours of ecological communities (Krylov, 2015), (Wells, 2020).

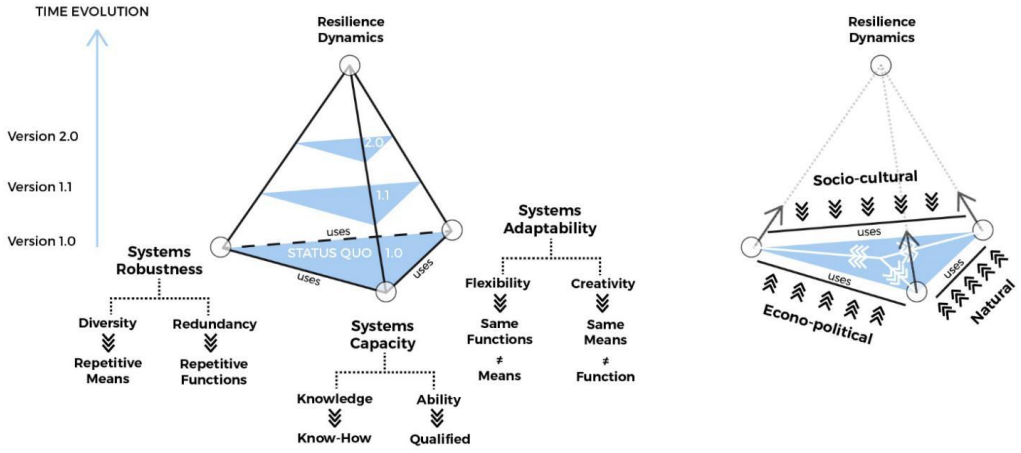

Figure 2. Nousala (Nousala et al. 2020). This research model is an example that focused primarily on changes in the constraining forces that drove complex-systemic adjustments regulating land-use. While researchers may be focused on a particular area or attribute of the complex adaptive system, it is also necessary to view the system in question holistically (Nousala et al. 2020), (Nousala & Marlowe, 2020).

There will, at any time, be other "candidates" emerging but will not always be visible. This is why the longitudinal aspects of any approach regarding the behaviours of preconditions, needs to be highlighted. It is common for these behaviours regarding preconditions to be bottom-up by nature. This is also why it is useful to show and represent these concepts as representational models, as visuals, as these are important tools for understanding the complexity regarding ecological communities. Longitudinal approaches also allow for comparative analysis over time, which affords rigorous understanding of the complex adaptive nature of any ecological community system. The comparative longitudinal approach can expose the various stages of preconditions, including effective starting points, useful for discussion and understanding. Whilst holistic, virtual or intangible behavioural dynamics can be hard to conceive, the comparative longitudinal approach that exposes the preconditions, offers useful, trackable understanding for applications towards rigorous qualitative type outcomes.

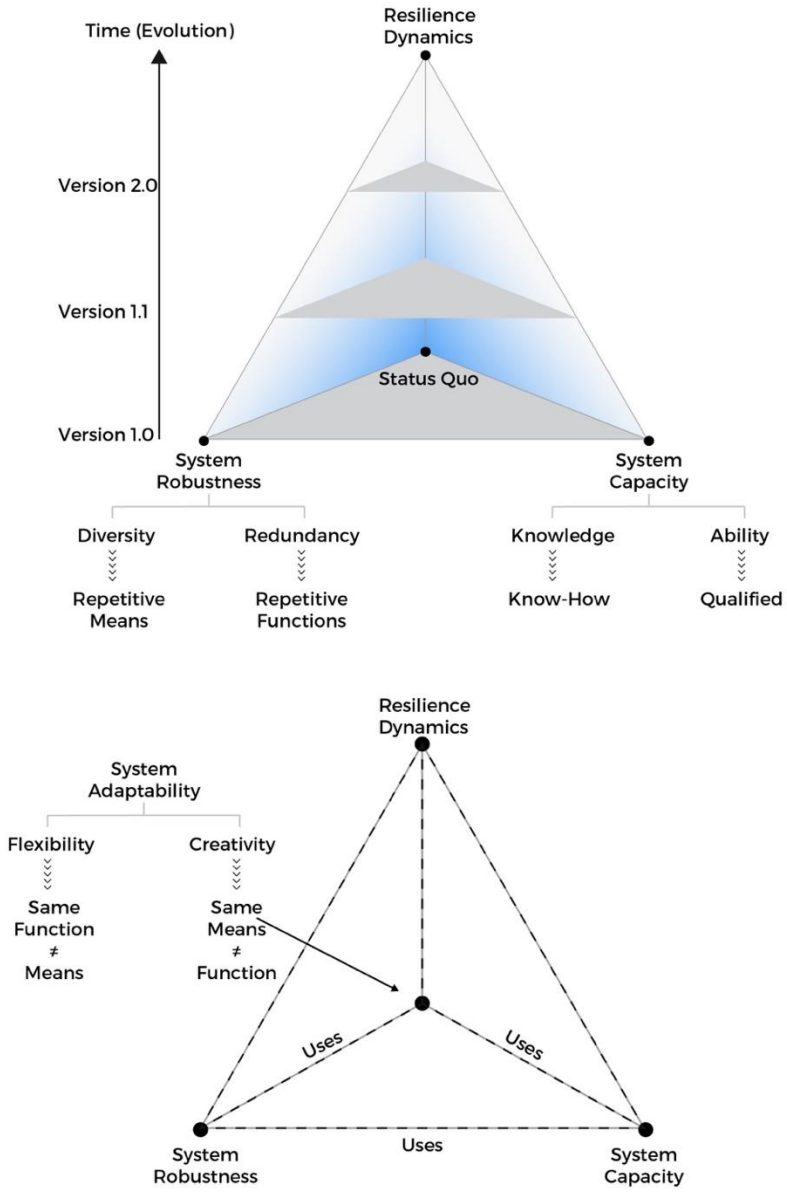

Figure 3. Sucic (et al., 2019) modified from Nousala (et al., 2020) Current research extensions to new dynamic potential.

Since ecological communities display many dynamic behaviours that occur simultaneously, it is important to utilise hybrid methodological approaches for understanding the precondition behaviours. This requires the application of non-dualistic and/or non-linear approaches, so as to develop multiple sets (and possible series) of outcomes for viewing preconditional behaviours. These approaches typically include multiple scales as argued by Salthe (1993) (See

Figures 2 and 3). The longitudinal view (see Figure 1) is also important for mapping emergent interactions, changing pressure between social and environmental (human and non-human ecological communities) shifts (Gunderson, 2000), (Nousala et al. 2020).

It will be important that future tacit, intangible phenomena encompassing precondition behaviours of ecological communities, continue to expand to include other elements such as frequency, rhythm and instances of community activities. These elements have great impact for the hidden process, including codification (Flusser, 2002), tacit knowledge networks (Nousala, 2006), autopoetic, self-producing communities (Nousala & Hall, 2008), and social complex adaptive systems (Ingold, 2007), (Nousala et al., 2014), (Nousala, 2014), that occur longitudinally, in a contiguous manner (Simon, 1982, 1962), (Nousala et al. 2020).

5.1 Lessons Observed from Multiple Perspectives

It is important to note that the difficulties to fully comprehend any dynamic state which maybe simultaneously acting on multiple levels and scales, do display points of commonality which are useful for future understanding and investigation.

The following examples have been previously stated by Nousala and Marlowe (2020, p. 180 -181):

- The progression of larger complex projects from the longitudinal view,
- Better understanding of knowledge level links and their impact for and on longitudinal networks,
- The re-surfacing and importance of longitudinal (in particular, viewed in a holistic and systemic manner) timelines and (of course for some disciplines this has not and did not diminish) perspectives,
- The impact and reinforcement of true multidisciplinary directions that rely on new emergent approaches of hybrid qualitative and quantitative methodological concepts and practices.
- The eventual effect of these new disciplines on their parent disciplines, and,
- The possibility of “speciation” in stages or even cycles.

In Figure 4 (whilst this arguably is a coalescence of the technical view), the biological, the human and the non-human spheres, may be expanded to explain a larger concept at play. Where previously Vines (Vines et al., 2010) had visualised the technical virtual community, and argued that the expanding element of “them” included a broader range of community, the biological, the non-human (specifically), so as to initiate the possibility for recognition of a much more complex range of relationships beyond the urban, technical,

information, impacting behaviours of any preconditions for any combination of ecological community.

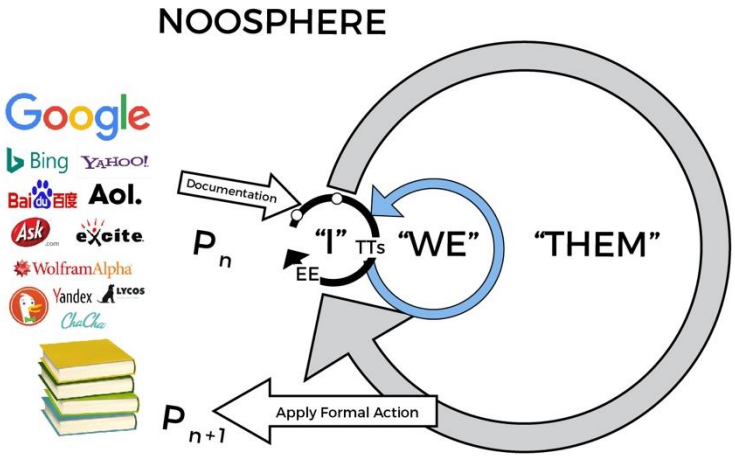

Figure 4. Re drawn from Hall (Hall et al. 2012, p. 11), Knowledge cycles in urban governance, with the "Them" demonstrating the possible inclusion of other community aspects. "Noosphere" is the sum of human knowledge. Individuals, groups and councils all draw from and add to this store of knowledge as consequences of their activities" (Hall et al. 2012, p. 11), (Hall et al, 2007) , (Hall et al., 2010b).

Without this attempt to recognise the subtle yet powerful preconditions that impact any community's foundation (however representational, regardless of its configuration), it would be difficult to comprehend longer range subsequent relationships and future impacts.

Taking the representational level of understanding a step further, Figure 5. shows the potential of an expanded holistic view which encompasses the concepts of Figures 1. 2, 3 and 4 on a meta-type level. Figure 5 potentially pulling together the many other layers of virtual and physical relationships (albeit relatively simply) in order to position certain action as multi, poly but definitely beyond dualistic thinking and/or approach.

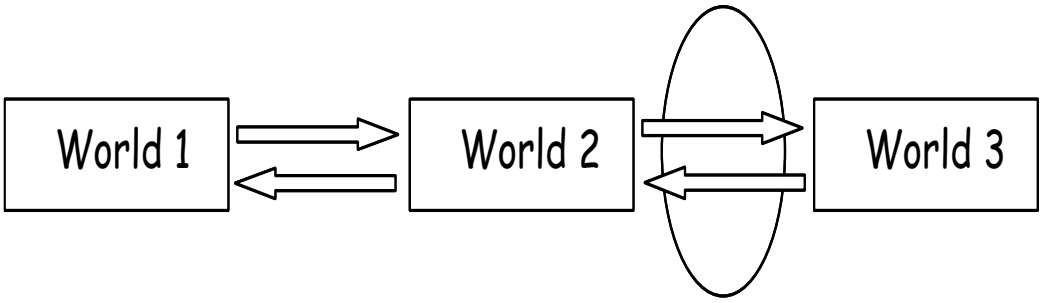

Figure 5. Nousala (2006), "Cyclic interactions of knowledge and control between Karl Popper's three worlds. W1 impinges on the living entity in W2 to create sense data. W2 entity constructs an understanding of W1 that may be made explicit for preservation and sharing via W3, based on sense data and prior knowledge sourced from W3. Based on its growing knowledge of W1, W2 attempts to control W1. The circle emphasizes cyclic exchanges between world 2 and world 3 as world 2 attempts to represent and interact with world 1" (Nousala, 2006, p.67).

6. Conclusions

In summary, preconditions from a systemic perspective, have the ability to set clear starting points for approaching and investigating the complexities of ecological community behaviours. The preconditional "setting" is critical for the task of comprehending holistically, the value and benefit for longitudinal perspectives. In particularly, preconditional initiations are relevant when mapping and tracking the behaviour of ecological communities. Understanding the initial points, means that multiple perspectives can be better understood, so as to enhance the understanding of these dynamic phenomena.

Concepts such as speciation, can also expose for examination, the social dynamics at play within ecological communities. The exploration of relationships between original starting points and emergent "offspring" is an area that will require further investigation, so as to support new emergent and hybrid methodological approaches.

It is very clear the hybrid approaches will increase understanding of the intangible and transitional actions from multiple perspectives that will continue to impact areas of study, including computer sciences, biology, ecology, land use, social complex adaptive systems, behavioural ecological systems to name a few.

Future investigations could also consider the emergent outcomes from "digital humanities" (Berry & Fagerjord, 2017) which are inclusive, rather than excluding other perspectives that already have rigorous foundations.

Finally, the discipline of artificial intelligence, that has an ever-increasing impact for our ecological communities (in both positive and negative ways), could be viewed or described as an "information field", so as not to negate, replace or overlay any intangible foundations or processes in play, that are essential to all ecological communities (Nousala et al, 2020).

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