MPhil Inclusive Innovation
Dissertation

A Structural Approach to Reimagining Community: Biomimicry, Biophilia and Living Labs

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Table of Contents

List of Figures

List of Tables

1. Abstract

The global economic operating system of capitalism is incongruent with the values required to sustain life on a planet with a growing population and finite resources. Living in marginalized communities the impoverished are the most negatively affected by the current system, as they are the most vulnerable to the vicissitudes of climate change, resource extraction, labor exploitation and wealth concentration. Our way of life needs to be reimagined to align with principles that are in accordance with the ecological worldview.

Aspects of an effective strategy rooted in the ecological worldview – especially Biomimicry, Biophilia and a Living Labs approach – are being created in silos but lack application at a systems level. The objective of this research is to bridge the disparate streams of these concepts into a community-based model, with the aim of replicating the emergent system in order to build alternatives to the current model. The research question to explored is the following: *how can the principles of Biomimicry, Biophilia, and Living Labs be integrated and systemically applied in communities?* Investigating this question will bring forth the *Principles for Transition Infrastructure* – an approach to building a resilient, self-sustaining, regenerative model for an alternative way of living.

This research concludes that there is an opportunity to dismantle the mechanistic worldview of isolating problems in silos and rather observe the multiple points of interconnectivity that weave together a solution that transcends the parts of the whole. In doing this, we draw from multiple disciplines and find the synergies to construct a reality that is conducive to building new systems and structures to support a harmonious life on this planet.

2. Introduction

2.1 Context

2.12 Pushing the Limits

On a global level we have divorced ourselves from the natural world misusing the resources on this planet to fuel more consumption, driving climate change and threatening all life. We are currently approaching what experts call the Earth's *sixth great mass extinction* (Barnosky et al., 2011, pp. 51–57). In the last 40 years we have killed 50% of species on the planet (Carrington, 2014). Sea levels are rising 25% faster than expected, which will lead to daily flooding for coastal cities by 2050 (Jamail, 2015). The World Health Organization estimates that 250,000 people will die per year globally between 2030 and 2050 due to climate change related factors (Leiserowitz et al., 2014, p. 4). WWF's Living Index Report concludes that today's average global rate of consumption would need 1.5 planet Earths to sustain it (McLellan, 2014, pp. 10–12). Clearly, this trajectory is unsustainable.

As a species we are pushing the limits. Research from the Stockholm Resilience Institute, led by an international team of scientists, shows that we have crossed four of the nine planetary boundaries as a result of human activity (Steffen et al., 2015, p. 736). Two of these, climate change and biosphere integrity, are "core boundaries", which scientists say would "drive the Earth System into a new state" (Steffen et al., 2015, p. 736). Lead author, Professor Will Steffan, explains, "it will make Earth a much less hospitable state, damaging efforts to reduce poverty and leading to a deterioration of human wellbeing in many parts of the world, including wealthy countries" (Steffen et al., 2015, p. 737). If we do not address the root cause of the overarching problem, whatever temporary solutions we implement through development or technological fixes will quickly become insignificant.

2.13 Global Operating System

The underlying structural cause of these imbalances is attributed to our global operating system, capitalism, a system that champions individual acquisition and economic growth at all costs, leading to the externalization of costs to the majority and a mass concentration of wealth among a tiny elite. Picketty's *Capital in the 21st Century* has shown through over 200 years of data that the overall logic of capital is to further and further congeal until the majority of the world's wealth lays in the hands of a tiny elite (Piketty, 2014, p.

32). In 2016 Oxfam's inequality report highlighted the fact that 85 individuals control more wealth than half the human population, 3.5 billion people (Hardoon, 2015, p. 2). Just one year later in their 2017 report, Oxfam states that now eight men hold the same wealth as 3.5 billion people (Elliott, 2017). Across borders consumption and resource extraction are the driving forces of economic growth, which we are dependent on for employment, which then provides income for us to consume more, driving more resource extraction and therefore more economic growth. However, this vicious cycle is incomplete as the social and environmental costs incurred through sourcing, distribution, production and consumption are not accounted for (Hutchins, 2013a, p. 41). And of course, given that all major currencies are debt-based – through fractional reserve banking, money is printed and initiated as debt – we are exponentially growing a global economy based on social, economic and environmental instability.

It is not an exaggeration to suggest that everything we do within a debt-based system makes us complicit in our own destruction. "We are told that in order for us to have a normal, healthy global economy, we need GDP growth rates of at least 3 per cent per year. Anything less, and economists tell us we're in crisis. Yet to grow at this rate means we have to increase the size of the global economy by $2 trillion next year. That means adding the equivalent of the entire size of the global economy in 1970 – and then more again the year after. To imagine that we can continue on this path is to completely disregard our planet's natural limits. It's a fallacy written into the very fabric of our economic system, and it is leading us rapidly to the brink of civilizational crisis" (Hickel, 2015). As economies struggle, many look to stimulate consumption by offering cheap credit and low interest rates on mortgages. This creates a false illusion, which feeds the downward spiral of destruction for a temporary spike in GDP. As Robert Kennedy famously remarked, "GDP measures everything except that which makes life worthwhile" (Rogers, 2012).

2.14 The Infrastructure for Transition

As it becomes more apparent that humanity is experiencing an ecological, social, spiritual and economic crisis, there is an opportunity to explore a new way forward. Yet is seems

that we are lacking an alternative or dialogue about alternatives. As Professor Roberto Mangabeira Unger points out, "the world today lives under a dictatorship of no alternatives. There is a very limited repertory of live institutional options available for the organisation of different domains of social life… None of these problems can be solved within the restraints of the social democratic compromise established in the middle of the last century" (Unger, 2013). Rather than waiting for governments and institutions to take charge, individuals, communities, and society must conduct these "radical experiments", as Unger suggests, and build what this dissertation will term *the infrastructure for transition*.

As we reflect on the current ecological, societal, political, and spiritual circumstances at this juncture in history, one can infer that we are in the collapse phase of our current model and the need for radical reorganization is upon us. Architect, author and economist, Tom Bender, suggests that we must explore new alternatives if we want to see a different future. He says, "Institutions based on greed cannot create either a living architecture or a sustainable society. An economics that discounts the future cannot create a livable future. The cities and urban culture we know are creations of a culture with a basic premise that is unworkable in the conditions of our future. The possibility or desirability of their continuance is uncertain. It seems wise to at least be aware of and explore alternatives, and not assume that the city is best, the only, or even a possible, sustainable solution" (Bender, 2008, pp. 313–323).

It would be naïve to assume that the civilizational problems we face can be solved by reform technological fixes and other elements that derive from the existing system. Fixing symptoms rather than treating the underlying structure contributes to perpetuate the status quo and further enmeshes people within a broken system. Broader structural solutions require systemic, holistic thinking. As Buckminister Fuller said, "You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete" (Ben-Eli, 2015).

To radically redesign the system we have to break the social construction of reality. As a global society, we have lost the original wisdom of our ancestors and are disconnected from Nature. For the first time in history, humans are living in a period where our actions are influencing all climatic, biophysical, and evolutionary processes occurring at a planetary scale. Scientists have named this new geological epoch the *Anthropocene* – the era of a human dominated planet (Lewis & Maslin, 2015). In the *Anthropocene*, life will be uncertain, unpredictable, chaotic and relentlessly changing with no precedent and will manifest in terms of changing climates, natural disasters, species extinction, biodiversity loss, disease epidemics, and ocean acidification, to name just a few vectors. It is clear we are running on depletive systems rather than regenerative ones. We are pursuing growth for the sake of growth, a strategy that Edward Abbey bluntly describes as "the ideology of a cancer cell" (Barry, 2009).

Albercht presents the potential alternative for the next epoch in human history, named the *Symbiocene*, derived from the scientific word "symbiosis" which implies living together for mutual benefit and the interconnections of life and all living things (Albrecht, 2015). "The *Symbioscene* will be characterized by human intelligence that replicates the symbiotic and mutually reinforcing life-reproducing forms and process found in living systems. The elements include: full recyclability of all inputs and outputs, the elimination of toxic waste in all aspects of human enterprise, safe and socially-just renewable energy and full and harmonious integration of human industry and technology with physical and living systems at all scales" (Albrecht, 2015). Albercht's depiction of the next era may at first seem otherworldly, but on deeper reflection is the necessary pre-requisite to realign ourselves with the dynamic equilibrium of the planet.

2.15 Ecological Worldview

A worldview is the stories we tell ourselves about how the world is constructed and how it functions. It structures a value system that informs our ideas and the paradigms we choose to believe.

The current mechanistic worldview, tells the story that living systems and mechanical systems can be approached in the same way – as a collection of parts that can be examined separately. This view impacts our approach to problem solving – compartmentalizing issues in silos and applying solutions in isolation. According to Hes and Du Plessis, this worldview is built upon the belief that, "not only can growth, development and progress continue indefinitely, only limited by our imaginations and technological sophistication, but that unfettered growth is something for which we should strive" (Hes & Du Plessis, 2014, p. 24).

This worldview has ultimately led to a social value system focused on individualism in which value and status can only be determined from observing how much material possessions one amasses. "In a world where only that which can be measured counts, concepts such as success, wealth and happiness came to be defined by the ability to acquire and consume. Measuring our self-worth in terms of the possession of material goods is one of the reasons why society today is challenged with adopting a more sustainable way of living (Hes & Du Plessis, 2014, p. 24)". Edward Goldsmith elaborates on this point further, "[this value system] allowed us to separate humans from nature, and then place humans above nature, with the right to use its resources and change its processes to provide maximum benefit for the human species" (Goldsmith, 2014).

While this worldview was helpful in advancing technological development it has limitations, which have become more apparent in the last century. Hes and Du Plessis explain, "New fields in science, such as quantum physics, complexity science, ecology and neuroscience are finding that, while the scientific paradigm underpinning this worldview is very effective when dealing with mechanical systems, it cannot adequately explain all of reality, especially when it comes to living systems and the subatomic realm" (Hes & Du Plessis, 2014, p. 24). However, the most damaging aspect of this worldview is the separation it created between humans and Nature. This allowed the development of an economic model that prescribes no limits to growth on a planet with finite resources and threatens vital planetary functions such as climate regulation.

The ecological worldview provides the opposing belief, which sees humans as part of a larger community of life. This worldview suggests that humans have evolved with Nature and are one species in a complex web of life with a purpose of maintaining and contributing to the entire system. What the ecological worldview shows us is in order for humankind to survive as a species we must shift from the mechanistic worldview to the ecological, from the belief that we have evolved beyond Nature to realize that we are Nature. This in no way diminishes the role of human beings but gives it a new type of primacy (Hes & Du Plessis, 2014, p. 27)..

One of the main differences between the mechanistic and ecological worldviews is the shift in emphasis from understanding the parts to understanding the whole. The understanding of the whole, as consisting of many systems, holds another important lesson for problem solving. "To understand how to solve problems, we need to look at the scale at which the problem is situated in addition to looking at the systems in the scales above and below it, as these systems contribute to the problem and will be impacted by its eventual solution" (Hes & Du Plessis, 2014, p. 27). It is a shift in perception to understand the holistic causes and implications of a problem rather than individuating the problem and applying a solution at one scale.

The ecological worldview, based on the premise that our world is interconnected, offers an alternative perspective of sustainability. Hes and Du Plessis suggest, "The objective of sustainability from this perspective would be to cultivate relationships that sustain the ability of the global sociol-ecological system to provide not just life-supporting, but also life-enhancing conditions for the global community. To achieve this, it would be necessary to align human efforts with those of Nature, resulting in activities, technologies and human habitats embedded in and contributing to natural processes of creation, evolution and regeneration" (Hes & Du Plessis, 2014, p. 39).

2.2 Research Problem

The global operating system – which can aptly be described as late-stage capitalism – has created a structure in which we are forced to govern our lives under the premise of infinite

material growth (Piketty, 2014, p. 42). The values of this system – short-termism, extraction, acquisition, selfishness, oppression, violence and domination – are incongruent with the values required to sustain life for a growing population on a planet with finite resources (Steffen et al., 2015). The problem is that the logic of capitalism creates poverty, inequality and environmental destruction – these are not externalities that can be solved by more economic growth – they are the logical outcome of the current system.

The people most adversely affected by this system are the world's majority, the billons of people living at what business-school textbooks call bottom of the pyramid – they constitute the vast majority of human beings on this planet. This majority are the most vulnerable to the shifts that are occurring due to a tiny elites' exploitation of the planet and they suffer the greatest as they are forced to remain in abject poverty because the structure ensures those without remain without (Hardoon, 2015, p. 2).

This is a problem that has been written into our social contract through the way we live, the items we purchase, the food we consume, the political parties we vote into power, and even the water we drink. It is a wicked problem that is all pervasive and will only be solved if we create alternatives articulated by new rules, values and incentives for the system at large. To create this scale of shift, we must transition to a new operating system and transcend the mechanistic worldview, moving to an embedded, ecological paradigm (Hes & Du Plessis, 2014, p. 27).

2.3 Research Area

In order to create something new, we must start by looking for clues about what has stood the test of time. Nature has built cooperative, resilient, adaptive, harmonious ecosystems for over 3.8 billion years. As a species our separation from Nature dates back to the Neolithic Revolution, when we went from hunter-gatherers who trusted the abundance of Mother Earth, to sedentary farmers who cultivated and exploited land with the aim of creating surplus (Quinn, 1999, p. 32). From the dawn of the city-state model that was born in the Fertile Crescent, we set the stage for an ever expanding imperial growth imperative, culminating in the Industrial and Scientific Revolution when we learned, in Francis

Bacon's words, to "torture Nature for her secrets" (Benyus, 2002). The realization that we can once again learn from Nature and be nourished by Nature will allow us to reestablish our relationship from using her as a resource, to revering her as the source of life. There are answers to be found all around us in the structures, patterns, strategies and organizing principles of Nature that we can apply to our human living systems.

Three areas of study will shape this research and therefore the literature review. First, we must learn from Nature's genius and apply the time-tested and proven innovations found in Nature to our human challenges. This principle is known as *Biomimicry*. Second, we must immerse and surround ourselves in Nature so we can operate at our peak potential and in constant immersion with our life-source. This principle is known as *Biophilia*. Finally, we must create an environment outside the system we currently operate in so we can organically iterate, test and experiment with new solutions, the way Nature does. This principle will be described as a *Living Lab* approach.

2.4 Research Need

What would our world look like if we reimagined the way we live to align with principles that are in accordance with the ecological worldview? The ecological worldview suggests, that humans have evolved with Nature and are one species in a complex web of life with a purpose of maintaining and contributing to the entire system. To achieve the ecological worldview, "we would need to align human efforts so that our activities, technologies and human habitats are embedded in and contribute to natural processes of creation, evolution and regeneration" (Hes & Du Plessis, 2014, p. 39). Aspects of an effective strategy – especially Biomimicry, Biophilia and Living Labs – are being created in isolation but lack application at a system-wide level. This siloed approach is in-line with the old paradigm of the mechanistic worldview. In addition, there is an established amount of work and study in these areas respectively, however there lacks any deliberate overlap and synergy across fields. There is an opportunity to use the principles from each one of these complementary subject areas and combine them to create a model that is holistic.

2.5 Research Objective

The objective of this research is to integrate the disparate applications of Biomimicry, Biophilia and Living Labs in order to understand where the synergies lie and how they can be applied to a community-based model on a systemic level. By doing so, this knowledge will help inform how we might build more resilient, self-sustaining communities and cities in accordance with the ecological worldview.

2.6 Research Question

In light of the concepts discussed above, the key research question to be explored is the following: *How can the principles of Biomimicry, Biophilia, and Living Labs be integrated and systemically applied in communities?*

In order to explore what we can learn about the systemic application and points of integration of these principles the research will investigate the following pillars in communities: architecture, ecology, culture, and economy. These pillars were selected in order to understand a community holistically.

Architecture will explore the infrastructure, sustainable building methods and layout of the community. Ecology will explore the ecological systems of food, waste, water and energy. Culture will explore social dynamics, decision-making, governance, spiritual practices, education, and modes of healing. Economy will explore creating and exchanging value, currency, and self-sustenance.

Ecovillages are traditional or intentional communities whose goal is to become more socially, culturally, economically and ecologically sustainable. For the purposes of this research the term ‘ecovillage’ and ‘community’ are interchangeable.

Global Ecovillage Network (GEN), a global organization that supports and creates connective tissue between ecovillages, believes that beyond the diversity of ecovillages they share four dimensions of sustainability at their core: ecology, economy, social and cultural (“Global Ecovillage Network,” 2014). The pillars selected for this research have been inspired by GEN’s work, however the architecture pillar has been added to allow for a greater understanding of the built environment. In addition, the cultural and social

dimensions in the GEN framework have been collapsed in this research to be encompassed by the culture pillar. Social and cultural aspects of community are similar in nature and by merging these areas there was an opportunity to investigate the architectural aspect, which creates more of a varied realm of investigation.

As the research question is explored, literature in the subject areas of Biomimicry, Biophilia and Living Labs will be discussed in the following section. For each subject area there will be a section defining the prominent concepts from the critical voices in the field, followed by a section on how communities are inspired by current theories, and lastly, an exploration of gaps in the research. Research has been gathered from books, journals, scholarly articles and reviews. From the literature review it is evident that there is an established amount of work and study in these areas respectively, however there lacks any deliberate overlap and synergy across fields. There is an opportunity to use the principles from each one of these subject areas and combine them to create a model that is holistic. However, before addressing this in further detail an understanding of each of these subject areas is presented.

3.0 Literature Review

3.1 Biomimicry

3.12 Biomimicry Defined

Biomimicry derives from the Greek roots *bios,* meaning life, and *mimikos,* meaning imitation (Flint, 2013). It is defined, "as an approach to innovation that seeks sustainable solutions to human challenges by emulating nature's time-tested patterns and strategies" (Benyus, 2002, p. 33). At the core of Biomimicry is the abiding belief that "Nature knows best" and the premise that after "billions of years of research and development, failures are fossils, and what surrounds us is the secret to survival" ("The Biomimicry Institute," 2014). Benyus, biologist, founder of the Biomimicry Institute and author of *Biomimicry: Innovation Inspired by Nature,* brought the concept into the mainstream arguing that Biomimicry, "helps us learn from the wisdom of nature and the processes and patterns that it has developed over eons of evolution, so that we can channel our human creativity into directions that can contribute to the regeneration of both our

ecosystem and ourselves" (Hes & Du Plessis, 2014, p. 74). She proposes that all the design guidelines we need to plan the future already exist in nature, but we must "…quiet our cleverness, go outside and listen to the lessons of Nature" (Benyus, 2009).

Biomimicry provides three avenues to find design solutions in nature. The first uses nature as a model, meaning we look to precedents in nature that can inspire more efficient or effective ways to design. For example, under a microscope overlapping scales called dermal denticles are seen on sharkskin. The pattern of these scales were found to discourage bacterial growth so scientists are creating products and surfaces in hospitals that mimic this design ("The Biomimicry Institute," 2014). The second is using Nature as a measure, providing sustainable benchmarks to evaluate design ecologically and sustainably. This means investigating if the methods we are using currently are as efficient, simple and sustainable as those found in Nature. Resilience thinking is an example, as we look to Nature's limits to understanding how we can adapt while staying within critical thresholds (Folke et al., 2010). The third is to look at Nature as a mentor, using its wisdom to guide a process for optimal development. For example, practices and design systems such permaculture use the "genius of place" to inform what is best to grow on the land considering rainfall, soil and climate conditions (Hes & Du Plessis, 2014, p. 74).

Benyus defines Biomimicry as "the conscious emulation of life's genius", suggesting that in a biomimetic world, the way we would interact with our surroundings is the way animals, plants and ecosystems do, following the laws of Nature. After years of working with ecologists, Benyus identifies the following nine laws that govern natural systems (Benyus, 2002):

1) Nature runs on sunlight
2) Nature uses only the energy it needs
3) Nature fits form to function
4) Nature recycles everything
5) Nature rewards cooperation

6) Nature banks on diversity

7) Nature demands local expertise

8) Nature curbs excess from within

9) Nature taps the power of limits.

Building on these laws she has identified life's design principles (Figure 1), which are the primary design lessons from Nature. All species on Earth, except human beings, adhere to these overarching principles to survive. Benyus poses that, "by learning from these principles, we can model innovative strategies, measure our designs against sustainable benchmarks, and allow ourselves to be mentored by Nature's genius" (Benyus, 2002, p. 25).

Figure 1- Biomimicry Life's Design Principles (Biomimicry 3.8, 2014)

Adding to the work of Benyus, architect William McDonough and chemist Michael Braungart have made significant contributions to the field, some of which is highlighted in

their book *Cradle to Cradle: Remaking the Way we Make Things*. *Cradle to Cradle* outlines a biomimetic approach to the design of products and systems. It's a philosophy that calls for the transformation of industry, envisioning materials that are nontoxic and can easily break down allowing them to flow through cycles that would maintain or even increase their value over time. They argue that "we can produce a world of abundance in which there can be many of us and the things we make, because we have the right system – a creative, prosperous, intelligent and fertile system" (Braungart & McDonough, 2002, p. 143).

Giles Hutchins, author of *The Nature of Business,* illuminates that humans have always exploited Nature and the popularization of Biomimicry can make us vulnerable to treading down this path. He states, "We often find our scientific explorations lack empathy for the objects of their examination. For instance, recently there has been excitement about using spiders' silk for human benefit. Research articles demonstrate this scientific endeavor with photos of spiders lined up and pinned down alive in a laboratory while silk is extracted from them. Is this really the "conscious emulation of nature's genius" that Benyus described? It's the kind of hubris that got us into this unsustainable mess in the first place" (Hutchins, 2013b). Hutchins stresses the importance of participatory engagement when applying the principles of Biomimicry in order to address the root causes of our crisis. "It is true that our analytical examination of nature is important, but only as part of a deeper, richer participatory engagement. If the deeper resonance of our nature is overlooked, such biomimetic transformations fail to address the root cause of our unsustainable way of life." He cautions, "Scientific rationalism will not get us out of this mess on its own; in fact, it will only add to our dysfunctional way of living unless it goes hand-in-hand with a deeper participatory way of engaging with life: scientific, sensuous and spiritual" (Hutchins, 2013b).

Researchers, Goldstein and Johnson, propose that Biomimicry, "…creates the conditions for new forms of enclosure, making ever more aspects of the world, human and nonhuman, available to be churned through the circuits of capital accumulation" (Goldstein & Johnson, 2015). They argue, "The ideal of a biomimetic future may be

inclusive, but the biomimetic future being enacted is a bio-political one, in which conditions are made conducive to some lives and not others. This is ultimately the problem with Biomimicry: though its stated intention is to learn from, respect and honor nature, by doing so through the available investment options for industrial R&D, the reproduction of life becomes intimately entangled with the reproduction of capital" (Goldstein & Johnson, 2015).

3.13 Biomimetic Inspired Communities

Examining the lacunas of Biomimicry at a systems level, there are very few accounts of biomimetic inspired communities and cities. One highlight is a project in Lavasa, India that is working with Benyus' consultancy, *The Biomimicry Group*. Together with global architectural firm, *HOK,* they are integrating solutions they have found in Nature into the planning and design of buildings, sites and cities. (Lazarus & Crawford, 2011). Another example, from South Africa, is less capital-intensive and demonstrates an application of Biomimicry to a community's water systems.

Lavasa, India

Lavasa is a hill town in India, southeast of Mumbai subject to monsoon flooding. The development will cover nearly 13,000 acres of land and give rise to five villages with populations estimated at 30,000-50,000 people with an additional million expected to visit each year. "*The Biomimicry Group* and *HOK* team created an ecological model for this site to generate data from which to develop design tools, strategies and methods to address sustainability" (Gendall, 2009). From their research, they learned that the site was a deciduous forest that had become an arid landscape due to hundreds of years of modern agricultural techniques. During monsoon season, the valleys fill up with water but dry up the rest of the year. Originally, the trees that existed would have prevented these extremes. Knowing this, they were able to design the building foundations to store water and clean their own surface just as the indigenous Banyan tree once did (Gendall, 2009).

Langrug, South Africa

In South Africa, an informal settlement of 4000 people, use the genius of Nature to clean a river that has been polluted from wastewater. Langrug is located on the banks of the Berg River, a waterway that supplies several farms in the area with water for their agriculture. Without basic infrastructure for water and sewage, the residents of Langrug are suffering health risks as contaminated water finds its way to the river. This leads to contaminated crops, endangering the Western Cape's agriculture and human health.

The team in collaboration with the community implemented a two-part solution. First, a system of living gutters was created that capture water and divert it into pits, where it will be filtered and its organic matter will be turned into soil. Secondly, an Eco-Machine is placed downstream to prevent surface runoff from entering the Berg River. "The biomimetic Eco-Machine is a custom-built wastewater treatment system that mimics the processes of natural ecosystems to clean contaminated water. Unlike typical treatment plants, it doesn't use chemicals and often blends right into the landscape" (Janisch, 2016).

A holistic system is being designed that, "…will not only treat wastewater, but also help improve the soil, increase biomass, and create beautiful spaces" (Janisch, 2016), Additionally, this system will create small enterprise opportunities within the community like growing flowers and plants using the nutrients in the wastewater and growing algae that can be used to feed a fish farm.

3.14 Gaps in Research

To date, Biomimicry has been used predominantly to inform architecture, largely single buildings rather than systems, and one-off product design challenges. For example, the Eastgate Building in Zimbabwe has an air conditioning system designed after the mounds of termites, the Shinkansen Bullet Train, the world's fastest train, was designed after the beak of the King Fisher bird in order to use less energy and makes less noise (Bagley, 2014). Referring back to the mechanistic worldview discussed earlier, these problems are still being solved by individual, atomized interventions rather than looking at the integrated whole.

There are of course many reasons why this is the case. The Lavasa project for example requires massive amounts of capital, government and corporate support, and very sophisticated tools and knowledge. This creates two issues. The first is that they operate within the capitalist system, requiring capital inflow and outflow, return-on-investment and the involvement of multi-national corporations. These are they key drivers of our current crisis and scaling up biomimetic versions of this will, at best, only slow down the collapse. The second issue is that this initiative is extremely top-down in orientation. Due to the scale, complexity and necessary capital, they become elite structures of command-and-control hierarchies.

The Langrug project is more of a bottom-up application that creates an opportunity for more inclusivity and for the application of biomimetic design by empowering people with the necessary knowledge and creating examples of community led, owned and operated projects. This is a great example of Biomimicry integrated into a water system within a community and demonstrates how these disciplines can be applied on a systemic level. However, the largest gap as evidenced by the research is that there is a lack of intersectional overlap between Biomimicry, Biophilia and Living Labs when applied to the community level.

Biomimicry is the design process – it is a way of seeking solutions. Therefore, the final design that comes from a Biomimicry process oftentimes does not look organic or like the organism from which the blueprints originated. For example, a solar cell used for solar power is derived from the way leaves photosynthesize sunlight, but they look nothing like a leaf (Gratzel, 2001). As discussed in the critique of Biomimicry, this has the potential to lead to the exploitation of Nature. However, when we introduce the biophilic perspective, which in practice refers to the direct integration of Nature and natural materials or forms, a more holistic perspective is formed.

3.2 Biophilia

3.21 Biophilia Defined

Biophilia literally means "love of life or living systems." Harvard biologist Edward O. Wilson, coined the term arguing that “Human beings have an innate and evolutionary based affinity for nature”. He proposed “The possibility that the deep affiliations humans have with nature are rooted in our biology” (Wilson, 2008). He argued that, “Human beings are predisposed to require contact with natural forms” and “…people are not capable of living a complete and healthy life detached from nature” (S. R. Kellert, Heerwagen, & Mador, 2012). Following this logic, access to Nature is a basic human need not a culturally determined preference (Salingaros & Masden II, 2008). Kellert continues, “Most of our emotional, problem solving, critical-thinking and constructive abilities continue to reflect skills and aptitudes learned in close association with natural systems” (S. R. Kellert et al., 2012).

Although the theory of biophilia can be argued, scientific research has been conducted measuring the affects on productivity, emotional wellbeing, stress reduction, learning and healing. Roger Ulrich, a behavioral scientist, was the first to conduct a controlled test to understand the benefits of nature on the healing process in 1984. He studied how a window view of nature would affect hospital patients. In his research, half the patients had a window that looked out onto a garden and the other half looked out onto a brick wall. The kind of surgery the patients had and other variables like age, gender and health conditions were matched. The results of the study showed that patients with the outdoor view used less medication for pain, had shorter recovery period and less complications post-surgery (Heerwagen, 2009, p. 39). Building on this research Loftness and her colleagues at the *Center for Building Performance and Diagnostics* (CBPD) at *Carnegie Mellon University* conducted research that linked access to the natural environment with improved health outcomes. In addition to health benefits, they found that, “Access to the natural environment increases productivity between 3-18% and reduces absenteeism between 9-71%” (Loftness et al., 2006).

Kellert’s main area of focus is in biophilic design in which the goal is to “Reestablish positive connections between people and nature in the built environment” (S. Kellert, 2005, p. 126). Biophilic design is the process of integrating Nature, natural forms

and materials into our ecosystems, buildings, communities and habitats. Building on Wilson's work, the nature-design relationship has been explored further by architectural firm Terrapin Bright to provide a framework for incorporating a rich diversity of biophilic design strategies into the built environment. Biophilic design can be organized into three categories – Nature in the Space (direct experience), Natural Analogues (indirect experience), and Nature of Space (experience of space) (Browning, Ryan, & Clancy, 2014, p. 9). The design patterns of each category are described below in Table 1.

Nature in the Space addresses the direct, physical and ephemeral experience of Nature in a space including water, air, fire, earth, plants, animals, sounds, scents and other natural elements. "Common examples include potted plants, bird feeders, butterfly gardens, water fountains, aquariums, courtyard gardens, fire pits and green walls or vegetated roofs" (Browning et al., 2014, p. 9).

Natural Analogues addresses organic, non-living and indirect experiences of nature. "Objects, materials, colors, shapes, sequences and patterns found in nature, manifest as artwork, ornamentation, furniture, décor, and textiles in the built environment…furniture with organic shapes, and natural materials that have been processed such as wood planks and granite counter tops" (Browning et al., 2014, p. 10) are analogous of the items in their 'natural' state.

Nature of the Space refers to spatial configurations in Nature. "This includes our innate and learned desire to be able to see beyond our immediate surroundings, our fascination with the slightly dangerous or unknown; obscured views and hidden nooks; and sometimes even phobia inducing properties when they include a trusted element of safety" (Browning et al., 2014, p. 10).

Table 1 – Biophilic Design Patterns (Browning et al., 2014)

Nature in the Space (Direct Experience)	Natural Analogues (Indirect Experience)	Nature of Space (Experience of Space)
Visual Connection with Nature A view to elements of nature, living systems and natural processes.	**Biomorphic Forms & Patterns** Symbolic references to contoured, patterned, textured or numerical arrangements that persist in nature.	**Prospect** An unimpeded view over a distance, for surveillance and planning.
Non-Visual Connection with Nature Auditory, haptic, olfactory, or gustatory stimuli that engender a deliberate and positive reference to nature, living systems or natural processes.	**Material Connection with Nature** Materials and elements from nature that, through minimal processing, reflect the local ecology or geology and create a distinct sense of place.	**Refuge** A place for withdrawal from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead.
Non-Rhythmic Sensory Stimuli Stochastic and ephemeral connections with nature that may be analyzed statistically but may not be predicted precisely.	**Complexity & Order** Rich sensory information that adheres to a spatial hierarchy similar to those encountered in nature.	**Mystery** The promise of more information, achieved through partially obscured views or other sensory devices that entice the individual to travel deeper into the environment.
Thermal & Airflow Variability Subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments.		**Risk/Peril** An identifiable threat coupled with a reliable safeguard.
Presence of Water A condition that enhances the experience of a place through seeing, hearing or touching water.		
Dynamic & Diffuse Light Leverages varying intensities of light and shadow that change over time to create conditions that occur in nature.		
Connection with Natural Systems Awareness of natural processes, especially seasonal and temporal changes characteristic of a healthy ecosystem.		

When biophilic design is implemented superficially there is a critique around its effectiveness and merit. Simply adding plants or a painting to a room with four walls does not constitute biophilic design. “Nature exists within connected and related environments of integrated wholes or ecosystems. By contrast, habitats comprised of disconnected and unrelated elements provide few benefits to its constituents and may even harm individual members. Thus, simply inserting an object of nature into a human built environment, if unrelated or at variance with other more dominant characteristics of the setting, exert little positive impact on the health and performance of the people who occupy these spaces” (S. Kellert, 2015).

Additionally biophilic design must be applied in a way that affects our conditioning as a species. “Any occurrence of nature in the build environment cannot be called biophilic design if it has no bearing on our species’ inborn tendencies that have advanced our fitness and survival… biophilic design focuses on those aspects of the natural world that have contributed to human health and productivity in the age-old struggle to be fit and survive. Thus, desert or deep-sea habitats or microorganisms or alien or extinct species or other obscure aspects of nature are largely irrelevant as aspects of biophilic design because they offer little if anything in the way of sustained benefits to people” (S. Kellert, 2015).

Lastly, the effectiveness of biophilic design is reliant on applications that are connected, complementary and integrated within the environment rather than being isolated. Additionally, repeated and reinforced contact with Nature within one’s environment is a key factor in effective biophilic design. “The benefits of biophilic design depend on engaging contact with nature rather than occasional, exceptional, or ephemeral experiences” (S. Kellert, 2015).

Biophilic design, when applied effectively, is beneficial to human performance and development. It also fosters an appreciation of nature, which leads to greater awareness for the environment and more sustainable behaviors. Helena Van Vilet, a biophilic architect, expresses that the importance of cultivating love for Nature. “We tend to take care of things that we love. Climate change is an abstract concept. Our reptilian brain knows how to deal with a snake, tiger, or bear but climate change is so abstract that we don’t fear it. The only other emotion that is powerful enough to motivate us is love. We need people to fall in love with nature. Motivate people with love and get them to change their view of climate change” (Vliet, Interview)**.** Robert Pyle writes of the resulting "extinction of experience" because many natural areas no longer exist or are accessible. Pyle argues, “that a lack of personal contact with nature breeds alienation from it, which transforms into apathetic feelings about future protection and conservation of nature in a self-perpetuating downward spiral, or cycle of disaffection” (M. R. Pyle, 2011).

Richard Louv, author of *The Nature Principle,* points to the growing disconnection we

have from Nature. “In 2008, for the first time in history, more than half the world’s population lived in towns and cities. The traditional ways that humans have experienced nature are vanishing, along with biodiversity” (Louv, 2011, p. 3). He suggests, “An age of rapid environmental, economic, and social transformation, the future will belong to the nature-smart – those individuals, families, businesses, and political leaders who develop a deeper understanding of nature” (Louv, 2011, p. 4). Linked to this urgency, he explores the consequence of a lack of exposure of nature to children development in his book *Last Child in the Woods*. Louv coined the term “Nature-Deficit Disorder” to explain the phenomenon that is occurring in the current generation of children. He argues how crucial it is for children to experience nature and play in the wilderness as it is central for the development of motor skills, increased cognitive functioning and attention capacities, alleviating childhood stresses, and results in greater creativity and problem solving abilities (Louv, 2005, p. 25).

3.22 Biophilia Inspired Communities

Building on the work of Kellert, Professor Timothy Beatly of the School of Architecture at the *University of Virginia* leads the *Biophilic Cities Project*, an international research initiative to advance the theory and practice of planning for biophilic cities. He describes a biophilic city as "...a city that puts nature first in its design, planning, and management. A biophilic city recognizes the many instrumental and economic values provided by nature and natural systems, as well as the essential need for daily contact with nature” (Beatley, 2009, p. 208). He also argues that biophilic cities are sustainable and resilient cities. “Achieving the conditions of a biophilic city will go far in helping to foster social and landscape resilience, in the face of climate change, natural disasters and economic uncertainty and various other shocks that cities will face in the future” (Beatley & Newman, 2013, p. 3328).

Examples of biophilic initiatives in cities such as modifying zoning codes to permit urban agriculture are happening everywhere, including large cities like Chicago and San Francisco. New York and Paris are creating elevated urban parks in place of old railway tracks (Beatley, 2009, p. 210) and Singapore, a city of 5 million people, is creating

extensive greenways and parks covering 47% of the city's green area (Newman, 2014, p. 48). It is observable that biophilic design in urban areas can happen at different scales and is completely unique to the location and its citizens. Beatley presents examples of biophilic design interventions in Table 2 and their varying scales.

Table 2 – Biophilic Design Elements (Beatley & Newman, 2013)

Scales	Biophilic Design Elements	Scales	Biophilic Design Elements
Building	Green rooftops Sky gardens and green atria Rooftop garden Green walls Day lit interior spaces Green courtyards	Neighbourhood	Urban forests Ecology parks Community garden Urban creeks and riparian areas Urban ecological networks
Block	Clustered housing around green areas Native species yards and spaces Green streets Urban trees Low impact development	Community	Green schools City tree canopy Community forest/orchards Greening utility corridors
Street	Vegetated swales and skinny streets Edible landscaping High degree of permeability Stream daylighting, stream restoration	Region	River systems Riparian systems Regional greenspace systems Greening major transport corridors

Although the physical environment is the obvious characteristic for biophilic cities, the extent to which a city and its citizens can be said to be biophilic, Newman and Beatly argue, will depend on the extent to which citizens interact and immerse themselves with Nature. "In biophilic cities, residents are directly and actively engaged in learning about, enjoying and caring for the nature around them and have developed important emotional connections with nature" (Beatley & Newman, 2013, p. 3331).

For example, across Australian cities there are networks of citizen groups whose members spend their free time working in urban areas that benefit the community or the environment. There are over one hundred different groups form the *Habitat Brisbane* organization whose objectives are "…conservation and restoration of biodiversity, education and awareness, and community cohesion" (Beatley, 2009, p. 75). Table 3 presents a comprehensive list of the key characteristics by which a biophilic city might be

described or defined.

Table 3 – Important dimensions of biophilic cities (Beatley & Newman, 2013)

Biophilic Conditions and Infrastructure • Percentage of population within a few hundred feet or meters of a park or green space • Percentage of city land area covered by trees or other vegetation • Number of green design features (e.g.. green rooftops, green walls, rain gardens) • Extent of natural images, shapes, forms employed in architecture and seen in the city • Extent of flora and fauna found within the city
Biophilic Behaviors, Patters, Practices, Lifestyles • Average portion of the day spent outside • Visitation rates for city parks • Percent of trips made by walking • Extend of membership and participation in local nature clubs and organizations
Biophilic Attitudes and Knowledge • Percent of residents who express care and concern for nature • Percent of residents who can identify common species of flora and fauna
Biophilic Institutions and Governance • Priority given to nature conservation by local government • Percent of municipal budget dedicated to biophilic programs • Existence of design and planning regulation that promote biophilic conditions (e.g. mandatory green rooftop requirement) • Presence and importance of institutions (e.g. museums) that promote education and awareness of nature • Number/extent of educational programs in local schools aimed at teaching about nature • Number of nature organizations and clubs of various sorts in the city, from advocacy to social groups

Resilience is another aspect of biophilic cities. Godschalk, describes a resilient city as "…one that – would be capable of withstanding severe shock without either immediate chaos or permanent harm … While they might bend from hazards forces, they would not break. Composed of networked social communities and lifeline systems, resilient cities would become stronger by adapting to and learning from disasters" (Godschalk, 2003, p. 203). There are direct and indirect links between biophilic cities and resilience. Direct links for example are restoring wetlands and planting trees which leads to reduced extreme temperatures and flooding. For example, New Orleans has been increasingly vulnerable to flooding due to a long history of altered wetlands. Indirect connections between biophilic design and resilience is when natural elements stimulate healthy behaviors like exercising which lead to increased resilience when it comes to people's health (Beatley & Newman, 2013, p. 3333).

3.23 Gaps in Research

There are examples of cities that are starting to integrate natural elements back into dense urban environments implementing principles of biophilic design. For example, "Singapore is working in many ways to integrate nature into denser, vertical urban environments, through a mix of regulations, subsidies and research and development. Green walls and rooftops, an urban trails network (known as "park connectors"), impressively restored urban waterways, and schoolyard gardens, are some of the ways Singapore is working to bring about its vision as a *city in a garden*" (Beatly, 2015). However, there are few examples of communities and cities that are built with these principles from their inception. This transition is necessary as most cities were constructed in a time where industry was priority and the effects of concrete urban jungles on our physical, emotional and spiritual wellbeing was unknown. However, as we build the *infrastructure for transition* we will want to incorporate these principles as foundational pillars and build cities and communities where integrating these principles are a primary consideration.

There are several existing communities or ecovillages, such Tamera in Portugal, Auroville in India and Damanhur in Italy to name a few, that understand the value and necessity of being deeply enmeshed within natural elements and are built biophilically from the ground up. Joubert & Dregger speak about the importance of Nature integrated within communities: "Ideally, every village and every city on this planet would become an ecovillage or a green city, with eco-neigbourhoods. We seem to think that we cannot live on this Earth without destroying the very foundations that our life rests upon. But ecovillages showcase what old wisdom traditions taught us: that communities can both sustain and regenerate life through intelligent and loving interventions. In community, we can replenish soils, diversify ecosystems, replant forests and purify waters; we can heal wounds of the past; find solutions; we can live in a web of fulfilling human relationships" (Joubert & Dregger, 2015, p. 209).

Biophilic design reminds us of what we already know intuitively. Pyle confirms this stating, "Ultimately, reconnecting people with nature is a nonsense phrase, for people and

nature are not different things and cannot be taken part. The problem is, we haven't figured that out" (R. M. Pyle, 2003, p. 206). The ecological worldview holds this truth at its core and demands an integrated approach between how mankind and nature co-exist in an interconnected web of life. Of course, humans must erect shelter, housing, buildings, cities, but doing so does not necessitate a complete separation from Nature. It is the act of integrating Nature into our built environments that will shift our wellbeing, foster a connection to place and help address some of issues we face in dense urban environments.

Only when we can return to a dynamic equilibrium will we start to truly see a transformation. The ancient traditions have always known the physical, emotional and spiritual necessity of living connected to Nature. However, it is evident that a greater consciousness is required to foster our remembering and our healing. Perhaps communities and cities built with biophilic design principles as an integral feature will serve as that reminder and set a precedent for the environments we choose to live in.

This choice is of course a dynamic principle. Nature is organic, always adapting and continually evolving. If we are to build from this ideology, our systems and structures from which we create must also be aligned to these principles. This leads us to our final discipline, Living Labs, which allows us to create a context of constant learning, iteration and conscious evolution.

3.3 Living Labs

3.31 Living Labs Defined

A Living Lab is a research concept defined as "a user-centric, place-based, open-innovation ecosystem that allows for co-creation, exploration, experimentation and evaluation of innovative ideas in real life use cases" (Leminen, Westerlund, & Nyström, 2012, p. 6). Living Labs often occur in a territorial context like real life cities, or communities.

The user communities in Living Labs are not only seen as subjects but as co-creators who are embedded in an experiential learning environment to design and experience their own future. The philosophy of the Living Lab is to create a container for an organic, living, evolving, adapting, experiment. The role of the subject in a Living Lab environment is multi-faceted, especially when compared to traditional consumer research (Kusiak, 2007, p. 863). This approach is used for designing and experiencing real-life scenarios and evaluating their potential impacts before implementation (Almirall & Wareham, 2011, p. 88).

Living Labs emerged as a concept in the United States in the 1990s to describe student-run projects to solve large-scale problems in their neighborhoods such as transportation and trash removal (Bajgier, Maragah, Saccucci, Verzilli, & Prybutok, 1991, p. 7). After William Mitchell of MIT used the concept as a user-centric methodology for studying smart homes, Living Labs got the attention of an international audience (Dutilleul, Birrer, & Mensink, 2010, p. 62). In 2006, in efforts to promote a common innovation system, the European Commission created The European Network of Living Labs (ENoLL), which now comprises 212 members. Apart from Europe, Living Labs also have a presence in China, Taiwan, Brazil, South Africa and Mozambique (Almirall & Wareham, 2011, p. 10).

There are a number of ways in which Living Labs are organized. The research of Leminen, Westerlund and Nyström studies the various approaches and puts forward four types of Living Labs: utilizer-driven, enabler-driven, provider-driven and user-driven. Each type differs in terms of their activities, structure, organization, and coordination. Table 4 offers a summary of the different types of Living Labs.

Table 4 – Characteristics of different types of living labs (Leminen et al., 2012)

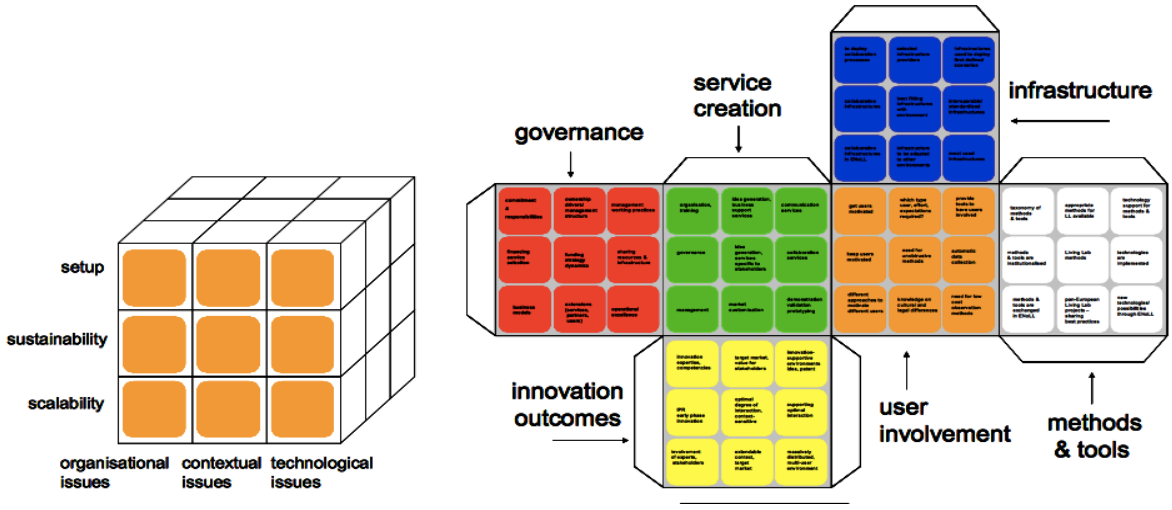
Characteristics	Types of Living Labs			
	Utilizer-driven	Enabler-driven	Provider-driven	User-driven
Purpose	Strategic R&D activity with preset objectives	Strategy development through action	Operations development through increased knowledge	Problem solving by collaborative accomplishments
Organization	Network forms around an utilizer who organizes action for rapid knowledge results	Network forms around a region or a funded project	Network forms around a provider organization(s)	Network initiated by users; lacks formal coordination mechanism
Action	Utilizer guides information collection from the users and promotes knowledge creation that supports the achievement of preset goals	Information is collected and used together and knowledge is circuited in the network	Information is collected for immediate or postponed use; new knowledge is based on information that provider gets from the others	Information is not collected formally and builds upon users' interests; knowledge is utilized in the network to help the user community
Outcomes	New knowledge for product and business development	Guided strategy change into a preferred direction	New knowledge supporting operations development	Solutions to users' everyday life problems
Lifespan	Short	Short/medium/long	Short/medium/long	Long

The details of the user-driven Living Labs are particularly interesting because of the methodology of this proposed research. Leminen, Westerlund, Nyström describe, "User-driven labs are established by user communities with the aim to solve specific problems in a way that is consistent with their values and requirements. Value is co-created mainly for the user community, but the companies and society in general also benefit indirectly. User-driven Living Labs are long-lived, because they are built around the user community … The activities in user-driven living labs are informally organized… User-driven living labs are characterized by the bottom-up principle. Therefore, the other actors in the network participate by supporting the users in terms of providing resources, knowledge, equipment, mentorship, or guidance. Information about the users and usage is collected and utilized in the network, whereas the resulted innovation may be later applied and commercialized by the participating companies in a different application or customer context" (Leminen et al., 2012, p. 7).

Dutilleul, Birrer and Mensink argue that "the very notion of 'user-driven' development is dubious because driving an innovation process effectively requires coordinating the other stakeholders, understanding the various perspectives as well as synthesizing skills and decision-making power. 'The user' cannot possess the required combination of knowledge, skills and powers. Even if such a user would be engaged, she is unlikely to be able or willing to do such work without substantial compensation and thus formal involvement with the innovating organisation" (Dutilleul et al., 2010, p. 65). Indeed this is a fair criticism, especially in a situation where the innovation is being researched or studied simply for commercialization or profit-gain. However, under the circumstances that a user or community is involved in a Living Lab to experience an alternative set of values or to be apart of creating a paradigm that requires experimentation outside of the current system, a different level of involvement and incentivization can be created.

An interesting outcome of a user-driven Living Lab is that the community may gain insights and be able to share it with another Living Lab within its network. This would reveal and replicated innovations that can apply to other contexts and cultures and those that are unique to place. In order to enable shared methods and tools from the European Network of Living Labs, Mulder, Velthausz, & Kriens introduced The Living Labs Harmonization Cube (Figure 2). "This is a framework that enables the definition of a shared reference of methods and tools. The cube recognizes these exchange possibilities and explicitly defines interoperability elements from organizational, technical, and contextual points of view in which different standards might apply in order to support seamless collaboration in each of these dimensions" (Mulder, Velthausz, & Kriens, 2008, p. 8).

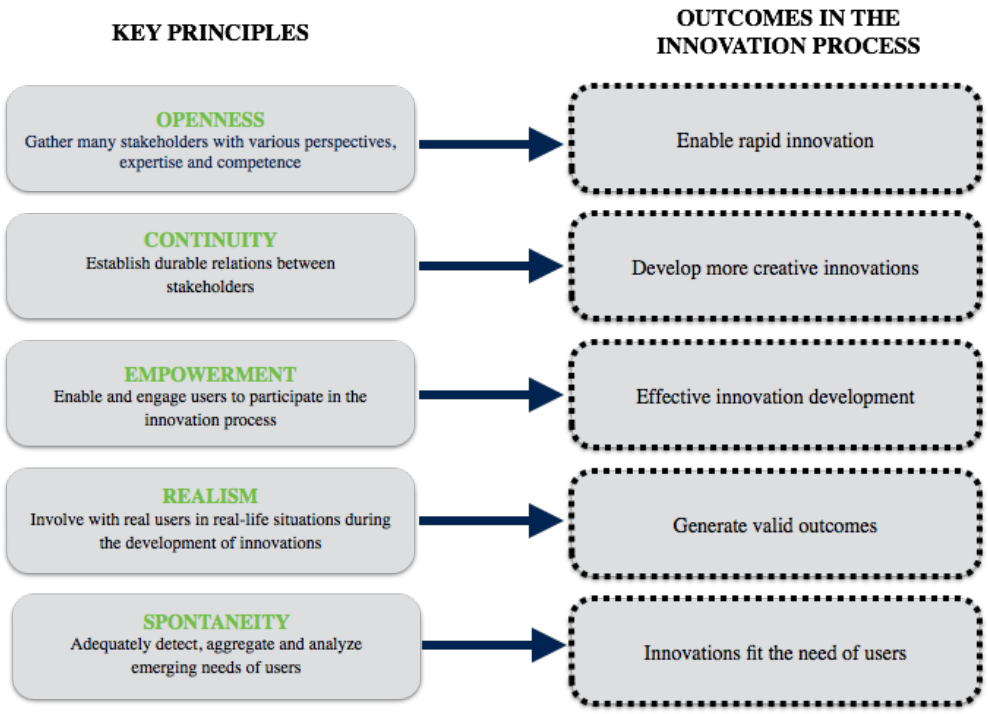
Figure 2 – The Living Labs Harmonization Cube (Mulder, Velthausz, et al., 2008).



A study conducted by CoreLabs for the European Network of Living Labs identified the five key principles that characterized the methodology of Living Labs. These include openness, continuity, empowerment, realism and spontaneity or '*CORES*' (CoreLab, 2010). These principles and, as a result, the outcomes of the innovation process summarized in Figure 3, represent what separates Living Labs from other methodologies for innovation and guide what should "permeate throughout all living labs' activities" (Bergvall-Kåreborn & Ståhlbröst, 2009).

Derived from the description of the key principles are specific outcomes. Living Labs help develop new innovations more effectively. The key principles suggest what approaches should be implemented to reach the desired outcomes. "For example, the key principle of 'empowerment' states that, in order to innovate more effectively, Living Labs should enable and engage users to participate in the development of innovations" (Humble, 2014, p. 13). The key principles for Living Labs and their desired outcomes are listed below in Figure 3.

Figure 3 – Key Principles and Outcomes of Living Labs (Humble, 2014)



Openness as a key principle refers to ensuring the innovation process is open allowing for multiple stakeholders, various perspectives, and expertise all to create the conditions to achieve rapid innovation. This principle is especially important in supporting a user-driven innovation process, including users wherever and whoever they are (Humble, 2014, p. 16).

Continuity as a principle encompasses establishing durable relations between stakeholders since good collaboration builds on trust and ultimately strengthens creativity and innovation (Humble, 2014, p. 17).

The empowerment of users is fundamental for a successful innovation process. The efficiency of Living Labs is based on the how engaged the user communities are so it becomes important to enable and empower users to be engaged fully (Humble, 2014, p. 18).

The principle of realism is fundamental to the Living Labs approach as facilitating realistic use situations and behaviors creating the conditions for valid outcomes. Creating a real environment is what distinguishes Living Labs from other kinds of open co-creation environments (Humble, 2014, p. 21).

The principles of spontaneity coincide with the outcomes of creating innovations that are fit for the need of users. In order to success with new innovations it is important to have the ability to detect, aggregate and analyze the spontaneous reactions and needs (Humble, 2014, p. 23).

A sub-sect of Living Labs that is emerging are social innovation labs which create a space of experimentation to generate solutions for society's complex and pervasive challenges. Westley and Taban explain the need for these types of innovation processes, "Scientists and activists concerned about the future of human society and the planet have pointed to the urgent need for what they term sustainability transitions. In other words, due to the complex, systemic and interrelated nature of the serious social, economic and environmental problems confronting us, we need entirely new forms of solutions. Clearly, we humans must learn to think differently about our complex world and to work together in unusual and very strategic new ways. We need to more fully see and understand the systems within which we all exist so that we can learn to identify and create conditions for social innovation" (Westley & Laban, 2015, p. 37).

Although social innovation labs are a pioneering model, there are challenges associated with their successful implementation. Currently, many labs have issues with securing the proper funding. This impacts decisions about which interventions are possible and the duration that these labs can be trialed (Schon, 2014). Additionally, the participatory and user-driven qualities of these labs have been criticized. Edwards-Schachter and Tams argue that, "…social and power dynamics have been largely overlooked in the literature around Living Labs, and the lack of focus on this issue may present a barrier to truly participatory innovation" (Tams & Edwards-Schachter, 2013, p. 13). Another challenge is

the transferability of solutions from one lab to alternative environments. The harmonization cube discussed earlier is one methodology that can be implemented to help in the application of different contexts however, there exists a level of risk involved when attempting to scale solutions. "Although a strength of labs is their ability to rapidly prototype and alter interventions which are targeted to specific problems and communities, it becomes much harder to manage risk when trying to replicate an intervention at scale" (Schon, 2014, p. 41). This is a concern that labs will have to address if they are to effect large-scale or systemic change.

When complex, large-scale, long-term challenges are the subject of research creating a container for the unfolding to emerge is required. Ecovillages or intentional communities that operate outside the current system provide a sandbox for experimentation. "Ecovillages combine a supportive and high-quality social and cultural environment with a low-impact way of life. They are precious playgrounds in which groups of committed people can experiment to find solutions for some of the challenges we face globally. Rapidly gaining recognition as demonstration sites of sustainability in practice, ecovillages naturally become places of inspiration within their regions and societies. Within them, new approaches can be seen, tasted and touched" (Joubert & Dregger, 2015, p. 212).

3.32 Living Lab Inspired Communities

As we delve deeper into the influence of Living Labs on communities, we find linkages that suggest positive effects such as prosperity, purpose and empowerment. Walt, Buitendag and Zaaiman suggest that, "To effectively design world-class sustainable and prosperous communities, innovation approaches such as Living Labs, are urgently needed" (Walt, Buitendag, & Zaaiman, 2009, p. 422). They propose that, "These collaborative systems will engage and empower communities to experiment and learn in real-world environments to create innovative solutions to their problems" (Walt et al., 2009, p. 7). They make the conclusion that Living Labs are gaining in popularity, especially in developing communities, because resources and technology are not easy to acquire. Rather than imposing external solutions, local users play significant roles by

identifying their own needs and formulating their own demands, thereby shaping solutions in their region through participatory design. They propose that, "Living Labs can function as a springboard to prosperous communities to build entrepreneurial capacities and achieve sustainable continuous improvement" (Walt et al., 2009, p. 422). Mulder et al. highlighted that "…within the South African rural context Living Labs will provide community-based solutions that will be scalable and replicable on the African continent" (Mulder, Bohle, et al., 2008, p. 8).

The following section explores two examples of a Living Lab community – *Reconstructed Living Labs (R-Labs)* based in South Africa and St. Clair County Community College in Michigan, United States.

R-Labs

R-Labs is a community-driven Living Lab that creates an environment for social innovation and reconstruction of lives through technology. R-Labs is an example of a Living Lab because it is place-based in Bridgetown, a depressed township in Cape Town. It's an open-innovation ecosystem that co-creates with it's participants new technologies and innovations to reconstruct the lives of ex-gang members and at-risk individuals. R-Labs was started in 2007 in Bridgetown where there were few opportunities for employment or education. Drugs, gangs and violence are a harsh reality for most of the community. Within this context, R-Labs offered a technology literacy program as an avenue for entrepreneurship and skill development. They created a space where people could feel secure resulting in a sense of hope.. "It was this sense of hope that empowered the change they experienced. That change opened up new possibilities and opportunities. By exploring and learning, these youth were becoming innovative, thinking outside the box about new and innovative ways to use technology to help others and to give back to their communities" (Low, Alexander, & Bonnici, 2014). The R-labs concept started gaining momentum as more people from the community started to take interest at the profound changes taking place. The R-Labs members understood the critical need for drug counseling services in townships and how incredibly difficult it was for substance abusers

to gain access to such services given the 6-12 month waiting period for most facilities. However, with mobile devices and chat functionality, people could receive discreet, immediate, inexpensive counseling. From this seedling, blossomed a drug-counseling service facilitated by mobile technology that had been accessed up to 27 million times. By combining technological innovation with first-hand knowledge about the community, R-Labs was able to create a valuable service (Parker, 2015). R-Labs has now established itself as a "global movement that provides innovative solutions to address various complex problems" and has gained international attention. It is now an engine of the community, providing access to education, skills training, employment opportunities and social innovation incubation (Parker, Wills, & Wills, 2010).

St. Clair County Community College

Michigan's St. Clair County Community College has transformed its 25-acre campus into a sustainable Living Laboratory. "Green roofs dot the tops of buildings, a bio-swale cleans tens of thousands of gallons of rainwater, and solar panels, wind turbines, and a geothermal field generate energy to power computer labs and other facilities"(Cohen & Lovell, 2013, p. 6).

A campus is a community where these projects can both reduce the college's environmental impact and provide its community-members (students and faculty) real-world, tangible learning opportunities. It also enables students to understand the interdependence of local environmental challenges empowering them as agents of change who can shift communities to become models of sustainability. Additionally, it makes for a more productive and environment that facilitates learning through the lived experience of the living lab, "63% of these institutions report that these spaces have improved student productivity and test scores" (Cohen & Lovell, 2013, p. 7).

The opportunity to make each college campus a Living Laboratory is immense. Only the environmental programs and faculty typically employ experiential learning as it relates to sustainability. However, changing behaviors and shifting paradigms about our

consumption and how we engage with the environment affects us all and is everyone's responsibility.

3.33 Gaps in the research

Living Labs have a strong focus on research and development for corporations and organizations in terms of product design, technology application, and solving localized social problems. They tend to be focused on very specific outputs rather than observing the entire system and how all aspects affect one another. Social innovation labs look at more complex, systemic issues but struggle in establishing labs that are properly funded and aren't affected by power dynamics. Ecovillages and intentional communities are examples of user-driven Living Labs that focus on holistic systems and are experiments in the areas of economy, ecology, social and architecture outside the current system. The aim of this proposed research is to create a model for a Living Lab with planetary scale and implications. Most Living Labs have been successful in their localized regions but have not been able to create a set of principles that can transcend borders. In addition, there is no record of a Living Lab that is intentionally built to explore the systemic application and integration of Biomimicry and Biophilia.

3.4 Literature Review Summary

In summary, the literature review explored the following research question: *How can the principles of Biomimicry, Biophilia, and Living Labs be integrated and systemically applied in communities?* The three areas of study that were analyzed in the literature review are: Biomimicry, Biophilia and Living Labs.

In light of the ecological worldview, two main premises must be adhered to:

1. the whole system in aggregate must be investigated rather than each part looked at in isolation;
2. humankind is a part of Nature rather than separate from it.

From the literature it is apparent that fields of Biomimicry, Biophilia and Living Labs are interrelated but their application has remained siloed. If Biomimicry, by definition, is

about mimicking blueprints from Nature and is not required to resemble it's organic host, then if implemented in isolation, it may very well perpetuate our disconnection from Nature. Kellert says, "Biomimicry exploits knowledge of nonhuman nature to advance human material interests, but in doing it carries the potential to ignore or even at times be in opposition to people's physical and mental proclivities to affiliate with natural systems and processes" (S. Kellert, 2014, p. 48). However, Biomimicry and Biophilia are not in opposition. In fact they are complementary in their philosophies and are alike in Nature's logic that governs all species. They converge as they both seek to enrich the human condition through better understanding and connection with the natural world. Benyus eloquently describes the essence of origin, "The conscious emulation of life's genius is a natural part of biophilia…to be drawn to life's mastery and to try, with equal parts of awe and envy, to do what birds and fish and insects do…The act of asking nature's advice, of valuing nature for its wisdom, bridges the distance that has developed between humans and the rest of nature. In this way, biomimicry is a process of homecoming akin to biophilia" (Benyus, 2008, pp. 39–40).The characteristics of Living Labs, especially openness, continuity, realism, and spontaneity also mimic Nature in the way that it provides an adaptable, organic container for which to experiment free from limiting structures. The Living Labs approach allows for experimentation in a way that mimics the layers and systems that exist within Nature. Within this context, the potential to create new possibilities that are in line with the natural world are greater. Only when these concepts are deliberately taken into consideration from the inception of an idea may we start to see the seeds of hope from their core blossom.

From the literature it is apparent that these areas of study have been explored from the mechanistic worldview, meaning that our living systems are looked at like mechanical systems – as a collection of parts that can be studied and fixed in isolation (Hes & Du Plessis, 2014, p. 27). There lacks discourse around the systems in question. Nature is integrated, but it is our compartmentalization and separation that is causing the disconnect. Currently there is a lack of integrated solutions for how we can build living systems in accordance with Nature that stems from the ecological worldview. Even the concepts of

Biomimicry, Biophilia and Living Labs which are aligned with the ecological worldview in essence, have been co-opted and force-fitted into the mechanistic worldview.

It is understood that for simplicity's sake, parts are looked at in isolation; however, the time has come to step back from that paradigm and consider the whole. The literature review illustrates that there is still an inclination to separate the field of vision to focus on siloed problems rather than approaching the systems in question. It is also apparent from the literature that the studies conducted have been explored from the top-down rather than a bottom-up approach, which inherently makes the process exclusive to corporations, organizations, and/or governments with large amounts of resources and capital rather than citizens motivated by justice, sustainability and symbiosis with Nature.

The proposed research will be conducted through the lens of the ecological worldview while maintaining the integrity of Biomimicry, Biophilia and Living Lab as concepts. It will explore the integration of solutions and systemic implications of what it means to build communities and living systems in accordance with nature.

4.0 Research Methodology

4.1 Introduction

As this study is based in the ecological worldview, the methodology and methods selected will reflect a more collaborative, experiential and bottom-up approach. The following section will discuss the research theory, strategy, approach and design.

4.2 Research Theory

4.21 Inductive

Goddard and Melville, describe inductive theory as a study that commences by collecting data relevant to the topic of study and then identifying themes and patterns in order to formulate a theory (Goddard & Melville, 2004, p. 32). The inductive theory allows the researcher to use observations to describe a picture of the phenomenon being studied (Lodico, Spaulding, & Voegtle, 2010, p. 16). For the proposed research this is the most

appropriate approach since this is a new area of study and the theory does not yet exist to prove or disprove.

4.3 Research Approach

4.31 Ontology

Ontology is defined as what is believed to be the nature of reality. This research is undertaken from a constructionist ontology which asserts that reality is socially constructed by the individuals experiencing it and is therefore a result of the context in which the phenomena happens (Gergen, 2009, p. 21). According to Bryman and Bell, "Constructionism implies that social phenomena are not only produced through social interaction but they are in a constant state of revision" (Bryman & Bell, 2011). Each case study that will be researched is unique and as such is best examined from within a research ontology that values and validates this uniqueness.

4.32 Epistemology

Carson et al. describe epistemology as "…the relationship between the researcher and reality" (Carson, Gilmore, Perry, & Gronhaug, 2001, p. 83). This study comes from an interpretivist position, which asserts that, "Reality is multiple and relative". Lincoln and Guba explain, "these multiple realities also depend on other systems for meanings, which make it even more difficult to interpret in terms of fixed realities (Lincoln & Guba, 1985, p. 113). The interpretivist position adopts more personal and flexible research structures which are receptive to capturing meaning in human interaction and making sense of what is perceived as reality (Carson et al., 2001, p. 84). Within this study it will be important to for the researcher to understand motives, meanings, reasons and other subjective experiences (L. W. Neuman, 2000, p. 77) which this epistemology recognizes and acknowledges.

4.4 Research Strategy

4.41 Qualitative Methodology

Qualitative methodology is proposed in order to provide a depth of understanding that is unquantifiable. Bricki & Green suggest that in situations where little is known, such as this study, it is best to start with qualitative methods. "These methods aim to answer questions about the 'what', 'how' or 'why' of a phenomenon rather than 'how many' or 'how much', which are answered by quantitative methods" (Bricki & Green, 2007, p. 11). Due to the emphasis on understanding people's experiences, perspectives, behaviors, motivations and attitudes, it is essential that the methods used in this research are qualitative. Although the nature of this method limits the sample size it provides greater depth and insight. The qualitative methods, discussed in greater detail in the section below, utilized in this research will be interviews, focus groups, observation, examination of cultural artifacts and conducting secondary research.

4.42 Case Study

Researcher Robert K. Yin defines case study research as, "An empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used" (Yin, 2009, p. 62). He poses that is best applied in studies when: 1) answering 'why' and 'how' research questions, 2) the researcher does not require control over behavioral events and 3) when the focus is on contemporary events (Yin, 2009, p. 63). According to Eisenhardt, "Building theory from case study research is most appropriate in the early stages of research on a topic" (Eisenhardt, 1989, p. 532). Case study methodology allows for serendipitous findings that may lead the research to take new directions because it does not rely on previous literature or prior findings. The flexibility that this methodology provides is particularly pertinent because it will allow the researcher to further explore emergent themes during the course of the study.

This study will use a multiple case study approach. Three case studies will be studied in the research in order to make comparisons, identify patterns and build theory. The unit of

analysis to be explored is how these principles manifest on a systemic level within communities and the points of interaction between them. More detail about which case studies were selected and how they were chosen will be discussed in the section under Research Design.

4.43 Rapid Ethnography

Ethnography is described as “The branch of anthropology that involves trying to understand how people live their lives” (Anderson, 2009). Anthropological researchers place themselves in the environment of their subjects to observe and listen with the goal of seeing people’s behavior on their own terms (Handwerker, 2001, p. 96). As Hammersley states, “The task [of ethnographers] is to document the culture, the perspectives and practices, of the people in these settings. The aim is to ‘get inside’ the way each group of people sees the world” (Atkinson & Hammersley, 2011, p. 248).

Ethnography places researchers at the core of the study, allowing them an inside look into the culture they are investigating. Such a role gives researchers valuable insights and nuance into their subject, which usually cannot be achieved simply by studying secondary sources (Golafshani, 2003, p. 597). Traditional ethnography is very time intensive. "Typically, ethnography will take place over a period of several months with at least the same amount of time spent in analysis and interpretations of the observations” (Millen, 2000, p. 280). In most cases, it isn’t possible to spend an extended amount of time, weeks or months, in the field gathering data. Nevertheless, the benefits of observing in the field are plentiful. In these situations a branch of ethnography named *rapid ethnography* is used. Rapid ethnography, "… is a collection of field methods intended to provide a reasonable understanding of users and their activities given significant time pressures and limited time in the field” (Millen, 2000, p. 283).

The objective of this method is to seek the most relevant information as quickly as possible. However, researchers must accept that getting a complete and detailed understanding of everything is an unlikely possibility. As mentioned earlier the proposed research is not intended to be an ethnographic study, however, rapid ethnography will be

used to gather additional data. Utilizing this methodology will provide insight from a variety of different sources that will aid in informing the prototype design.

4.5 Research Design

The following section will outline the research in a two-phase approach, I) Community Assessment and II) Expert Discovery, and the associated methods.

4.51 Phase I: Community Assessment

The objective for the community assessment phase of research is to acquire knowledge and understanding of how the Biomimicey, Biophilia and Living Labs currently exist, where they interact and the potential for their application on a systemic level within a community. Table 5 outlines the research design for the first phase of research.

Table 5 – Research Design: Community Assessment

Task	Method	Sampling
Research case study communities to understand if and how Biomimicry, Biophilia and Living Labs currently exist, their points of interaction and their potential to be implemented on a systemic level	• First-hand site observation • Semi-structured interviews with founders and members (3 per community) • Examination of cultural artifacts and secondary sources	Maximum Variance

4.52 Phase II: Expert Discovery

The objective for the expert discovery phase of research is to inquire with trained academics and practitioners in the respective fields to gain an informed opinion on the integration and systemic applications of these principles. Table 6 outlines the research design for the second phase of research.

Table 6 – Research Design: Expert Discovery

Task	Method	Sampling
Understand perspectives of experts in each subject area and thoughts on interaction points and applications of principles within communities on a systemic level	Semi-structured interviews with experts (3 per field)	Expert Sampling

4.6 Sampling

4.61 Purposive Sampling

For the first phase of the research, purposive sampling has been selected. "Purposive sampling relies on the judgment of the researcher when it comes to selecting the units that are to be studied. The sample being investigated is quite small, especially when compared with probability sampling techniques. However, the goal of purposive sampling is to focus on particular characteristics of a population that are of interest, which will best help answer the research questions" (W. L. Neuman, 2011, p. 80).

4.62 Case Study Sample Selection

Specifically for the Phase I, the type of sampling used will be maximum variation sampling. According to Leedy and Ormord, "This sampling technique is used to capture a wide range of perspectives relating to the subject that you are interested in studying. The basic principle behind maximum variation sampling is to gain greater insights into a phenomenon by looking at it from all angles" (Leedy & Ormrod, 2010, p. 77). Therefore, this technique will help identify common themes that are evident across the sample.

The three case studies selected for the research proposal are outlined below in the table. Ecovillages are traditional or intentional communities whose goal is to become more socially, culturally, economically and ecologically sustainable. For the purposes of this research the term 'ecovillage' and 'community' are interchangeable. Prior to selection of

case studies, the researcher conducted desk research in addition to conferring with thought leaders in the alternative community arena, including members of *Global Ecovillage Network* (GEN). As described earlier, GEN is a global organization that supports and creates the connective tissue between ecovillages to "…envision a world of empowered citizens and communities, designing and implementing their own pathways to a sustainable future" ("Global Ecovillage Network," 2014). GEN defines ecovillages as, "intentional or traditional communities, consciously designed through locally owned, participatory processes to regenerate social and natural environments"(Joubert, 2015, p. 2). GEN describes the shared vision and values of an ecovillage as "Designing its own village and own lifestyles, living in harmony with nature, becoming guardians of the surrounding nature, celebrating their cultural identity and diversity, upholding human rights for all, supporting oneness and solidarity, while helping each individual to find his or her unique way of serving the whole" (Joubert, 2015, p. 4). More characteristics that ecovillages share are summarized in Table 7 below.

Table 7 – Guidelines for Ecovillage recognition

Best cultural practices	Best social practices	Best ecological practices	Best economic practices
Connecting to a higher purpose in life/spiritual practice,	Strengthening community and embracing diversity	Sustainable water management and clean energy	Significant collective ownership of land, water and resources
Growing awareness about the impacts of modernization,	Participatory decision-making processes,	Organic agriculture and permaculture	Strengthen local economy: barter systems, microcredit, local currencies, diverse income streams and green enterprise,
Honouring traditions that are good for the people (and eradicating practices that harm human dignity),	Conflict facilitation and peace-building skills, recognizing and empowering leadership of those willing to serve the community,	Natural and traditional healing methods for humans and animals	Work towards economic justice and building bridges between rich and poor
Political activism for justice	Building networks and alliances	Ecological and traditional building methods	Engage in ethical and transparent fair trade
Celebrating life: the people's dance, music, art.		Conservation and restoration of ecosystems	Develop appropriate legal forms and transparent administration for our organisations

The ecovillages selected all share these characteristics and a common mission towards regenerating social and natural environments. However, they are very diverse in their dominant worldview and have unique propositions. Table 8 outlines the selected case studies and the unique proposition of each.

Table 8 – Selected Case Studies

Case Study	**Self-Described Proposition**
Auroville (India)	Universal Town to Realize Human Unity
Damanhur (Italy)	A Laboratory for the Future of Humankind
Tamera (Portugal)	School and Research Station for Realistic Utopia

Apart from their unique propositions, these communities vary in geography, size, and culture. In addition, an important criterion was to select communities that are long-lived having been around for at least 20 years. Details about each community are explored in section 4.8 Selected Case Studies. Finally, these communities were accessible within the budget constraints and time frame of this research study.

4.63 Expert Sampling Selection

For the second task in Phase I, expert sampling is the purposive sampling technique selected. This technique is used when a study needs to glean knowledge from individuals that have particular expertise (Bryman & Bell, 2011, p. 43). Due to the lack of empirical evidence of identifying the integration points and systemic application of Biomimicry, Biophilia and Living Labs to a community-model, drawing on the knowledge of experts in these areas of study will be helpful. Three experts within each subject area will be selected for the sample. The criteria for selecting experts are individuals who have experience in their respective field either as scholars or practitioners. They have published articles or papers within their field of study and are regarded by their peers as thought leaders. A one-hour phone or in-person interview was conducted with each expert. A sample discussion guide can be found in the appendix.

Biomimicry Experts

Dayna Baumeister has worked in the field of Biomimicry since 1998 as a business catalyst, educator, researcher and design consultant. She is the co-founder, alongside

Janine Benyus, and partner of Biomimicry 3.8. a social enterprise that trains, certifies and connects biomimicry professionals worldwide.

Claire Janisch is a Biomimicry professional and is the founder of BiomimicrySA, the regional biomimicry consultancy in South Africa. She is a sustainability and innovation advisor with a Masters of Science in Chemical Engineering. She has worked on several projects to revitalize communities through biomimicry.

Jamie Brown-Hansen is a managing partner of Biomimicry Switzerland where she resides. She has focused on regenerative financial architecture since 2005 and has an interest in interconnecting the community credit systems that are emerging through local networks worldwide to form a global, bottom-up exchange infrastructure for the mature human species.

Biophilia Experts

Helena van Vliet is a Biophilic architect and researcher. Her focus is where the built environment and health intersect. Helena considers architecture a health care profession and has made the design of spaces that foster a positive emotional connection her primary focus. She has served as a visiting critic at the University of Pennsylvania, a contributor at Human Spaces, and is a steering committee member for the international Biophilic Cities Network.

Timothy Beatly is a professor at the Department of Urban and Environmental Planning, School of Architecture at the University of Virginia, where he has taught for the last twenty-five years. Beatley's work focuses on creative strategies for communities and cities to reduce their ecological footprints and becoming more livable, equitable places.

Jonce Walker, a LEED AP and a Certified Sustainable Building Advisor, is an urban planner and senior project manager at Terrapin Bright Green, a large scale sustainable architectural firm, in their Biophillia Design Services department. His background

includes sustainability policy, green building, urban planning, and community building interventions.

Living Labs Experts

Dominuque Hes received a science degree from Melbourne University and followed this with a graduate diploma in Cleaner Production and a Doctorate in 2005 at RMIT University, Melbourne. Her research interests are identifying and filling the knowledge gaps in sustainability practice and application in the built environment. She is the co-author of *Designing for Hope: pathways to regenerative sustainability*.

Kosha Joubert is the President of the Global Ecovillage Network (GEN). GEN started in 1995 with an impulse to connect ecovillages from all over the world and support societies to transition into resilience. They are now connected to 10,000 ecovillages worldwide. Kosha is an international facilitator, trainer and consultant working extensively in the fields of curriculum development, international collaboration, community building, and sustainable development.

Dieter Van den Broeck is co-founder of Living Lands, an NGO in South Africa that builds multi-stakeholder partnerships to create collective action to restore resilient landscapes. He has experience in facilitating grassroots social change processes, ecosystem management, community building and social entrepreneurship.

4.64 Community Sampling Selection

For the community member interviews, three people per community were selected as interviewees. These individuals are founding members or have been immersed and involved in the community for 10+ years with knowledge about the pillars of community that are being explored –architecture, ecology, culture, and economy. The first names of the interviewees are listed in Table 9 below in addition to a short description that explains their position in the community.

Table 9 – Community Member Interviewees

Auroville	
Marti	Worked in environmental education, spiritual philosophy, youth and cultural programs
Luigi	Responsible for the conceptual planning and design of Auroville
Lalit	Works with volunteers and students on the building and architecture of Auroville
Damanhur	
Gazza	Member of Damanhur's worldwide outreach team and educator in the Alchemy School
Macaco	Coordinator of International Community Relations and Former President of Global Ecovillage Network
Formica	Coordinator of the Public Relations office
Tamera	
Vera	Key community member and organizer; raised in Tamera, is a Global Campus Coordinator and Member of the Tamera Government
Martin	Lived at Tamera since he was 16 years old. Coordinator of the Terra Nova School and the Political Department
Bernd	Leads the Global Ecology Institute, which puts the practical work of Tamera´s ecology department into a global context

4.65 Sampling Selection Summary

This research will explore the points of integration and systemic application of the disparate but synergistic fields of Biomimicry, Biophilia and Living Labs. Using a case study approach and elements of rapid ethnography, the research will investigate existing communities and interview industry experts to glean insight into how these principles come together to illuminate a way forward for more resilient, self-sustaining communities that are in accordance with the ecological worldview.

4.7 Gathering Data

The following section describes how the data from the two research phases were collected and organized in order to prepare for the analysis phase of the research. The research question, *how can the principles of Biomimicry, Biophilia, and Living Labs be integrated and systemically applied in communities,* remained at the heart of the research and informed the data gathered during site observation, interviews with both community members and experts, as well as secondary sources.

4.71 Phase I: Community Assessment Data Gathering

The method of gathering data in the community assessment phase was three-fold including rapid ethnography, interviews and secondary sources. The unit of analysis is the interconnections between Biomimicry, Biophilia and Living Labs (the overlapping area in the center of the three circles) and how they manifest on a systemic level. See Table 10 below for a visual depiction of the data gathering for the community assessment phase.

Table 10 – Data Gathering: Community Assessment

	Auroville	**Damanhur**	**Tamera**
Rapid Ethnography			
Interviews			
Secondary Sources			

Rapid ethnography was a method used to collect data incorporating journaling about the experience of the community immersion, note taking about the observation of the occurrence of Biomimicry, Biophilia and Living Labs, photography, tours and immersions with community members, and interviews. The researcher needed to understand the culture of each community and what makes them unique which was achieved through a deep immersion with community members and time spent experiencing the different

community pillars with individuals who carried the knowledge of these respective areas (architecture, economy, culture, ecology). Attention was made to the occurrence of Biomimicry, Biophilia, or Living Labs within the community pillars and the interconnections between the three. Notice was also taken to whether these principles are applied systemically or in isolation.

The researcher visited each community and spent at least seven days immersed in each culture. Interviews ranging from 60-90 minutes were conducted with the selected interviewees at the community or after the initial site visit over the phone and then transcribed. The researcher explained Biomimicry, Biophilia and Living Labs and then asked the interviewee if there are any examples throughout the community that demonstrate these concepts. An example of the discussion guide can be found in the appendix.

4.72 Phase II: Expert Discovery Data Gathering

A one-hour interview with experts were conducted either in person or over the phone and transcribed. Within each discipline, common themes and interesting observations were identified. The same questions were asked across disciplines in order to reveal the similarities, differences and interconnections between the currently divergent, yet complementary, areas of study. The interview discussion guide can be found in the appendix.

Answers in these interviews were coded to reveal whether the discipline is applied systemically or in isolation, and whether the discipline is integrated across fields or exists in silos.

4.73 Data Analysis

The data was recorded on a matrix with the community pillars (architecture, ecology, culture, economy) organized in horizontal rows and the disciplines (Biomimicry, Biophilia, Living Labs) in the vertical columns. The data gathered was coded if it was an example of Biomimicry, Biophilia or Living Labs. Then coded to reveal the

interconnections between the disciplines and finally their systemic applications, or lack thereof. See Table 11 for the configuration of the matrix.

Table 11 – Data Gathering: Community Assessment Matrix Configuration

AUROVILLE	**How does Biomimicry manifest?** (applied systemically or siloed)	**How does Biophilia manifest?** (applied systemically or siloed)	**How does Living Labs manifest?** (applied systemically or siloed)	**Where are the points of intersection between these principles?** (applied systemically or siloed)
Architecture				
Ecology				
Culture				
Economy				

The following is an example that illustrates integration between all three principles. In Auroville, soil erosion and degradation of the land was being caused by cyclone-strong winds coming from the coast. Members of the community investigated the area and found that trees and vegetation used to line the coast before they were destroyed by deforestation. They started reforesting the area with a dense plantation of trees to act as a barrier, which has remedied the problem and restored the land. This is an example of the interconnections of Biomimicry, Biophilia and Living Labs applied systemically. Biomimicry, in this case, is emulating what was naturally protecting the coast prior to deforestation and implementing a multi-functional solution. In addition to protecting the coast, these trees also sequester carbon, regulate temperature and serve as a habitat for a diverse set of animals. Biophilia, is the use of Nature to create this barrier rather than cement or some other man-made contraption. Living Labs is the intention of the community to investigate and experiment with ecologically sustainable solutions to this problem. This observation and insight from an Aurovillian community member would be marked as shown in Table 12 on the matrix.

Table 12 – Data Gathering: Matrix for Data Analysis I

AUROVILLE	**How does Biomimicry manifest?** (applied systemically or siloed)	**How does Biophilia manifest?** (applied systemically or siloed)	**How does Living Labs manifest?** (applied systemically or siloed)	**Where are the points of intersection between these principles?** (applied systemically or siloed)
Architecture	Planting trees to create barrier was inspired by seeing what was there naturatlly prior to deforestation	Use of nature (trees and vegetation) to create barrier to protect land	Community investigates ecological and sustainable methods to create barrier	Reforestation of the East Coast has created a barrier against cyclone strong winds which has caused soil erosion and degratation of the land (systemically)
Ecology				
Culture				
Economy				

Another example that only shows an occurrence of one discipline without any interaction between the other disciplines is in Damanhur where citizens choose to adopt a plant and animal name to use everyday rather than their given name. The founder of Damanhur, Oberto Airaudi, is known as Falco Tarassaco that translates from Italian to Falcon Dandelion. This is an example of Biophilia since being identified in this way shows reverence and unity with the plant and animal kingdoms. This would be recorded in the matrix as shown in Table 13.

Table 13 – Data Gathering: Matrix for Data Analysis II

DAMANHUR	How does Biomimicry manifest? (applied systemically or siloed)	How does Biophilia manifest? (applied systemically or siloed)	How does Living Labs manifest? (applied systemically or siloed)	Where are the points of intersection between (applied systemically or siloed)
Architecture				
Ecology				
Culture			Many Damanhur citizens choose to adopt an animal and plant name, which they use everyday (systemically)	
Econony				

The interviews with community members were transcribed and the insights transferred to the matrixes as well as additional data points to supplement the site-observation. Interviews were used to augment what was not apparent or obvious from site observation.

Secondary sources, like the community's website or books that were written by the community founders, were referenced for more in-depth insight. These sources were also used to triangulate information and account for any bias.

4.8 Selected Case Studies

The following section describes the three case study communities that were selected, Auroville, Damanhur and Tamera, to give the reader more of an understanding of the sample selected.

4.81 Auroville

Mission

Auroville is located near Pondicherry in southern India and home to approximately 2400 people from 49 different countries. Founded in 1968 by Mirra Alfassa, also knows as "The Mother" and her spiritual collaborator Sri Aurobindo who had a vision to create a

"Universal Town to Realize Human Unity" ("Auroville," 2014). Auroville strives to create a place where people of all cultures, religions, and nationalities are able to live in unity and peace. Auroville is recognized as "an ongoing experiment in human unity and transformation of consciousness, sustainable living, and the future cultural, environmental, social and spiritual needs of mankind" ("Auroville," 2014). They conduct research in the realms of artistic expression, educational models, organic farming practices, water treatment, waste disposal, communitarian living and spiritual development.

Architecture

Auroville was conceptualized by The Mother who believed, "The city already existed in a subtle level. It is already constructed and that it is only necessary to pull it down, to make it descend on Earth" (Marti, Interview). The city is laid out in the form of a galaxy resembling a spiral with several lines that unwind from a central region. At the center stands the Matrimandir, the "soul of Auroville", a place for meditation and personal reflection ("Auroville," 2014).

Radiating out beyond the Matrimandir are four zones, each focusing on an important aspect of community life including: Industrial (north), Cultural (north east), Residential (south west) and International (west). Surrounding these zones is the Green Belt, which consists of forested areas, farms and sanctuaries. Even with this layout and infrastructure in place, the citizens of Auroville believe that, "The city is invented through the daily experience and rhythm of the Aurovilians. Everything is flexible, nothing is fixed" (Luigi, Interview).

Laws or societal conventions do not bind the architecture in Auroville, therefore varied expressions have manifested in the course of the community's development. Experimentation includes, "Building materials, building technology, eco-friendly architecture, climate responsive designs, integration with natural surroundings, cost-effective buildings, integrating rainwater-harvesting systems, waste water treatment systems and integration of renewable energy" ("Architecture," 2014). However varied, the architecture shares the purpose of promoting research and experimentation, community integration, and establishing a strong relationship with the environment.

Ecology

In Auroville living sustainably and close to nature is part of the ethos. The Green Belt acts as a zone for organic farms, orchards, forests, and wildlife areas. It serves as a source for food, timber, medicine and as a place for recreation. Only fifteen percent of Auroville's food is grown organically within the community and the remaining is sourced from local farmers in surrounding areas and near Pondicherry.

The Auroville community has been experimenting with small-scale wastewater recycling systems for over fifteen years. From this research they found the best solution is planted filters. "Now, more than 60 natural wastewater treatment systems are in use in Auroville. Most recycling systems combine a pre-treatment device, a main treatment planted filter, and a post-treatment holding facility, usually consisting of one or more ponds or polishing tanks" ("Decentralised Waste Water Treatment Systems in Auroville," 2015).

Auroville has become a center of research in waste, promoting the process of transforming water to energy and upcycling to create new products from waste.
The concern for climate change and the urge to have a smaller footprint is encouraging further innovation and application of renewable energy designs, systems, and modules in Auroville. The community continues to test and refine renewable energy sources such as bio-gas, solar, thermal and wind energy. The Matrimandir hosts the largest solar installation in India and the Solar Kitchen, which is equipped to cook for about one thousand people everyday, runs completely on solar energy ("Auroville," 2014).

Culture

With such a diverse community, there is no overarching religion that is practiced in Auroville. The belief within the community is, "The failure of religions is... because they were divided. They wanted people to be religious to the exclusion of other religions, and every branch of knowledge has been a failure because it has been exclusive. What the new consciousness wants is no more divisions" ("Auroville," 2014). Rather than a dogmatic religion, spirituality and self-realization is encouraged. At the heart of the community sits

The Matrimandir, a non-denominational temple, which provides a place for spiritual practice and personal reflection. There are several rules that must be abided once inside the temple and visitors must register beforehand and be accompanied by an Aurovillian in order to enter. Shoes must be removed and white socks are provided in order to enter. There is no group congregation that happens in the temple, rather there is a meditation space that people are welcome to use to delve into their individual consciousness.

The community strives to be a place rich in diversity where all of the world's people can come to live together and create a model of human unity. Many cultures come together in Auroville to create something emergent within the rural southern Indian context. Residents of Auroville are comprised of people from 50 different nations with the majority being: Indian, French, German, Italian, Dutch, American, Russian, Spanish, British, Swiss, Korean, and Israelis.

There are several administrative systems put in place to achieve order in Auroville. In lieu of a government, Auroville consists of self-formed committees that make decisions: Housing, Working, Women's Safety Task Force, Funds and Assets Management, Entry, International, Green Group, Board of Services. Beneath committees there are subcommittees and councils, startups and private groups, volunteers, and visitors. Any internal problems are handled by the Executive Council, but there are also a number of people skilled in conflict resolution who can mediate if necessary. An interviewee reflected, "Of course we have our differences and our disagreements, but the 'glue' that ultimately binds us is the shared aspiration to realize the ideal of Auroville together." (Lalit, Interview).

Economy

In the summer time many foreigners depart for up to six months to return to their home country to see family and earn a living. To live in Auroville, one must contribute funds to live in a home however; they are only deemed caretakers or stewards of the units they live in. A very modest maintenance is paid to Aurovillians for their services in the community. Auroville requires that you work for five hours per day in a capacity of your interest or

skill set, the rest of your time is meant for inner work. However, there is a large economic disparity between people that work in business, such as clothing design or woodworking versus social services, such as administration or teachers.

The community has several small and medium-scale industries ranging from skincare, crafts, clothing to musical instruments, woodwork, design services and technology. Thirty-three percent of profits from these enterprises are meant to be reinvested into Auroville, however, this protocol is not enforced and therefore not abided by across the board. An interviewee expressed frustration, "We can come up with great solutions but it's harder to implement and enforce" (Marti, Interview).

4.82 Damanhur

Mission

Damanhur, located in Turin, Italy, was founded from the inspiration of Falco Tarassaco in 1975. Damanhur, described as "A Laboratory for the Future of Humankind", has received attention as a community that experiments with sustainable ways of living. "Damanhur actively utilizes the practical application of science, research and a spiritual philosophy in harmony with the planet and has been recognized by the UN as a model for a sustainable society. Damanhur is both a social experiment and an innovative laboratory, where every vein of research is applied to a whole system that involves hundreds of people every day"("Damanhur," 2014). Damanhur is is home to an extraordinary subterranean work of art and architecture, a cathedral known as the *Temples of Humankind*.

Architecture

Ecological building materials and renewable energy sources, such as solar panels, geothermal and biomass heating are used in the Damanhur community. Green building in Damanhur begins with improving materials and energy conservation. The approach architects take is to begin with an analysis of what already exists with the intention of reusing materials as much as possible. If new materials need to be used, they are are all eco-friendly, such as clay, wood and natural lime. Many alternative solutions are intended to save energy, such as high thermal insulation and solar panel installation. Some

Damanhur homes are truly cutting-edge examples of houses with a Zero Carbon Footprint.

The Temple of Humankind rivals the most exquisite churches and have been compared to the pyramids. They are a collection of subterranean temples buried 30 meters in the earth with cathedral high ceilings, secret passageways, murals, ancient hieroglyphics and chambers allegedly used for time travel. The temple has seven different halls – Hall of Mirrors, Hall of Water, Hall of the Earth, Hall of Metals, Hall of Spheres, The Labyrinth, and The Blue Temple. Each room has a different purpose and features different artwork and energetic anchors.

Ecology

Damanhurians believe that "The planet is a living being to be respected and protected. In addition to cultivating a respect for nature, their ecological vision includes an awareness of how all of humanity is deeply connected with everything that surrounds us" ("Damanhur," 2014).

Damanhur has a closed-loop system using organic septic and wetland systems for grey and black water treatment, collecting rain water to be used in homes and using compost as fertilizer for agriculture.

Damanhur has always invested in acquiring numerous acres of woodlands that were often cut down by the previous owners to have wood for heating, suffering decades of intensive exploitation. In Damanhur's philosophy, "A forest is a magical place where the complexity of life is expressed in a harmonious interweaving of many forms of animal, plant and subtle life. The Sacred Woods Temple now has dedicated spaces for meditation and contact with trees and nature spirits. There are also intentionally placed spirals and labyrinths that form pathways amongst and around the trees" ("Damanhur," 2014). The sacred forest is located above the Temple of Humankind and is believed to be the antenna to the higher realms.

The desire for deep contact with nature, has led Damanhurians to develop an instrument that is able to capture the electromagnetic vibrations of the surface of plant leaves and roots, and turn them into sounds. *Music of the Plants* has inspired concerts in which musicians perform while accompanied by the music created by the trees. This device is now available to be purchased by the public and a version that can be operated by a smart phone is in development.

Culture

The citizens of Damanhur commit to an ongoing process of self-exploration and search for the meaning. This is facilitated through the study of ancient magical traditions and the celebration of the rhythms of nature. Spirituality is a state of mind and philosophy that governs the values of the community rather than a dogmatic set of rules. As the needs of the community have evolved, so have the practices. For example, the decision-making model has evolved to a system based on elected bodies, allowing for the true participation of all citizens.

Depending on an individual's level of commitment, Damanhur offers various options for citizenship from living full time in the community to living abroad yet staying connected to the Federation. "Citizens who choose the community formula live in large houses where residential groups are formed, called "nucleos," ranging from 15 to 25 people. In one dwelling, there may be couples, couples with children, singles, youth and elders. Everyone has their own private space and shares common areas like the kitchen and living rooms with others" ("Damanhur," 2014). Other citizens will choose to live elsewhere but be connected to Damanhur through its educational courses. Others will opt to create their own eco-community in other parts of the world but be affiliated with Damanhur and are considered part of the Federation.

The people of Damanhur are light hearted and jovial people who recognize that having a sense of humor is an important aspect of living a full life and accepting change with grace and ease. In Damanhur, union between all the people and involvement in community life is important, but the individual is a fundamental element of the collective. One

interviewee explained, “Community means *union between individuals*, which signifies valuing individual personalities through our thoughts and common actions. The most precious thing in Damanhur is its people, because it is only through the diversity of each individual that we can have such a rich and colorful, varied and complex world.” (Gazza, Interview).

Damanhur has a culture of collaboration, as they believe that to stay healthy as a community, “It is necessary to keep an open dialogue with other individuals, organizations and communities. For this reason, they seek exchange and communication in all areas and with many different resources-from environmental organizations and innovative scholars and researchers to specialized companies and communities” (Tucano, Interview).

Economy

Damanhur's economic system combines solidarity and sharing with free enterprise to encourage both individual wealth and collective possibilities. Since it’s inception 40 years ago, the economic structure has evolved. In the early days all citizens chose to share their income in a common fund that was used to purchase land and create the basis for the community. After this phase, the citizens chose to return to managing their own finances and contributing to the projects of the community such as the Damanhur School and the Temples of Humankind. The housing and land is held in a collective ownership in which every citizen is a shareholder and can choose to withdraw their shares if they decide to leave. All the agricultural and livestock is owned by a Damanhurian cooperative. There is however, great controversy regarding Damanhur and irresponsible financial management and fraud by the founder. When pressed on this subject, the community members deny allegations.

“Damanhurians have created many businesses in the fields of arts, crafts, design, construction, renewable energy, nutrition, publishing and many more. The common denominator among all Damanhur activities is the vision of the work as a means of spiritual refinement. Work is seen as a way to offer yourself to others, as a way of expressing the creative dimension and an opportunity to choose materials and processes

with a low environmental impact" ("Damanhur," 2014). Many of these products and services are sold at the *Damanhur Crea*, which is a central market where Damanhurians and people outside the community can come to purchase goods, including organic foods and access various medical and health services. Work is not completely isolated to the community, many Damanhur citizens work in their own companies, while others are work in various other enterprises in the area.

4.83 Tamera

Mission

Tamera was initially founded in Germany in 1978 but was met with hostility from society. In 1995, founders Dieter Duhm and Sabine Litchenfeld reignited the project in Portugal and now it is home to approximately 330 people. The birthing impulse of Tamera was to develop a "non-violent life model for cooperation between humans, animals and nature" ("Tamera - Healing Bioptope," 2015). Central to this is healing and establishing a social construct that is based in trust and frees sexuality, love and partnership from fear. Tamera does extensive research in regenerative ecological practices and technological innovations for more sustainable living. Described as a "School and Research Station for Realistic Utopia", they share their knowledge and resources with a global network through the Global Campus and the Terra Nova School to create the social, ecological and ethical foundations for a new Earth ("Tamera - Healing Bioptope," 2015).

Architecture

The buildings in Tamera experiment with different methods and design inspirations. One approach for low-cost and low-footprint building is using natural resources that can be found locally. The other design inspiration that is used in building is multi-zone architecture in which nature comingles effortlessly with built structures. One example of this is the semi-permeable membrane structures that stretch over the Village Plaza of the Solar Village. These arching roofs of rainproof tent fabric provide shade from the hot sun and shelter from the rains and are reminiscent of huge flowers or mushrooms.

Another example of this type of design is Casa Sandra, which is the artist studio in Tamera. This building is built to blend into its surroundings rather than being an intrusion to the ecosystem that was present before. This structure is built with biophillic design in mind allowing light to spill into the space and air to flow through. The living area blends into the outside sculpture garden and invites animals, birds to come and go as they please.

Ecology

Tamera is innovating and experimenting with new technology and ecological practices. Desertification has increasingly become an issue in Southern Portugal. The land has suffered from soil erosion due to years of poor farming practices from previous landowners and the river that used to flow has dried up. In the winter, extreme rains cause floods and in the hot, summer heat long periods of drought are suffered. To heal the land, Tamera is experimenting with creating water retention landscapes – an approach that allows the land to absorb the rains and reduce run-off and erosion.

Tamera has a number of innovative methods that are being implemented in the areas of agriculture, renewable energy and water autonomy. Via The Global Ecology Institute that Tamera has established they organizes courses and professional training to share solutions that can then be implemented globally. They also work in close collaboration
with Terra Deva, their group for spiritual ecology, which is focused on deep ecology and communication with the elements and spirit of nature.

Creating a system where water, energy and food are autonomous is a political act for Tamera. They strive to create a replicable model in which they live in equilibrium with nature and are able to be self-sustaining outside the current capitalist, patriarchal system.

Culture

Dieter Duhm and his partner Sabine Litchenfeld are the founders of Tamera and play an active role in decision making and continue to contribute literature to the public domain and are involved in the external research and educational courses that Tamera offers.

Ideals about forming a post-capital, post-patriarchal civilization based on peace are practiced within Tamera including cultivating a culture where peace is achieved between genders. Tamera provides a social foundation for free sexuality which they define as creating the conditions for long term partnership and truth and trust in exploring one's sexual desires. The belief within Tamera is, "Marriage and free sexuality complete each other, they belong together, and together they form the essence of a new erotic culture. However, they can only be compatible under certain social and ethical preconditions ("Tamera - Healing Bioptope," 2015). Experimenting with this new social construct and creating the conditions for trust, solidarity, compassion and tools for conflict resolution form the core of Tamera's internal practice and external education via Terra Nova School.

The culture is firmly based in a commitment to ongoing inner work and intensive participation in community life that is based in trust, support, communication, compassion and peaceful conflict resolution. When inquiring about a shared religious or spiritual practice, one interviewee answered, "Community is our religion. We dedicate one hour each day as a group to a process called forum in which we gather in circles of about 30 people and take that time to allow each member of the circle to express him or herself in anyway they feel called. These circles are safe spaces where issues are brought to the surface, truths are spoken and compassion is mirrored so as an individual every member of the community can feel heard and supported. (Benjamin, Interview)" As a community, Tamera believes that they are a living laboratory and an "alive cultural concept" in which "the most important attributes are its productive incompleteness and its openness to change, self-correction and development" ("Tamera - Healing Bioptope," 2015).

Economy

Tamera is currently both communal and private property with the increasing orientation towards a communitarian economy. Income for the community is generated by guests who come to visit, revenue from seminars, book sales, donations, and the community itself. All community members work for room, board and receive a small monthly stipend. There are several 'groups' or projects in the community that members can choose to be active in

depending on the skills and passions including: agriculture, architecture, technology, healing modalities, artistry, The Global Ecology Institute, The Political Ashram, and Global Love School to name a few. There are service-based roles that are imperative for the day-to-day function of the community such as kitchen staff and administration. Although this contribution to the community will cover basic living many people leave Tamera for months at a time to return to their home countries to work to generate additional income so they may live more comfortably.

5.0 The Principles for Transition Infrastructure and Framework

The following section will discuss in greater depth rhe *Principles for Transition Infrastructure* that were mentioned earlier and the framework used to analyze the data that emerged from the various streams of research.

5.10 The Principles for Transition Infrastructure

As discussed in earlier chapters, our current system of global capitalism has humanity on a trajectory towards collapse. If we look to the natural world, a dying grandmother tree has a critical role to play in the forest even as it decays. The same is true of our systems if we choose for them to take on this role. A dying tree invests its remaining resources through the underground fungal networks into saplings emerging from the ground. Conventional systems, which powered a youthful phase of our species' development, can secure their evolutionary legacy even further by investing in the next-gen systems like ecovillages in their early gestation and infancy stage, which will eventually empower a more mature iteration of sustainable human development. As our old system decays, we must build the infrastructure for transition (Brown-Hansen, 2015).

Throughout the research process patterns and themes started emerging that pointed to principles rather than prescriptive directives. Each community is so unique and diverse although they share a core set of pillars. The climate, context and consciousness of each community will dictate the appropriate implementation of the pillars however; there was a set of overarching principles that emerged consistently that were applicable across the

sample of communities. These principles are the catalyst for a deeper understanding of what is necessary to build community that is in accordance with the ecological worldview as we transition into the post-capitalist world.

5.11 Ideology

As a society, priority is always given to finding the right answer. From our education system to how we are rewarded in the workplace, the dominant focus is the output, rather than understanding if the input is congruent. Our socialization has created a fixation on giving the right answer instead of *asking the right questions*. The irony is that you must ask the right questions, if you intend to find the right answers. Hence, the framework for the *Principles for Transition Infrastructure* revolve around a set of questions that filtered through the Ecological Lens (the disciplines of Biomimicry, Biophilia and Living Labs) inspire a way forward for a community or group to build, organize and inhabit in accordance with the ecological worldview.

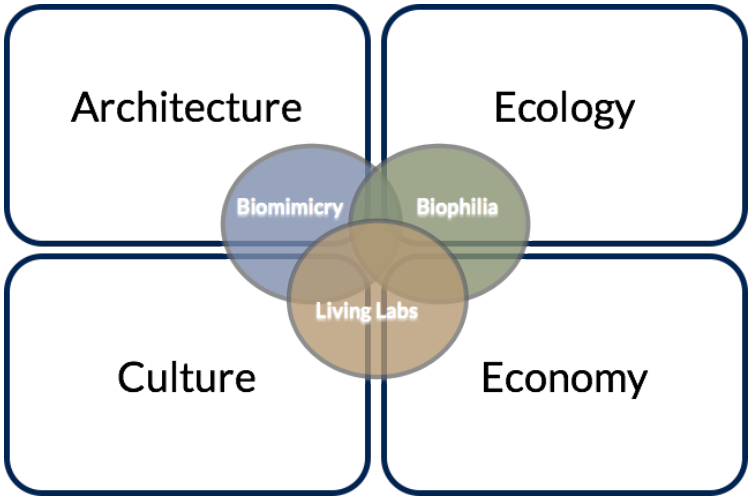
Questions provide a platform for continued discussion rather than the stagnant finality of 'the right answer'. Further, it is not necessarily the right solutions that can transcend borders, but the right questions that can be explored in depth regardless of the context, culture or climate. Part of the ethos of the *Principles for Transition Infrastructure* is to be organic and adaptable. Therefore, a 'living question' allows for a foundation of exploration as new conditions, circumstances, and consciousness emerge to continually form what is the appropriate solution for that time.

5.12 Framework

The *Principles for Transition Infrastructure* emerged from a framework that was used to analyze the data. The framework investigates one pillar at a time and overlays the Ecological Lens to inspire a set of questions. The answers to these questions have been informed from the insights gathered from the research and bring forth the Principles.

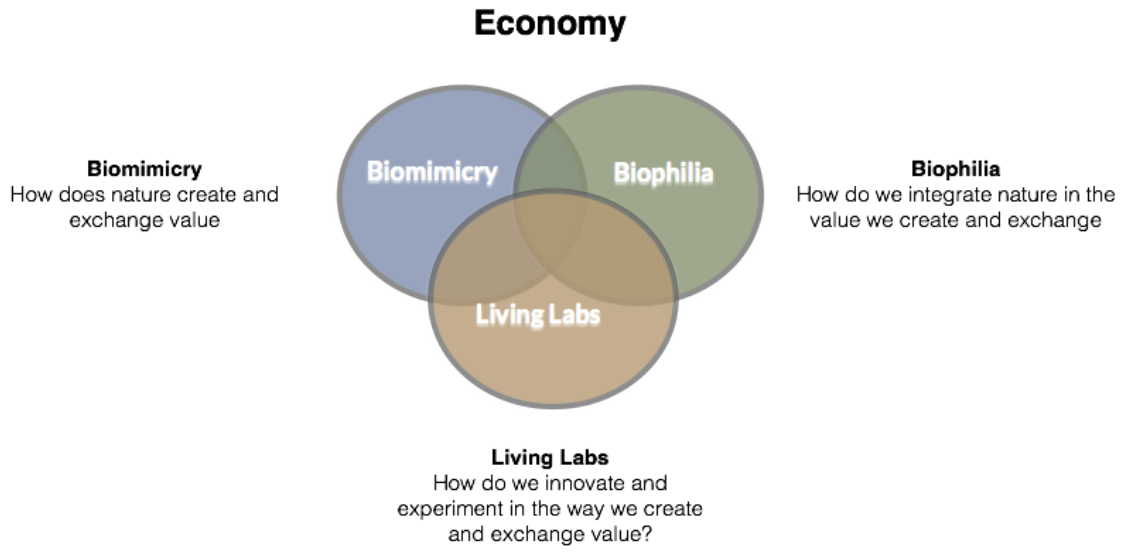
The following explains the structure of the framework in steps. First, we select a pillar of the community to delve deeper into. For this example, the economy pillar is selected as depicted in Figure 4. The Ecological Lens (Biomimicry, Biophilia and Living Labs) is overlaid to investigate how theses principles apply to the economy of the community.

Figure 4 – Framework Structure I



A question is used to inspire discussion pertaining to each discipline. In the context of the economy of a community where the intention is to understand the creation and exchange of value, as depicted in Figure 5, the question posed for biomimicry is "How does nature create and exchange value". For biophilia, "How do we integrate nature in the value we create and exchange? For living labs, "How do we continuously innovate and experiment in the way we create and exchange value?"

Figure 5 – Framework Structure II



These questions are then answered from the insights gleaned from the research, providing overarching principles and best practices that embody each discipline. This process allows for a group or community to execute these principles in a way that is appropriate for their own context, climate and culture. More detail on the following principles will be discussed in the findings section.

The same process is then repeated with the remaining pillars of the community. The complete *Principles for Transition Infrastructure* will be discussed in detail in the findings section.

6.0 Findings

The following section will feature the framework in action. The *Principles for Transition Infrastructure* will be discussed in detail and draw the interconnections and systemic application for each pillar of the community.

6.1 Architecture

Architecture encompasses the aspects of a community that include the building of structures and layout of a community. Rather than imposing and infringing on the natural environment, there is a way to build with nature, integrating into land in such a way that symbiosis is created rather than separation.

6.11 Questions

In the context of the architecture of a community with the intention to understand how do we build in a way that is symbiotic with nature, the question posed for biomimicry is "How does nature build?" For biophilia, "How do we integrate natural materials and forms into our architecture?" For living labs, "How does our lived environment contribute to our experimentation and growth?"

6.12 Principles for Transition Infrastructure

Biomimicry: How does nature build?

Using materials and forms that are multi-functional

Observing nature reveals the elegance and complexity of organisms that are multi-functional in their strategy and design. A tree for instance, provides shade, manages floods and sequesters carbon. Building in a way provides a level of resilience and efficiency that is unparalleled to modern ways of building.

In regards to Biomimicry, Claire Janisch, speaks about the benefits of using multifunctional design, "In terms of resilience and multifunctional design, it oftentimes is only nature that is able to achieve the level off resilience we need. We haven't yet been able to mimic that with technology. So you end up having to bring in more nature into urban space. Imagine if all your grey infrastructure is now all green you have a completely different design strategy and you are combining both biomimicry and biophilic design in your building" (Claire, Interview).

In Tamera, bright arching roofs of rainproof fabric are erected around buildings and gathering places to create semipermeable architecture that allows for nature and daily life to comingle. They provide shade from the intense sun and shelter from the rains. The shade structures mimic the form of large petals of flowers or mushroom caps ("Tamera - Healing Bioptope," 2015). "Many of our structures are shade roofs, design structures that are changing during the season and according to the necessities of the people. When we invite a group to Tamera and 200 people arrive our needs are quite different from the winter months when we are only the 250 people of the community. We have architecture that is flexible and connected to nature. We experiment with how far is it possible to build with regional available material. We are very advanced in building with models of straw bale and clay" (Bernd, Interview).

At Auroville, many different building practices are used. One of the techniques is referred to as Fly Ash which is recycled material from charcoal mines which is lighter, easy to handle and removes pollution from the atmosphere. "The beauty of research is that it should not be dogmatic and prescriptive. The parameters of applied research are never to have only one approach or field it has to be a totally open minded to a research group or individual. The choice of material changes from local stones to a natural cement that are heat resistant because the summers here are no joke! There is a love of nature that is translated into techniques and the use of materials that reduces the impact on the environment and beautifies our surroundings at the same time" (Luigi, Interview).

Although, these communities are building in sustainable ways that utilize local materials and are built for context, there is an opportunity to be even more considered in the manner in which they create structures to mimic nature. For example, using materials that are multi-functional such as hemp bricks to build structures. Hemp is a material that has many functions and is sustainable to grow. Hemp is an insulator and moisture regulator. The strength and flexibility of hemp creates foundations that are resistant to stress-induced cracking and breaking. The building material is fireproof, waterproof, and resistant to rotting, rodents and insects. Hemp building materials doesn't require the same amount of water that cement requires. Lastly, it sequesters carbon in the atmosphere, making it a

regenerative building input and practice (Bedlivá & Isaacs, 2014).

As we become aware of the genius around us, we are able to apply the lessons from Nature into our daily lives creating architecture that shelters and nourishes while contributing back to the larger system that is beyond the metaphorical four walls.

Start with the function not the form

The limits of our reality are the limits of our imagination. Therefore, when we start to build structures we default into creating what has always existed before. The standard box-shaped, four walls and a roof is only one possibility. When we start with asking what do we want this space to achieve then a whole set of possibilities emerge.

Claire, a biomimetic expert, speaks about the possibility created when taking this approach. "One thing you'll notice when you look at nature is that you build from the bottom-up so then what we should be doing is building from the bottom up. What we should be doing is saying what would be the principles we should put in place in order for this to flourish? For example, if you are designing a community you say you need a transportation system. There are two problems with this type of thinking: firstly, it's top-down, we will decide what happens to you and secondly, it's based on a different context, a context where you have abundant resources. The idea is then, how do we design for our needs? Imagine instead of designing for a transport system, we designed for accessibility? Designing for accessibility leads to other possibilities, such as creating a more interconnected and diverse space that doesn't even require a transport system. You have a completely different design process because you're asking a completely different question" (Claire, Interview).

The Mother's dream for Auroville was to overcome personal differences, while maintaining unity in diversity and build a real world of the future. A world with vision, clarity and compassion for all sentient beings, a world that honors nature and where we become true manifestations of a divine consciousness. From this vision, the architectural layout of Auroville's town plan is based on a concept of a galaxy. In the middle of it all is

the dome of the Matrimandir, a quiet, powerful place to connect with one's inner being. "The galaxy plan shows the four zones, which are interconnected through the 'Crown', the second circular road around the Matrimandir. From the Crown, twelve roads radiate outwards as part of the infrastructure. Some of them are accompanied by a succession of high-rise buildings, which constitute the so-called 'Lines of Force', essential for the framework of the city and for the integration of all access to the city center. But the plan is not finished. On the contrary, the city is still to be invented. Everything has still to be done through the daily experience and rhythm of the Aurovilians. Apart from these lines of force, everything is flexible, nothing is fixed" ("Auroville," 2014).

At Damanhur there are several experiments with different methods to build. "We are always trying to build in a way that honors nature. One building we have is constructed from wood and is built to circulate according to the sun's rays. A sensor triggers this movement allowing for the house to rotate and heat with the sun's rays similarly to how a flower would turn to face the sun" (Macaco, Interview).

At Auroville, there is constant experimentation with urban planning. Luigi speaks about mimicking Nature's design. "We did research on the principles of clusters in the universe. It is one of the fundamental laws of the universe in the macro and microcosm expression such as a cluster of stars or a cluster of cells. We asked how we can inspire our pavilions so that we make the cluster of the 50 pavilions of Africa. This means we design the layout of these pavilions with unity and diversity, not uniformity, just like the stars" (Luigi, Interview).

At Tamera, the energetics and meridians of the land are taken into consideration before anything is built. In addition, the architecture is unique all around the community because it is dependent on the specific environment on which it is built. Bernd explains, "When we first came to Tamera we knew some places were sacred, like where the Stone Circle is. Therefore, we decided never to build there. The energetic design influences the architecture and the infrastructure. The second thing we take into consideration is the watershed management principles and we build according to that because understanding

the flow and harvesting of water is crucial. Then we take into consideration finer social design. Whatever we build is connected to nature. We don't build on the land we build in and out of it. The house should grow as a tree grows. If you plant 100 seeds on land, every tree grows differently. The same goes for our houses. Every spot we decide to build on has different conditions and the architecture design comes from that" (Bernd, Interview).

When we allow the function to dictate the form of the structures that are built, we allow ourselves to be governed by possibility rather than limitations.

Biophilia: How do we integrate natural materials and forms into our architecture?

All organisms exist within related environments bound together as interconnected ecosystems therefore the effectiveness of Biophilic design depends on interventions that are integrated within the overall environment rather than being isolated. "Biophilic design should never occur in piecemeal or disconnected fashion, but rather in a manner whereby the diverse applications mutually reinforce and complement one another, resulting in an overall integrated ecological whole" (S. R. Kellert & Calabrese, 2015)..

Integrate environmental features to stimulate the senses

Environmental features in the built environment including light, air, water, fire, plants and animals all contribute to the direct experience of Nature. "All these Biophilic design qualities are experienced through a variety of human senses including sight, sound, touch, smell, taste, and movement. The visual sense is by far the dominant way people perceive and respond to the natural world. When we see plants, animals, water, landscapes, and other natural features, a variety of physical, emotional and cognitive responses are triggered" (S. R. Kellert & Calabrese, 2015, p. 11).

When observing the community case studies, the homes or personal dwellings tend to be more traditional in design. But the common spaces incorporate Biophilic design through the direct experience.

The Matrimondir in Auroville, for example, boasts flowing water and sunlight that pours in through the windows. The twelve gardens surrounding the Matrimandir each with their variety of flowers, shrubs and trees all represent a different virtue. All over the community flower mandalas are created to serve as a reminder of the beauty and powers of all the flowers and their meaning (Auroville).

At Damanhur, when a house is being built, it is integrated into its environment and this feature is seen with the utmost importance. "We take into consideration which direction the house is facing in order to build windows where the sunrises in the east and position the house in such a way that there is a natural green house effect" (Gazza). This effect ensures that the homes are kept cool in the summer and warm in the winter based on the way the sun hits the property and the materials that are being used in building and insulating. The homes are built with local materials like straw and clay. These organic materials and the bio-inspired simplicity of the interiors are reminiscent of the surroundings and stimulate a connection to the natural surroundings.

At Tamera, the Political Ashram, where the political work is combined with the spiritual work, sits at the core of the community. Nearby there are horses grazing and a light filled dome shaped structure is in the middle of a field. This space is shared by the community and used for internal education, *Forum* processes, or even individual contemplation. "This structure is in the middle of nature, it is part of nature. Every structure here is consciously in contact with Nature. This is integrative to the design" (Bernd, Interview).

Incorporate natural materials and patterns found in Nature

Incorporating the indirect experience of Nature refers to contact with the representation or of Nature, the transformation of Nature from its original condition, or exposure to particular patterns and processes characteristic of the natural world. These include, "… pictures and artwork, natural materials such as wood furnishings and woolen fabrics, ornamentation inspired by shapes and forms occurring in nature, or environmental processes that have been important in human evolution such as aging and the passage of time, information richness and natural geometries" (S. R. Kellert & Calabrese, 2015, p. 9).

Biomimicry is also considered part of the indirect experience as it reminds us of the genius of nature.

At Damanhur the exterior walls of buildings and houses are painted and decorated with flowers, plants and animals to honor and celebrate the importance of the ecosystem in which they are immersed ("Damanhur," 2014).

The Aula, the community's gathering space, "…is a communal structure that consists of a wooden construction stacked with straw bales and plastered inside and out with clay. On the outer walls the clay was mixed with lime as protection from the rain and the roof is used to grow herbs and plants, which also contributes to insulation. The earth-coloured walls and green roof blend harmoniously into the landscape" ("Tamera - Healing Bioptope," 2015). The space is designed with cathedral-like ceilings, sacred geometric proportions, and solar panel technology. This building approach is using traditional building methods with new technologies and scientific techniques.

Auroville's kindergarten building is made of "…warm red sand brick with deep window seats and accents of wood, with an inviting circular central space in which one wall is devoted to a large bulletin board where volunteers have arranged that week an attractive display to illustrate the concept of wind. On another wall there is a very large aquarium at child's eye level where fish float dreamily amongst the underwater ferns" ("Auroville," 2014).

Biophilic design is creating less of a distinction between the outdoors and indoors. It allows for a deep connection to be awakened that helps with our cognitive functioning, ability to heal, productivity, and the way we handle stress.

Living Labs: How does our lived environment contribute to our experimentation and growth?

Create modular spaces that allow for interconnections

Our built environment acts as the container for our interactions. By limiting our spaces to

one configuration, we limit the way we can interact and the level of our creativity.

In Auroville, for example, teenagers typically live with their parents in the family home. However, Kailash is a residency program for youth from the age of 14 to 21 that aims to diversify the living experience for young adults. There are 14 rooms for Aurovilian and non-Aurovilian boys and girls, who must fulfill the criteria that they are involved in an educational process – meaning in school, in an apprenticeship, or at work. Kailash offers a place to live for those who want to experience a collective life, but it also answers a fundamental need of all young Aurovilians who, for material, personal, or relationship reasons, want to leave their family home ("Auroville," 2014).

Damanhur Crea is a multipurpose space in the community that is also open to the public, and is described as a Living Laboratory. It is 4,000 square meter cultural space occupied by different services, businesses and studios, as well as common meeting areas. "Damanhur Crea is home to several businesses related to food and nutrition, green building design and construction, a health clinic, several wellness services, art studies and more. Basically, without ever leaving Damanhur Crea, you could do things as diverse as receive a dental implant, get a hair cut, design an eco-house, buy organic produce for dinner and pose for a clay bust to be placed in your garden" ("Damanhur," 2014).

Dieter, a Living Labs specialist, remarks on the importance of integration and interconnection of spaces to fuel innovation: "Innovation happens in the spaces of overlap, the integration of concepts, ideas and people. Going deep in one discipline is one type of innovation but Nature shows us that it's the interconnections that create strength. We must shift from social innovation to social integration" (Dieter, Interview).

At Tamera, there is no ownership of housing. Different groups require different live and work spaces. These live and work configurations change often in order to facilitate new relationships and project group assembly. Multi-zone architecture allows people to choose the level of contact with nature and the elements they want according to their needs and wishes at any time. "Their life and work spreads organically in places where they like

being together. Life in a multi-zone landscape is the opposite of that resulting from urban concepts which have for centuries contributed to the isolation of the human being from an environment that is perceived as threatening" ("Tamera - Healing Bioptope," 2015).

The spaces we inhabit play a critical role in how we behave in those environments. When we can create spaces that allow for deep interconnection, social dynamics and relationships also change.

Build spaces for self-expression

To ensure continued evolution, growth and experimentation we need spaces for self-expression, creativity and connection to our values. These spaces need to be a place for dreaming and realizing dreams.

Damanhur is best known for its otherworldly subterranean work of art and architecture, a cathedral known as the *Temple of Humankind*. This complex structure was entirely dug by hand into the heart of a mountain that is the geographical base for the community. "Decorated with mosaics, stained glass, sculptures, wall paintings and other works of art, it is dedicated to the awakening the divine spark present in every human being" ("Damanhur," 2014). The *Temple of Humankind* features artwork by Damanhurian civilians. This temple is an outcome of several thousands of hours of volunteer work by artists and community members. All the art and creative input by the community adds to the significance and energy felt within the space truly creating an opportunity for self-expression and play.

With the vision of being the city for all of humanity, Auroville is home to a "Unity Pavillion" as well as different pavilions to represent all cultures. "Auroville's aim is to create in the Hall of Peace a simple and aesthetically pleasing environment that can generate an actual atmosphere of peace and harmony, an atmosphere conducive to inner awareness and a sense of oneness with all humanity. The space is designed to be used for dialogues, meetings and presentations related to Peace, as well as for gatherings of the International Zone. It acts like a powerful catalytic chamber wherein people can find an

ideal supportive atmosphere to create the sort of harmony that is essential for real mutual search and intercultural understanding" ("Auroville," 2014).

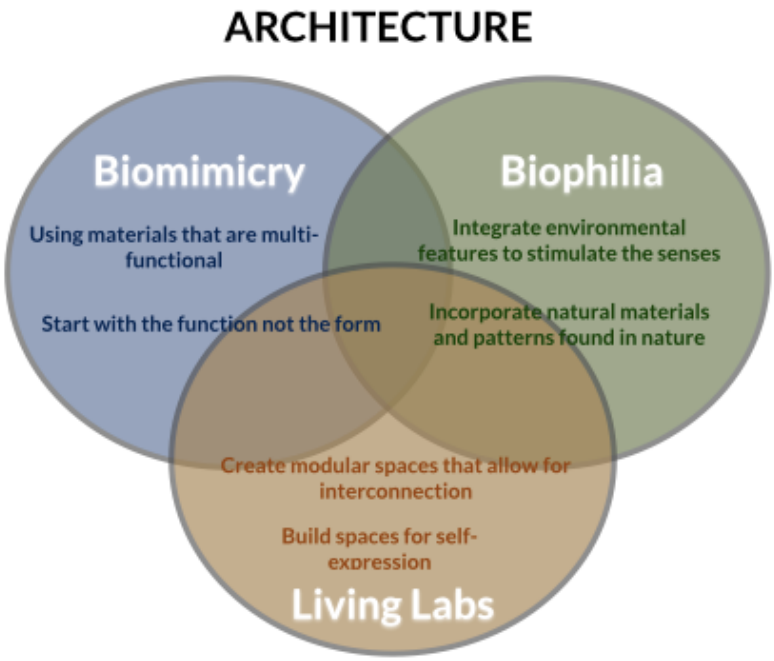
Bernd speaks about a place in Tamera that is reserved just for the children where they can be themselves and play without the supervision of adults. "There is a small forest ecosystem only for children. That's their special place. Adults are not allowed in there unless children call them in. The older children take the younger ones in and they spend their time there by themselves playing in nature without having to explain themselves to the adults. I know this space is completely protected and safe. In the summer months the children even camp out there and don't want to leave. Having this sacred space for the children is really important for them to unfold their energy and have a place they can be completely free. It's their secret" (Bernd, Interview).

Spaces that allow for self-expression bring out the creativity in a people. It allows for the unexpected to emerge and gives permission for play. These aspects are important when cultivating a culture of innovation and experimentation.

6.13 Summary

The *Principles for Transition Infrastructure* for a community's architecture is summarized in the following chart (Figure 6). These principles originate from all different disciplines but when combined and executed together create a holistic approach to creating architecture that is in accordance with the ecological worldview.

Figure 6 – Architecture Principles for Transition Infrastructure



6.2 Ecology

Ecology encompasses the aspects of a community that include the living systems required for food, water, waste and energy. In a healthy ecological system, everything is considered a nutrient or resource – including waste – to continue feeding into a healthy, regenerative system.

6.21 Questions

In the context of the ecology of a community with the intention to understand the flow of nutrients and resources, the question posed for Biomimicry is: "How does Nature ensure the flow of nutrients within living systems?" For Biophilia, "How is Nature used in living systems?" For Living Labs, "How do our living systems continue to evolve?"

6.22 Principles for Transition Infrastructure

Biomimicry: How does Nature ensure the flow of nutrients within living systems?

Establish bottom-up, decentralized, diverse systems

The dominant system in which we currently live is top-down, highly centralized and uniform. Decisions are made top-down by so-called elites with power and wealth which are primarily governments and corporations. Our living systems – food, waste, water and energy – are highly centralized and privatized. Dayna, a biomimetic expert, says "There's an interesting tension between the fact that the healthiest and most thriving communities and ecosystems are emergent. I am not seeing the conversation about how do we put the habitat conditions in place to allow a healthy community to emerge. Instead we are still trying to design it and manipulate it from the top-down." Nature is bottom-up, decentralized and diverse allowing for efficiency, cooperation and life-creation.

Tamera's ethos celebrates these bottom-up principles, "We are working on cooperation and contact instead of exploitation; for open, holistic, decentralized systems instead of central control and for diverse biotopes instead of mono-cultures. Water, energy and food are freely available for all humankind, when we no longer follow the laws of capital, but rather the logic of nature" ("Tamera - Healing Bioptope," 2015). Tamera, is involved in extensive research about how to create autonomous energy sources. Utilizing biogas for energy has proven to be a true win-win, simple, decentralized solution for many. "The system we have created works with many different kinds of biomass. We generally feed it with ground kitchen and garden scraps. These so-called waste products are transformed into a source of both biogas and living, liquid fertilizer, both of which have great value ("Tamera - Healing Bioptope," 2015)." At Tamera, waste is seen as a treasure.

At Damanhur, diversity is considered humanity's treasure and the *Seed Bank* project is an example of the way they preserve plant biodiversity, as well as self-sufficiency with the production of seeds. Community member, Formica says, "We have always understood that the real riches are nature. Our money is in the earth, in resources and in life." Damanhur has collected sacred seeds over the years and has been involved in a battle

against the big agricultural companies with other seed savers to create a movement of seed sharing between farmers in Italy. Damanhur's *Seed Bank* ensures diversity of agriculture and non-GMO crops (Formica, Interview).

Damanhur also creates it's own decentralized, diverse energy systems by experimenting with different methods for energy. "Forty percent of Damanhur is self sufficient when it comes to energy. We have photovoltaic and solar panels for heat and electricity. In the summer time we don't have to use any electricity from the grid. We use biomasses – which burn pieces of wood with an inverted flame. The flame is pushed down so you don't have fast burning of the wood so you have a slow burn and the gases that released are cycled through again resulting in less emissions. We also have houses that run on geothermal energy" (Macaco, Interview).

In Auroville, More than 60 natural wastewater treatment systems are used. Most recycling systems combine a pre-treatment device, a main treatment planted filter, and a post-treatment holding facility, usually consisting of one or more ponds or polishing tanks. These tanks house a variety of different plants and organisms like algae that feed off waste and breakdown matter ("Auroville," 2014).

Throughout the communities that were studied, it is evident that new methods for living systems were continually explored. What remained constant is that these experiments were bottom-up, decentralized and diverse – aligned with the laws of the natural world.

Cultivate regenerative systems not sustainable ones

All of Nature's systems are naturally regenerative. There is no organism or living system in nature that is sustainable. All organisms feed into each other creating a harmonious cycle of cooperation and regeneration. Sustainability is no longer enough; we need to be regenerating our planet, not just sustaining it.

At Damanhur, ecological systems are regenerative because they understand that they are part of the larger ecosystem, not separate from it. Gazza, a community member, says, "We

are an ecovillage as a consequence of seeing ourselves as part of the larger ecosystem. This is our mindset and the values that we all share as a community. We have always respected Nature. It is not even a thought to pollute or use resources without ensuring that they are regenerative (Gazza, Interview)". Because the mindset at Damanhur is one of being part of the whole and honouring the world around them creating systems that are akin to nature is the blueprint they start with.

At Tamera, building the *Water Retention Landscape* is an approach to healing the land and creating regenerative systems. "Through this approach to water management we create a regenerative basis for autonomous water supply, for the production of healthy food, the regeneration of topsoil, pasture and forest, and greater diversity of species" ("Tamera - Healing Bioptope," 2015). Naturally shaped lakes and dams are constructed with clay and rock, which allow rainwater to collect and be absorbed into the earth. The rainwater recharges the aquifers and allows for the cycle of evaporation and cloud formation to regulate rain patterns and put an end to the extreme floods and droughts. This process has regenerated the land transforming the plant and animal life in Tamera and providing an autonomous water resource for the community.

Tamera honors the land and animals that they come into contact with and have a deep relationship with healing the land and creating regenerative systems. "The way we deal with plants, how we cultivate and harvest, how we treat animals and the Earth should not be not exploitative or harmful, but enriching and healing. Sustainability in the deepest sense is that which is not directed against the cycles of life, but cooperates with them. In such systems there can no longer be any losers. The Nature thanks us for this approach with stable, high yields, healthy food and an abundance that re-opens our human soul and nourishes us" ("Tamera - Healing Bioptope," 2015).

The *Auroville Botanical Gardens* has been transformed into a luxurious landscape that serves as an area for research into environmentally regenerative approaches to land management, as well as a location for environmental education. "More than 250 tree species have been planted in the 25-acre arboretum, 5,500 specimens have been planted in

the 10-acre conservation forest, and a plant nursery has been created, capable of producing 50,000 seedlings per year to promote the reintroduction of the indigenous flora of the region" ("Auroville," 2014).

These communities understand the harmonious flow of Nature on a deep level. Their resources are limited to what the earth provides so there is an understanding that not only can their systems utilize the gifts that they are given by the land, but that it is there obligation to also heal and regenerate that land.

Biophilia: How is Nature used in living systems?

Use natural materials, forms, and processes

Using natural materials, forms and processes in our systems that create food, water, waste and energy connect us to the world around us and remind us of how life can produce life when cultivated in a way that honors nature.

Damanhur uses organic septic systems and constructed wetland systems for grey and black water treatment. The natural environment is used as a filter to clean the used water providing nutrients to the wetlands contributing to their flourishing. Rainwater and stream water is collected for household use and food waste is used for compost to create fertilizer for the agriculture. "We see 'waste' as 'nutrients' and understand the cyclical nature of our systems". (Gourza, Interview).

Vera, of Tamera, speaks about their water system which is engineered using natural materials: "Our next goal in water supply is a ring duct, designed with the help of Sepp Holzer [a German water management expert], which should provide all of Tamera with constantly moving, vital drinking water from a well. Located at a high-altitude, in a round or egg-shaped container made of burnt clay and embedded in the earth, high-quality well water will pass through all households, bathrooms and kitchens of Tamera, and will then flow back to a second container, which is located a little lower than the first. Whether or not people use the water it remains in constant movement. From the second container, it is pumped through back to the first. All taps connected to the ring duct will deliver clear,

vital drinking water" (Vera, Interview).

In Auroville, Nature is consulted prior to any development and natural processes are utilized to create the most ideal conditions. Luigi explains, "the development and ecology is linked by the same golden thread. There is no planning without full honoring of the ground. For example, in the International Zone we know that the land slopes so when there are heavy rains it creates flooding. In this area we prepare water catchment systems. This has also helped us create four different water management systems using the rainwater collected with the catchment systems. We listen to the earth and plan in accordance. This starts within yourself, the more you feel empathy and unity with nature, the more she reveals herself to you" (Luigi, Interview).

This level of awareness for the natural world around us reconnects us to the land and to the knowledge of our ancestors helping us create the support structures we require for living in accordance with nature.

Affirm a connection to place

Each place on the planet has a special climate, context and consciousness that makes it unique. By celebrating the natural surroundings we affirm a connection to place that creates an affinity within us for the land and concretes our symbiotic relationship. By listening to Nature we are rewarded with the genius of the place and guided to how to care for the land and ourselves.

Bernard speaks about a connection to Tamera and the power of tapping into the energetics of the land. "Every piece of land when we as human beings are able to connect with it gives us a spiritual call. Here in Tamera we start to feel where we have resonance and actively support the energies we perceive to build accordingly. We are consciously connecting here to nature spirits and the land" (Bernard, Interview).

In Auroville, the summers are extremely hot and then the monsoons come in the rainy season. "The way we build and the materials we use must be resistant to heat and heavy

rains. We need to know what plants can withstand the cyclones and storms. The strength of Auroville is ecology through trial and error as we have learned how to be more in harmony with nature and how to create a win-win situation" (Luigi, Interview).

Gazza speaks about the materials that are used in their living systems that are appropriate for their context. "In Damanhur we experiment with different materials - straw bale houses, wooden houses, mud houses. Here we have a humid climate and long winters so we consider these materials in our context. Meanwhile we are building with ecological materials and investing in solar because we don't have strong winds for energy" (Gazza, Damahur).

Damanhurians believe that there are networks of energetic meridians that flow from the North to the South poles of the planet. Damanhur is situated precisely in the presence of four Synchronic Lines. "The network of Synchronic Lines is like the central nervous system of the universe and each individual planet. Being in contact with the Synchronic Lines means being at the center of a flow of thought and information, which can be extremely inspiring. It is possible to contribute to this flow through awareness and the ability to direct one's thoughts. This region is one of two places on the planet where four Synchronic Lines converge; the other one is in Tibet" ("Damanhur," 2014). This understanding of energies and the natural surroundings gives Damanhurians a connection to the land that is very sacred.

All biological organisms transform the natural environment in the process of inhabiting it. Biophilic design encourages a relationship and responsibility between humans and Nature by promoting a positive relationship and a sense of place(S. R. Kellert & Calabrese, 2015, p. 7). By creating living systems with biophilic design you create more productive and resilient natural environments.

Living Labs: How do our living systems continue to evolve?

Experiment with new methods and materials

Testing and learning is a vital part of understanding how to continue improving. Nature is alive, organic and constantly changing, therefore experimenting with new methods and materials is an integral part of our living systems.

Gazza from Damanhur speaks about their ethos as a community, "We've done many experiments and made many mistakes to get to where we are now based on learning and failing with the idea of always wanting to get better. For example, to create energy and heat for homes we have experimented with many different modalities including solar panels, photovoltaic and even geothermal energy. One experiment we pursued was to excavate a long circle all around the perimeter of the house. A pump captures air and it flows inside the tubes that are 15 meters underground. When the air passes through the house, the air is heated which means when it is winter it requires low energy and in the summer it means that we don't need air conditioning because the air is cool. This house has a lot of different systems to conserve energy to the point that we can sell the energy to the grid. In Damanhur we are self-taught in everything. We have always been about sustainable building and trying different methods so this type of experimentation is fueled by our passion and ambitions. Sustainable. We now have a relationship with the university and the architects who come here to study these methods" (Gazza, Interview).

Tamera describes itself as a Living Laboratory and is constantly innovating and seeking ways to find new solutions to solve ecological problems. "Tamera is a test field and model for the future. We urgently need viable ecological solutions and alternatives in order to survive. These solutions must be tested and optimized before they can be applied on a large scale. Humans must reintegrate into the ecological cycles not the other way around. The living systems are all connected and we need to constantly find new innovative ways to allow these systems to emerge and thrive" ("Tamera - Healing Bioptope," 2015). The Solar Village at Tamera is an example of this, "It assembles the various living areas for humans in an exemplary new way, so as to harmonize with universal laws and patterns. It

supports human beings to consciously cooperate with nature and the forces of nature, without either breaking or exploiting them. The term *Solar Power Village* describes the technological core and its accompanying new ecology, a cooperation of solar technology, greenhouse and plants. All of it makes for a system, which will supply enough electrical, mechanical and thermal energy, a solar-driven water pump, e.g. for drinking water, and a greenhouse to cover the special needs of approximately 50 inhabitants. The system is to cover the core components of human provisioning in a new way. It is a plan to develop a system that can be built with simple means and under minimal conditions, a system that can be produced and used independent of large industry and subsequent complicity" ("Tamera - Healing Bioptope," 2015).

Auroville, "…has been experimenting with small-scale wastewater recycling systems for over fifteen years. During that time pilot systems were built, experience was gathered, and the operating skills with such plants improved. The preferred choice for recycling domestic wastewater shifted towards treatment systems called planted filters. The large space requirement for this kind of system was not viewed as a disadvantage since the treatment systems can be beautifully landscaped into any environment" ("Auroville," 2014). Over time these systems have been integrated all over Auroville and they are also helping villages in the surrounding areas install these recycling systems.

It is the dedication and curiosity of the people of these communities that drive the innovation and experimentation. Damanhur, Auroville and Tamera all attract students, scholars and researchers to apply their knowledge and skills to advancing new ways of experimenting with new methods and systems.

Pioneer practices that are shared

As incubators for holistic system change these communities act as laboratories for experimentation in living systems. This knowledge is then shared and disseminated outwards.

Auroville works in collaboration with state, national and international research institutions to share their ongoing work in water management, soil conservation, organic farming and seed collection. This research and proven methodologies help promote the policies of food security and agriculture both locally and nationally ("Auroville," 2014).

In Tamera, a project called *Blueprint* has been initiated in response to the refugee crisis and increasing number of climate change triggered natural disasters that are displacing people from their homes. "*Blueprint* is bringing together knowledge carriers to create model solutions that can be applied to immediate crisis situations and long term regenerative settlements. Here at Tamera we are creating these solutions and living with the technology to stress test it. Aid organizations bring technologies to places and they have no personal experience with the solutions. We can recommend these solutions only because we too choose to live with them so they are sustainable, low-cost, dignified solutions. The *Blueprint* that is being explored now is called *The Hope Container* and it is being created specifically for refugee camps. Refugees have lost everything so we need to find a way for many different technologies can be put together in a container and be brought to crisis areas to provide alternatives for all the necessities – sleeping, cooking, washing, etc." (Vera, Interview).

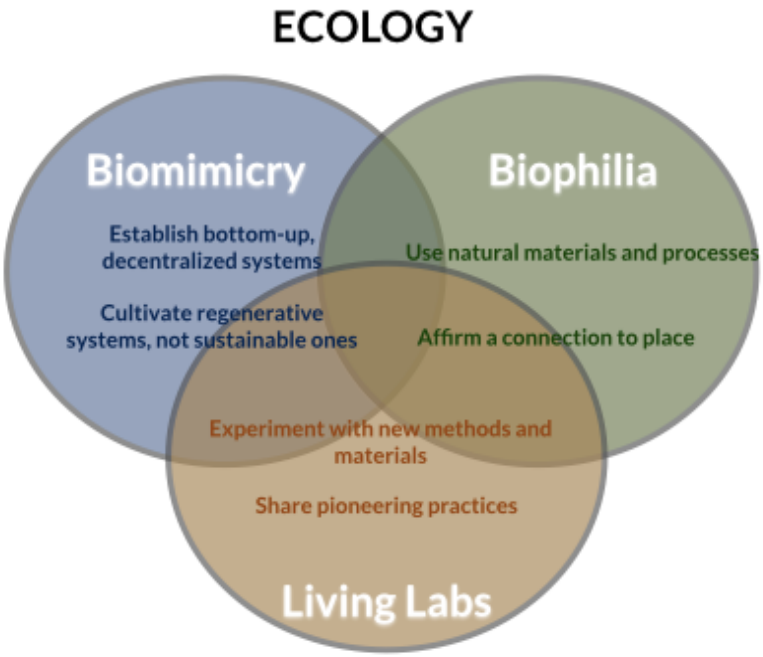
Damanhur has been selected to participate in the *Origin* pilot project, an initiative funded that focuses on the design, installation, and experimentation of advanced technological equipment for energy management in homes with the goal of identifying and preventing waste in energy use through highly innovative technology. Three European communities: Tamera in Portugal, Findhorn in Scotland and Damanhur in Italy, are participating in this project in addition to several universities. "The *Origin* project implements the experimental monitoring of all forms of consumption in a house during the various stages of the year to detect any kind of waste, as well as the under-utilization of energy by the occupants. Consumption is monitored through the energy grid, the self-production of energy with photovoltaic panels, solar concentrators or wind turbines, and solar thermal" ("Damanhur," 2014).

As these communities unearth new possibilities for the future, they share this knowledge so that it may impact and shift structures outside the system and help others imagine a new way forward.

6.23 Summary

The *Principles for Transition Infrastructure* for a community's living systems is summarized in Figure 7. These principles originate from all different disciplines but when combined and executed together create a holistic approach to creating a living system within a community that is in accordance with the ecological worldview.

Figure 7 – Ecology Principles For Transition Infrastructure



6.3 Culture

The social structures that delve into understanding culture will include social dynamics, governance, spirituality, education, and healing aspects of a community. Investigating culture through the lens of Nature requires the understanding that the only constant in

nature is change. “Community design that integrates culture and nature has to emulate nature’s way of dealing with unpredictability, interconnectedness and dynamic transformation” (Wahl, 2006).

6.31 Questions

In the context of culture we look at the ecosystem of community with the intention of understanding how our culture can be symbiotic with nature, the question posed for biomimicry is “How does Nature support a community ecosystem?” For biophilia, “How do we integrate Nature in the community ecosystem?” For living labs, “How do we allow for experimentation and evolution in our community ecosystem?”

6.32 Principles for Transition Infrastructure

Biomimicry: How does Nature support a community ecosystem?

Cultivate Deep Diversity and Polyculture

Diversity in Nature is critical for the survival and flourishing of natural habitats. Biodiversity boosts ecosystem productivity because each species has an important role to play. Each species depends on the services provided by other species to ensure survival. For example, a larger number of plant species means a greater variety of crops because polyculture farming aids in protecting against disease, which makes pesticides redundant. Greater species diversity ensures natural sustainability for all life forms and it helps ecosystems be more resilient. Deep diversity within human networks and ecosystems follows the same logic with greater exposure to various perspectives, skills, knowledge, and modalities offers a rich and resilient fabric of life.

This diversity in Auroville is noted in the composition of their community members. “Aurovillians come from 49 nations, from all age groups (from infancy to over eighty, averaging around 30), from all social classes, backgrounds and cultures, representing humanity as a whole” (“Auroville,” 2014). The original plan of Auroville accounted for 50,000 inhabitants. Luigi says, “I miss the other 150 nations represented on the Earth and 47,500 others. You need a critical mass for change to occur and to understand the

dynamics that occur at that size. We need universality. The world is going to become more mixed and we should learn the clash of diversity until we take away the outer form and we see the gold that each one carries inside. This is what Auroville is trying to do. We haven't achieved this yet but this is the aim"(Luigi, Interview).

Among Auroville's four zones is the Auroville International Zone, which represents all major cultures. They are centers of research, study and creative activity that concretely and richly express human unity in diversity. The essential aim of the cultural pavilions is, "to help individuals become aware of the fundamental genius of the nation to which they belong, at the same time bringing them into contact with the ways of life and genius of other nations, so that they can learn to know and respect equally the true spirit of all the countries of the world" (Luigi, Interview).

In addition to the existing Temple of Humankind, Damanhur has plans to create The Temple of the People. The vision for this new temple is to have a place where all the world's people of all religions, traditions and cultures can come together and meet to envision the better world we know is possible. "We need to demonstrate that we can cooperate that we are not only destroying the planet and this is a signal that we need to send out (Gazza, Interview). The Damanhurians have sent out invitations to many shamans, religious leaders and cultural representatives and many have begun to visit and bring with them artifacts that represent their traditions. "Diversity is the true treasure of humanity. We want to create a sacred space that holds all the wisdom that we have maintained and developed. We have ancient knowledge and traditions and it's so important to preserve this diversity" (Formica, Interview). Even the way the temple will be constructed will be done in a way that honours diversity, "We will invite people to help build the temple so everyone feels like they are a part of it. We would even like to crowd source funds to help build it for those who are unable to come and help build it themselves. This is a shift for us in the mentality to ask people if they want to contribute. But we truly want it to be a shared project" (Formica, Interview).

In Damanhur, unity within the community is the ideal, but the individual is a fundamental element in order to achieve this. “Each one of us, with our particular diversity, makes the lives of others more rich and colorful, and vice versa. *The Tecnarcato* is collection of techniques and tools that favors and encourages individual renewal through the use of a strategy. Every person "designs" their own personal transformation and every three months, they establish a program of practical objectives and ethical values. An important tool in this process is the "Individual Law." This is a personal rule that we decide for ourselves, yet always with the verification from our chosen "mirror." With this person's help, we pay attention to our own character so that it is not an obstacle to our self-development but rather a positive stimulus towards our individual goals” (“Damanhur,” 2014).

From all the communities, Tamera is one that places free love and unconventional family structures at the heart of their culture. “This decision came from witnessing many other intentional community projects and seeing them all fail because there was no consciousness around the inner conflict of unresolved sexual desires that would torpedo the beautiful ideas and solidarity among it’s members. It’s impossible to create coexistence without transition to free sexuality. It takes a lot of space holding and work to create an environment of trust so that people may explore their authentic selves through free sexuality and their erotic truth. As Tamera has explored this model and as the network grows bigger and bigger, something in the world is opening up and there’s a request from the world for guidance in this realm….” (Martin, Tamera). The experience that Tamera has acquired through this work is shared via *The Global Love School* which takes the form of seminars and online courses. “Over the last 3 years our global network has exploded than it has in the 10 years before, because there is a readiness growing in adopting new paradigms”.

Through *Global Campus*, Tamera brings together diverse people from all nationalities and cultures to cultivate peace. “*Global Campus* is a project that has been active for 10 years now. It includes a peace village in Colombia, different groups (both Israeli and Palestinian) from the Middle East creating a peace village, a favela project in Sao Palo

that is battling with drug use, a community in Chiapas Mexico and a community in Kenya. In all these places there's intent for creating holistic models. Models that are both material (autonomy, decentralized design), about inner transformation to anchor in ethical values such as truth, solidarity, compassion and very importantly the consciousness that it's an impact on a global crisis that demands change. We are on a path of mutual learning from one another. We learned how much we can really give to each other and how precious it is. It has taught us quite a lot on how not to impose an ideology and impose colonial patterns. We hold these partnerships on a level that is fully equal, under the common roof of a shared global vision. The *Global Campus* work is about anchoring certain memes in the noosphere of humanity which will support and accelerate the growth and a network of communities, where people collaborate these types of goals" (Martin, Interview).

In all communities, diversity of all forms is seen as a fundamental key to the evolution of humanity and is protected. The monoculture apparent in society today is contrasted with the polyculture that is celebrated within these communities.

Harness collective intelligence and collaboration

Super-organisms, which are defined as groups of genetically distinct individuals of the same species, don't survive alone for long, everyone has a job to do, and the whole is more than the sum of it's part. Humans, just like ants, must collaborate in order to survive. Their colonies comprise millions of diverse individuals, but together they accomplish the same tasks a single organism does, with far less processing power (Woolley-Barker, 2014). To operate in such a way, collective intelligence and collaboration is required.

In Tamera, the community is considered one organism comprised of multiple individuals. Trust and transparency are core, fundamental values at Tamera that enable them to create the conditions required for the high levels of collaboration that is required. "For example, even a man and woman's decision to conceive a child, from the decision, to the birth process itself, to bringing up the child is brought to the community. The input of the collective is necessary since the child is to be sustained and supported by the community" (Interview, Martin).

To cultivate this type of trust, transparency and create the container for collective wisdom and collaboration Tamera engages in a process, or "social technology" called Forum. It's a basic tool for transparency and shedding the masks that we wear. The process invites one person to the center of the circle to speak their heart and mind. The facilitator guides the person in the middle to speak about things that are generally not spoken. The group mirrors back to the individual their reflections of what they are hearing, rather than any giving any prescriptive counsel. You come to see that underneath all conflicts there is the underlying root of wanting to be seen and accepted. This is a big healing tool, I look at the world and the issue I see is people not feeling loved and accepted so a culture is created where we put on a mask in order to belong in society. With this wish to belong, you deny parts of yourself in order to fit in and as a result you are not living in accordance to your truth. Forum is a tool where we try to shed these layers of disguise. Seeing means loving - if you really see a person it triggers love. Almost everyone has the same issues underneath and we are getting this healing" (Vera, Interview). This process ensures the community is aware of all the conflicts or tensions and is a tool to create transparency, express motivations, reveal hidden truths and process questions and resolve conflicts. It is part of the systems change that Tamera is creating in its model for a new society.

Damanhurians encourage the pursuit of one's individual talents and developing one's own path, however the collective is equally as important. "The individual is both *I and We"* (Formica, Interview). Damanhur's decision-making model has evolved to a system based on elected bodies allowing for the participation of all citizens. "Regulatory changes are sanctified in accordance with the Constitution, which has been updated several times until the 2007 version, which is currently in use. The King Guides are at the head of the federal structure. They are periodically elected and have well-defined responsibilities that entail the administration of the communities and coordination of their development. They communicate about their activities with all of the citizens during weekly meetings. The constant exchange of information with those who hold roles of responsibility allows all citizens to participate in the public affairs of the community. The responsibilities related to the Federation, the Four Pillars, and the communities are many, and nearly all citizens

have roles to carry out, whether they are big or small responsibilities. Decisions are made by majority vote, favoring the sharing of opinion expressed through a vote, so everyone ratifies the choices made with their own personal participation" ("Damanhur," 2014).

At Auroville there is a governing board that has overall responsibility for the ongoing development of Auroville in keeping with its aims and ideals, and a resident's assembly that monitors the various activities of Auroville, decides on the terms of its membership, and is responsible for evolving and implementing a Master Plan for Auroville's future development in consultation with the Governing Board.

Auroville has a governing board and a resident's assembly. The governing board is responsible for ensuring Auroville is developing in line with its goals. The resident's assembly decides on terms of membership and monitors activities. Together these bodies implement the Mastter Plan for Auroville's future development. "Decision making in the Residents' Assembly of Auroville is based on the principle of universal suffrage. This means that each person has the right and privilege to participate in decision-making, but that there is no compulsion to exercise this right. Whether or not a person participates in decision-making is a private matter. People should be respected for their participation as well as for their decision not to participate" (Auroville Citation). Marti, a community member speaks about some of the challenges of this model: "We continually evolve new systemic models to draw people into the participatory process but when it comes to decision making, the decisions are made by whoever shows up. So we can come up with solutions but it's harder to implement and enforce across the community" (Marti, Interview).

Within a super organism, individuals bring their own unique intelligence and gifts that are integrated into the whole. A balance must be accounted for in systems to allow for every voice to be heard and to allow for enough autonomy so that decisions can be made without unnecessary deliberation and stagnancy.

Biophilia: How do we integrate Nature in the community ecosystem?

Follow natural rhythms and create sacred spaces in Nature

Nature has cycles, seasons and rhythms that humans should be in tune with because we are part of Nature and synching with these movements can harmonize our lived experiences. Each community has acupuncture points – a space where people gather to make decisions, have ceremony, receive guidance, or contemplate. These can be described as sacred spaces that are honored as places to attain clarity and peace. As discussed in the literature review, humans are part of nature and our neocortex has evolved from a deep immersion with nature. The integration with nature and the sacred site brings forth resolution and energies to support the intentions made in the space.

At Tamera, a sacred Stone Circle, made of 96 granite and marble stones, were placed in a meandering oval configuration in the heart center of Tamera. "Every stone represents an archetype; the stone circle, as a whole, stands for complementation and cooperation in a universal peace community. The stone circle has become a centerpiece of the Tamera community and their guests and used for many rituals, ceremonies and meditation. Many projects and plans have been presented here before their manifestation; questions have been asked, prayers spoken, births, deaths and special events celebrated" ("Tamera - Healing Bioptope," 2015). Bernd from Tamera explains the ritual the community participates in, "Our stone circle, which we call the Natural Cathedral is where the community gathers to ask questions directly to nature and the spirits that are represented there. We ask to receive spiritual guidance for certain projects and ask how we can work with the land. It's a space that is open for everyone to connect to nature and spirit. There's a weekly prayer once a week at sunrise that the community is invited to for common prayers. Our networks all over the world also gather at sunrise for prayers and the momentum of this energy we call the ring of fire" (Bernd, Interview).

During the winter season in Tamera, the community ceases any external programing and makes the conscious decision to venture inwards. During this time, the community reflects on their vision and takes the time to assess the work they have contributed and where they would like to set their sites for the coming season. "We have a financial gap in the winter

time, we close and really focus on the community and it's an essential time for us. We're open half of the year and then we choose to close to the external world the other half. This helps us stay in the integrity of our vision. However, it is an intense working time as we go into planning, visioning, aligning and internal education" (Vera, Interview).

Damanhur's Sacred Forest is located directly above the Temple for Humankind and it is believed by the Damanhurians that the trees "act as an outdoor continuation and amplification of the energy of the Sacred Temples that have been build underground. Each tree is considered to be an antenna transmitting and receiving constantly" ("Damanhur," 2014). It is also believed by the Damanhurians that, "being in nature helps dissipate negative energies or tensions. Trees, for example, are more than aesthetic, they are therapeutic" (Gazza, Interview). In the heart of the Sacred Forest there are also labyrinths made of stone, which are considered "to modulate the energies of the earth and sky, as it has been done around the world for centuries in ancient traditions. These labyrinths of stone serve as active paths for meditation in motion and encompass one of the most important ritual sites in Damanhur…Rituals are the language through which [Damanhurians] communicate with all the forms of intelligent life that inhabit the spiritual ecosystem, that is, the non-material dimension of existence. There are Great Rituals connected to the rhythms of nature, such as the Solstices and Equinoxes, where they celebrate union with nature and the divine forces" ("Damanhur," 2014). Macaco, describes further, "We celebrate the big rhythms of nature following solstices, full moons and new moons. We also have daily rituals to put ourselves in resonance with the food that we eat. We have rituals in our territories to clean any negative energies or big fights through an evening prayer" (Macaco, Interview).

At Auroville, the Matrimandir is located in the center of the community and surrounded by twelve gardens each representing a different virtue including: Existence, Consciousness, Bliss, Light, Life, Power, Wealth, Utility, Progress, Youth, Harmony and Perfection. Each garden is home to a specific set of flowers that represent and evoke the experience of the virtue. For example, the flower that represents the *Garden of Wealth* is the mymphaea, a water lily, and the flower that represents Existence is hibiscus. When

envisioning these gardens "the Mother indicated that they would have to be of such quality and beauty that people visiting them would experience, physically and concretely, the significance of each garden" ("Auroville," 2014). These gardens are places for meditation and self-reflection. When you need to strengthen or evoke a virtue you select the garden corresponding with that virtue and spend time in the 'petal' meditation room of the Matrimandir and the corresponding garden. All around Auroville, you will find beautiful flower mandalas made with the same flowers from the gardens. "Understanding and cherishing the sacredness of Nature is a bond that we need to nurture as a community… spending time in Nature and creating sanctuaries together is essential for connecting with the highest aspects of our human nature. In Auroville, we believe that all aspects of life prepare us for a transformation" ("Auroville," 2014).

Activating Nature's acupuncture points within communities provides an anchoring for people to connect on a deeper level to themselves and each other. Nature is a natural anti-depressant and stress-reducer triggering healing responses in the body. Being connected to nature aids with cognitive functioning like complex problem solving and increases the ability to focus. In addition, it reminds us of our connection to nature, our interconnectedness to each other and the divinity in all organisms.

Treat Nature as healer

Nature is seen as the greatest healer and natural, holistic modalities are preferred, especially to promote a healthy lifestyle to prevent any illness or disease.

In Damanhur, a holistic approach to health and a healthy lifestyle is central to their culture. It is believed that, "health is not the absence of illness but the fullness of living. It means getting up in the morning with a dream and having the strength to realize it. Good health is about having a balanced lifestyle that nourishes the body through nutrition and hygiene, as well as the mind and spirit through social relations, creative pursuits and the capacity to get out of our routines and be adaptable to any situation. Methodologies range from herbal medicine to emergency medicine, from Selfica to genetic screening, to fighting the battle against GMOs. From hypnosis and positive thinking to art therapy, from

connecting with the divine essence within us to communing with nature: these are just some of the elements that contribute to restoring and maintaining optimal health" ("Damanhur," 2014).

At Tamera, there is a specialized program that uses horses to help individuals through trauma and trust issues. Horses are incredibly empathic and are able to work with humans bringing out subtle energies and healing. "Horses help on this path, by confronting the human without prejudice and unreservedly, mirroring immediately and neutrally his or her behavior. From this the human can grow in a very special way. The inner growth that we experience while being with the horses, we can than transfer to the contact with any other being, including human beings" ("Tamera - Healing Bioptope," 2015).

At Auroville, health is linked to education, spirituality and natural modalities. "We start from the principle that the natural state of health is harmony which is the natural tendency of the body. When there is a disharmony or dis-ease, this manifests in the physical. We know that the body is the expression of what is happening inside. The body never lies. With the mind we can tell ourselves a hundred reasons but the body always shows us the truth. Part of living a healthy life is about becoming much more aware of the deep psychology trauma or disharmony of any type. The Institute for Integral Health bridges the knowledge of Western practices with Eastern practices and the doctors all consult with each other before they treat a patient. They take the best from each modality and integrate for a holistic approach (Luigi, Interview).

In addition, there is lots of research being done to understand the healing power of flowers. Luigi recounts, "The Mother gave names to about 700-800 flowers and she explained identification of the deep meaning of these flowers. These flowers are being turned into tinctures and medicines based on their properties. For example, parvinca is a flower named "progress" and it has been found to cure cancer. These remedies are being researched and tested scientifically" (Luigi, Interview).

Nature holds infinite healing potential. Incorporating natural modalities and plant

medicines reestablishes our connection with the wisdom of our ancestors.

Living Labs: How do we allow for experimentation and evolution in our community ecosystem?

Create a vision and continually refine it

The only way to create something that doesn't exist yet is to dream it. Tamera, Damanhur and Auroville were all manifestations of a dream for a better world. These communities are all living organisms and so they continue to evolve as as their members continue to dream, refine the vision and themselves.

Tamera is described as a "Healing Biotope – the model of a future society". This concept is described in detail in the recently published Healing Biotopes Plan written by the community founder, Dieter Durhm. "Just as a new prototype is first developed in a laboratory, the Healing Biotopes plan is based first on building a new society in a model before it can be applied on a large scale. In a future culture of peace, the global problems, which lead to war all over the world, are solved or are in a process of solution. Healing Biotopes are therefore places where these solutions are prepared. This healing goes beyond the treatment of individuals and is essentially creating a healing environment where everyone and everything – people, animals, plants, the earth – is healthy. Thirty-five years of community research and experience has shown how much presence or absence of trust among people determines whether they are sick or healthy. This trust is not an individual achievement. It is a cultural asset – the result of a healing environment" ("Tamera - Healing Bioptope," 2015).

Aurovillians believe that a "…solid, organized community provides a significant contribution to the social well being of an area. It contributes to improving the quality of life of those both inside and outside the community" ("Auroville," 2014). The vision for Auroville is to be, "A laboratory to achieve human unity. Education for Human Unity is our long-term project. Included in this category are many sub-themes essential to the main one – perceiving education as an unending process, education of the integral personality, perceiving each being as unique, and giving the freedom and opportunity to each person to pursue his or her own path of growth and progress" ("Auroville," 2014). Research and

experimentation is always ongoing to refine these processes and adapt to changing conditions and consciousness.

Organic change and adaptation is a critical aspect of a living lab and will become even more important in times of increasing uncertainty. At Damanhur, everything from the constitution to the political system is constantly adapting, "…because that which is alive is continuously transformed and generates new life. Change is not something to be feared, and the ideal social structure is one that takes its own obsolescence into consideration" ("Damanhur," 2014).

Damanhur is a living example that new forms of society are possible and achievable. This is an important step toward the creation of a new social, economic, and cultural paradigm. For Damanhurians, "living in community means being open to the world, being part of a social and political system that is capable of responding to the needs of citizens, with a sense of service to society. In 2005, Damanhur received recognition as a model for a sustainable society from the Global Human Settlements Forum of the United Nations (UN)" ("Damanhur," 2014).

It takes courage to envision a society that doesn't 'fit' into the current structure and create from the bottom-up a new way forward. This requires humility to continually question and refine, participation from the collective to protect against hierarchy and a set of shared values that act as a compass guiding in the right direction.

Decolonize the mind

Education is part of the intrinsic machinery of programing within the dominant system. The method, content, approach and social conditioning of school is incredibly influential in the development of a child. The observed communities have a much more holistic approach to education which enables more free, critical thinkers with more tools to address all facets of the self – mental, physical, emotional and spiritual.

In Auroville, children are exposed to and invited to be conscious of the world around them. Learning is done through experiencing their surroundings and is facilitated through

trips to the farms, beaches, forests, canyons and lakes in and around Auroville. Appreciating nature and its diversity is cultivated through these experiences. "Our students took major field trips to regional river systems to the south and the west in 2010, in order to become familiar with their importance to the natural environment. And all have participated in community-wide environmental education projects" (Luigi, Interview).

At Tamera education starts from the moment people decide they want to become parents. "We have a parent's school because raising children is one of the most political issues so we really try to make it a conscious process. The choice to become parents is a wish you bring to the community, get feedback and try to distinguish what the need is – whether it is to accompany a soul into this world or are you searching for something else? We try to protect the child's pure and free being. Parents have a habit to entertain them and fixate on them. This makes beings dependent and disconnects them from their own independent source. We educate the parents to protect their space and be present when they need something but not constantly make them dependent. At Tamera they try not to make such a big separation from education and everyday life. "If you observe children they are learning all the time, we don't need to put them in a classroom. We ensure the content they are learning is relevant and this of course includes social skills -teamwork, speaking what your truth, asking critical questions. We encourage diving deeply to acquire wisdom rather than learning knowledge by heart. We also teach through practical experience. We take kids on journeys to visit other projects and other cultures. A few months ago some of the youths made a journey to Brazil and got involved in a project there. This way they learn about politics and are able to design campaigns to create real impact and change" (Vera, Interview).

Damanhur also identifies as a Living Laboratory, a school where everyone is a student every day. "It is a learning environment where we study and experiment together, respect each other's viewpoints, and test every thesis and hypothesis. More experienced students teach and learn from the younger ones, and common findings are exchanged with those of many others from around the world" ("Damanhur," 2014). When it comes to their education system their children are in school from 6 months to 14 years. "It's difficult in

Italy to be recognized as a school", Macaco states. "But we want to teach our children what isn't taught in conventional schools. Apart from the arts, foreign languages, theatre and horse riding there is a focus on knowledge of the self. Throughout their education, each child has a tutor that follows their growth throughout the years so there is one person that consistently sees their development. Our children have three hours where they learn how to talk about themselves. I'm amazed at their self-awareness" (Macaco, Interview).

Luigi speaks about the education system at Auroville. "The aim of education is to keep the deep self, that force, that presence that typically gets silenced in conventional education. There is great diversity in the different methodologies and approaches of education offered at Auroville. The unifying factor is to allow that part of us, the self, to grow rather than be repressed and pushed far away. The "free progress" method schools have an atmosphere of freedom, but the sensitivity and caring attention and intuition of the educator guides the child towards discovery of learning. Every subject comes from the interest of the children. Other schools balance more academic methodologies with free progress. We have diversity of experience, not a monolithic approach. The beauty is when you give many different techniques and approaches to education. One thing we see in the children is strength of character that emerges. We see in the children how they are so receptive to this atmosphere we create. But here we see when a new family comes it is much easier for the children to integrate than the adults" (Luigi, Interview). Future School seeks to provide an environment in which youth from Auroville may develop their own uniqe gifts and reach their potential through balanced development of the body, mind, emotion and spirit.

Holistic education using alternative modalities to develop all aspects of the self is critical in order to impart new skills to children and youth in today's world. Integration of all different kinds of intelligence and social skills is fundamental to creating creative, free-thinkers that are able to dismantle the structures and programing of the dominant system.

Encourage experimentation with structures

Structures are a social contract. The activist and author Abdullah Ocalan, in *Manifesto for*

a Democratic Civilization, articulates, "people mistakenly believe social institutions and structures to be natural entities because the regimes striving to construct legitimacy for these social systems present them as unchangeable and sacred" (Ocalan, 2015). It is necessary to question all structures – education, healthcare, marriage, religion – and encourage experimentation to reveal the virtuous path.

Damanhur was born around the *School of Mediation* because the knowledge had to be lived out and put into practice to refine a different level of consciousness. "Knowledge once lived becomes consciousness. It is theory that wants to become real. We experiment with this knowledge – it's our life. We have structured all the teachings as schools and at the foundation is the school of meditation. The *School of Meditation* leads every citizen through a lifelong process of self-exploration and search for the meaning of existence. This is facilitated through the study of ancient alchemical traditions and the celebration of the rhythms of nature. Damanhur is neither a cult nor a religion, as it does not offer a revealed truth to follow. Instead, the secular message of Damanhur invites everyone to seek answers to life's fundamental questions within themselves, but through exchange and discussion with others. Through community life – the values of which are solidarity, sharing, mutual love and respect for the environment – Damanhurians aspire toward self-improvement that also benefits others and the planet, while through the *School of Meditation*, they explore the energies present in the universe".

At Tamera the structure of relationships is a point of experimentation. "Central to building trust is the reconciliation of the sexes. There can be no peace on Earth as long as there is war in love. The patriarchal society dominated by men must be transformed into a form of life in which women and men reconnect with their sensual knowledge and apply it for a future culture of partnership between men and women. Healing Biotopes show how cooperation and trust can be permanently and structurally developed by creating new living environments" ("Tamera - Healing Bioptope," 2015)

Tamera also imagines a new structure that helps replicate and propagate the vision for a new world. "The concept of the Healing Biotope originated with the idea that there must

be a structure – we called it the "cultural crystal" – that initiates a process of self-replication, much like a biological cell, once the structure is sufficiently developed and complex. This cultural crystal would be a universal structure applicable to all peoples and continents. In other words, the image of a Healing Biotope came from an intention to create a morphogenetic field for a new humane world. The newly built "cultural crystals",have the ability to scale and replicate at a rate that could actually address the deep destruction of late-stage capitalism. As more and more people realize that the current system cannot be reformed, there will, concurrently, be an increasing flux into existing communities, and the creation of new ones. The pre-existing models for Healing Biotopes may play a crucial role in the knowledge transfer and modeling the new modes-of-being. They also have the ability to capture the imagination of a new generation awaiting hope and transcendence on a planet headed towards a Great Collapse of some kind" (Duhm, 2015).

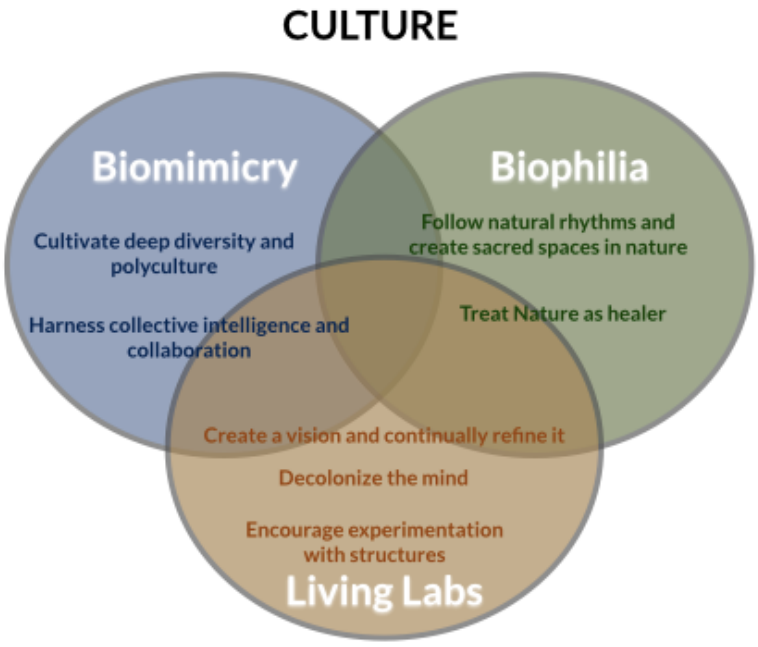
At Auroville the aim is to continue breaking down structures that create separation between people. Luigi explains, "Education is first to educate ourselves to dissolve progressively all the laws that we are boxed into and discover new laws of the universe. Sometimes we fail at the individual level or there is incredible contradiction at the collective level so our old laws have a greater hold on us. But if you free yourself of certain fears, subconscious or conscious, a new law comes into the picture and gives you the safety that you were holding on to the old law for. This is a process of liberation and there are springboards towards all the new innovation, discoveries and dreams that you can manifest once these structures are broken down. At the root of the education is the search for the force of the future. We know a few things – that is contained in the depth of ourselves, in the depth of quantum physics, and in the natural unfolding of evolution. That is the motivation of what we have dedicated our lives" (Luigi, Interview).

As the structures that are imposed on society at large are examined and reduced to their truths, liberty is revealed. From this breaking down rises opportunity to create a culture that is more aligned with the values we wish to see honored in the world.

6.33 Summary

The *Principles for Transition Infrastructure* for a community's culture is summarized in Figure 8. These principles originate from all different disciplines but when combined and executed together create a holistic approach to creating architecture that is in accordance with the ecological worldview.

Figure 8 – Culture Principles for Transition Infrastructure



6.4 Economy

The economy of a community pertains to any facet that is related to the creation and exchange of value, income generation, and currency. Observing these communities it is apparent that having an economic engine at the heart is crucial to being self-sufficient. "We always say that the way we keep ourselves funded is through miracles", Vera of Tamera takes respite in self-deprecation. "Economy is one of the topics that is coming up more and more into a conscious, integrated design of the model. It was something we have

always dealt with because we had to but it's necessary to build it into the structure of community" (Vera, Interview).

6.41 Questions

In the context of the economic engine of a community where the intention is to understand the creation and exchange of value, the question posed for Biomimicry is: "How does Nature create and exchange value?" For Biophilia, "How do we integrate Nature in the value we create and exchange?" For Living Labs, "How do we continuously innovate and experiment in the way we create and exchange value?"

6.42 Principles for Infrastructure Transition

Biomimicry: How does Nature create and exchange value?

Nurture symbiotic relationships

In Nature, all organisms thrive in cooperative relationships and are interconnected in elegantly complex ways. One typically cannot survive without the other and interesting synergies occur between two seemingly distinct species. For example, the plover, a small bird, and the crocodile have a symbiotic relationship. The crocodile opens its mouth allowing the plover to fly in and feed on bits of decaying meat stuck in the crocodile's teeth. The crocodile appreciates the dental work and the plover appreciates the meal (Nguyen, 2010). Additionally, one organism's by-product or waste becomes the other organism's life source. One cannot thrive without the other and the balance of an ecosystem prevails through the interconnections and entanglements of a cooperative system.

Dayna, a biomimetic, recounts an example that mimics the cooperation and closed ecosystem of nature in the form of an industrial eco-park. "Symbiosis means co-existence between diverse organisms in which each may benefit from the other. In the ancient harbor town of Kalundborg, Denmark, various processing companies, a waste handling company, and the Municipality of Kalunborg participate in industrial symbiosis. All participants exploit each other's residual or by-products mutually. An industrial symbiosis

results in mutual economic and environmental benefits that are made possible via bottom-up organization initiated by the companies themselves and actively choosing communication, collaboration and cooperation. For example, Gyproc, a plasterboard manufacturer, has recorded a 90-95% saving in oil consumption after switching to gas supplied by the adjacent refinery. The heat generated from the industry park heats 3500 households eliminating the need for oil-burning domestic heating systems" ("Kalundborg," 2013). The argument can be made that this industrial ecosystem, comprised of a coal-fired power station, an oil refinery, a pharmaceutical company, an industrial manufacturer and the city's utilities providers, in their very existence are contributing to environmental destruction and perpetuating old systems. However, the current reality is that these entities would exist in isolation and create significant environmental damage if they didn't exist as a symbiotic-system.

As we look at a community model, the configuration of a symbiotic closed ecosystem is one to match with sustainable, renewable and regenerative industries rather than the ones demonstrated by Klaudborg. In a community, the same symbiosis should exist ensuring the flow of 'nutrients' from cradle-to-cradle. A closed loop system will ensure that any waste created is seen as and is treated as a precious resource. For example, waste from food scraps becomes compost and then fertilizer for the vegetable garden creating more food to consume or exchange.

In Tamera, they have established a network to regional self-sufficiency, which involves a network of different organic farmers. "We grow 20% of our own food and the rest we need to source from this wider region network. We're starting to partner with other communities around us. This is capital-based and involves a transaction of money and nurtures people to stay in this region because there is a lack of opportunities for economic exchange. We trade crops that are grown in the region and we create a network for seed harvesting. This is to create a common ground for this vision to create a vision that claims it's autonomy and reclaims its culture. We want to create regional self-sufficiency on the basis of regenerative and permaculture purposes and creates model solutions for how you can become autonomous, but this means you have to restore the water and heal the earth

before this can happen" (Martin, Interview).

At Damanhur, they are connected to the local region in many different aspects. "We have an organic food store which we supply and locals can shop at. We sell the products from the local farmers since we like to keep a very short food chain and ensure all of the foods we eat are organic. We have very good healthcare practitioners and specialists that people from outside the community come to visit. The companies that are formed in Damanhur service the surrounding areas. We even have some of our companies employ people that are not Damanhurians. Essentially there is an exchange on both sides. We are very integrated with the bioregion" (Macaco, Interview).

Auroville is very interconnected with its local surroundings seeing it as an integral part of their community. "The relation of the surrounding is essential for the survival of the organism. If you are not fully interacting with the surrounding, sooner or later you will die or be rejected. One of the main concerns of Auroville from the beginning was how we interact with the villages. Around Auroville there is a population of about 12,000 people, some are inside the master plan and some are outside. From the very inception it has been natural to work with them at all levels – from food, water implementation, artwork, etc. These villages have always respected Auroville. Interestingly, because at the center of city there is an unusual building, the Matrimondir, where you pay your love and respects for "The Mother" [the Earth itself] and this resonates with them more than anything else. I later understood that in each of the surrounding villages you will find a temple dedicated to a goddess. For our Western mind this temple is religious. But for them it is the love for the Shakti, the creative force, this is the divine feminine, the goddess. This connection has come before any economic relationship. That creates true sustainability along the years and demonstrates that we are here for something greater, for the love of the goddess. Auroville employs between 5000-6000 people and a lot of locals have been integrated as Aurovillians. They are not second-class citizens. They have access to all the services and even the governance of Auroville. This is not to say that everything is easy. There are tensions that arise but this core connection is what anchors our relationship" (Luigi, Interview).

The symbiotic relationship that is created between the communities and the surrounding areas is a signifier of health. Just as in nature, everything is interconnected and there is strength in collaboration, cooperation and symbiosis.

Establish Alternative Networks for Exchange

As a society we are currently embedded in the bank credit system, which is a capitalistic, global, homogenous system that is top down, not adaptable to local context and premised on quantitative expansion only. This system was useful for the expansion of global markets, however, now that humanity has surpassed this phase, we need to shift from a growth model. This becomes difficult on a global scale when our 'progress' is measured strictly by GDP. Changing the way we acquire goods and services means establishing alternative economies, like community credit systems with non debt-based currencies, and other methods of trade, like gift economy, barter, cooperative models and local currencies.

Jamie Brown-Hansen, a researcher exploring new economic models based on biomimicry, is piloting a community credit exchange system. "Community credit systems don't require national currency because they are created whenever a group of people directly issue credit to one another for their own goods and services. Community exchange systems compile and distribute a directory of goods and services offered by the users registered with them, as well as a list of their wants or requirements. When a user requests something advertised in the directory the seller is contacted and the trade takes place. The largest Local Exchange Trading Systems platform is out of South Africa and is used by more than 800 communities worldwide. These systems are consistent with biological design principles. They are bottom-up, locally attuned and adapted, decentralized, diverse, self-organized, iterative and modular, in short, everything we dream of from a biological design perspective" (Brown-Hansen, 2014). Money is a social contact that we as a society have bought into. Therefore, moving into a system of community credit is a viable option for localized groups that choose to move into a new paradigm of exchange. Brown-Hansen explains, "Money is a collective technology, so the choice to move into community credit becomes more substantial with every person, community, organisation

and business that makes this decision. Money's circulation is powered by our acceptance of it in the payment of goods and services, and this is a distributed phenomenon throughout the network of veins and arteries of the economy. A monetary system collapses not when banks collapse, but when people stop accepting the money" (Brown-Hansen, 2014).

Tamera maintains it's self-sufficiency from seminars and workshops they offer but within their community they operate under a gift economy. "Charles Eisenstein has said that Tamera is one of the most advanced examples of gift economy he has seen. This was surprising to us because we live together and trust each other so we exchange for free. Your basic necessities are covered and there's no salary for the work but the work ethic of what you put in is based on transparency and the commitment you take on. We follow the communication principles of trust and transparency. It does raise the question how do you create the same commitment and goal orientation that capitalism creates with money. We're seeing that the more the vision is seen, the more you get commitment. The shift is from pressure to suction, from pushing to attracting" (Martin, Interview).

In Auroville, there is no transfer of cash within the community. Funds and monthly maintenances are put into an account and exchanges are made via 'chits', which are pieces of paper that denote the amount that is owed. Administration then processes this and funds are transferred to and from accounts. One interviewee explained, "Although the system can be rather process-heavy, not having to exchange cash changes the dynamic of working with people. Your mindset changes from being money conscious to resource conscious" (Marti, Interview).

Communities are also creating their own internal currencies and reclaiming the meaning behind the method of exchange. Damanhur's internal currency is called the *Credito*, translated to English means "credit" and "…is meant to remind us that money is a tool through which we grant trust…This currency system raises the concept of money to a more noble status. It is not considered a goal in and of itself, but rather a functional tool for exchange between people who share ideals and values of cooperation and solidarity" (Tucano, Interview). Today, the *Credito* has the same value as the Euro and is used within

the community as the preferred method of payment for all economic activities. Damanhur is reclaiming the 'original wisdom' of the unit of exchange, however the utilization of the currency is similar to that of the global debt-based system creating an opportunity for more autonomy and experimentation with other systems such as a gifting or bartering culture.

The economic engines within communities benefit from being a cooperative structure as the people who live in that community all have an incentive to contribute and are working towards a shared goal. This sense of purpose and collaborative initiative creates a sense of comradeship and solidarity. An example of this is in Damanhur where they have created systems that make self-sufficiency possible and ensures all production is strictly organic and GMO free. "A large agricultural cooperative, Punto Verde, which is responsible for extensive crops, horticulture and livestock on behalf of the entire community. Community members who are passionate about agriculture run the cooperative and supply Damanhur with 60% of its food" ("Damanhur," 2014). The products produced are provided to the community at a local market and the surplus is sold externally to people in neighboring villages. "Self-sufficiency has been a goal for Damanhur so we are investing in our agriculture and the methods we use to increase our yield and maintain the quality of our organic foods" (Gazza, Interview).

All of these alternatives methods of exchange will allow for a break from the dominant capitalistic system and create a new paradigm that is more aligned with biological systems. Part of shifting from a bank credit system to alternative methods is a matter of choice. These options exists but it's not effective as a system until people and communities choose to embrace the alternatives.

Biophilia: How do we integrate Nature in the value we create and exchange?

Revere Nature as the source, not a resource

Organic and sustainable goods created through regenerative systems acknowledge that Nature can provide us with everything we need to survive. Once we see that Nature is the source of life rather than a resource we can exploit, our relationships changes and

everything we take from the land, we return cultivating a regenerative system that continues to provide.

Bernd, a researcher at Tamera's *Global Ecology Institute*, speaks about honoring Nature to show us the way to heal itself. "Victor Schowberger, researcher and water specialist, once said 'when human beings learn to move water in the right way, only then nature responds with such abundance that all living beings will have access to food, water and energy'. This is a radical statement, which is far away from our lived reality that I have dedicated my life's research to proving this. When you follow natural principles all else flows from this. We stand for the ecological research where we look into our global situation we face destroyed ecosystems all over the world and we can change this. As a human made crisis humans can also change it. The first and most effective way to start this is with water management. Water is life. If you know you want to become a regional autonomous system you need to start with water management system" (Bernard, Interview).

Another way to create this connection is by building expertise in methods and practices that preserve and celebrate nature. As experimentation occurs with new ecological practices, people within the communities develop this deep expertise. With this newfound knowledge and skills small businesses are developed within these communities to service its needs as well as the surrounding areas.

From the experimentation with new methods of building several companies, Inauge, EdilArca, and Solerà, are companies in the fields of design, green building and renewable energy that have been conceived within Damanhur. These companies currently do work throughout northern Italy, building innovative structures and applying technologies born from the philosophies of Damanhur (Gourza, Interview).

At Auroville, most of the 125 active business units originally started to fulfill certain need of the community in the areas of organic foods, renewable energy, natural dyeing, and sustainable building. Most of these pioneering technologies face competition from alternatives like fertilizer based agricultural practices, fossil fuel generated electricity, and chemical dyeing of textiles. Now these products that are produced consciously with

minimal impact are used within the community and commercially sold externally. For example, "Auroville produces a world-class wind pumping system, the need for which arose in the 1970s to pump water to nurture the reforestation efforts. Now this technology has been improved, innovated and commercialized, meeting the needs of Auroville and elsewhere in India ("Auroville," 2014)".

By seeing nature as the source, rather than a resource, a deep bond is formed with nature, fostering a symbiotic relationship and a deep appreciation for place creating social and landscape resilience.

Invest in ecological based solutions

As discussed in the literature review, biophilic design is about more than incorporating nature into the lived environment. It is also measured by the extent in which people interact with and immerse themselves in nature. Stephen, a social ecologist and professor of biophilic design, says, "Nature and our understanding of ourselves as part nature and part of the greater whole is something we have forgotten. Creating and sharing value via agriculture or ecological innovations and practices directly connects us with nature and allows us to create regenerative and healing sources of value to benefit from and exchange" (Stephen, Interview).

Auroville is home to *Matuvam Healing Forest*, a seven-acre medicinal forest and garden, which serves as a healing clinic and educational center. Thousands of medicinal plants are grown organically without pesticides and used directly in medicine prepared by the healing center. The mission of *Matuvam* is to grow and provide medicinal herbs to the community, educate all peoples about the traditional Indian medicine system of "Siddha", and preserve the traditional, local knowledge of plant medicine. Martuvam promotes the use and general knowledge of herbal medicine through workshops, clinics, volunteer opportunities and forest walks. The healing clinic offers consultations and treatments, massages, workshops in different alternative healing methods, and education and information about herbal wellness practices ("Auroville," 2014).

Damanhur understands the importance of investing in ecological solutions. They have started a sacred seed bank for self-sufficiency and to protect biodiversity. “For human nutrition, only 150 major species are cultivated and, among these, just a few of them account for 90% of the food produced. By 2050, an estimated 40,000 species will have disappeared, compared to the variety available at the dawn of agriculture in the beginning of human history. Thia is a disaster of epic proportions of which even the smartest scientists among us cannot predict the outcomes of. Fortunately, many seed-savers are working worldwide to conserve seeds that would otherwise be lost forever. Currently, the Seed Bank has about 50 varieties of vegetable species, or a total of about 10,000 seeds-most of which are local.” (“Damanhur,” 2014). Gazza speaks about the value that this seed bank holds for the community, “Since the beginning we have understood that the real richness is nature. We have no bank account because our money is in the earth and in the resources that exist in real life. This is the bank of natural resources. We have saved the ancient seeds that we have found. In many different countries seed sharing is not possible because of the law and the regulations put in place by Monsanto. We are part of a big battle with other seed savers and we have been part of this global movement” (Gazza, Damanhur).

Tamera offers education, courses and workshops about their innovative ecological solutions. “The Global Ecology Institute, led by Bernd Walter Müller, was founded in 2013 to put the practical work of Tamera´s ecology department into a global context. The institute works on practical ecological responses to current ecological issues with a particular focus on developing model solutions” (“Tamera - Healing Bioptope,” 2015). Tamera holds a wealth of knowledge and experience regarding water, waste, energy and food production, which they disseminate through courses and workshops that reinforce their connection to nature while disseminating this valuable information worldwide. This education is part of the value they create and exchange within their community. This level of expertise ensures that Tamera is constantly immersed in nature implementing and testing these ecological solutions. In addition, they are empowering others with tools to apply these practices wherever they are in the world.

Sharing knowledge about ecological based practices (permaculture, Biomimicry, Biophilic design, intuitive farming practices, etc.) allows for a greater connection to Nature. It also allows us to remember and reconnect to the lost ancient wisdom of our ancestors and preserve their knowledge.

Living Labs: How do we innovate and experiment in the way we create and exchange value?

Create a global network of solidarity

With more communities emerging globally and the technology to support the communication and connection between one another, the strength is found in the collective rather than several fragmented nodes.

Dieter, who has established his own incubator for social change called Living Lands, says, "There's a power in sharing resources, insights and processes but the biggest outcome in connecting people is a sense of inspiration and a shared purpose. Connect people together not to teach them how to create livelihoods but to create support structures for human beings."

Kosha through her experience connecting ecovillages notes, "As a human family, we're moving towards more systemic awareness and application. This is where our next step lies we are going to create a global consciousness and a global awareness. We see communities don't continue to flourish if they don't see themselves as part of a larger network that brings inspiration" (Kosha, Interview).

Traditional villages in Senegal are transitioning to sustainable ecovillages. These villages are consciously taking their power back and adapting to changing factors such as climate change. The government is seeing the progress and has agreed to subsidize 14 000 traditional villages in their transition because they see it as a participatory way to move towards more sustainable development (Kosha, Interview). Damanhur as an established community that has been around for the last 40 years, see themselves as having a global responsibility and are conscious about contributing to projects and partners globally.

Currently they are collaborating with a sister community in Senegal and helping them with the design and process of their community structure.

Vera of Tamera speaks solidarity and weaving a web of connection necessary to shift consciousness. "There are different levels to supporting the creation of a morphic field and there's amazing knowledge that is accessible to overcome the crisis we are facing. We need to develop the global self - we are one planet, one humanity and if we want to survive we need to do it together. The Institute for Global Peace (IGP) is reaching out to other peace projects around the globe. It's not a critical mass that will shift the paradigm it's *critical connections*. Who are the people to know that can shift the system? It's those people that we seek out and we create alliances with" (Vera, Interview).

Martin speaks about the World Wisdom Counsel that gathers at Tamera annually which is comprised of leaders and change makers that are ushering in a new paradigm but also representatives from other communities such as Damanhur. "There is a growing consciousness for the planetary task that intentional communities have as being places that help ground and demonstrate and disseminate an alternative to this dying global mega system. This is especially strong in Damanhur. It's kind of a mutual recognition that our conversation has become more intense and honors the particular gifts that each brings into the conversation and how we can support each other. It might be that Damanhur hosts a Love School in their community and we'll host something about their spirituality practice. It's unofficial, but we will definitely do something together. It was in this wake that Damamnhur had its representative in the Healing Biotopes Plan conversation, which really intends to create an entity that is beyond communities. My hope is that other communities will join in these conversations in the future" (Martin, Interview).

These communities act as nodes that connect outwards and create a network, support structure and the required infrastructure for transition to a post-capitalist society. As more communities expand outwards and build these alliances, the stronger this infrastructure becomes.

Strengthen resilience in community

The prime directive of economic activity is to increase resilience and self-sufficiency in the community both locally and globally. As a collective body, the aim is for the community to generate enough income to remain autonomous from the existing bank system. Re-distribution of wealth back into the community ensures equality among members, development of infrastructure and the opportunity for exploration and interaction beyond the community.

Kosha, President of the Global Ecovillage Network, speaks about a community in Egypt that is creating their abundance outside of the system. "Sekhem, a community in Egypt works with 800 farmers that have become organic producers and have developed a sustainable economy and a social entrepreneurship university. They are producing organic food, cotton, and medicine in a sustainable way. The effect they have is enormous because they create profits from an economy of love. Products are created that are healing and have healing effects. They create healthy income that is reinvested in the community so they're not dependent on outside sources" (Kosha, Interview).

At Auroville the multiple different business units are required to donate 33% of their profits back into the community. The concept is that every Aurovillian engaged in business should support an Aurovillian engaged in a service position. Similarly to the infrastructure that all community members use and benefit from, there is the invisible architecture, or service roles, that make Auroville function. This re-investment in community allows people to pursue their passions and gifts and allowing for the redistribution of wealth across the community.

Martin speaks about creating resilience as a regional stronghold that can operate outside of the current system. "When we speak of the regional networks, the inner will be a radical model and externally it's more conventional. Within the region you have different autonomous communities changing goods on a basis of self-sufficiency and people that have a commitment towards shifting towards a decentralized model. For us, the first thing is to create self-sufficient pockets around us to think about how we can install as fast as

possible a regional currency. If the base is not clear, if you're not autonomous you are still in a dependency. So long as people work in normal jobs, you can call it differently but its still based on the central currency" (Martin, Interview).

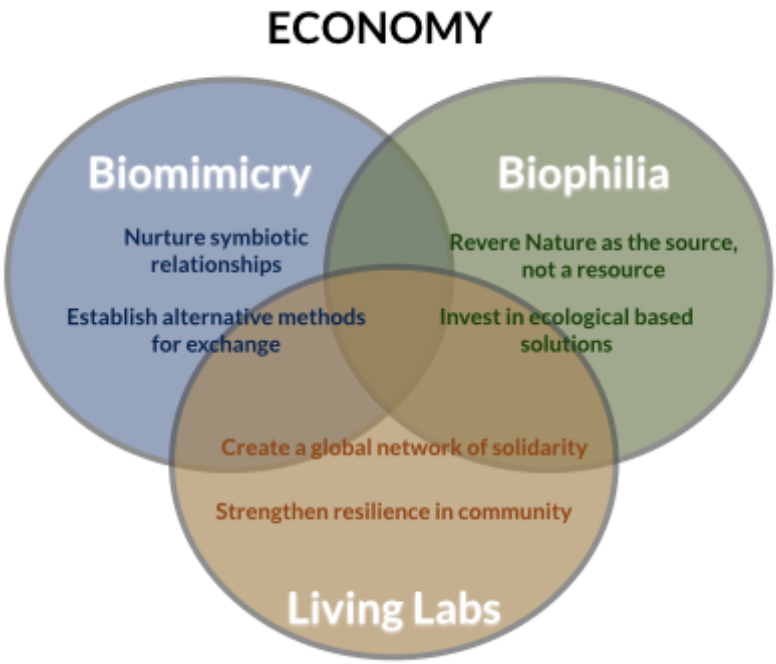
Damanhur has a shared economy where everyone gets a salary and there are many shared contributions at the base so there is an infusion of support that comes from the community members allowing for resilience to flourish. "We share costs for houses, our territories and houses are in a big real estate cooperative in which everyone is a member, everyone owns everything but nothing belongs to anyone. We participate in paying off the loans on the houses and shared structures. At the social level we all contribute the same amount to the children whether we have children or not. This covers food, clothing, school, and sending them to university. We have a solidarity fund, which we contribute to and provides you with monetary support should you become sick or need to care for elderly parents. We also all dedicate 24 hours a month to communal work, 1/2 day in the week plus 2 or 3 evenings a month where we work together on the territories which is what we call 'devotional work'" (Macaco, Interview).

This cyclical flow of energy ensures abundance and focus on a common goal that all the community members can contribute and benefit from. Although funds are reinvested into the community, there is an opportunity to create resilience across communities as well by sharing resources such as knowledge, innovative healing modalities, solidarity and support.

6.43 Summary

The *Principles for Transition Infrastructure* for a community's economy is summarized in Figure 9. These principles originate from all different disciplines but when combined and executed together create a holistic approach to creating an economic engine within a community that is in accordance with the ecological worldview.

Figure 9 – Economy Principles for Transition Infrastructure



7.0 Discussion

7.1 Research Question Answered

From this analysis we illuminate the answer to the research question "*how can the principles of Biomimicry, Biophilia, and Living Labs be integrated and systemically applied in communities?"* Each context will be different, so the framework is applied for the *Principles for Transition Infrastructure* which, filtered through the Ecological Lens (the disciplines of Biomimicry, Biophilia and Living Labs), evoke a set of questions to be explored. Questions provide a platform for continued discussion rather than the stagnant finality of 'the right answer'. Further, it is not necessarily the right solutions that can transcend borders, but the right questions that can be explored in depth. The answers to these questions will reveal the way to integrate and systemically apply these principles within each pillar of a community – architecture, ecology, culture and economy. The answers to these questions are the emerging themes and insights that were observed in each case study community. They are the best practices and dominant worldview within these communities. In this analysis using three communities (Tamera, Damanhur and

Auroville) as case studies, The *Principles for Transition Infrastructure* reveal the following insights for each pillar. These findings are also all summarized at the end of each section in a diagram.

For a community's architecture to integrate and systemically apply the principles of Biomimicty, Biophilia and Living Labs one must: use materials that are multi-functional; start with the function not the form; integrate environmental features to stimulate the senses; integrate natural materials and patterns found in Nature; create modular spaces that allow for interconnection; and create spaces for self-expression.

For a community's ecology to integrate and systemically apply the principles of Biomimicry, Biophilia and Living Labs one must: establish bottom-up, decentralized, diverse systems; cultivate regenerative systems; use natural materials and processes; affirm a connection to place; experiment with new methods and materials; and share pioneering practices.

For a community's culture to integrate and systemically apply the principles of Biomimicty, Biophilia and Living Labs one must: integrate deep diversity and polyculture; govern through collective intelligence and collaboration; follow natural rhythms and create sacred spaces in nature; see nature as a healer; create a vision and continually refine it; decolonize the mind; and experiment with structures.

For a community's economy to integrate and systemically apply the principles of Biomimicry, Biophilia and Living Labs one must: nurture symbiotic relationships; establish alternative methods for exchange; see Nature as the source not a resource; invest in ecological based solutions; create a global network of solidarity; and strengthen resilience.

These are the *Principles for Transition Infrastructure* that emerge from the communities selected as case studies. These principles are very comprehensive in representing the case studies but these principles are not meant to be prescriptive. These principles can be used directly or alternatively this process can be applied to any context, climate and consciousness to reveal a different set of answers to the questions inspired by Biomimicry,

Biophilia and Living Labs.

7.2 Literature Review Gaps

At the inception of this research three distinct areas of study, Biomimicry, Biophilia and Living Labs, were identified as subject areas that when integrated and applied systemically can help build a community-based model that is in alignment with the ecological worldview. This contribution is important to inform how we might build more resilient, self-sustaining, regenerative communities to create the Infrastructure for Transition needed before climate change and the capitalistic-industrial complex continue humanity's trajectory towards collapse.

There were gaps identified in the literature review that this analysis helps answer. The gap in the literature review for Biomimicry was that it was being used to predominately inform architecture or product design in isolation rather than within systems, like entire cities or a community. In addition, any application of Biomimicry applied at a systemic level was top-down and capital heavy. This research provides an opportunity for more inclusivity for the application of biomimetic design by using the ecological lens and empowering people to create community led, owned and operated projects. The use of Biomimicry in this research shows how its principles can be implemented from the bottom-up and without heavy investment.

The gap in the literature review for Biophilia was the exclusive focus on biophilic design used to integrate natural elements back into a dense urban environment or used in stand-alone buildings. There was no literature discussing creating cities or communities that are built from their inception to be integrated with nature. Through this research the starting principles take into account Biophilia and biophilic design not only in the built environment but in all aspects of a community, even in less tangible areas like economy and culture. This approach and framework puts biophilic design at the forefront of the community design ensuring that this principle is integrated into the fabric of the community on all levels. Additionally, this could be used within cities or more dense urban environments when constructing a new neighborhood or community.

The gap in the literature review for Living Labs is that there are no labs intentionally built to explore the systemic application and integration of the principles of Biomimicry and Biophilia. This research serves as that model while also creating a blue print for the *infrastructure for transition* through a community model. The value communities, as experiments outside of the system, provide are innovative solutions and beautiful alternatives to a broken system and allow for the wide dissemination of this knowledge. This sharing of knowledge happens in three ways. "First, the majority of ecovillage inhabitants, who generally live in those villages for several years, fundamentally transform their lives and way of living towards more sustainable and more collaborative practices. When they move they carry on these practices to their new living and working environments. Second, the larger ecovillages run education centers (i.e. ecological gardening, community building, conflict resolution) with several thousand visitors per year. Third, media interest in approaches to regenerative, thriving, inclusive living has increased enormously during the past years bringing more of this information into the mainstream" (Kunze, 2015).

In the literature, Hutchins illuminates that humans have always exploited Nature and the popularization of Biomimicry can make us vulnerable to treading down this path. Hutchins stresses the importance of participatory engagement when applying the principles of Biomimicry in order to address the root causes of our crisis. Through the interconnections between these disciplines the risk of exploitation of nature that Hutchins cautions about dissipates. With inquiry about how to emulate nature's genius and how to integrate nature into our lived environment in a context that encourages organic, experimentation, and reverence is created for nature rather than its exploitation.

Similarly, Goldstein and Johnson argue that " ... the problem with Biomimicry: though its stated intention is to learn from, respect and honor nature, by doing so through the available investment options for industrial R&D, the reproduction of life becomes intimately entangled with the reproduction of capital." Helena Van Vilet, in reference to biophilic design, says, "...we tend to take care of things that we love". By implementing biomimicry interconnected with the principles of Biophilia and Living Labs more

consciousness about the role that nature and living systems play are taken into consideration so that its value is held beyond the reproduction of capital.

Kellert makes the observation that biophilic design isn't effective unless the interventions are "…connected, complementary and integrated within the environment rather than isolated allowing for repeated and reinforced contact with nature." By integrating biophilic design systemically throughout all pillars of community you avoid the inconsistency that makes its design application ineffective.

Newman and Beatly argue, the extent to which a city and its citizens can be said to be biophilic will depend on the extent to which citizens interact and immerse themselves with nature. "In biophilic cities, residents are directly and actively engaged in learning about, enjoying and caring for the nature around them and have developed important emotional connections with nature" (Beatley & Newman, 2013). In a Living Lab where the principles of Biomimicry and Biophilia are integrated and applied on a systemic level the affect on the citizens of the community will be one of continuously engaging and being immersed in nature.

Edwards-Schachter and Tams argue, "…that social and power dynamics have been largely overlooked in the literature around Living Labs, and the lack of focus on this issue may present a barrier to truly participatory innovation" (Tams & Edwards-Schachter, 2013). Another challenge is how solutions that work well within one lab transfer into alternative environments. Within the Living Labs the pillar of culture includes participatory decision making processes and tools for empowering communication and conflict resolution. With these aspects integrated into the design of the Living Lab, social and power dynamics will be managed. Additionally, the model of *Principles for Transition Infrastructure* is designed especially to be able to transfer solutions and knowledge from one environment to another as it is based on asking questions that will illuminate the appropriate answers for any context, climate and consciousness.

This research begins to answer the gaps in the literature for the disciplines in question, but it also creates new findings as the interconnections begin to reveal synergies that amplify and transcend the application of the disciplines in isolation. The following section explores these interconnections in more detail.

7.3 Systemic and Integrated Applications

The research question explored is "How can the disciplines of Biomimicry, Biophilia, and Living Labs be integrated and systemically applied in communities?" The pillars of community that have been examined specifically are: architecture, economy, culture and economy. The literature demonstrated that the disciplines of Biomimicry, Biophilia and Living Labs have been applied deeply in their silos but rarely integrated to birth a more holistic approach to community building. Additionally, these disciplines are more commonly applied in isolation rather than through systems.

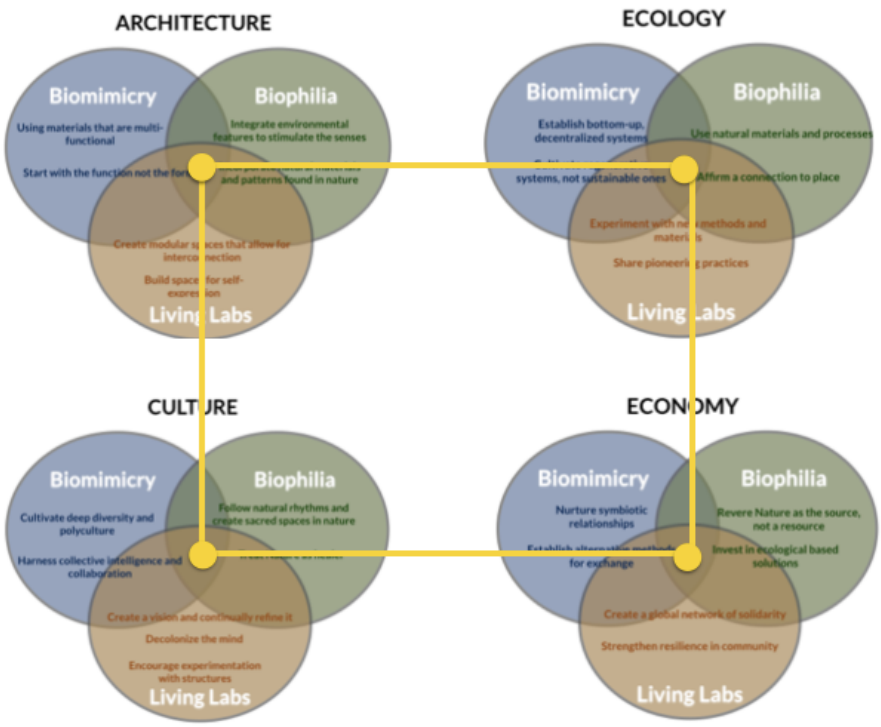
The following analysis illustrates three categories that answer the research question in a way that includes: 1) Systematically applying disciplines 2) Integration of disciplines 3) Integration of principles. Each will be analyzed and discussed using examples. These distinct categories are explored to thoroughly answer the research question and demonstrate the variance in each approach.

1. Systemically applying disciplines

When the disciplines of Biomimicry, Biophilia and Living Labs are applied throughout all community pillars - architecture, ecology, economy and culture – they become the original impulse or foundational philosophy of the community (Figure 10). As the building blocks of design, these disciplines are integrated on a systems level, permeating all aspects of the community rather than being isolated or siloed occurrences.

Figure 10 – Visual Depiction of Systemically Applying Disciplines

Principles for Transition Infrastructure



For example, biomimetic principles are applied on a systems level throughout all pillars of community. Starting from this design criteria the entire ecosystem of the community is held by this ideology. Table 14 summarizes the biomimietic principles applied across pillars.

Table 14 - Biomimicry Applied Across Pillars

	Biomimicry
Architecture	Use organic, multi-functional materials
	Start with the function not the form
Ecology	Establish bottom-up, decentralized, diverse systems
	Cultivate regenerative systems

Culture	Nurture symbiotic relationships
	Establish alternate methods for exchange
Economy	Cultivate deep diversity and polyculture
	Harness collective intelligence and collaboration

Similarly, biomimetic principles are applied on a systems level throughout all pillars of community. Table 15 summarizes the biophilic principles applied across all pillars.

Table 15 - Biophilia Applied Across Pillars

	Biophilia
Architecture	Stimulate the senses by integrating environmental features
	Integrate natural materials and patterns found in nature
Ecology	Use natural materials and processes
	Affirm a connection to place
Culture	Follow natural rhythms and create sacred space in nature
	Treat Nature as Healer
Economy	Revere nature as the source, not a resource
	Invest in ecological based solutions

And finally, Living Labs principles are applied on a systems level. Table 16 summarizes the Living Lab principles applied across all pillars.

Table 16 – Living Labs Applied Across Pillars

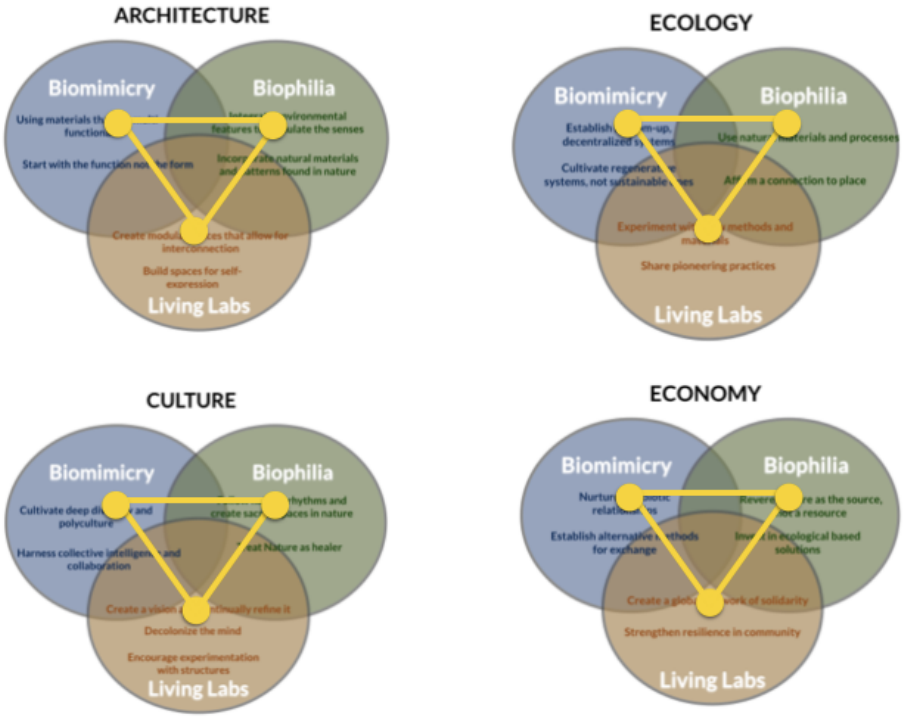
	Living Labs
Architecture	Create modular spaces that allow for interconnection
	Build spaces for self expression
Ecology	Experiment with new methods and materials
	Share pioneering practices
Culture	Create a vision and continually refine it
	Decolonize the mind
	Experiment with structures
Economy	Create a global network of solidarity
	Strengthen resilience in community

2. Integration of disciplines

The disciplines of Biomimicry, Biophilia and Living Labs are integrated within each pillar feeding one another and resulting in holistic design solutions. When the design principles of each discipline are integrated there is synergy that occurs transcending the outcome of applying one of the principles in isolation.

Figure 11 – Visual Depiction of Integration of Disciplines

Principles for Transition Infrastructure



How this manifests in a tangible example will be illustrated for each community pillar below.

Architecture

Looking specifically at the architecture pillar, when building infrastructure, the design process begins by following the *Principles for Transition Infrastructure* to guide the design as shown in Table 17.

Table 17 – Architecture Principles for Transition Infrastructure

	Biomimicry	**Biophilia**	**Living Labs**

Architecture	Use organic, multi-functional materials	Stimulate the senses by integrating environmental features	Create modular spaces that allow for interconnection
	Start with the function not the form	Integrate natural materials and patterns found in nature	Build spaces for self expression

These principles start to reveal the interconnections between the disciplines. Imagine a family dwelling needs to be constructed. The organic materials used to build are locally sourced and abundant bamboo and clay. These materials are multi-functional for construction (can be used for roof, walls, shelving, floors, etc.), a biomimetic principle, and because they are used in their raw form, they integrate natural materials and patterns found in nature into the built environment, a biophilic principle. By building in round shapes with curved forms, high ceilings and screened walls, there is significant air flow, light, sounds and scents of the surrounding environment which stimulate the senses and affirm our connection to place, a biophilic principle. A two-bedroom dwelling is built modularly emulating a seed structure, with two pods as bedrooms and a third pod for a shared living area and kitchen. This seed structure design is biomimetic and it's modular function of facilitating interconnectedness is a living labs principle. Recycled bottles are used to create beautiful mosaics in the walls, pebbles collected from a nearby river and shells from the ocean are used for the floors in the bathroom. These decorative details allow for self-expression, a living labs principle and is another opportunity to use natural materials and patterns found in nature, a biophilic principle. The family's favourite vegetables, herbs and fruit trees planted outside the dwelling are harvested regularly and used in the kitchen, another application of a living labs principle of creating spaces for self expression. This vegetation serves the functional benefit of feeding the family and creates privacy and a sound barrier between the next family dwelling, a biomimietic principle of multi-functional design.

Ecology

Looking specifically at the ecology pillar, when creating the systems for food production, the design process begins by following the *Principles for Transition Infrastructure* to guide the design as shown in Table 17.

Table 17 – Ecology Principles for Transition Infrastructure

	Biomimicry	**Biophilia**	**Living Labs**
Ecology	Establish bottom-up, decentralized, diverse systems	Use natural materials and processes	Experiment with new methods and materials
	Cultivate regenerative systems	Affirm a connection to place	Share pioneering practices

These principles start to reveal the interconnections between the disciplines. Imagine a system for food production needs to be designed. Regenerative agriculture is a method of food production that regenerates the soil and surrounding environment, while sequestering carbon from the atmosphere. Common practices associated with regenerative agriculture are growing a polyculture of plants, focusing on perennials, avoiding pesticides and other chemicals, and not tilling the land. This method of farming is the default for a large percentage of smallholder farmers that have not yet been forced into the industrial model with its focus on monoculture, seed privatization, pesticides and economic dependency. Cultivating regenerative, diverse, decentralized systems are biomimetic principles. "Biodynamic food production aims to create a diversified, balanced farm ecosystem. Preparations made from fermented manure, minerals and herbs are used to harmonize the fertility and vital life forces of the land to enhance nutrition and quality of food.... Biodynamic practitioners work in cooperation with the subtle influences of the wider cosmos on soil, plant and animal health" (Briggs, 2015). Biodynamics uses natural material and processes, a biophilic principle. Implementing this type of farming experimenting with new methods and materials is a principle of living labs. Raising food that is indigenous to the bioregion and thrives in the climate affirms a connection to place, a biophilic principle. Creating an educational program that invites students and practitioners to learn these methods and champion regenerative, biodynamic farming is a Living Lab principle of sharing pioneering practices.

Culture

Looking specifically at the culture pillar, when creating the systems for participatory decision-making, the design process begins by using the *Principles for Transition Infrastructure* to guide the design as shown in Table 18.

Table 18 – Culture Principles for Transition Infrastructure

	Biomimicry	**Biophilia**	**Living Labs**
Culture	Integrate deep diversity and polyculture	Follow natural rhythms and create sacred space in nature	Decolonize the mind
	Govern through collective intelligence and collaboration	Heal through natural modalities	Create a vision and continually refine it
			Experiment with structures

These principles start to reveal the interconnections between the disciplines. Imagine a participatory process that facilitates the collective community and its individual members to make decisions, resolve conflict, heal and grow. Including all members of the community in the process and implementing a participatory, democratic process to make decisions achieve biomimetic principles of deep diversity and collective intelligence.

The community gathers in a sacred space nestled in nature regularly twice a month during new moon and full moon. During new moon, the beginning of a cycle, intention is put towards the activities of the community that need to grow or be cultivated. This is the time when intentions and action plans are set for the month. Full moon is a time for reflection, receiving feedback and course correction for the following cycle. The moon governs our natural cycles and attuning to these natural rhythms and facilitating this process in a sacred space in nature are biophilic principles. Using natural modalities to move energy and heal such as dancing, singing, drumming circles, sacred fires and plant medicine ceremonies once a month help bring the community together and create a safe container.

This provides an opportunity for members to voice concerns, issues, problems and be heard by the community or a counsel aided by the intelligence of these ancient tools, rituals and practices. Utilizing these natural modalities for healing is a biophilic principle.

Breaking down the conditioning of hierarchy and patriarchy present in our dominant system is embedded within this structure and is a process that cultivates free thinking and decolonizing the mind, a principle of living labs. Gathering with the intention of creating a better world and regularly revisiting it to evaluate progress challenge the approach, adapt to changing conditions and course correct is part of this adaptive process and is a principle of living labs. Experimenting with this structure, another living labs principle, may occur periodically or necessarily as the community grows. For example, smaller circles may gather to create different group dynamics and alchemy such as holding a separate circle for women and men and then coming together as a larger group.

Economy

Looking specifically at the economy pillar, when creating the systems for an economic engine, the design process begins by using the *Principles for Transition Infrastructure* to ask the following questions to guide the design as shown in Table 19.

Table 19 – Economy Principles for Transition Infrastructure

	Biomimicry	**Biophilia**	**Living Labs**
Economy	Nurture symbiotic relationships	Treat nature as the source, not a resource	Create a global network of solidarity
	Establish alternate methods for exchange	Invest in ecological based solutions	Strengthen resilience in community

These principles start to reveal the interconnections between the disciplines. A community requires an economic engine to ensure its self-sufficiency. Imagine a co-operatively owned regenerative trading company – bringing goods produced by regenerative agriculture systems to markets around the world. In a way that all stakeholders are engaged to increase their vitality and viability as agents of change, by working together to

build an alternative economic and distribution model in order to catalyze, grow and finance the global regenerative revolution that increases biodiversity and reverses climate change. Offering this alternative to consumers and producers creates a global network of solidarity and strengthens resilience in communities, both principles of living labs.

Regenerative design is a process-oriented systems theory based approach to design. The term 'regenerative' describes processes that restore, renew or revitalize their own sources of energy and materials, creating sustainable systems that integrate the needs of society with the integrity of Nature (Roös & Jones, 2017, p. 205) . Treating Nature as the source is a biophilic principle. As a trading company, goods will be sourced from the community in addition to local farmers and other producers of regenerative products. This nurturing of symbiotic relationships and establishing alternate methods of exchange are biomimetic principles. Distribution will occur via cargo sailing ships known as transatlantic emission free freight service. This shift in focus of the distribution channels is investing in ecological based solutions, a biophilic principle.

3. Integration of disciplines and pillars

When pillars intersect, the integration between disciplines are made on a deeper level resulting in design principles that create a symbiotic and purposeful design directive that creates an interconnected ecosystem governed by Nature's principles. See Figure 12 for the visual depiction of this web of integrated interconnections. The following matrix in Table 20 explains the visual description using tangible examples and reveals the synergies that emerge. A detailed explanation of each interconnection is explained after the matrix.

Figure 12 – Visual Depiction of Integration of Disciplines and Pillars

Principles for Transition Infrastructure

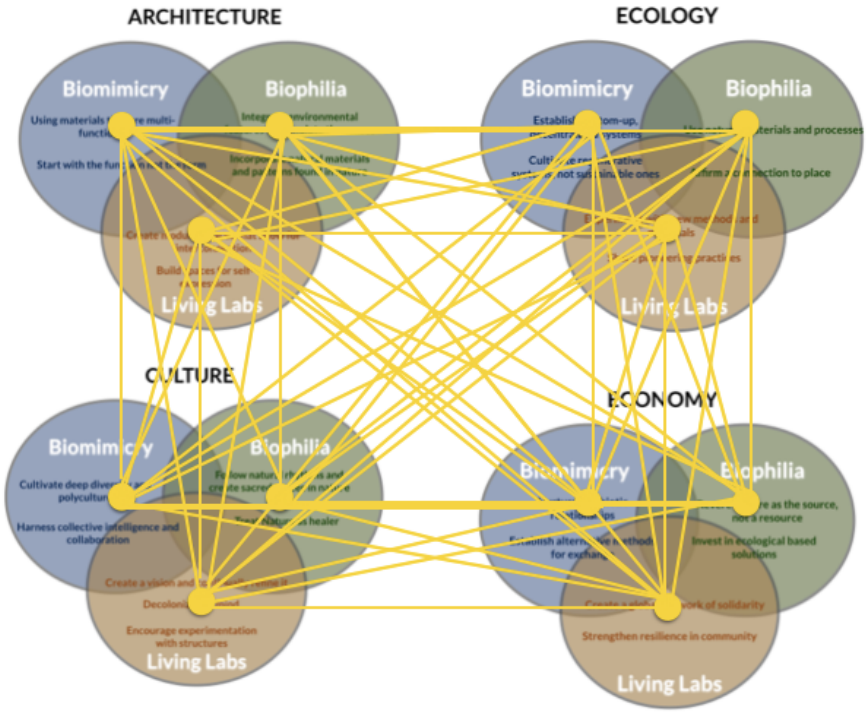

ARCHITECTURE
ECOLOGY
Biomimicry
Biophilia
Living Labs
CULTURE
ECONOMY
Biomimicry
Biophilia
Living Labs

Table 20 – Matrix to show Integration Across Pillars (Architecture Example)

Architecture (build infrastructure)	**Ecology**	**Culture**	**Economy**
Biomimicry	**Establish bottom-up, decentralized, diverse systems** Build infrastructure that is bottom-up decentralized and diverse **Cultivate regenerative systems** Build regenerative systems for infrastructure	**Cultivate deep diversity and polyculture** Build different types of housing and structures for the diverse needs of the community **Harness collective intelligence and collaboration** Build structures via consensus based decision making	**Nurture symbiotic relationships** Building dwellings integrated into agricultural land **Establish alternate methods for exchange** Exchange time or skills rather than monetary
Biophilia	**Use natural materials and processes** Create food systems in the form of mandalas **Affirm a connection to place** Build a temple on a sacred site and incorporate all four elements (wind, water, fire, water) in the structure	**Follow natural rhythms and create sacred space in nature** Build beautiful small nooks and meditation areas in nature **Heal through natural modalities** Create a medicinal or sacred seed garden and infirmary structure to honor the healing wisdom of nature	**Revere nature as the source, not a resource** Build infrastructure using materials that are local and abundant **Invest in ecological based solutions** Create biophilic learning centers for ecological solutions
Living Labs	**Experiment with new methods and materials** Use biodynamics for food, water, waste systems **Share pioneering practices** Host workshops to share the models and processes of systems implemented	**Decolonize the mind** Create a non-traditional space in nature for learning **Create a vision for a better world and refine it** Continue to experiment with methods and materials for building structures **Experiment with structures** Expand the limits of reality via inspirational structures	**Create a global network of solidarity** Create an open-source process for building locally that can be applied globally **Strengthen resilience in community** Share building costs for infrastructure

Architecture Matrix

The matrix above uses building infrastructure as the case example within the architecture pillar. This matrix outlines the design outcomes that occur when applying the *Principles for Transition Infrastructur*e across disciplines and pillars. This matrix was completed by looking at each principle and inquiring about how it would affect, in the case of the architecture example, the infrastructure build.

Architecture intersecting with Economy

The principles of biomimicry in the economy pillar are: *Nurture symbiotic relationships* and *Establish alternate methods for exchange*.

Nurture Symbiotic Relationships

When applying these principles to how a community would build infrastructure one consideration is to create structures that are integrated into the agricultural land so that community members can be responsible for harvesting the plot of land that is closest to their dwelling. They benefit from this harvest while the grey water and black water from the dwellings gets processed and acts as fertilizer for the agriculture. This symbiotic relationship saves labour costs for farmers required, costs for fertilizer and promotes a sense of place and connection to the land.

Establish Alternative Methods for Exchange

A consideration for infrastructure build that falls under the principle of establishing alternate methods for exchange is how community members will 'buy' a home and contribute to the infrastructure build. While some may exchange through money, others may exchange through time contributed through work.

The principles of biophilia in the economy pillar are: *Revere Nature as the source, not a resource* and *Invest in ecological based solutions*.

Revere Nature as the source, not a resource

Building infrastructure using natural materials that are local and abundant not only saves on costs for building but also incorporates organic materials into the lived environment. For example, land that is abundant with clay and bamboo can be used for building dwellings and communal structures in an inexpensive way. These 'natural analogues' described in Biophilia refers to organic, non-living and indirect experiences of nature. Objects, materials, colors, shapes, sequences and patterns found in nature, expressed through the built environment.

Invest in ecological based solutions

Build biophilic communal structures that serve as learning centers or areas for education of ecological practices like regenerative agriculture, permaculture, biodynamics, biomimicry, etc. These educational programs will be a revenue source for the community.

The principles of Living Labs in the economy pillar are: *Create a global network of solidarity* and *Strengthen resilience in community*.

Create a global network of solidarity
Create value through an open-source process for how to built architecture and infrastructure locally that can be adapted globally.

Strengthen resilience in community
To strengthen resilience in community when considering infrastructure build, share costs across the community for construction.

Architecture intersecting with Ecology
The principles of biomimicry in the ecology pillar are: *Establish bottom-up, decentralized, diverse system*s and *Cultivate regenerative systems not sustainable ones*.

Establish bottom-up, decentralized, diverse systems
Build infrastructure that is bottom-up, decentralized and diverse such as John Todd natural systems for the treatment of wastewater.

Cultivate regenerative systems not sustainable ones
Build regenerative systems such as water retention landscapes to reverse decertification and create food production systems using regenerative agriculture methods.

The principles of biophilia in the ecology pillar are: *Use natural materials, forms, and processes* and *Affirm a connection to place*.

Use natural materials, forms, and processes
Plant gardens in the form of mandalas (circular form) to combine aesthetics and practicality. A mandala garden incorporates permaculture principles that save resources like water and allow for the use of mulching for moisture retention and soil conditioning.

Affirm a connection to place

Identify a sacred site on the land and build a communal temple that incorporates all four elements (water, wind, fire and water) in the structure.

The principles of Living Labs in the ecology pillar are: *Experiment with new methods and materials* and *Pioneer practices that are shared*.

Experiment with new methods and materials

Use biodynamics for living systems to promote better growth and more vibrant, nutritious foods. "Biodynamics is an approach that creates a diversified, balanced agricultural ecosystem that generates health and fertility. Preparations are made from fermented manure, minerals and herbs are used to help restore and harmonize the vital forces of the farm and to enhance nutrition of the food cultivated…. Biodynamic practitioners also recognize and strive to work in cooperation with the subtle influences of the wider cosmos on soil, plant and animal health" (Briggs, 2015).

Pioneer practices that are shared

Host workshops to share the models and processes of the systems implemented. Create a learning institute to continue to attract new thinking and sharing.

Architecture intersecting with Culture

The principles of biomimicry in the culture pillar are: *Cultivate deep diversity and polyculture* and *Harness collective intelligence and collaboration*.

Cultivate Deep Diversity and Polyculture

Build different types of housing and structures for the diverse needs of the community ranging in materials, sizes and geography locations.

Harness Collective Intelligence and Collaboration

Plan structures via consensus based decision-making processes and have community-members collaborate to help with build.

The principles of Biophilia in the culture pillar are: *Follow natural rhythms and create sacred spaces in nature* and *Treat nature as healer*

Follow natural rhythms and create sacred spaces in nature

Build beautiful small nooks and meditation areas in sacred spaces around the land to encourage individuals to take time to themselves to explore and commune with nature. Gather the community in a shared structure, such as a temple, during celestial events to honor the natural rhythms such as full moon and solstice.

Treat Nature as healer

Create a medicinal or sacred seed garden and infirmary to honor the healing wisdom of nature. Create a culture around preventative care for health issues, natural treatments and alternative medicine.

The principles of Living Lab in the culture pillar are: *Decolonize the mind*, *Create a vision and continually refine it* and *Encourage experimentation with structures*.

Decolonize the mind

Create an imaginative, inspiring, non-traditional educational space in nature.

Create a vision and continually refine it

Continue to experiment with building structures, test new methods and materials that continue to push the edges of achieving structures that allow us to live, work and play in harmony and symbiosis with our surroundings.

Encourage experimentation with structures

Expand the limits of the reality via imaginative structures that inspire. Imagine structures beyond four walls and a roof. Create structures that deconstruct what is imposed and create a new reality.

By delving into each aspect of the matrix and applying the *Principles for Transition Infrastructure,* it is evident that integrating each discipline and pillar results in a more cohesive and synergistic approach to, in this example, building infrastructure in a way that is in alignment with Nature. This analysis uses the architecture pillar as a starting point and explores the case example of "how do we build infrastructure?" As this question is explored through the filter of the principles, the outcome is a highly integrated approach to building infrastructure that is anchored in the design principles of Biomimicry, Biophilia and Living Labs. The same process can be implemented, creating a matrix with each remaining pillar (Ecology, Culture, and Economy) intersecting the disciplines to demonstrate the application of the principles and deep level of integration.

7.4 Implications for Practice

Through the findings phase of the research it was apparent that the communities observed are implementing Biomimetic, Biophilic and Living Lab principles intuitively in some form or another; however, there isn't a consciousness around these disciplines and their depth of application. In addition, although examples of these principles exist throughout the community in instances, it was rare to find examples of the interconnections. The framework allows for inquiry about all three disciplines for each pillar so there is a consciousness around the integration of each. Additionally, there are synergies that when coupled and integrated transcend the current perception of what is possible.

These communities have an ethos and intention of living in accordance with nature, therefore there is an innate impulse to leave a light footprint and integrate regenerative and sustainable practices that honor their environment. Because of this natural impulse, Biomimicry, Biophilia and Living Lab principles are generally applied systemically across the different aspects of the community. This is seen more frequently and concretely in

architecture and ecology and seen less frequently in the areas of economy and culture. Although this natural impulse is strong throughout all community aspects, there isn't awareness of the theory behind Biomimicry, Biophilia and Living Labs and foundationally what it would mean to create an entire community from this seed. Once these concepts are discussed with the community, there is greater appetite to structure aspects of the community in this way because there is recognition of the wisdom that nature holds. When looking at the framework the principles are coded to be applied systemically throughout the whole infrastructure of a community rather than be present in an isolated incidence. By applying these principles systemically throughout all the manifestations of the respective pillars, holistic systems change begin to emerge and the connective tissue between the disciplines start to be woven.

When the interconnection and systemic application between the three disciplines is aligned the function, form and intention of any aspect of the community upholds the values of the ecological worldview. To explain further, the function (Biomimicry) is emulating Nature's genius; the form (Biophilia) is utilizing inspiration from Nature and natural materials; and the intention (Living Lab) is having a philosophy of experimenting and constant evolution.

Through the analysis process it became apparent that a preliminary understanding of Biomimicry, Biophilia and Living Labs is required in order to accurately apply this process to a community and truly understand it's benefits. An implication for practice is to ensure there is a basic understanding of these concepts individually and how they fit together prior to engaging in this process.

Additionally, the ethos of the *Principles for Transition Infrastructure* is to be organic and adaptable, just like nature. Therefore, a 'living question' allows for a foundation of exploration as new conditions, circumstances, and consciousness emerge to continually form what is the appropriate solution for that time. In each assessment consideration should be made to how often this process is revisited, for example, annually, seasonally, or every solstice. Consideration should also be made to where this process is facilitated

ensuring that the participants are in a natural environment or surrounded by biophilic design to allow for the connection to Nature to be prevalent.

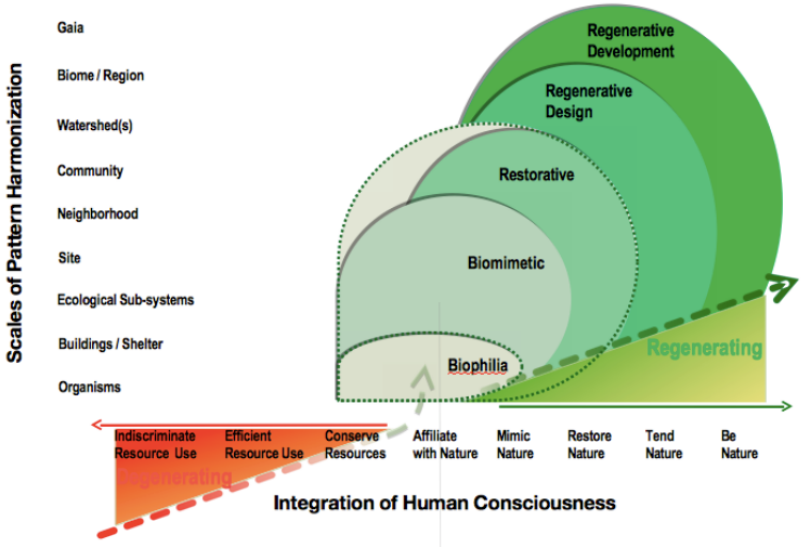
As more communities implement this approach and these principles, a larger movement is created where more experiments outside of the current system are all aligning their constitution to the principles of Biomimicry, Biophilia and Living Labs. This will create a cohesive culture among these communities and a network of solidarity and shared practice all around the globe. Setting these natural laws as a foundation and allowing them to be expressed in each climate, context or circumstance in their own unique way creates diversity that is rooted in a new paradigm that is aligned with the rhythms of nature, the source of all life. Implementing this approach in communities, allows for the next evolution to be applied to more densely populated areas or urban environments where urban planners, governments, and organizations can take the necessary steps to change their systems and structures to follow these natural laws. This in turn will have a domino affect on the broader culture, helping to realize Tamera's notion of cultural crystals, and transmutating these crystals into a broader macro-cultural shift.

7.5 Additional Literature

As this research comes to completion there is additional literature emerging that explores the scenario when human consciousness fully embodies that it is nature and therefore the impact on our surroundings is only one of regeneration. This thinking transcends the disciplines of Biophilia and Biomimicry and catapults us to the edge of Regenerative Development as shown in Figure 13. "As we evolve we begin to identify with larger and larger systems, recognizing the nested nature of subsystems and the uncountable interconnections between them. Using the terminology from Reed, we can see this process of transforming identity (role & relationship) as a function of expanded human consciousness and pattern harmonization. The more aware we become of how Nature works, the more clearly we recognize that we are an integral part of the planetary system (Gaia). The separation between man and nature perpetuated by those lingering narratives is wilting away — though there is a lot of important work to be done to send it on its way once and for all" (Reed, 2015). This shift in consciousness would evolve past the principles of Biomimicry and Biophilia and explore regenerative development in which

nature is no longer seen as separate. "Here the purpose of humanity aligns with the purpose of the planetary system itself, having an evolutionary function that looks to continuously improve through feedback loops, learning, and adaptation toward ever-increasing levels of diversity, resilience, beauty, abundance, etc." (Reed, 2015). This description by Reed also alludes to a Living Labs approach that prescribes continuous adaptation, growth, testing, and refining. When these concepts are brought together and integrated, as shown in this research, the overall affect creates a heightened sense of awareness of the interconnectedness to nature and the understanding that we are Nature. This creates the possibility of our consciousness shifting at a faster rate to completely transcend the disciplines of Biomimicry and Biophilia to bring us to a state of any development being completely regenerative and in equilibrium with the planet.

Figure 13 – Movement towards Regenerative Development (Reed, 2015)



Additional literature speaks to the systems that are constantly changing and the importance of communities learning to integrate more closely with nature to build a stronger system of resilience. "The complex dynamic systems that join nature and culture into a mutually dependent whole require us to create flexible and adaptable solutions that can respond to dynamic system changes. Nature constantly changes! Anthropogenic climate change and ecosystem degradation only accelerate systemic change. Sustainability is not an achievable steady state. Rather, it is a continuous process of community-based

learning of how to participate appropriately in natural process. Design for sustainability is materially expressed through sustainable products and infrastructures, but more profoundly, through sustainable communities, lifestyles, and societies. Increasing sustainability is about creating flexible and dynamically networked structures of self-sustaining, autopoietic wholes within wholes. This requires the creation and empowerment of sustainable communities of responsible, eco-literate citizens adapted to the challenges and opportunities of a particular, local ecology and culture cooperatively linked into mutual support networks that span from local to regional to global scale (Wahl, 2006)."

Additional literature on ecovillages as Living Labs has reinforced the importance and the role that these communities take on as incubators for holistic systems change. Researcher, Kunze, explains further "While the core intentions, purposes and motivations may differ in each ecovillage, they all have one crucial feature in common: by experimenting with new forms of sustainable living, governance, economy, education and everything that can be done in a newly founded village, they serve as incubators for social innovations in many different fields …the ecovillages I describe are not isolated islands, scientific laboratories or utopian heavens, but real neighbourhoods, where people live their daily lives…Moreover, the practices which have been developed and established over the years do not remain inside single ecovillages." (Kunze, 2015). As we shift from the dominant system and established ways of being, we will require more examples and experiments of alternative modalities to model.

Industry experts that were interviewed mentioned alternative models and trends that communities might implement in the future, however they weren't observed in the case studies. An interesting aspect of the economy pillar that was alluded to by the industry experts and was highlighted in the literature but wasn't observed was *respecting the natural law of entropy*. The Natural Law is a cycle of birth, growth, death and rebirth. No form of growth, let alone the exponential kind, lasts forever in nature. Money does not decay over time; it remains constant or grows exponentially thanks to the made-up construct of interest. Brown-Hansen explains, "…once real growth lags behind the compounding interest of the credit money supply, the system's logic decouples it from the

real economy in favor of moving into the virtual reality: the only realm where exponential growth can last forever" (Brown-Hansen & Slater, 2014).

Charles Eisenstein speaks about demurrage currency which is money that, like elements of Nature, decays over time. "Demurrage redefines money as a medium of exchange instead of being a store of value. No longer is money an exception to the universal tendency in nature toward rust, mold, rot and decay that is, toward the recycling of resources. No longer does money perpetuate a human realm separate from nature… Conceptually, demurrage works by freeing material goods, which are subject to natural cyclic processes of renewal and decay from their linkage with money that only grows, exponentially, over time. This dynamic is driving us toward ruin in the exhaustion of all social, cultural, natural, and spiritual wealth. Demurrage currency merely subjects money to the same laws as natural commodities, whose continuing value requires maintenance (Eisenstein, 2011)." Incorporating demurrage currency into the economic pillar of a community upholds the principles of the economic worldview. The communities observed have not implemented this but this could be a topic that would be interesting to apply and study over time.

Cooperative economic models were also discussed at length by industry experts but only observed in some instances in communities. Cooperative business models are the structures in which cooperative relationships to create and exchange value manifest. The co-ownership structures allow for people to enjoy the benefits of pooled risk and empowerment of ownership and control. They're also not required to grow, which provides an alternative to the existing economy's drive to use resources and produce waste for profits. Gar Alperovitz, founder of the Democracy Collaborative, "a research center dedicated to the pursuit of democratic renewal, increased civic participation, and community revitalization", says, "In contrast to corporations, which have every interest in cutting costs wherever possible, locally rooted cooperative institutions are inherently responsible to people and place. They give local people a stake in the enterprise, which means that the health of the community comes first. Local people have good jobs, and the land, air, and water are treated with care" (Alperovitz, 2014). Cooperative models are becoming more popular in an increasingly precarious economy, "There is a competitive

advantage in cooperatives, particularly as our world crumbles around us. There's environmental crises, there's capital crises, people are starving and homeless in the richest country in the world. And as that begins to filter through the consciousness of everyday people…how do we envision a different system?… This actually is a system that foregrounds member benefit and community benefit in the [organization's] form" (Chen, 2016).

The additional literature shows that innovations and solutions that exist, such as demurrage currency, that are not yet implemented in a community setting but could explored within a Living Lab. By applying innovative solutions from other industries to a community setting an opportunity is created to continually evolve what it means to live in accordance with the ecological worldview, and to create pathways for a just transition to a truly post-capitalist world.

7.6 Limitations

The limitations of this research may be attributed to the small case study sample. Only three communities were selected as part of the sample due to time and budget constraints. The observations, interviews and secondary sources for three case studies cannot possibly reveal all the insights for all aspects of community. If the research looked at more than three communities more breadth would be revealed however if the research focused on only one community more depth and detail would emerge. However, selecting three communities allowed the similarities and differences to come to the surface allowing for the opportunity to compare and contrast.

Another limitation may be attributed to the relationships held in the case study communities. As these interviews with community members were conducted in some cases with individuals that the researcher has met before or has a personal relationship with, this may have some bearing on the responses and information that was shared. On the contrary, interviewees that don't know the researcher may not have felt completely comfortable sharing some information with the researcher.

The researcher is always the instrument so researcher's bias is worth noting as a limitation. As aspect of the research analysis was observing the multitude of expressions within the communities and labeling each as possessing the signature of Biomimicry, Biophilia and/or Living Labs. This labeling is guided by the understanding of each discipline although ultimately it is the researcher who makes these categorizations. The researcher is pursuing creating a prototype of a community in Costa Rica that ascribes to these principles so there are subconscious biases at play in receiving and interpreting of the information even though the data is collected objectively.

8.0 Conclusion

In conclusion, this research investigated the interconnections and systemic applications of Biomimicry, Biophilia and Living Labs within the multi-facets of community in order to create a model for more resilient, self-sustaining communities to serve as *infrastructure for transition* to a regenerative system.

What this research aims to do is create a framework to ignite the starting conditions and discussions around designing a lived reality that is in alignment with the ecological worldview. Whal speaks about the importance of shifting the perspective of culture, "As the postmodern world is taking shape amidst globalization, climate change, economic instability, global and local inequality, resource wars and rapid species loss, an ecologically and socially literate worldview is emerging. This intention changes significantly when design is approached from within a perspective of culture as separate from nature and aiming to control and manipulate nature more effectively, or from within a more holistic and eco-literate perspective that regards culture as a co-dependent participant in natural process. Such changes in intention are changes in meta- design that affect all human activity. Changing the intentions behind design – changing mindset – is design at the paradigm level and lifestyle level. The creation of a sustainable civilization is primarily about such fundamental changes in dominant worldviews, value systems, intentions, and life styles" (Wahl, 2006).

One of the key takeaways from this research is that there's an opportunity to dismantle the mechanistic worldview of isolating problems in silos and rather observe the multi-interconnections that weave together a solution of cooperation and collaboration. In doing this we draw from multiple disciplines and find the synergies to construct a reality that is conducive to building new systems and structures to support a harmonious life on this planet. Looking at the different aspects of community through the Ecological Lens (Biomimicry, Biophilia and Living Labs) creates a new starting point for discussion and design that transcends any old beliefs and paradigms of how we construct our living reality. Simply, if the existing models are accepted than decisions are made based on this structure and ultimately we create a world that perpetuates the status quo. Alternatively, if this notion is rejected we will seek innovation. In these times of uncertainty, we must embrace the power of the paradox to build innovative models to change the world.

The challenge that this research presents is that once the framework is applied to a context, the application of these solutions will require an implementation plan to design and execute these solutions in a systematic way throughout the multiple aspects of community building and creating *transition infrastructure*.

8.1 Future Research Direction

As this research was being conducted, community members were very interested in the discipline areas of Biomimicry, Biophilia and Living Labs. Although they incorporate aspects of these principles already, most of the time this is happening unconsciously. There was great interest in how these concepts can be applied with more intention into their existing structures. A future research direction that would be interesting to explore would be to introduce the *Principles for Transition Infrastructure* tool to existing communities through a workshop or deep immersion and observe their process. Will this tool help focus the efforts of the community in their respective pillars of architecture, ecology, culture and economy? Is this tool useful to engage the community around shared values and a vision of creating community in accordance with the ecological worldview? If this tool is used among a number of communities, does a natural solidarity and bond

emerge? This research would ideally be a follow up to the existing research to understand how this tool is best utilized and the impact it can make to create more self-sustaining, resilient, regenerative communities.

Each community will implement these principles in different ways because each community is unique however, the core values and shared understanding of living in accordance with the ecological worldview will be shared. It would be interesting to explore whether communities that share this initial process are more networked and connected to each other. In addition, it will be interesting to research how this framework inspires organizations and governing bodies of urban areas and cities to think more holistically and in line with the ecological worldview.

8.2 From Concept to Reality

Since the culmination of this research, a real-life prototype of community has been birthed using the principles for transition infrastructure. This community will serve as a Living Laboratory for an open-source model that is replicable in other geographies and contexts. *Brave Earth* is an open-source model for an alternative community based on post-capitalist principles. These principles include: the primacy of the commons (stewardship versus ownership), direct democracy (participatory decision-making), local resilience (cooperatively-owned economic engines and strong bio-regional self-sufficiency) and ecological symbiosis (Biomimicry, Biophilia, Living Labs and regenerative agriculture).

The long-term vision for this model is to create a network of self-sustaining, resilient communities around the world that serve as *infrastructure for transition* to a regenerative system. This initiative aims to build one of the first Living Laboratories of this kind in the world, based in Costa Rica, as a blueprint in which we implement, test and refine these principles. The vision document for this prototype will be outlined in the appendix.

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10.0 Appendix

10.1 Discussion Guide – Expert Interviews

I'm a graduate student at University of Cape Town and I'm conducting research to understand how we can reimagine communities to align with the ecological worldview, specifically through biomimicry, biophilia and living labs.

1. How did you get into this field? Tell me about your journey.
2. How would you describe the current state of biomimicry/Biophilia/living labs in the world today? Is it optimistic, building momentum, pessimistic, lacks credibility?

    - Biomimicry is an approach to innovation that seeks sustainable solutions to human challenges by emulating nature's time-tested patterns and strategies
    - Biophilic design is the process of integrating nature, natural forms and materials into our ecosystems, buildings, communities and habitats.
    - Living Labs is a user-centric, place-based, open-innovation ecosystem that allows for co-creation, exploration, experimentation and evaluation of innovative ideas in real life use cases.

I'm interested in understanding the synergy when these areas of study are integrated or applied to systems rather than applied in isolation.

3. Can you share an example of when Biomimicry/Biophilia/Living Labs has been applied on a systems level?

4. Do you see an opportunity for the disciplines of Biomimicry, Biophilia and Living Labs to be integrated? How?

10.2 Discussion Guide – Community-Member Interview

I'm a graduate student at University of Cape Town and I'm conducting research to understand how we can reimagine communities to align with the ecological worldview, specifically through Biomimicry, Biophilia and Living Labs.

- Biomimicry is an approach to innovation that seeks sustainable solutions to human challenges by emulating nature's time-tested patterns and strategies.
- Biophilia, or biophilic design, is the process of integrating nature, natural forms and materials into our buildings and habitats.
- Living Labs is a user-centric, place-based, open-innovation ecosystem that allows for co-creation, exploration, experimentation and evaluation of innovative ideas in real life use cases.

I'm interested in the intersecting points and interconnections between these three concepts.

1. Tell me about your journey. What first drew you to join this community? What is special to you about this community?
2. Do you think Biomimicry, Biophilia, and Living Labs can be applied in communities at a systems level?
3. Is there an example in your community where Biomimicry, Biophilia or Living Labs is applied?
4. Would you consider implementing these principles in your community if you had more awareness of how they could be applied?

10.3 Prototype and Vision Document

BRAVE EARTH

A LIVING MODEL FOR A NEW WORLD

Investor Proposal
February 2017

“YOU NEVER CHANGE THINGS BY FIGHTING THE EXISTING REALITY. TO CHANGE SOMETHING, BUILD A NEW MODEL THAT MAKES THE EXISTING MODEL OBSOLETE.”

- BUCKMINISTER FULLER

Vision

Brave Earth is an open-source model for community based on post-capitalist principles.

Our aim is to create one of the first post-capitalist communities in the world in Costa Rica. This community will serve as a 'living laboratory' for a new type of open-source model that is replicable in other geographies and contexts.

By post capitalist we simply mean that we will build the better world we know is possible, with the values of:

- Gifting over commodification (i.e. social value rather than absolute economic value)
- Primacy of the commons (i.e. stewardship versus ownership)
- Direct democracy (i.e. participatory decision-making)
- Local resilience (i.e. coop-owned economic engines and bio-regional self-sufficiency)
- Ecological symbiosis (i.e. biomimicry and regenerative agriculture)

The long-term vision for this project is to create a network of self-sustaining communities around the world that serve as infrastructure for transition to a regenerative system.

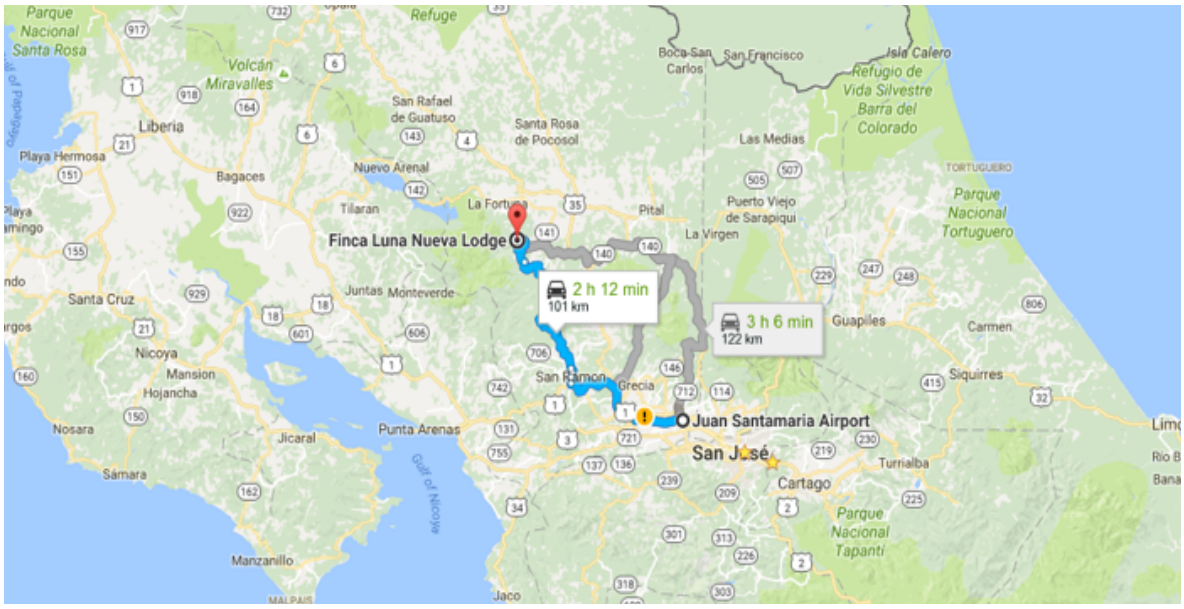
We are looking to incorporate the Original Wisdom of our ancestors who lived in symbiosis with Mother Earth with the best of Western technology. The aim is to create multiple revenue inputs to sustain the community including a Regenerative Trading Company, a retreat center for yoga and healing, and an education center for biomimicry and regenerative agriculture. That being said, we are not looking for investors interested in ROI, but rather, tribe members looking to build a new type of community.

The vision is to work, play and grow in community with like-minded individuals with an open heart who are committed to ushering in a new paradigm of living and being.

The Land

The land is situated in San Isidro de Peñas Blancas, which is approximately 2.5 hours from San José airport and 30 minutes (10 miles) from Arenal Volcano, which many consider to be the spiritual center of Costa Rica. The property is adjacent to the protected 55,000-acre Children's Eternal Rainforest (considered by many experts in the field as a world-treasure of biological diversity) via a biological corridor, and near other protected areas that total approximately 200,000 acres.

The property is less than 3 hours from the closest beach. In the long term, this protects the land from climate change related sea level rises. The elevation of the land allows for consistent temperature and rain year round, and therefore, for ideal food growing conditions. Moreover, Lake Arenal is approximately 15 miles away and there are many water activities like wind surfing and stand-up paddle boarding. Arenal is home to many world-class thermal baths created by the large slumbering (and sometimes snoring) volcano. The area is also full of many extraordinary hiking trails, including the Arenal Volcano itself.



The Property

The property consists of approximately 79 acres, with 37 acres of forestland and 42 acres of agricultural land, which includes five housing structures. The farmland is Demeter certified Biodynamic (the oldest and most prestigious agricultural certification) and has been used to grow high-grade organic biodynamic turmeric and ginger at commercial scale.

The existing main structure has four hotel style rooms (sleeps 2 people each, 8 in total) as well as an open kitchen area and living room area on the first level. The second largest structure is a caretaker cottage that has 3 bedrooms (sleeps 5 people total). There are 3 smaller bungalows that are single bedrooms with a bathroom (sleeps 2 in each, 6 people total). Currently there are spaces for 19 guests on this property.

There is an ecologically sensitive 'sacred wetlands' area on the northern end of the property, which is home to many indigenous frogs and other species. Part of the reason there are so few mosquitoes on the land is that these frogs, in addition to dragonflies, geckos, bats, hummingbirds, and others, create ecological balance.

A larger river, Rio Chachagua, borders the northern part of the property, which is about a 15-minute walk from the proposed main structures. There are also numerous streams contributing to the wild beauty of the property. The drinking water for this property is harvested from an artesian spring, originating in the Children's Eternal Rainforest.

Our Collaborators - Finca Luna Nueva

The property was developed to be integrated with Finca Luna Nueva (New Moon Farm), a regenerative rainforest eco-lodge hotel. Finca Luna Nueva has been using this property for guests of their eco-lodge and previously using the agricultural land to grow turmeric and ginger.

Finca Luna Nueva will continue to manage our existing inventory on the land. We have agreed to an inventory/cost agreement structure where we share net profits equally. Fiinca Luna Nueva will be a long term collaborator for all aspects of this project.

We have made arrangements with Finca Luna Nueva so that we may access their property, amenities and gourmet farm to table restaurant at a fair exchange as we build our infrastructure. Finca Luna Nueva has several eco lodges, an observation tower, a solar heated Jacuzzi, an ozonated swimming pool, multiple rainforest trails, and a large open aired yoga structure.

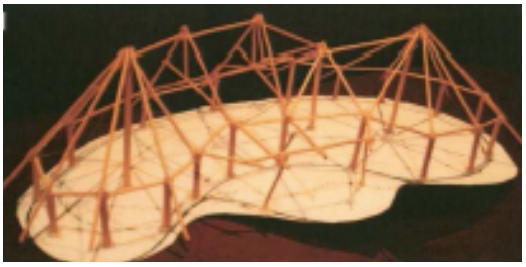
Our Collaborators- Blue Green Planning

In this one-year agricultural design phase, we are collaborating with Blue Green Planning led by Derek Chittenden, an environmental planner and biomimetic designer from South Africa, to design and build out the infrastructure phase of this project.

Derek is committed to building through biomimetic and regenerative design principles with local materials and a soft footprint. He has experience working with natural materials, organic forms, living systems, and preserving the integrity of the environment for present and future generations.

Derek has led projects in remote ecosystems as well as urban centers of Mozambique, South Africa and Zimbabwe. Derek is providing discounted rates for his work as part of his commitment to this project.

bluegreen
planning + design



Stewardship Share Structure

A central principle of Brave Earth is stewardship rather than traditional ownership. While we have formed a Corporation (Tierra Valiente S.A.), we are exploring holding the land in a trust with the core group as board members having decision-making authority.

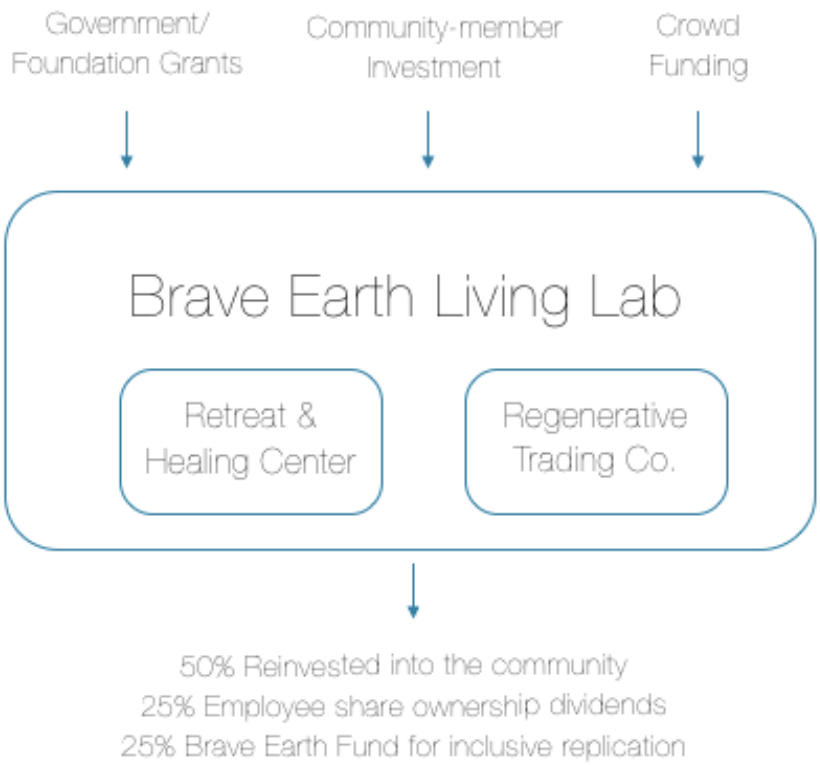
We see two main types of shareholders:

1. Community leaders – These are people that will both invest funds and are committed to living on the land for at least six months a year. The majority of the initial 24 shareholders will come from this segment.
2. Community investors – These are people who want to support Brave Earth and will have access to the community as a second home. We encourage all Community Investors to stay on the land a minimum of three months a year to be of influence and be integrated into the community culture (this is however optional).

Brave Earth shares are not typical shares in a company. We do not measure success here on return-on-investment. Partners are supporting a new type of post capitalist model. As one form of energetic exchange, partners will have access to the land and buildings as well as the opportunity to be a part of the building process of something unique. If a partner decides to leave the Brave Earth community, their share will be bought back by the community at the last sale price (after a holding period requirement).

Economic Engine

The economic engine of Brave Earth Costa Rica will be a co-operatively owned and managed Regenerative Trading Company as well as a retreat and healing center. The current model we have been exploring is a 50/25/25 model where 50 percent of the profits are reinvested into the co-operative and the community (as decided by the community), 25 percent of the profits will be distributed among community members as ESOP dividends (employee share ownership), and 25 percent will be invested into a not-for-profit foundation called the Brave Earth Fund that will provide the seed funding to other communities within the Brave Earth network (I.e. communities that adhere to this model and Brave Earth values).



Community Infrastructure

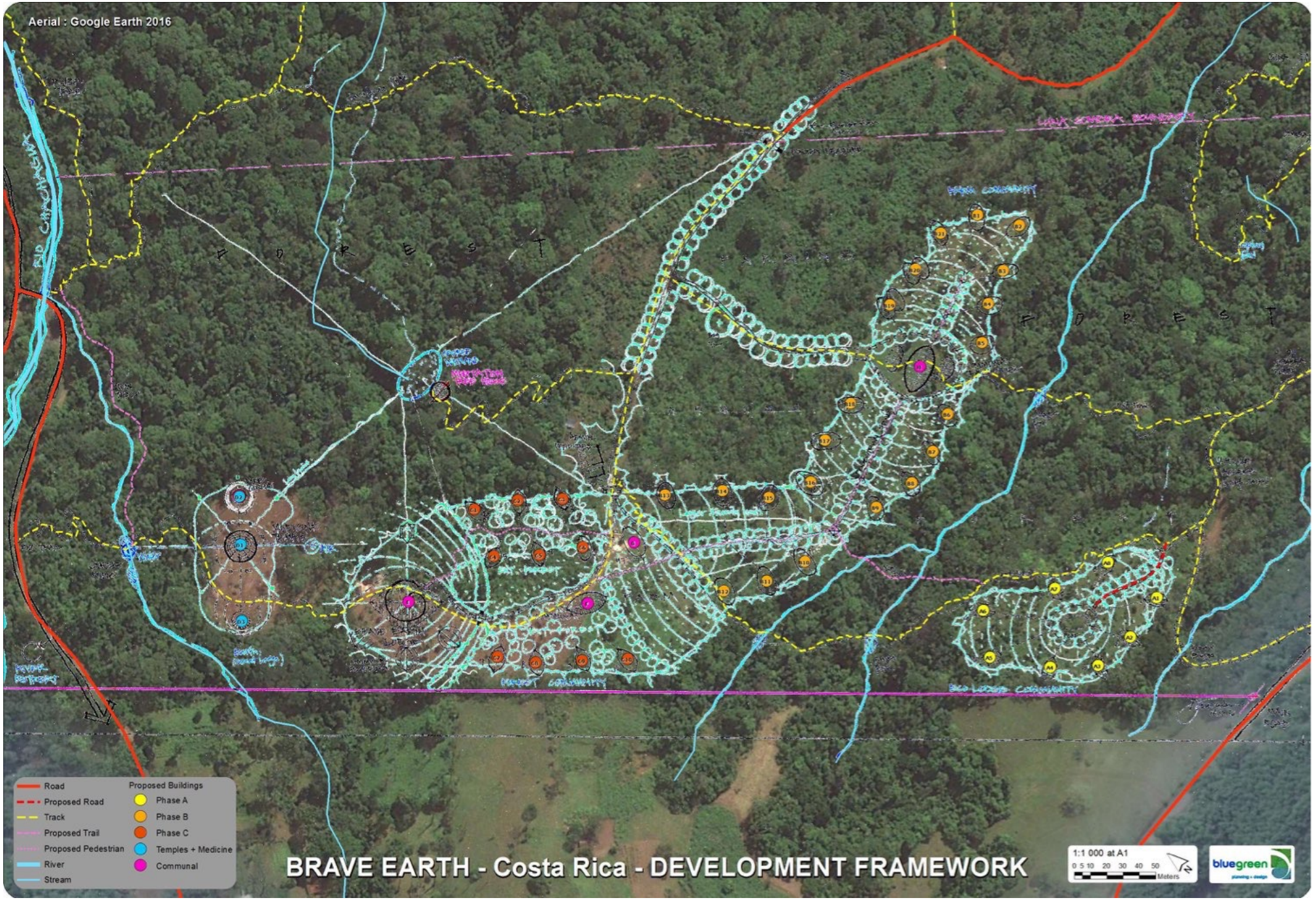
In addition to the infrastructure accessible on La Finca Luna Nueva, we will create communal spaces that share a set of resources to maximize sustainability, comfort and community. The development of the following communal spaces will be completed in phases.

- Brave Earth Temple
- Brave Earth Lodge (community gathering space)
- Sacred sanctuary and meditation areas
- Education center and library
- Healing and yoga center
- Creative work center
- Dining and gathering area
- Swimming and relaxation area

Regenerative agriculture will be planted throughout the property including in the settlement areas allowing community members to live within 'the garden' and be integrated with the purpose of the land. This will also be conducive to educating community members and guests as well as sharing responsibilities for food harvest.

Infrastructure for water, waste and energy will be built based on closed-loop, living, regenerative systems. Access to fiber Internet will be provided at the communal creative work center.

A map of Brave Earth property with an overlay of the community development framework is shown on the following page.


Aerial : Google Earth 2016
Road
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Track
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BRAVE EARTH - Costa Rica - DEVELOPMENT FRAMEWORK
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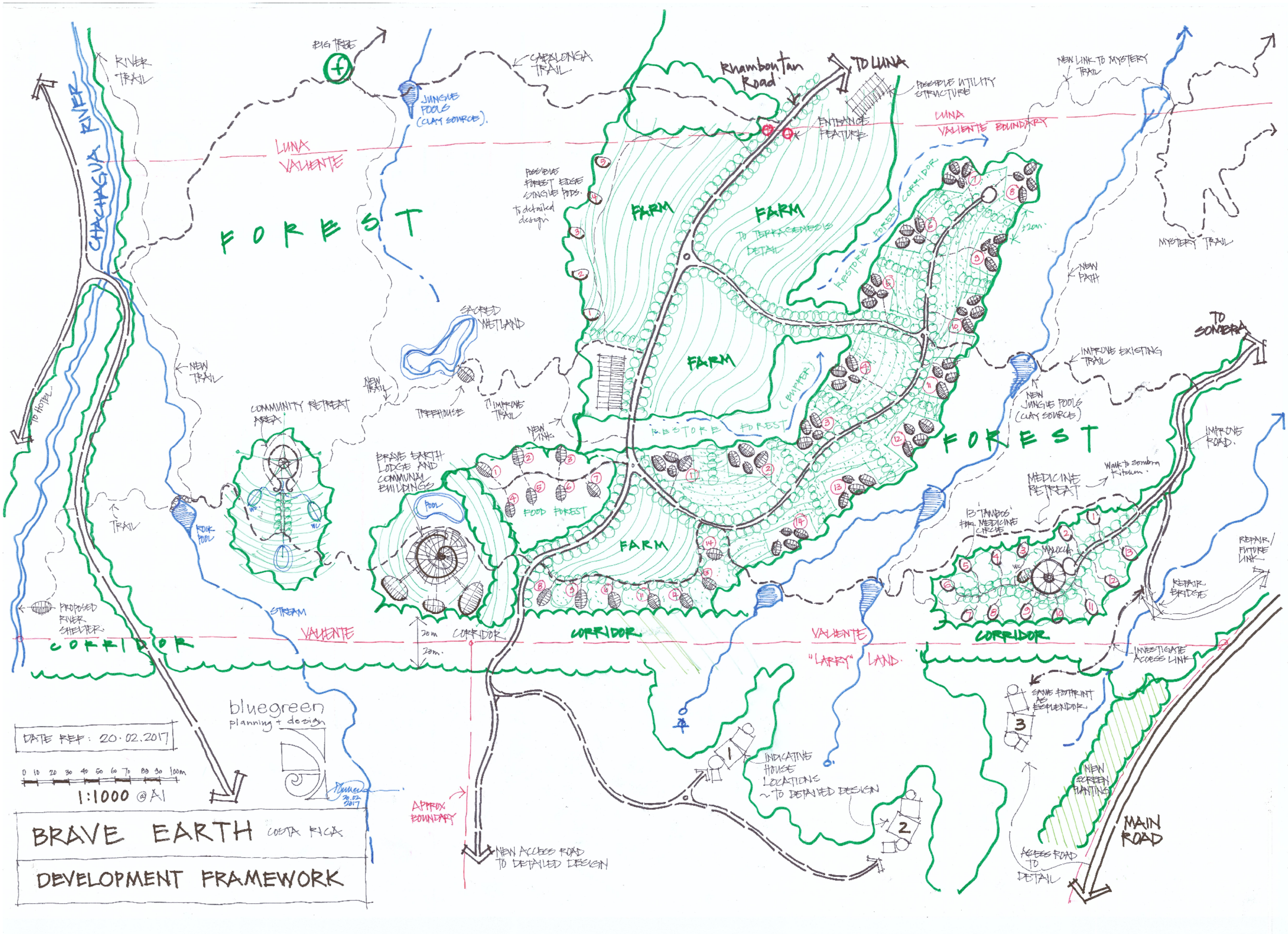
BRAVE EARTH COSTA RICA
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CHACHAGUA RIVER
RIVER TRAIL
TO HOTEL
BIG TREE
JUNGLE POOLS (CLAY SOURCE).
CARALONGA TRAIL
LUNA
VALIENTE
FOREST
Rhambou tan Road
TO LUNA
POSSIBLE UTILITY STRUCTURE
ENTRANCE FEATURE
LUNA VALIENTE BOUNDARY
NEW LINK TO MYSTERY TRAIL
MYSTERY TRAIL
NEW PATH
POSSIBLE FOREST EDGE JUNGLE PODS.
To detailed design
FARM
TO TERRACE DETAIL
RESTORE FOREST CORRIDOR
SACRED WETLAND
TREEHOUSE
IMPROVE TRAIL
NEW TRAIL
NEW LINK
BUFFER
RESTORE FOREST
TO SOMBRA
IMPROVE EXISTING TRAIL
NEW JUNGLE POOLS (CLAY SOURCE)
IMPROVE ROAD.
COMMUNITY RETREAT AREA
BRAVE EARTH LODGE AND COMMUNAL BUILDINGS
POOL
FOOD FOREST
MEDICINE RETREAT
Walk to Sombra Kitchen.
13 'TAMBOS' FOR MEDICINE CIRCLE
MALOCA
REPAIR/ FUTURE LINK
REPAIR BRIDGE
TRAIL
ROCK POOL
STREAM
PROPOSED RIVER SHELTER
CORRIDOR
20m
VALIENTE
"LARRY" LAND
INVESTIGATE ACCESS LINK
SAME FOOTPRINT AS ESPLENDOR
INDICATING HOUSE LOCATIONS ~ TO DETAILED DESIGN
NEW SCREEN PLANTING
MAIN ROAD
ACCESS ROAD TO DETAIL
APPROX BOUNDARY
NEW ACCESS ROAD TO DETAILED DESIGN

Residential Pod Structures

To meet the needs of our diverse community and the living requirements for different life stages, various pod sizes will be available. The price of a share will be reflected in the cost required to build the desired pod size. The quality and design of the pods will remain at the same standard. The initial seed fundraising round used to purchase the land and initial costs closes April 30, 2017.

	ROUND 1 Closes Dec 1, 2017	ROUND 2 Closes Dec 1, 2018
Basic Pod	$75,000	$100,000
Basic Plus Mezzanine	$100,000	$125,000
Double Pod	$150,000	$200,000
Double Plus Mezzanine	$175,000	$225,000

Residential Pod Design

In alignment with biomimetic and regenerative principles, the structures will all be inspired by the natural surroundings and built to integrate symbiotically with the environment.

Design principles for the pods borrow from nature and are modular, diverse and interconnected with their environment. A preliminary concept for structures is mimicking the design of a seed pod, borrowing its design from the Fibonacci sequence, the spiral that is present in all life. To create shelter, a design mimicking a leaf serves as a roof to protect from rains. The leaf-roof will feature solar panels to create energy for the pod and a water catchment area to provide potable water.

When pods are not in use, they will be added to the inventory of the community and used for guests attending workshops/retreats or rented for guests.

Residential Pods:

- 14 sites for ‘single pod’ options:
    - Single pods include a Queen size bed, shelving, desk, bath, shower, toilet, vanity table, kitchenette and outdoor seating area.
    - Single pod with Mezzanine (loft style second floor) option is available
    - Located closer to the Brave Earth lodge precinct with easy access to the communal facilities —the furthest walk is 100 meters
- 14 sites for ‘double pod’ options:
    - Double pods include two single pods plus a third structure that houses a kitchen and living area
    - Double pod with Mezzanine (loft style second floor) option is available
    - the cluster of 14 double sites along an approx. 200m long ‘spine’ provides privacy and allows space for the ‘food zones’
- only if required – a possible 5 exclusive single pod sites along the main forest fringe

The following pages depict a conceptual drawing of a double pod and aesthetic inspiration for the design.

PROTOTYPE DOUBLE POD

(WITH STORE/DRY ROOM AT REAR)

• APPROX 50m² (excludes outside area) ± 15m²

TOTAL ± 65m²

BEDROOM POD.

LOUNGE POD ± 35m²

13 COLUMNS + ROOF BEAMS. (Fibonacci).

LOUNGE, DINING KITCHENETTE POD.

PRIVATE VIEW TO FOREST

DESIGN TO FOREST EDGE

ROOF LINE

SLIDING SCREENS.

ROOF

OUTSIDE DECK

EIGHT

ROOF OVERHANG. (private outdoor area).

Possible kitchenette.

BEDROOM 2

RAMMED EARTH WALL AND CUPBOARDS.

LOW ROOF

EARTH.

Queen/King Bed.

DRESSING area

WC

SHOWER (OPEN)

LOW ROOF

DESK

THICK ADOBE EARTH WALL (PRIVACY)

SCREEN PLANTING

TO STOREROOM / DRY ROOM.

BEDROOM 1.

ROOF DESIGN

- 13 columns.
- central support like a tree structure.

0 1 2 3 4 5m

1:100 @ A3.

Residential Pod Design Inspiration

Biophilia is defined as the inherent human inclination to affiliate with nature. Biophilic design, an extension of biophilia, incorporates natural materials, natural light, vegetation, nature views and other experiences of the natural world into the modern built environment. The design of the pods will follow biophilic principles which has been proven to reduce stress, promote healing in the body, increase cognitive functioning and general wellbeing. Locally available and abundant materials like bamboo and clay will be used for construction.