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Reimagining the future: The biomimetic economy

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Re-imagining the Future: The Biomimetic Economy

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Introduction and Process

The final project for our social systems class was the Gigamap: *Reimagining the Future: The Biomimetic Economy*. Our research purpose was to explore the nature of the economic system in relation to ecological systems and the design principal of Biomimicry. Our goal was to create a learning map that allows users interested in developing healthy economies and sustainable business practices to follow and learn from the principles.

As we mapped out nature's principles in parallel to today's capitalist economic system, flaws and sustainability gaps which become immediately evident. And yet, when we analyzed the Sharing and Circular Economies against nature's principles, we found that these systems closely adhere to the principal tenants of Biomimicry. Our social system contexts include both Social Context and Instrumental Context. The boundary for this system is organization and society. We have not yet mapped out the larger system boundary representing "the industry" within Instrumental Context and "the world" within Social Context.

Our map follows a sequential analysis systems design process and provides scenarios along the way. The gigamap flows from left to right starting with how things are represented by Horizon 1 and ending with Horizon 3 possibility. The middle is taken up by two spirals based on the fibonacci sequence; the *Golden Spiral* - a mathematical form in nature (Zhao, H., & Li, X.) that repeats itself over and over again: $F_n = F_{n-1} + F_{n-2...}$ The bottom spiral consists of three examples in industry today that reflect the three Horizons: Detroit manufacturing industry representing Horizon 1, oil subsidies representing Horizon 2, and the Kalundborg Ecopark representing Horizon 3.

It is also in Horizon 3, where we lay out the visual process for how Sharing and Circular Economies could function given the principal tenants of Biomimicry. They principles are: resilience, optimization, adaptive, systems based, value based and life supporting. These primal rules govern nature at all levels, and it was our goal to show how our current capitalist economy could move towards a shared economy that values these tenants using the 3 Horizons framework.

Our two major sources for inspiration for this topic were Janine Benyus' *Biomimicry: Innovation Inspired by Nature,* and Jane Jacobs' *The Nature of Economies*

Biomimicry and the Principal of Succession

Janine Benyus, in her information-packed book *Biomimicry,* lays out the case for the integration of biological principals in all walks of life. Biomimicry is the design process of looking to nature for inspiration. It is the study of how nature operates at all levels: from the inner workings of the cell to the systemic view of our Biosphere. In all of the Biome's of nature; in all creatures on earth, wisdom can be gained from how nature functions. In the elements and systems of earth, information (DNA) is used to give shape which gives function. Through the process of evolution, elegance has been created in the dance of life - and it is our role as designers to discover and decide which solutions fit best with our complex human problems. For our purposes, this is the economy.

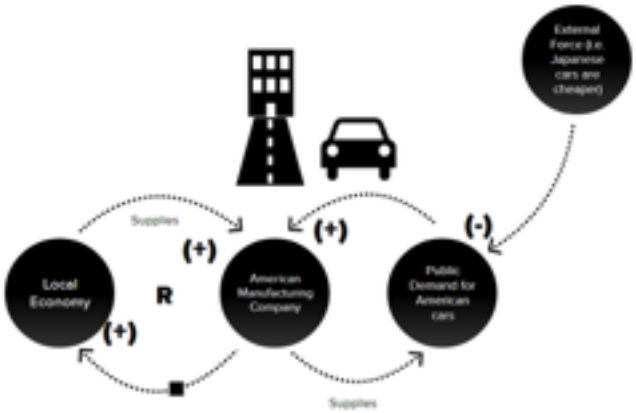
In Chapter 7, Benyus narrows her focus: *Closing the Loops in Commerce: Running a Business like a Redwood Forest.* In it, she explains the principal of succession - how moss becomes ferns, which then grow to become forests (p. 250).

Type I System

Currently, on Horizon 1, we are mimicking a Type I system. As Benyus explains, we have excessive growth rates which use up the resources in one area. We are not sustainable in place; nature is. Once we have exhausted our resource, we move on to the next horn of plenty, spreading many progeny along the way, displaying a linear growth curve.

Type I System Example

Detroit is a prime example of an economic system mimicking a Type 1 system in nature. Automobile manufacturing used to dominate the city's economy. Many of the independent suppliers were bought out by the large car companies, and surviving suppliers didn't seek out new customers, just focusing on catering to the demands of the dominant car manufacturers. Skilled workers were not looking for work in other industries or starting independent ventures. Detroit was operating as a "well-oiled machine" until an external force disrupted public demand for American cars, putting not only the manufacturing companies, but the whole economy in jeopardy and eventual collapse. The Detroit specialization occurred at the expense of diversification. When an external force impacts the highly specialized system, the system is vulnerable and is unable to sustain itself.



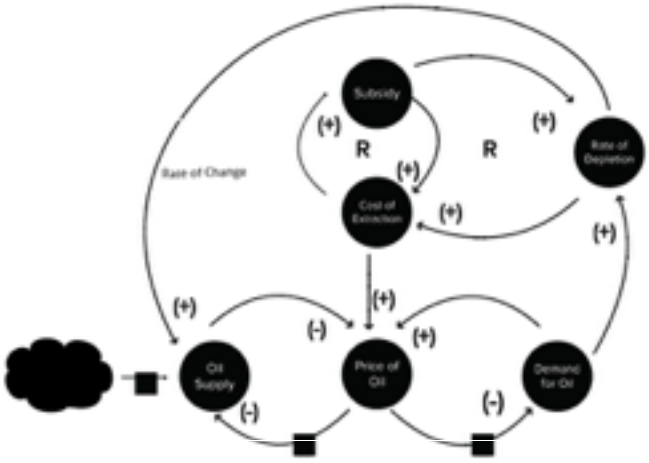
Detroit manufacturing process - impacts of external force

Type II System

Type II system, our Horizon 2 in the Gigamap, is a bridging mechanism displaying growth rates that hover around the limit of the environment that they inhabit. They, however, exist in place, and shunt their nutrients down into their roots for the winter, only to regenerate in the spring. They display an oscillating growth pattern that mimics the panarchy that is described in Lance Gunderson and C. S. Holding's paper, *Panarchy: Understanding Transformations in Human and Natural Systems.* This panarchy displays elements of type I systems, in that the 'S' curve upswing is repeated by our current businesses, without any consideration for renewal. As such, their activities taken together summate to linear and unsustainable growth. In the natural Type II systems, decay and the reorganization of elements are integrated into the system, however, even these systems have their limits to growth, as each panarchy builds upon itself.

Type II System Example

Government subsidies to oil companies are an example of a Type II system. Subsidies falsify costs and prices, and perpetuate an unsustainable economic growth. Nature provides feedback loops that generally help us restore balance. Think of predator and prey relationship, or our own breathing – the exchange between carbon dioxide and oxygen. In nature, negative feedback loops helps to balance out existing systems by signalling when, whether, and how to change course. Negative feedback controls are most reliable when two conditions are met:



- Data is accurately reported.
- Data and response are functionally integrated so there is no possibility of misunderstanding the information or triggering a mistaken response.

In economic systems, money exchange is the feedback carrying mechanism. However, when subsidies get introduced, the price that is normally controlled through a supply and demand

mechanism does not have the chance to correct itself. For example, the Canadian government spends $26 Billion (4% of the government revenues) on fossil fuel energy subsidies to keep prices artificially low (International Monetary Fund, 2011). On average each Canadian pays $787 or over three thousand dollars per year for a family of 4 spent invisibly on energy. However, because Canadian consumers are not aware of this, they do not alter their demand, as the price at the pump is kept artificially low.

Type III System

The final and most desirable Horizon 3 mimics that patterns of an old growth forest, where 'old' can be designated as a reversed wisdom of how to exist in place, maintain high biodiversity, and share the elements of nature in a system that mimics the shared economy. This loop, interestingly, looks like the infinity loop, a redesigned panarchy where the growth phase equals the decay, and where successive cycles equate to equilibrium. We called this loop *Shared Futures Infinity* (SFI). The process of getting here is what our map is about.

Type III System Example

The Kalundborg Ecopark resides in the small Danish town of Kalundborg and contains several companies and processes that work in close proximity and use the waste products of each of their processes to power or seed other operations. The net effect is a system that reduces waste and increases energy efficiency through cycling of materials. Waste steam from the Asnaesverket power company goes to power the fermentation tanks at Novo Nordisk, which it uses to produce insulin and enzymes. This produces a nitrogen-rich slurry which is given to local farms who produce plants which feed the fermentation tanks. More waste steam from the power company goes to the Statoil refinery which uses it to purify waste gas. Some of the waste gas goes back in the refinery, but most of it is shipped to Gyproc, along with a calcium sulphate solution to make wall boards. This process

produces sulphuric acid which is shipped to Kemira down the production line where paper products are made. Yet more waste steam from the power company is used to power 3500 homes in the town of Kalundborg, who are employed in the farms, the power company, the refinery, and the pharmaceutical company. Excess cooling water from the power company goes to produce 250 tons of sea trout every year in large tanks beside the power plant, which are in turn consumed by the town and shipped as a product. This system runs on the principal tenants of systems based, life-supporting, and optimizing behaviour, where feedback loops are constantly monitored so the system runs smoothly.

Nature of Healthy Economies

As part of this project, we wanted to understand how nature's principles can apply to an economic system. We chose to anchor the design of our economic systems as natural process using Jane Jacobs' book *The Nature of Economies*.

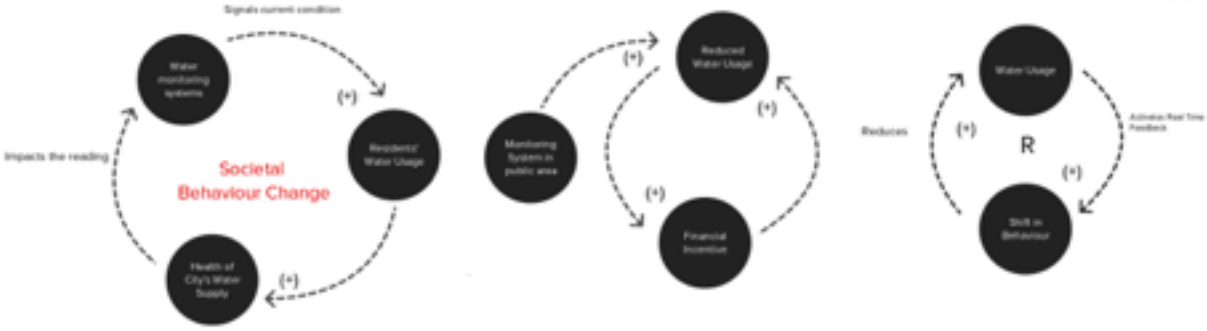
Jacobs begins explaining the nature of development, showing that in nature as in economic systems, everything evolves over time and doesn't stay the same. Once a differentiation emerges, it becomes the new generality from which further differentiation occurs (p. 17). This cycle of repeated growth, stabilization, decay and renewal became the basis for our investigation into the panarchy loops and how they could be integrated into a visual learning experience for our gigamap users.

Jacobs also explains that in nature, successful economies expand through diversity. Three billion years ago, the earth started out as a barren rock. Yet now it is populated with plants, bacteria, and animals - including 7 billion people. For three billion years the sun bathed Earth in "free" energy. Eventually things emerged that could use that energy to eventually become more complex organisms. In some systems, as in a desert, most energy is wasted, bounced right back up at the sun. But in a forest or meadow, the energy goes through millions of conduits and organisms, doing work at every step along the way. The energy leaves behind, in complex webs of life, ample evidence of its passage. This is visually evidenced in our Type III system example of the forest.

Diverse economies also expand in a rich environment, which is created by diverse use and reuse of received goods and services. In our economic systems, this is similar to Import Replacement and Import Stretching.

According to Jacobs, Import Stretching occurs when new value is added to an existing good or "import" and is turned into a new product for export. The more an "import" is transformed or stretched, the more it adheres to diversity of use. Import Replacement occurs when there is capacity to make things locally that used to be imported from afar. It is a process that enables local economies to capture new imports, creating diversity. This process creates a virtuous cycle of local economic diversity, meaning that dependent settlements have a path to economic independence.

Jacobs also explains nature's mechanisms for evading collapse. Among these mechanisms is "feedback loops". In nature, termite colonies produce balanced portions among different castes. Adult sizes differ depending on their function. Termites use chemical scent to communicate the existing population size and composition which allows larva to evolve into soldiers or workers – depending on what's best for a healthy thriving colony (pg. 109).



IBM Water Conservation Project. (left to right: design for societal change, community change, individual change)

A great example of usage feedback mechanisms is IBM's Water conservation Project. IBM worked with SmartDesign on water conservation solution using Biomimicry principles and designed solutions for Individual, Communal and Societal levels. By using feedback mechanisms in the form of pulsating water tap at individual level; water usage elevator displays in communal areas; and water monitoring systems in public parks; IBM hopes to shift usage behaviors and encourage citizens to conserve water.

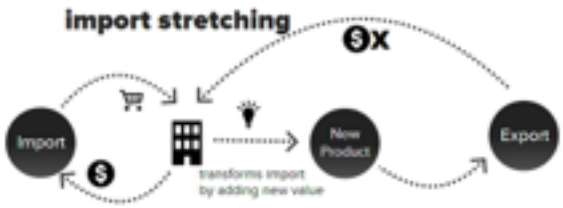
Circular / Sharing Economies

The Circular Economy is a regenerative economic model which is in the nascent stages and has the potential to help companies and societies create more value while reducing their dependence on scarce resources. Growing global population and rising middle class are putting a strain on the environment and depleting the world's stock of resources. The current economic system is linear and based on the rapid use, disposal, and replacement of goods and is poorly prepared to deal with unexpected events such as climate change, and its impacts.

We see Circular Economy is a Bifurcation. It is radically embodying new practices and models for value exchange and altering the existing economic system. Participants in the system are radically

disrupting existing industries and opening up whole new area of opportunity. According to Jacobs' *The Nature of Economies,* in nature, bifurcations happen before system collapses, and frequently begin as sidelines to other activities. Bifurcation allows for the system to correct itself, it allows for a dynamic stability.

In our gigamap, we placed this economic system as an example of Type III system, mimicking an old growth forest. Just as ecosystems reuse everything in an efficient and purposeful cycle, a "circular" economic system would ensure that products were designed to be part of a value network, within which the reuse and refurbishment of products, components, and materials would ensure the continual re-exploitation of resources. This is similar to Import Stretching economic principle mentioned earlier.



Even looking past the moral perspective, the circular economy makes great financial sense valued at over $1 trillion in business opportunities (Ellen MacArthur Foundation featuring analysis from McKinsey) This will ensure better savings, increased productivity and efficiency, new jobs, new forms of currency or a new trajectory in our monetary system and certainly new markets. For instance, looking at the cost equation, on average, a car costs $715 dollars a month and it sits idle 23 hours a day (95% of its time) whereas an average power-drill is for only fourteen minutes its entire lifetime. There is huge potential in unlocking the hidden wealth of the underutilize resources we possess.

With technological innovation, a shift in values, economic realities and environmental pressure are driving this economic shift, the Circular Economy has reinvented the way we produce and distribute goods, and has the potential to transform our consumption patterns. It has decentralized finance from social investing to crowdfunding ($4 Billion raised in the US alone annually) and P2P lending (worth $28 Billion according to 'The Economist') and finally democratized education and learning. This is also resulting in a lot of empathetic design because as consumers are involved in production, the end result resonates better with the end user.

Sharing Economy is a community based system that happens at the local settlement level. It is built around the sharing of human and physical assets. It includes the shared creation, production, distribution, trade and consumption of goods and services by different people and organizations.

Emergency Adaptations

Jane Jacobs also talks about the importance of Emergency Adaptations, found in nature to address temporary instabilities that can nevertheless be devastating. For instance, our bodies will combat diseases with emergency measures such as fever, or multiplying of cells to battle infectious organisms.

Sharing economy also possess emergency adaptations. After hurricane Sandy, hundreds of AIRBNB hosts offered their place for free. This influenced the launch of BayShare with a mission to support emergency management and respond in a more resilient way with a premise that the best time to prepare for an emergency is when there isn't one.

BayShare member companies, including Sharing Economy companies, created hyper-local networks of resources. In times of need, these networks can be activated to quickly send much needed assistance to residents throughout San Francisco.

Company Examples

The examples that we provide in our gigamap are operating at the local level, leveraging their communities, but many are being scaled using social media networks to affect more communities globally.

The gigamap displays biomimicry design principles as symbols next to each company examples so that users can easily learn which principles each model mimics.

Some examples references in the map include:

Taskrabbit_ can be termed as eBay for errands where posters bid to do tasks and services. It turns out that 70% of all Task Rabbits are either unemployed or underemployed. Even Walmart realized its potential and partnered with them to deliver medicines.

PivotDesk_ where Freelancers or entrepreneurs who can't afford or don't desire permanent office space can connect with businesses who have excess space.

OpenDesk_ on the other hand gives away furniture plans for free but offers add-ons like CNC, cut self-assembly pieces or furniture construction by local woodworkers.

Stackd_ uses social networks to connect businesses within the same building. Users are prompted to act upon the information Stackd provides, as updates are extremely timely and because of proximity. Sharing resources between multiple floors uncovers new opportunities for business.

Next Steps

For our next steps, we are interested in holding a Structured Dialogic Design workshop, where we invite stakeholders from business, government, non-profit agencies, consumers, the investing community, and the biomimicry community to learn their perspectives about barriers and opportunities in scaling an economy that adheres to biomimetic principles.

We also see a benefit in promoting this work to cities and local communities in an effort to put in place emergency adaptations as in the BayShare example provided earlier.

Collaborative projects and real-time creation have the potential to radically disrupt industries and open up a new area of opportunity allowing consumers to be part of the creation and innovation process. Both circular and sharing economies could allow consumers to develop stronger relationships with brands that share their values and provide meaningful experiences. This would require ethnographic as well as experiential research to determine under which circumstances consumers are willing to participate. A key challenge we may face is consumers' unwillingness to participate in a sharing economy.

Yet, there is a glimpse of hope. Yochai Benkler, a professor at Harvard Law School, in an interview with The Atlantic magazine, suggested that the "biggest gift Wikipedia has given us" is "a way of looking at the world around us and seeing the possibility of effective human cooperation, on really complex, large projects, without relying on either market or government processes."

Benkler argues that we had shifted from an "industrial" information economy to a "networked" one, in which a new model of "distributed, collaborative production" plays a major role.

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