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Regenerative Development:
The Art and Science of Creating Durably Vibrant Human Networks

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We are searching for a path that will lead us beyond our current unsustainable economic system.

John Fullerton, Capital Institute

Regeneration refers to the self-feeding, self-renewing processes that natural systems use to nourish their capacity to thrive for long periods of time and their ability to adapt to unexpected, sometimes threatening circumstances. No system can sustain itself over the long-term, if it is not designed to continuously regenerate.

Regenerative development uses the universal laws of systemic health and self-renewal to show how we can develop durably vibrant socio-economic systems as well. It uses the empirical study of flow-networks to make this idea precise.

This approach to development suggests new answers to a critical question for our uncertain times: Can the tools of development be used, not just for episodic interventions that provide short-term relief, but to build the long-term regenerative capacities of local communities and economies? In other words, can the enterprise networks we develop be both profitable and also serve as engines of long-term, regenerative vitality?

This paper explores how Regenerative development backed by the empirical science of flow-networks creates a holistic, humanistic, rigorous, and actionable theory of systemic economic health that.

- Organizes much of what is already known in development into a working model of systemic health that allows us to address the root causes as well as the symptoms of economic dysfunction;
- Identifies the key factors behind regenerative vitality including the relational structures and social norms needed to create widespread well-being and abundant opportunities;
- Clarifies the connection between moral imperatives and the proper economic functioning;
- Provides effective measures and clear targets for key factors such as inclusivity, resilience, balance, reciprocity, and circulation;

Regenerative vs Extractive Economies: A Contrast in Vision

> We are the poorest urban county [in the US] not because we can't produce wealth, but because we haven't built what we need to capture it. You spend your life enriching someone else, somewhere else.
>
> Yorman Nunez, The Bronx Cooperative Development Initiative, 2013[1]

We live in interesting economic times. Communism and socialism have failed, and events such as the global economic crisis of 2008 and the Greek debt crisis are generating concerns about the reigning neoliberal capitalism as well. Indications of increasing public concern can be seen in the rise of Occupy Wall Street and the economic populism tapped by players such as American presidential candidate Bernie

[1] http://fieldguide.capitalinstitute.org/bronx-cooperative-development-initiative.html

Sanders. But, until we can articulate an effective alternative to neoliberalism˘s trickle-down approach, we will be unable to channel these pressures and concerns into constructive and unified reform.

We believe Regenerative economics can provide the effective alternative we need, but we should also note that, in most ways, it is not so much a new economic approach as it is a more accurate understanding of the conditions that support healthy free-enterprise economies. In turn, understanding the real conditions for vitality clarifies both the causes of chronic poverty and the root problem with today˘s trickle-down approach. Thus, the science of flow networks distinguishes between two basic types of economic systems with two fundamentally different theories of how to create lasting economic vitality:

- *Extractive economies (strength-based)* tend to treat most local, regional and even national economies as places from which wealth ¯ resources, money, labor, etc. ¯ can be extracted. Extractive activities are common because they help build strength and power by concentrating resources. In turn, size and power helps make organizations more *risk-absorbing*, that is, it improves improve the organization˘s ability to withstand crises and absorb shocks.

  Extractive theories tend to assume that vitality rises from the accumulation of wealth and power. Their Achilles˘ heel is that overly concentrated wealth tends to corrupt critical institutions, pushing organizations from governments and media to medicine and academia to place the interests of the rich and powerful over pressing public needs and the institution˘s actual role in service to society. Over time, excessive extraction and corruption take their toll on the real economy. So, while accumulation may indeed increase vitality in the short term, if economies extract too much, nourish internal capacities too little, and allow corruption to continue unabated, they end up creating only the illusion of vitality, a shimmering bubble of elite wealth that masks an ever-more fragile real economy.

- *Regenerative economies (learning-centered)* pump money, information, energy and resources back into developing internal capacities and infrastructure (particularly the human kind), so as to maintain vitality long-term. Regenerative economies are common, especially at the small-scale, because they improve group innovation, productivity and learning. Instead of trying to absorb risks afterwards, regenerative institutions are *solution-seeking*: they try to eliminate or mitigate risks before they happen, as for example, trying to switch to renewable energy before fossil fuel reserves become critical.

  Regenerative theories tend to assume vitality comes from nourishing human networks and their capacity to identify risks, develop solutions, and marshal resources to implement those solutions. While this self-nourishing, solution-seeking approach tends to make economies more vibrant, adaptive, and systemically healthy, its dependence on human-scale relationships and its inability to maintain unity across scales makes it susceptible to shocks and power intrusions from stronger entities.

The neoliberal capitalism, which dominates global economic policy, is extractive; it treats most local, regional and national economies as places from which wealth ¯ resources, money, labor, etc. ¯ can be taken. Yet, many traditional economies, even of the free-enterprise variety, tend to be regenerative. In regenerative economies businesses pour money into their people and factories, and governments pour money into education, infrastructure, and other constructive common-cause purposes. Here, people earn their living in ways that are constructive, synergetic, and anchored in a culture based on common-cause. In a series of books from the early 1960s to the early 2000s, author Jane Jacobs documents the existence of such regenerative economies worldwide, while exploring the factors which make or break their vitality.

Mr. Nunez (opening quote) pinpoints the key idea behind Regenerative development. Instead of trying to increase GDP or even jobs per se, Regenerative development takes a holistic-humanistic approach to revitalizing socio-economic networks by designing them to: 1) generate widespread, inclusive wealth; 2)

capture it; and 3) return much of it to build and renew capacities in the system as a whole. The goal of regeneration is to build long-term, cross-scale, economic vitality by arranging real-economy networks to be naturally self-nourishing, self-correcting, and adaptive. The Bronx Cooperative Development Initiative (BCDI) summarizes the basic idea:

> BCDI is guided by a deep intention to harness the essence of the people, resources, and place of the Bronx, and to enable the members of the community to co-create the borough˘s regenerationŭ BCDI has undertaken considerable work in laying the ground for this more holistic approach, building a collaborative of organizations focusing on a regional development strategy to support economic democracy in the borough, with shared ownership at the core of that vision. The collaborative includes local business leaders, organized labor, anchor institutions, including hospitals and universities, and the local zoo, as well as a diverse array of local nonprofits.[2]

The art of creating such durably vibrant networks is in line with a great deal of existing development theory and practice. Indeed, over the decades, numerous theorists have pointed in a similar community-centered, capacity-building, interdependent systemic direction. In *Development as Freedom,* Amartya Sen argues that real development cannot be reduced simply to increasing basic incomes, but instead requires a focus on developing human capabilities, meaning the ability to transform resources into value-added products. In *Death and Life of the Great American Cities,* Jane Jacobs (1961) explains how the intricate human networks that grow up in certain places account for the vitality or lack thereof in urban centers. In *Governing the Commons,* Elinor Ostrom (1990) outlines eight principles that allow groups to govern common resources equitably and sustainably.

Indeed, since factors such as resilience, diversity, inclusive growth, and distributed empowerment are central to regenerative vitality, growing interest in them suggests development practice is beginning to swing in a more regenerative direction. For instance, because distributed empowerment is a key factor of systemic health, the growth of stakeholder-owned networks, such as Mondragon in Spain, Organic Valley Dairy in the US and Canada, and the Evergreen Cooperatives of Cleveland, indicate a regenerative trend.

A self-nourishing approach can even be seen emerging in finance, as shown in the story of Bendigo Community Banks (BCB).[3] Begun in the 1990s, BCB reflects a `self-organizing_ response to the closing of over 2,000 bank branches in rural Australia. Suddenly cut off from access to financial capital, residents and businesses of these communities appealed to Bendigo Bank to reestablish a banking presence in these areas. Now 300 strong, the resulting bank model ¯ part franchise and part cooperative ¯ has helped revive these communities, and given local leaders the business acumen and tools they need to sustain their own regenerative process. Wheatley similarly shows that Community Currency initiatives have soared in recent years in response to a `global demand for a resilient monetary system that supports sustainable, complete communities._[4]

The Surprising Science of Flow: Holistic, Humanistic, Rigorous & Universal

Regenerative approaches offer new answers to a key question: How can we develop economic networks that generate a broad range of desirable outcomes ¯ from full employment and environmental health to resilience and inclusive well-being ¯ in a reliable and lasting way? Regenerative economics uses the empirical science of flow-networks to make these answers precise. Not only does the science of flow identify the critical factors, and offer precise targets of systemic health in a way that traditional statistical methods cannot, it also seamlessly integrates social and cultural factors into the economic equation.

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[2] http://web.mit.edu/colab/pdf/papers/MITCoLab_BCDI_Development_Study.pdf
[3] See http://fieldguide.capitalinstitute.org/bendigo-community-bank-model-part-one.html
[4] Wheatley, J., Younie, C., Alajland, H. McFarlane, E. 2011. Calgary dollars: Economic and social capital benefits. *International Journal of Community Currency Research*, 15 (A) p. 84.

This new understanding of economic vitality is derived from the study of *flow-networks,*[5] meaning any system whose existence arises from and depends on circulating energy, resources, or information throughout the entirety of their being (Figure 1). Your body, for example, is an integrated network of cells kept healthy by the circulation of energy, nutrients, and information. Ecosystems are invisibly connected webs of plants and animals that add to and draw from flows of oxygen, carbon, nitrogen, etc. Banks are organized monetary-flow systems, and economies are interlinked networks of people, communities, businesses and governments that contribute to and draw sustenance from the circulation of resources, energy, information, and money.[6]

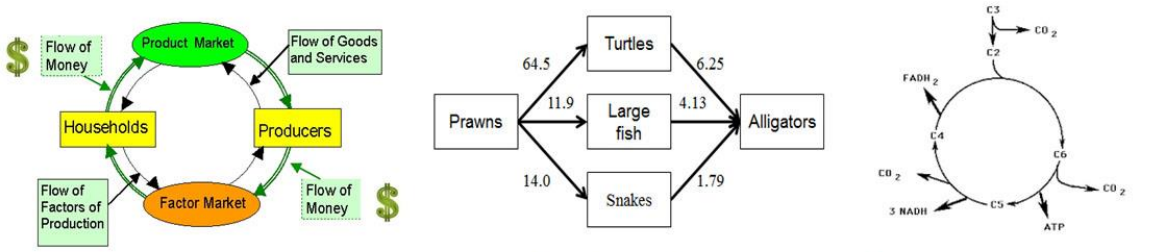

Figure 1. ***Three Flow-Networks: Economies, wetlands and metabolic networks.***
Note that flow always moves in circular circuits that are often referred to as "cycles" as, for instance, with the Carbon and Krebs cycles. The circular nature of such circuits means that all elements of the circuit must be present and healthy for circulation and processing to work. In other words, every part of the whole must be healthy for the system to thrive.

Over the last 50 years, Systems scientists studying such networks have discovered that many flow-principles (such as pressure and circulation) and patterns of network structure (such as hierarchy) apply across fields. The discovery of universal patterns and principles explains why this rigorous research applies as much to economic networks (Leontief, 1951; Boulding, 1981; Fischer-Kowalski et al., 1998; Odum, 2007) as to ecosystems (Lindeman, 1942; Hannon, 1973; Odum, 1983).The result is a fully transdisciplinary Systems Science that is surprisingly precise and predictive.

Energy dynamics make sense as the basis for a rigorous transdisciplinary science because they are:

- *Universal* ¯ Energy dynamics apply to everything (literally) because energy is the primary driver of all movement, growth and development. It fuels growth, drives development, and creates pressure for change in everything from tornadoes and living organisms to human societies. Energy patterns and principles are therefore universal, applying equally to living, non-living and societal systems ¯ e.g., metabolic systems, electrical circuits, and economic circulation.

  Such universal dynamics explain why many of the same laws that govern health and development in ecosystems and living systems apply to human networks such as economies and societies as well (Prigogine, 1980; Cvitanovic, 1984.) So, where ecologists taught us to see the natural world as a

[5] The study of flow-networks is taking place in a wide variety of disciplines, including Energy Network Analysis, Self-organization Theory, Panarchy, nonequilibrium thermodynamics, ecological complexity, and many more. To encompass this variety, I will refer to the science using the umbrella term the "Energy Network Sciences" (ENS) or simply the science of flow.
[6] Physicists see flow-networks as a natural result of the web of forces and flows that makes up the fabric of the universe. Here, `forces_ refers to invisible binding ties such as gravity and electromagnetism, and `flows_ refer to the flow of energy and, with it, all other things including matter, money, resources and information. This all-embracing web of forces and flows forms an omnipresent, motivating and unifying meshwork that moves and shapes all things. Forces shape and bind all things; Flows nourish and animate all that is.

series of nested networks of interdependent specialists through whose veins resources such as carbon, oxygen and water transverse the globe, the generalized study of flow-networks explains why similar images and principles apply to social and economic systems as well.

- *Dynamic* ¯ Instead of images of stasis ¯ of automatic equilibrium and final perfect systems ¯ energy˘s penchant for creating organization and driving change gives us new insights into how societies and economies change, what makes them healthy and what causes them to collapse.
- *Measurable* ¯ Many of these dynamic insights are both easy to see, and relatively easy to measure. This measurability stems from the fact that many flow-factors ¯ such as pressure and circulation (see Carbon Flow in Figure 1b), and optimal network arrangements ¯ such as intricacy and properly balanced hierarchy ¯ can be assessed by such simple concrete measures as magnitudes of flow, number and diversity of organizations at each scale, and layout of where flow goes. We can also use certain universal, optimal network patterns (which nature has selected over billions of years) we can to create mathematically-precise *targets* for network health (Figure 2.)

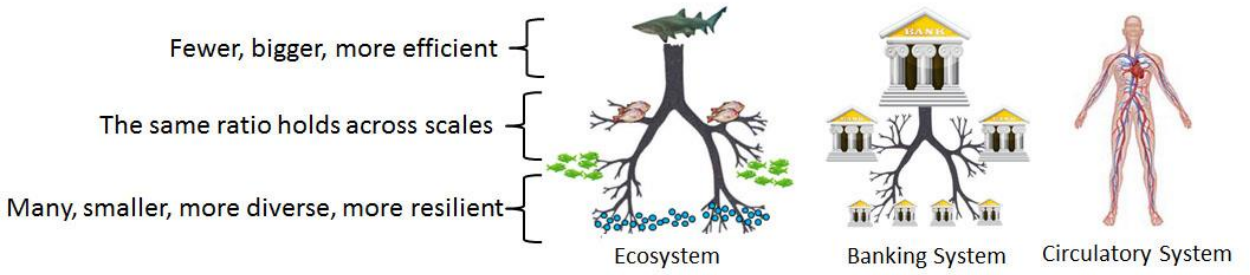

Figure 2. ***(Fractal) Branching Structures are measurable & common because they optimize cross-scale flow.*** *The familiar branching pattern, with a few large and successively smaller and more numerous components, is found in a wide variety of systems because it optimizes circulation across scales. Nowadays we call it a fractal. Just as ecosystems need to balance predator and prey, so we can assess systemic economic health by measuring its balance of small, medium, and large components.*

Yet, the science of flow also houses a holistic, humanistic bent that offers a more unified vision of much that what we already know about human systems. Most people find the rules of flow easy to follow because they already understand how circulating systems such as ecosystems and living organisms work. These laws also seem familiar because many regenerative insights are rediscoveries or validations of ideas and practices already well-known in development. Yet, regenerative economics also produces a distinctly different picture of vitality because regenerative flow differs dramatically from the heavily extractive pursuits promoted by neoliberal economics.

This strange mix of well-known and unexpected comes from the fact that regenerative economics is not so much a new approach as it is a new way of organizing and integrating the known facts of economic life. In other words, like an optical illusion that can be seen in two ways, regenerative development is novel because it organizes existing facts into a very different picture of how to create lasting socio-economic economic vitality. This perceptual shift rests on three key changes:

- ***Analytic to Holistic (Systemic).*** Where most modern theories imagine economies are built of independent agents following rational self-interest, Regenerative economics argues that economies are actually built of *interdependent specialists* linked in common-cause networks. Systemic health requires systemic design because just as your body needs all its organs to be healthy, so too a society needs all its human capacities and institutions to be in full working order.

  Because whole circuits only work when all parts are healthy, regenerative health depends much more on *where money goes* and whether its impacts are *constructive or destructive*, short-term or lasting ¯

than on *how much* money is exchanged (GDP). It is also particularly important for circulation and processing that specialists be arranged in a *whole circuit*: a set of circularly-connected value chains that link incoming resources and processing to final distribution and payment.

Systemic design involves *a synergetic alignment of all parts*. Instead of focusing on only one piece of the puzzle ¯ say finance or environment ¯ all sectors and factors must be designed to work together because whole systems only work well when all parts are smoothly connected and productively fulfilling their role. Cross-scale alignment and integration¯ that helps top, middle and bottom work synergistically ¯ is particularly important because critical functions are handled by organizations at higher and lower levels, as well as by those at the same scale.

- ***Money-centered to Human-centered*** – While money, profits, and environmental health are important to health, the real engines of economic vitality come from the quality, adaptability, and strength of *human organizations*. We say Regenerative economics is `humanistic_ because it is `human-centered_ , it places human organizations at the center of development design. Because human capacities, institutions and organizations are central, regenerative development also emphasizes the need to *nourish the full range of capacities* (particularly the human ones) including social, cultural, intellectual, financial, material, living, etc.

- ***Solely Self-interested to Common-Cause Culture*** – Instead self-interest alone driving vitality, Common-cause culture is central to systemic health both because interdependent specialists must work together, and because all members depend on the health of the whole as well as self-interest. Common-cause values such as justice, fairness, freedom, and democracy tend to be selected over time because they grease the wheels of synergetic cooperation. More traditional free-market values, such as competition and rational choice, are still important, but they are anchored in an over-arching context of common-cause cooperation.

The science of flow adds several refinements to this basic holistic, humanistic vision.

How Do You Create Lasting Vitality? Lessons from the Science of Flow

> Cities ... need all kinds of diversity, intricately mingled in mutual support. They need this so city life can work decently and constructively, and so the people of cities can sustain ... their society and civilization. ... I think that the science of city planning ... must become the science and art of catalyzing and nourishing diverse, close-grained working relationships that support each other economically and socially.
>
> Jane Jacobs, *Cities and the Wealth of Nations*, 1984

The science of flow is beginning to turn new understandings of how the cosmos builds durably vibrant networks into a cogent set of *laws of systemic health* that can be applied to human systems as well. The goal of Regenerative economics is to use these principles to replace today˘s flawed economic ideology with these more accurate rules of health and development.

So what makes economies vibrant? Key flow principles include:

CIRCULATION: In flow networks, just as blood must reach every cell in your body, so the robust cross-scale circulation of money, resources, information etc. must reach and nourish every level and sector because specialists at every level play important roles. The importance of circulation means that healthy, inclusive growth will require ˙inclusive circulation,˘ the robust, cross-scale nourishing kind.

Ironically, the importance of robust circulation is both well-known and often ignored. Keynesians, for example, point out that economic health in general is harmed when local monetary circulation goes down

because lower wages, fewer benefits, and a larger slice of income going to rent means more money flowing upward and less circulating horizontally. But, the neoliberal economists who dominate policy discussions tend to see such issues as simply the detritus of unerring market forces.

In contrast, Regenerative economics sees problems such as: low wages, poor access to loans, chronic poverty, a vanishing middle class, and the siphoning of wealth to upper levels ¯ as signs of *economic necrosis*, the slow starvation of economic tissue due to poor cross scale circulation with too much money flowing to the top, and too little circulating throughout the rest of the real economy. It sees neoliberal pro-policies ¯ such as austerity for struggling nations; tax breaks for the wealthy; privatizing Commons; and trade policies which outsource jobs to the lowest-wage nations ¯ as exacerbating the circulation problem. Strategies such as increasing the minimum wage help somewhat, but they are temporary, Band-Aid solutions to the deeper problem of an increasingly frail real-economy with feeble job-creation due largely to too much money flowing away from middle- and lower-scale real-economy organizations, and not enough flowing through them.

Since the starvation of wide swaths of economic tissue damages the health of the entire system, flow-logic sees signs of inequitable circulation not just as ethical issues, but as symptoms of economic disease.

SELF RENEWAL: Because circulation must reach all parts of the system, systemic health is more a function of *where money goes* than of *how much money* is exchanged (i.e., GDP). The two key questions for regenerative health are: 1) how much energy (i.e., money, resources, and information) is directed towards *constructive activities* like building a road, vs *destructive* ones like polluting the environment; and, 2) how much is directed toward building and maintaining *capacities*. The latter is particularly critical. So, just as your body turns the food you eat into the energy and nutrients you need to feed your brain and muscles, so any society that wants to stay vibrant over the long-term had better pour money and resources back into developing and endlessly renewing the human capital and material infrastructure that allows it to function well.

The importance of self-renewing activities explains: why developing internal capacities is more important than GDP growth per se; and why open and equal access to a wide range of essential Commons ¯ from education and healthcare to the environment and the Internet ¯ is critical to economic health. It also clarifies why reducing funds to education, road construction, healthcare and many other such critical activities harms the long-term economic health, and why forcing austerity on struggling nations makes economies dangerously worse.

NETWORK STRUCTURE: *Intricacy & Hierarchy; Balance & Integration* – In flow networks, form and function are tightly connected. So, just as the structure of a bird˘s wing serves the function of flight, so the way human organizations and institutions are structured has a profound effect on their functioning and health. Nature uses two familiar network structures ¯ intricacy and hierarchy ¯ to optimize cross-scale circulation.

Intricacy – When organizations are small, nature uses an *intricate weave* of small, interconnected circuits (businesses and value chains) to support robust circulation at small, local scales. Intricacy is essential to local functioning because it increases local circulation in the form of wages, taxes, and scale-appropriate services. The best way to increase intricacy is to increase the number and diversity of small-scale, local businesses that both generate flow and circulate it largely within the local community. As Figure 3 shows, the regenerative rule of thumb is that *the more locally-rooted capacities and businesses an economy has, the more robust it will be long-term*.

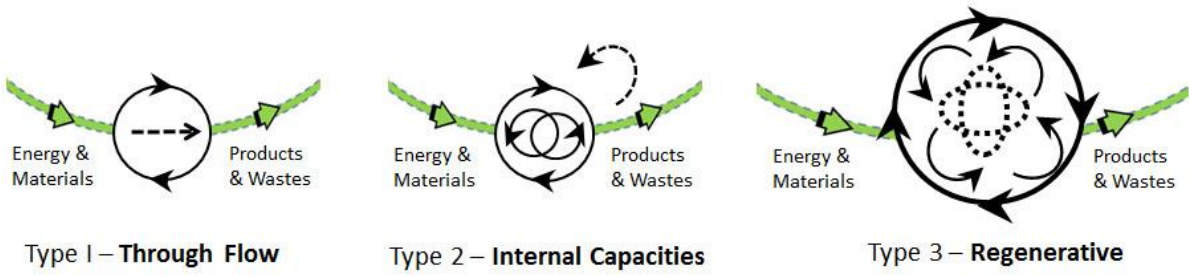

Figure 3. ***A Circulatory View of Vitality: Through-Flow to Regenerative*** (See Allenby & Richards, 1994)
In flow terms, the least vibrant economies are "through-flow" systems: ones with few locally-rooted capacities and businesses, and little reinvestment in local capacities. Such economies are generally built around the extraction of some set of resources by a more powerful outside entity (usually a corporation). Because through-flow economies have few self-sustaining, locally-rooted circuits, once the outside entity is finished extracting, the local economy is left moribund, unable to generate enough activity or pull in enough resources to thrive. This situation is easily seen in coal towns and corporate towns, but it is also visible in multinationals' race-to-the-bottom pursuit of ever-cheaper labor. In contrast, regenerative economies such as New York or London have so many, interlocking, mutually-reinforcing, synergetic systems that the loss of one or two businesses makes little difference. Such economies become economic engines that attract the resources – monetary, intellectual, labor, etc. – they need to thrive. The ones that thrive long term also have governance systems which heavily invest in internal capacities.

Figure 4 ***Fractal Flow-networks with Hierarchical Branching***
Pyramidal structures with a particular balance of small, medium, and large components are common because they help optimize circulation across scales. Nowadays we call this balance a "fractal".

Hierarchy and multiscale circulation ¯ Intricacy works well at small-scales, where connections remain tight, but the larger and more multiscale a society becomes the more complex its circulation needs become. While multiscale communities still have small-scale needs for connection, communication and internal circulation, they also have large-scale needs such as building highways and hospitals and transporting high-volume resources across larger distances. Nature meets the need for multiscale circulation by using intricate weave to maintain robust circulation at the small-scale, while using hierarchical structures to connect organizations and speed movement across scales.

The familiar hierarchical (fractal) branching structures, with a large numbers of small elements at the bottom and successively larger and fewer elements moving towards the top, epitomizes this strategy (Figure 4). It is found in systems as diverse lungs, lightning bolts, trees, River deltas and the circulatory systems precisely because it serves multiscale needs: connecting, catalyzing and fueling critical activities at every level. The big, efficient conduits (arteries or rivers) provide the high-volume and speed needed for rapid, cross-level circulation, while the many small elements (capillaries or wetlands) reach every unique nook and cranny.

Since optimal network arrangements improve systemic health, the main implication here is that economic networks seeking optimal health should mirror nature˘s optimal structures. For instance, just as an ecosystem must maintain a particular balance of predators and prey, so healthy economies must also maintain a proper balance of small, medium, and large organizations. But, this basic rule also comes with a number of interesting corollaries:

The Goldilocks Rule: *Why economies need organizations that are "just right" to meet each scale's needs*
Just as wetlands perform different eco-services than rivers and lakes, so like Goldilocks, healthy economies need organizations that are `just right_ to serve the needs of each scale. One reason a proper balance of small, medium, and large organizations is critical is that this arrangement supports sufficient actors at each scale to perform that scale˘s functions. Maintaining proper balance of power also helps keep actors at any scale from doing excessive harm to other parts of the system.

In this view, healthy banking systems, for example, need a particular balance of small, medium, and large banks because different size financial organizations are needed to serve the needs of each scale. In Goldilocks terms, small banks are `just right_ to serve local commercial needs because they know the market and have a vested interest in the success of the loan. Large-scale banks are `just right_ to serve large-scale needs, but cannot effectively serve small-scale needs because they know little about the local people or communities receiving small loans, and small loans are uneconomic for big banks anyway.

The concept of scale-appropriate entities actually has wide application. It explains, for example, why maintaining sufficient diversity of perspectives and/or talents is critical to healthy functioning, and why hiring local workers, who know and are well connected to the local community, has benefits for businesses that want to serve local needs effectively. Salingaros (2003) has even shown that cities work best when their transit systems maintain a healthy balance of small, medium, and large pathways ¯ i.e., walking paths, bike paths, small roads, medium roads and superhighways ¯ because different scale conduits catalyze different scale interactions ¯ i.e., casual conversations to rapid transit.

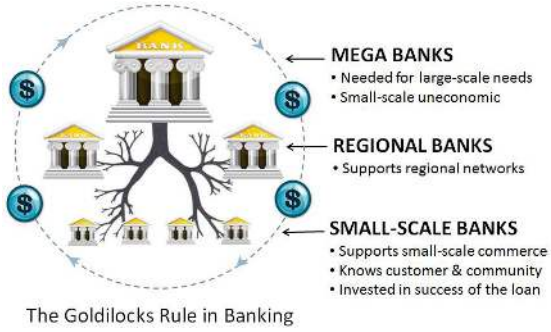

Figure 5 ***The Goldilocks Rule: Having banks that are "just right" to facilitate activity at each scale***

At the same time, the Goldilocks rule also explains why economic *imbalances* ¯ such as too much monopolistic concentration ¯ are dangerous. For example, the Goldilocks rule suggests the banking crisis of 2008 may have been due in part to massive imbalances caused by big banks gobbling up too many small banks. Big, powerful banks ¯ like big predators ¯ are perfectly capable of consuming or destroying excessive numbers of small banks. As with the Bendigo banks, the loss of local bankers left no one who knew or cared about the actual people or success of loans being made. The remaining banks also reduced local circulation and increased extraction because they were primarily focused on moving money upward.

Balancing Resilience & Efficiency *(The Window of Vitality)* – The need to maintain a balance of small, medium, and large elements also explains why vitality also requires a balance of efficiency & resilience. *Resilience*, the ability to spring back from crises, generally increases with diversity and the flexibility that

goes along with small size. *Efficiency*, meaning ability to focus efforts and move large amounts of materials, generally increases with the high capacity and streamlining uniformity that tends to go along with large size. Systemic health requires a balance of these two critical factors because both are important, but the characteristics that support them run in opposite directions. Too many small-guys with too little efficiency or capacity leads to economic stagnation due to lack of efficiency. Too much monopolistic concentration with too few small guys creates economic brittleness due to loss of resilience. Consequently, Ulanowicz, et al (2009) showed that healthy ecosystems maintain a balance of resilience and efficiency within a particular `window of vitality_ that defines the optimal balance between these two factors (Figure 6).

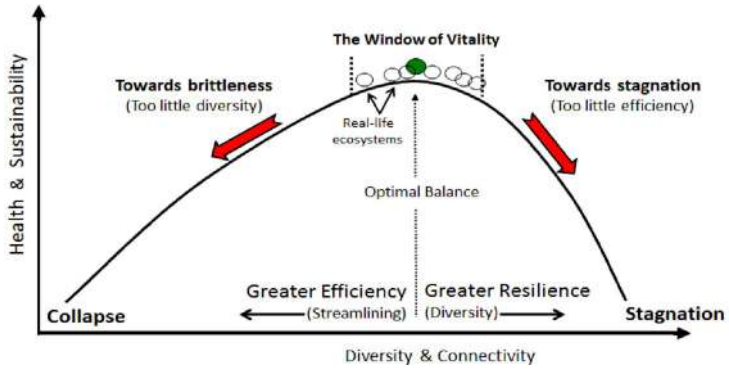

Figure 6. ***The Window of Vitality: Why systemic health requires a balance of efficiency & resilience***
Because efficiency and resilience are both important to systemic health, healthy systems must maintain a balance of ***resilience factors*** *(small, diverse, flexible & densely connected) and* ***efficiency factors*** *(big, streamlined & powerful) within a Window of Vitality representing optimal network health.*

COMMON CAUSE CULTURE: As mentioned earlier, Common-cause culture is critical to whole system health because values such as justice, fairness, reciprocity, distributed empowerment, and democracy grease the wheels of synergetic cooperation, and because interdependent members depend on the health of the whole as well as each other. The importance of common-cause validates such classic strategies as:

- *Empowering Education*: If you want your economy to flourish far into the future, then you had best energize your `interdependent specialists_ to think critically, creatively, and synergistically. William Butler Yeats makes the point succinctly: `education is not a pail to be filled, but a fire to be ignited_.
- *Inclusive Participation & Empowerment* ¯ If you want your society to remain vibrant for long periods, then you need to harness the energies and talents of all its members, not just the ones at the top or in some loyal core group.

Yet, the fact that complex systems must balance many equally-critical but competing characteristics to stay healthy also adds a number of twists to this story of common cause. We˘ve seen how balance works in efficiency & resilience; it also plays out in:

Balancing Competition & Cooperation – Both cooperation and competition are essential, but they too can pull in opposite directions. Cooperation allows interdependent specialists to work together, and competition for excellence helps us build new businesses, find new ways and improve on existing ones. But, competition practiced as predation is dangerous because it often destroys more than it improves. When combined with excessive power, predatory competition both corrupts mainstay institutions, and creates powerful extractive pulls that wreak havoc on economic root systems by destroying huge numbers of small and medium-sized businesses. In this way, the requisite balance of competition and cooperation requires we be clear that `competition_ does not mean a ruthless dog-eat-dog struggle or a predatory zero-sum game with big guys destroying little guys, but rather a competitive striving for excellence taking

place on a fair playing field within an overarching cooperative context. Figure 7 from Mike Field of Development Alternatives, shows some of the forces driving a healthy balance of cooperation and competition, and their impact on venture capital effectiveness.

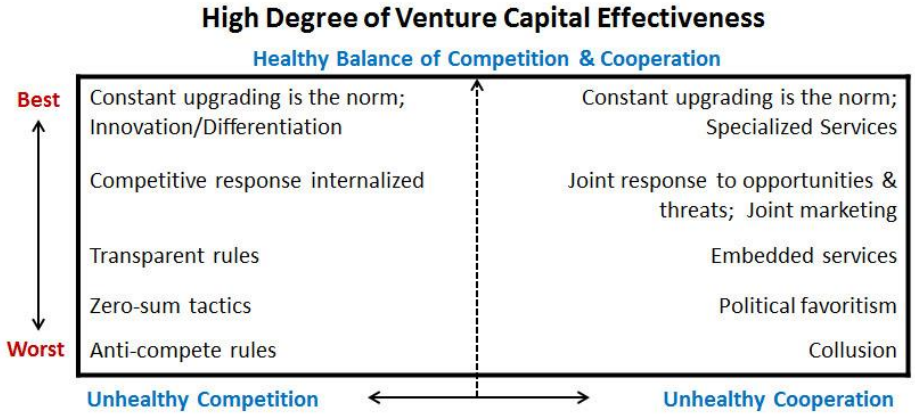

Figure 7. ***The forces driving the balance between healthy competition & cooperation***
How the rules and relationships in interconnected systems influence venture-capital effectiveness.

Balancing Unity & Diversity – The unity provided by common cultural norms, language and practice is essential because it allows diverse specialist to work together. Humanity˘s wide a variety of talents, interests, beliefs, etc. is essential to filling niches and finding new ways. Too much unity (conformity) suppresses diversity; too much diversity makes it hard to work together.

Balancing Freedom & Constraints (Laws) – Freedom empowers the diversity and flexibility we need for learning. Constraining laws and norms keep free individuals and organizations from doing excessive harm to others or the whole. Constraints are particularly important for extremely large, monopolistic organizations because they have the power to drain and destroy huge swaths of the real economy. While certain imbalances are clearly destructive ¯ such as too much of authoritarian constraint, or too little constraint for overly powerful entities ¯ finding the optimal balance of freedom and constraint is an endless work in progress. Societies must constantly re-examine what balance works best as we evolve better understandings about which types of freedoms and constraints best contribute or detract from long-term systemic health.

Balancing incentives to grow larger & to develop internally *(positive & negative feedback)* – Both intricacy and hierarchy play important roles, but too much small-scale diversity leads to stagnation, while too much hierarchical power and efficiency leads to brittleness through the destruction of smaller scale players. The importance of balance explains why today˘s extractive economies are `unsustainable_ because they incentivize extreme imbalances of size and power ¯ i.e., gigantism, hyper-concentration of wealth, and endless, overheated growth. Consequently, economies that want to remain vibrant must learn to regulate growth by balancing pressures for growth in size (strength) with incentives to develop internal capacities, diversity, and infrastructure (resilience and learning). In scientific terms this means balancing positive and negative feedback: incentives to amplify growth and constraints that dampen it. Excessive dampening growth stifles enterprise; excessive amplification creates overheated growth that will eventually cause the organization to burst like a bubble.

Creating Self-Sustaining, Synergetic flows

What does all this theory mean for development? Many of the lessons coming from the science of flow are already standard practice in development, including:

- Pouring energy into building human capacities and supportive infrastructure;
- Increasing internal circulation in local networks by building locally-rooted organizations;
- Improving access to finance in undernourished sectors particularly in the lower- and middle levels (for example, using public banking or micro-finance initiatives).

Yet, flow-logic also suggests some more unusual strategies particularly with regard to creating naturally self-sustaining flows. As we˘ve seen, flow networks thrive on common cause values; hence activity should be aimed at reciprocity and synergy. Systemic health also requires flows be aligned to circulate thoroughly, reinvest generously and naturally reinforce healthy patterns of behavior. Putting these factors together suggests that network arrangements should be designed to be *synergetic* and *self-reinforcing* because this is what make a system *self-sustaining*.

Self-reinforcing systems have outcomes are so logically-connected, and mutually-beneficial for the participants and the whole that they tend to maintain themselves naturally. Synergetic arrangements tend to create a broad range of positive outcomes, which in combination with self-reinforcing alignments, tend to create sustainable vitality that lasts for long periods. The transformative power of such self-sustaining, synergetic flow is both amazing and also easier to arrange than one might expect. All it takes is a little creative connecting.

One of the best ways to increase synergetic flow at lower levels of the economy is to *connect underutilized resources with unmet needs*. For example, Jaime Lerner, mayor Curitiba, Brazil simultaneously solved problems (i.e., unmet needs) of poor education, ill health, low employment, and uncollected garbage accumulating in local favelas by aligning underutilized resources ¯ including unemployed residents in favelas , an underused municipal bus system; and abundant, cheap, local food ¯ in ways that gave rise to naturally self-sustaining flow.

Lerner˘s creative realignment began by giving residents free bus tokens in exchange for the garbage they collected and sorted. Those who collected paper and cartons also received plastic chits they could exchange for parcels of seasonal fruits and vegetables. Employment improved because residents could use their bus tokens to commute to jobs father away. Homeless people and alcoholics were also employed at the recycling plant, where they were also retrained on computers they rescued from the city˘s bins. Health improved because the garbage was soon removed and fresh food was more readily available. Education improved because a school-based garbage collection program supplied poorer students with notebooks. In one three-year period 100 schools traded 200 tons of garbage for 1.9 million notebooks. Eventually initiatives were created to finance affordable housing, the creation of green areas, and the restoration of historical buildings. Floodplains surrounding the city were converted to parks with boating lakes that acted as overspill areas. Housing was tackled in a similarly simple, yet revolutionary way. Land next to the electricity company was converted into affordable-housing estates, and residents were encouraged to design their interiors, so they felt more pride and ownership over their properties.

Not only were the human impacts of these synergetic alignments were profound, but the economic outcomes were impressive in monetary terms as well. As Lietaer and Belgin note:

> From 1975 to 1995, the Gross Domestic Product (GDP) of Curitiba increased an average of 75% more than its parent state Parana, and 48% more than the GDP of Brazil as a whole. The average Curitibano earned more than 3 times the country˘s minimum wage. If nontraditional monetary gains such as exchange of garbage collection for provisions are taken into consideration, the real

> total income for residence was at least 30% higher still. The results in human terms ¯ the renewal of dignity and hope for a better future ¯ can only be imagined.[7]

The impact on city life also transformed public opinion. As Lerner says, `Those that were most against us transformed into our greatest supporters ¯ they just needed to see the results. Now they are proud of their city._[8]

Curitiba is also not the only example of the transformative power of synergetic flow. Nobel-prize winner Wangari Maathai improved economic vitality and environmental health in Kenya simply by organizing local women into `virtuous circles of empowerment_ aimed at planting trees. The women earned income from harvesting fruit and timber from the trees. Because they did not have to travel long distances for firewood, women also had more time to care for their families. Soon, women had more time and money to educate their children and often themselves as well. Started in 1976, the citizen-foresters of the Green Belt Movement have now planted more than 20 million trees and thousands of families are healthier, happier, better fed, better educated, and more in control of their own lives.

Confronting the Paradigm Problem*:* How extractive biases keep us locked in line

Jaime Lerner˘s Curitiba and Wangari Maathai˘s Green Belt movement show the lasting benefits of self-reinforcing, synergetic arrangements. But, despite their power, such strategies are not widespread. Instead, we seem to keep on using economic strategies that produce mostly limited, short-term benefits. Why do we keep accepting unsustainable outcomes, when better ways have already been identified? The most obvious answer is that we are using a faulty economic paradigm. The simplest answer to what˘s wrong with our current paradigms is that it˘s excessively extractive and insufficiently regenerative.

The combination of excessive extraction and insufficient regeneration explains why so many cities and countries are plagued by chronic, debilitating poverty which `growth_ does nothing to alleviate. It also explains why modern economies are often unstable and unsustainable. So, instead of the inevitable outcome of unerring market forces, Regenerative thinking follows Daron Acemoglu and James Robinson˘s work in *Why Nations Fail* (2012) seeing signs such as entrenched poverty and a vanishing middle-class as indications of an *extractive* economy, one designed to support the process of wealth moving upwards, with little channeled back into internal capacities. Using concrete examples such as Nogales, Mexico, and Nogales, Texas ¯ which are culturally and geographically identical, but politically and economically distinct ¯ Acemoglu and Robinson demonstrate that real cause of chronic poverty lies in how much the political system supports economic policies that encourage wealth to move upward (extractive) vs those designed to empower, develop, and circulate. These last are all characteristics of a Regenerative economy.

Flow logic also adds a few refinements to this basic explanation. Economies that are overly extractive and insufficiently regenerative have too much wealth going to the top and too little going everywhere else. The resulting poor monetary circulation to the middle- and lower levels leads to *economic necrosis*, the slow starvation of wide swaths of economic tissue that damages the health of the entire system. Such excessive extraction leads to the world we see all around us: bubbles of elite wealth hiding increasingly fragile real economies. Starving economies rarely get better because the money and resources they need, and much of the wealth that they have created, are constantly being funneled away.

Unfortunately, failed paradigms, such as today˘s neoliberal capitalism, are difficult to change for number of reasons:

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[7] Bernard Lietaer and Stephen Belgin, *New Money for a New World*. 2012. p. 4.
[8] http://www.theguardian.com/environment/blog/2009/nov/05/jaime-lerner-brazil-green

- Most people have faith in the dominant paradigm. They also see the world through its lens and find it difficult to see the world differently;
- The better ways we need are hard to see because they are not presented in a clear, unified narrative;
- A powerful matrix of incentives and punishments create tremendous pressures to follow dominant beliefs and practices regardless of whether one believes in them or not.

The matrix of rewards and punishment is particularly important. We've argued that economies are built of networks of interdependent specialists. Institutional economics refines this basic model by adding the concept of *institutions* - specialist subnetworks that serve some key social function, such as media, finance, government, medicine, etc. Institutions each serve some *core function* of the social system, and a society's health largely depends on how well they play their *authentic* role in *service* to the larger society. Economic health, for instance, depends on how well the finance system circulates money to fuel constructive economic activity, and societal health depends on how well media disseminates accurate information and supports effective discussion.

In turn, how well institutions play their role is largely determined by the cultural beliefs, values, norms or *biases* held by the wider society. Most people and organizations follow the society's dominant biases because they are enforced by a matrix of rules, rewards, punishments, incentives, etc. which create constant pressure to do so. For example, if a society believes win-lose competition creates the best of all possible worlds, then its people salt incentives for competition everywhere. If a society believes GDP growth leads to economic health, then its people create incentives to up GDP.

This matrix of incentives explains why the market's `invisible hand_ is not automatically optimal, but largely determined by the society's dominant paradigm and biases. For instance, Figure 8 from Mike Field of Development Alternatives shows how Strategy biases for extractive vs value-add activities and Relational Network biases for Patronage vs merit-driven behaviors affect market inclusivity and resilience.

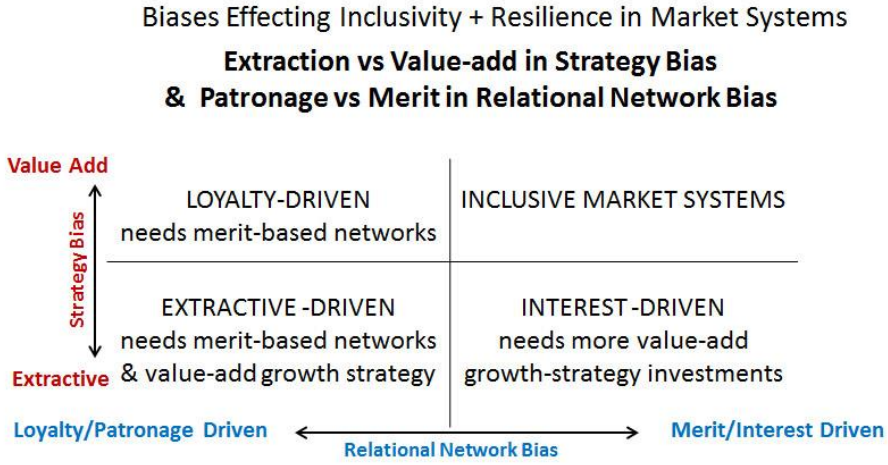


Figure 8. ***Effects of extractive vs value-add biases, and patronage vs merit-driven biases***

So the deeper answer to why we keep using a failed economic paradise is that a matrix of rewards and punishments keep us locked into these failed beliefs. How can we get out of today's disastrous economic lockstep? The first step is to find an articulate a better paradigm, but an equally critical step lies in developing different incentives.

Incentivizing Regenerative Behavior: *A synergetic approach to transformation*

Societies get the economy their biases encourage. In today˘s case, our biases encourage extractive and self-serving processes such as maximizing profits for elites regardless of the harm done to anyone or anything else. Understanding the difference between regenerative and extractive economies helps us identify the core problem. Understanding the role incentives play in determining behavior offers a new view of how to expedite reform.

Today˘s neoliberal biases are driving global civilization towards disaster, and the incentives maintaining this behavior will be hard to overcome. Yet, it is important to proceed anyway because the science of flow suggests today˘s rising pressures will eventually force us to either learn or collapse. During choice points there is every reason to believe we can make the world better, and no reason not to try.

So, instead of seeing today˘s free-market economy as the final economic system, the science of flow views it as but one stage in a broader, ongoing process of cultural development. Over time, inadequate understanding such as those we have today naturally generate both crises and pressures. In turn, economic, social, and political pressures drive change, which eventually forces the society to choose to change or collapse. In this way, today˘s growing pressures are driving a learning challenge: a chance to correct what isn˘t working before crisis turns to calamity.

Still, instead of beating one˘s head against the walls of power, flow-logic suggests a more effective way of bringing forth our next stage of development lies in `going with the flow_, that is, in channeling existing pressures and energies towards more naturally self-sustaining synergy.

The process of realigning flows starts with a systemic assessment of where energies and pressures lie. Knowing where pressure is building ¯ whether from economic malaise, political oppression, environmental ruin, or socio-economic instability ¯ allows us to `connect unmet needs with underutilized resources_ in much the same way that Jaime Lerner did in Curitiba. Once pressures have been identified, those seeking lasting systemic shifts must then design a systemic approach to re-channeling existing pressures and restructure existing incentives to support regenerative norms. Lasting change will require aligning incentives to be both synergetic and self-reinforcing ¯ for example, more shared-valued from transactions. It will also require a matrix of everyday incentives that re-direct capacities and energies towards a more regenerative way of life. While there are no pat answers, realigning activities to create win-win flows may generate profound effects at little or no cost because the main ingredient is creativity.

Today, new methods for measuring systemic health also offer new hope for finding our way out.

Measuring Systemic Health: Tools to guide our steps

Over the last several decades, it has become clear that GDP growth primarily assesses accumulation of wealth, not progress towards desirable goals such as good jobs, high employment, and widespread health. Worse, undesirable outcomes including fewer jobs, lower incomes and increasing environmental devastation often increase with GDP growth. In flow terms, GDP is a dangerous mis-measure of economic health because it only registers how much money is exchanged, and ignores whether the overall flow is constructive or destructive, capacity-building or -eroding. This blindness explains why efforts to: grow GDP; maximize profits; reduce taxes on the wealthy; and apply austerity to a struggling public, usually do more harm than good. As Cobb, et al (1995) put it: `GDP not only masks the breakdown of social structure and the natural habitats upon which the economy and life itself ultimately depend, worse, it actually portrays such breakdowns as economic gain._[9]

[9] Cobb, C., Halstead, T. & Rowe, J., 1995. `If the GDP is up, why is America down?_ *Atlantic Monthly,* 276(4), October, p. 52.

Indicators of desirable outcomes, such as income level, do a better job of gauging economic health, but offer little insight into how to create the kind of systemic vitality that would produce these outcomes on an ongoing basis. Similarly, most economic theories focus on profits, margins, or revenues, but offer little explanation for how to achieve or maintain desirable outcomes other than entrepreneurship, competition and the invisible hand of markets.

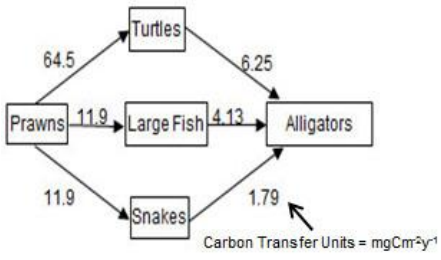
Yet, while the problems of misleading measures and inadequate explanations are increasingly well recognized, the response so far has been to tinker at the margins of the current system. The science of flow opens new ground by showing how we can use the laws and structures of optimal flow to create precise targets and measures of systemic health. Precise measures are possible because:

- Most of the factors that govern healthy flow ¯ such as pressure, circulation and volume of flow ¯ and the main indicators of optimal structures ¯such as intricacy and fractal hierarchy ¯ can often be assessed by mapping the layout and magnitudes of flows, and/or counting the number, size, diversity, and connectivity of nodes and connecting channels (Figure 8). Measurement simplicity is aided by the fact that many analogous metrics already exist. For example, the Multiplier Effect and measures of `stocks and flows_ already chart the location and magnitudes of flow.

- The optimal structural patterns nature has selected over billions of years represent *targets for systemic health*. For example, as we˘ve seen the specific balance of small, medium, and large found in fractal hierarchies can serve as a target for systemic health because these pervasive arrangements create a relatively-optimal system of cross-scale circulation.

  These targets are measurable because, as scientists since the ancient Greeks have observed, nature˘s universal patterns are mathematically precise. For example, as Figure 2 shows, our fractal branching structures only work when they maintain a particular power-law balance[10] of small-, medium- and large-size components. This balance of sizes allows circulation to nourish functions at every level, while keeping actors at any scale from doing excessive harm to another part of the system. We can use this balance to assess economic health by measuring how closely an economy˘s distribution of sizes fits the optimal balance found in nature.

Figure 8. ***Measuring Network Health as a Function of Network Structure and Volume of Circulation***
Ecologists assess network structure by counting the number, diversity and size (capacity) of all connections and components, in this case, alligators, fish, etc. They measure flow principles such as circulation by monitoring the volume of chemical flows: carbon, nitrogen, etc. The above chart shows carbon transfer in the cypress wetland ecosystem of south Florida (after Ulanowicz, et al., 1986).



Flow dynamics and measures are apropos of human systems because, as we˘ve seen, they are highly compatible with what we already know about human factors such as reciprocity, distributed empowerment, fairness, etc. This compatibility allows us to incorporate existing measures of human factors into our understanding of systemic health without compromising rigor.

Fractal patterns are also apropos of human realities because, like snowflakes, they are simultaneously universal and unique (general and specific). For example, all trees and lightning bolts have a fractal branching pattern, but no two trees or lightning bolts are ever exactly the same. This combination of

[10] By a "particular" balance we mean a particular "power law" balance, meaning the number of organizations at each scale is a power law of the one below it. For example, 2^1, 2^2, 2^3, 2^4ŭ

universal and unique explains why different types of system, such as living organisms and societies, and each individual manifestation, such as London and Bangkok, always exhibit certain unique properties, while also adhering to certain underlying universal patterns and principles. We can still use these patterns to measure and diagnose health because, as Mandelbrot (1997) and others have demonstrated, underneath uniqueness, the fractal structure of things like trees, lungs and cotton prices on the stock market tell us a great deal about leverage points, breakpoints, and the system˘s underlying stability, robustness and health.

Still, just as there is no single measure of human health, so there is no single measure of systemic economic health either. Nevertheless, the laws of systemic health coming out of the science of flow allow us to identify a number of critical measures. Figure 9 lists the top 10 factors governing systemic health as developed jointly by researchers from the Capital Institute, Towson University, and FHI 360. For convenience, we group these factors into flow factors, cultural factors and structural factors:

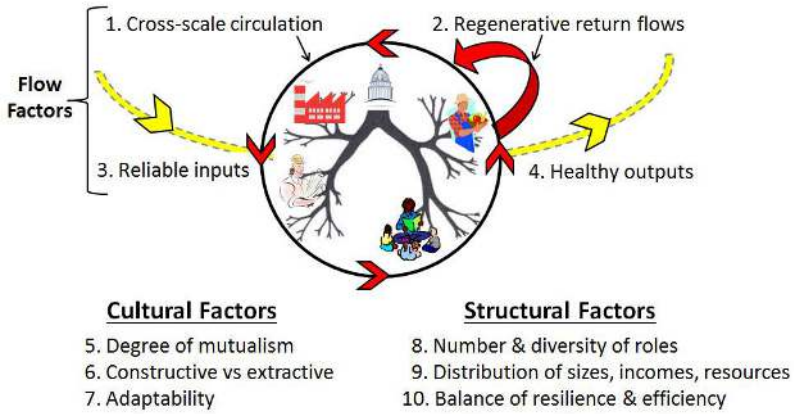


Figure 9. ***Our "top 10" measures of systemic health.*** *Factors 1 – 4 involve flow factors including where flow goes and how it affects the system. Factors 5 – 7 are human factors, key relationships that impact systemic behavior and outcomes. Factors 8 – 10 are structural factors, the balance of big and little, resilience and efficiency, diversity and number that effect circulation and vitality.*

MEASURES OF FLOW:

1. *Robust cross-scale circulation*: Assesses how rapidly and well resources reach all levels. Current measures of flow include Flux Density, Multiplier Effects, wage levels, and Total System Throughput (which is the flow-network equivalent of GDP).
2. *Regenerative return flows*: Assesses how much money and other resources the system recycles into building and maintaining its internal capacities including human capital as well as physical infrastructure. The Finn Cycling Index, for instance, measures how much of the system˘s flow is recycled into constructive internal processes.
3. *Reliable Inputs*: Assesses how much risk and uncertainty there is for the critical resource, information, and monetary flows upon which the system depends.
4. *Healthy outflows*: Assesses how much damage the system˘s outflows do externally.

MEASURES OF HUMAN FACTORS:

5. *Degree of mutualism*: assesses ratio win-win versus win lose relationships within the network. Is currently measured as weighted relationships.
6. *Constructive vs exploitative*: assesses the level of value add and capacity building activities vs. organizational draining or gradient degrading ones (extractive). Can be measured as a balance of value-add and capacity-building activities vs organization- or gradient-degrading (exploitative) ones
7. *Adaptability (place in the adaptive cycle)*: assesses the system˘s readiness for change and its place in a classical S-curve cycle of development. Is currently measured using Fath˘s adaptive cycle measures.

***MEASURES OF STRUCTURE*:**

8. *Number and diversity of roles*: assesses both the diversity and number of players in different activities critical to system functioning, for instance, the number of grocery stores, banks, hospitals, or schools in a given area with a particular population.
9. *Distribution of sizes, incomes or resources*: assesses where money and resources go. Can be plotted using weighted distribution of stocks or flows.
10. *Balance of efficiency & resilience*: assesses the balance between levels of diversity and flexibility (resilience) and streamlining of throughput (efficiency). Is currently measured using Ulanowicz˘ Window of Vitality or robustness metrics.

Regenerative Development

> In *The Nature of Economies*, Jane Jacobs suggests that economies are governed by the same rules as nature itself. Jacobs˘ actual hypothesis, however, is that living organisms, ecosystems and economies are all types of *flow networks* ¯ and that similar principles of growth and development apply to them all.
>
> Goerner, Fath & Fiscus (2014)[11]

Regenerative development˘s goal is *sustainable vitality* ¯ using nature˘s laws of systemic health to develop economies that produce lasting cross-scale vitality, and widespread social, economic and environmental health. This approach is not so much a new system of economics, but a new way of organizing much of what we already know.

Regenerative logic is easy to understand because practitioners see the impact pressure, poor circulation, and excessive extraction have on human systems every day. It is surprising because it converts the usual laundry list of desirable outcomes into a working model of a how to achieve those outcomes. It is shocking because it comes with effective measures of systemic health to guide our steps. The fact that many of its suggestions are rediscoveries of existing theory and practice suggests that the main challenge facing practitioners will be perceptual, not factual.

We believe Regenerative development backed by the empirical sciences of flow can provide both a beacon of hope and a solid path to a better world. Here, the only lasting solution to societal sustainability lies in replacing today˘s hyper-powerful, solution-blocking, extractive approach to economics with regenerative institutions pursuing inclusive vitality and effective collective learning aimed at the long-term health of civilization as a whole. Achieving this new paradigm will require a unified narrative of regeneration that is both specific and measurable, accompanied by a matrix of incentives that channel existing energies towards naturally synergetic and self-sustaining regeneration.

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