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## White Paper

### *The Rainforest: How “Chicago Thinking” Explains Silicon Valley*

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What makes places like Silicon Valley tick? Can we replicate that magic in other places? Despite enormous public investments globally, only a few regions like Silicon Valley have become enduring *innovation ecosystems*—human networks that generate extraordinary creativity and output on a sustainable basis. *What is the nature of such innovation ecosystems, and how can we deliberately build them?*

This white paper and a related book propose a radical “theory of everything” to explain the workings of innovation ecosystems. My colleagues and I call this model for such a system *the Rainforest*. By weaving together our personal observations with what we know about human nature, evolutionary biology, economic cooperation, physical systems, and social systems, we can offer a new and more productive way of thinking about innovation. We argue that neoclassical economics fails to explain the real-world workings of Rainforests. Instead, the innovation process is intimately bound with the dynamics of human nature, the invisible transaction costs caused by human nature, and the development of social norms that help people in Rainforests overcome those transaction costs.

Therefore, while the neoclassical Chicago School does not easily explain the mystery of places such as Silicon Valley, “Chicago Thinking” in general—as an interdisciplinary practice that blends social science, hard science, and empirical analysis—can meet that challenge.

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## Plantations vs. Rainforests

We are atypical venture capitalists. Our practice consists of two interconnected halves. On one side, we do what many venture capitalists do—we identify and invest in highly selective technology startup companies, and try to help them grow quickly and profitably, forming close partnerships with our entrepreneurs. On the other side, we take the insights gleaned from our hands-on experience and apply them to global development by working with governments to develop venture funds, startup incubators, and technology policy in emerging markets. We have a rare set of proficiencies at this intersection of private venture and public policy. We have advised dozens of institutions, such as the World Bank, the U.S. Agency for International Development, and numerous foreign governments. Over decades of combined experience, we have developed a unique field of expertise—*the analysis and fostering of innovation systems*. In so doing, we have discovered that the development of entire innovation systems differs profoundly from the conventional wisdom for encouraging innovation at the scale of individuals or small teams.

What is the difference between a *plantation* and a *rainforest*? This is not a trick question. The differences are telling. The model of business emerging from the Industrial Revolution can be described in many ways as an *agricultural* model. Such a model is focused on controlling complex systems, using the latest technical tools to finely calibrate accuracy, precision, and productivity. The greater the degree of control, the better the output. Companies are rewarded for efficiency in production, much like farmers trying to squeeze greater crop yields out of every square foot of land using the best fertilizers, pesticides, or farming methods. Think of the archetypal image of garment workers toiling at rows of sewing machines. Or an assembly line in an automobile plant. The faster the assembly line, the more money you make. The more dependable the quality, the more customers will buy the product over and over again.

By contrast, when we think about innovation systems, the greatest productivity comes from environments that resemble not cropland but *rainforests*. In nature, a rainforest functions not because of the mere presence of raw carbon, nitrogen, hydrogen, and oxygen atoms. It thrives because of the way in which these elements mix together to create new and unexpected flora and fauna. A rainforest is an environment with special characteristics—the air, the nutrients in the soil, the temperature, for example—that encourage the creation of new species of animals and plants that are greater than the sum of their elements. A rainforest takes lifeless inorganic matter and creates systems of thriving organic matter.

Natural rainforests do not predetermine the certain evolution of new and valuable species, but they provide the right setting to foster their serendipitous evolution. In rainforests, the most promising life forms emerge in unpredictable ways from highly fertile environments. The Rainforest model we propose is similar. When we

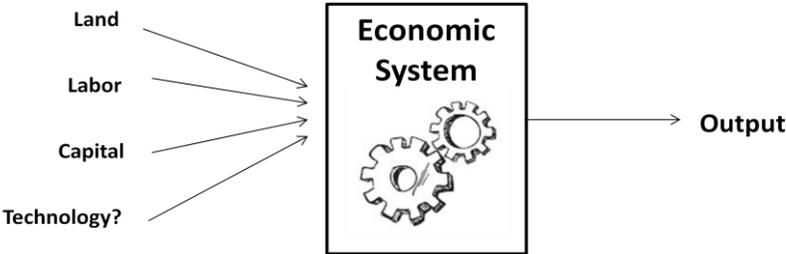
think of innovation systems, we should not try to force individual innovations into existence, but we should try to design and shape the proper environment that cultivates such innovations to be born and thrive.

This paradigm shift is not easily made, because the agricultural model has dominated the way we create and perceive value in business. Think about how real businesspeople behave. In the agricultural model, one usually pulls out a weed that does not belong. If you are planting corn, you want to kill the dandelions. You would normally fire the oddball employee who chooses not to build the auto part according to predetermined, detailed specifications. In the Rainforest, however, what looks like a weed might be the most valuable new plant in the entire ecosystem. Think of companies such as Google and Facebook today—they were indistinguishable from weeds only a few years ago. The oddballs are the gamechangers in innovation systems. *In Rainforests, we want to nurture the weeds to grow.*

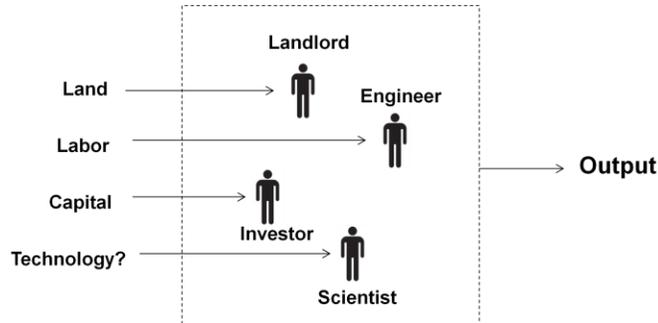
Thus, we discover an interesting paradox. A company that seeks to manufacture cheaper, better, more profitable laptop computers would run operations like an agricultural plantation. It would seek to control and tune all of the specific processes for producing that computer to the finest degree possible. However, a community that seeks to generate high levels of innovation throughout the whole system would do the opposite. It would run operations like a rainforest, not controlling the specific processes but instead helping to set the right environmental variables that foster the unpredictable creation of new weeds. *While plants are harvested most efficiently on farms, weeds sprout best in Rainforests.*

### The Failure of Neoclassical Economics

By constructing a new bottom-up explanation for human behavior in innovation ecosystems, the Rainforest model challenges some basic assumptions that economists have held for over a century. Whereas neoclassical economists believe that macroeconomic output is determined by inputs—such as labor, land, capital, and (some argue) technology—such a theory fails to describe the behavior of real-life innovation ecosystems. The neoclassical model might be drawn like this:

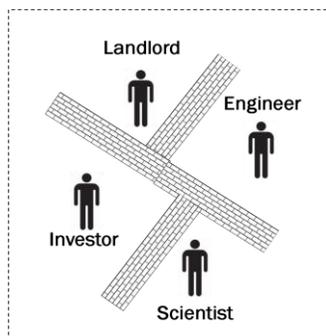


The fundamental flaw of this model, however, is that in the real world, economic systems are made of human beings, not anonymous gears. And human beings control *all* of these factors of production. Human beings, not invisible hands, are the ones in reality who sign leases, who work hours, who invest money, and who invent ideas. If we imagine a system of four people, for example, the land might be controlled by a landlord, the labor by an engineer, the capital by an investor, and the technology by a scientist.



To explain the differences between highly productive systems like Silicon Valley and most other places in the world, what is most important are not the *ingredients* of economic production, but the *recipe*—the way in which the ingredients are combined together. In the real world, human nature gets in the way. Our brains are instinctively tribal. We are designed to trust people closer to us and to distrust those further from us. High social barriers outside of close circles of family and friends are the norm in the world.

Scientists are discovering that innovation and human emotion are intertwined. Human nature, with its innate prejudices, creates enormous transaction costs in society. Thus, *what we think of as free markets are actually not that free*. They are still constrained by transaction costs caused by invisible social barriers based on geographical distance, lack of trust, differences in language and culture, and inefficient social networks. Those social barriers can be high, and they can keep people isolated, and thus not transacting with one another. Social barriers create transaction costs that stifle valuable relationships before they can be born.



Ironically, the greatest economic value is created in transactions between people who are the most different from one another. The greater the diversity in human specialization, the greater the potential value of exchanges in a system. The mathematics of social networks demonstrate that the greater the number of people in a network, the greater the potential for highly valuable exchanges between individuals with highly specialized skills. Thus, the instincts that once helped our ancestors survive—favoring distrust over trust when it comes to strangers—are hurting our ability to maximize innovation today.

A scientist and a businessman might even be the perfect theoretical partnership “on paper” if they could actually figure out how to understand, communicate with, and trust one another. According to economists, people should connect and collaborate and do business if it is in their rational interest to do so. In reality, what often happens is that inventors and entrepreneurs can sit in the same room, looking at the same presentations, hearing the same words, even having the same goals, but they still do not understand or trust each other enough to work together. We have seen this happen time and again. Startup companies—and Rainforests—are built from the bottom up, where irrational behavior reigns.

Rainforests like Silicon Valley are able to overcome these transaction costs caused by social barriers through a distinct set of social behaviors. These social behaviors correspond to the mechanisms that are necessary to maximize the free flow of talent, ideas, and capital in a human network. These behaviors, however, require that individuals rise above short-term selfishness and focus on long-term mutual gain. The key factors in the strength of human innovation ecosystems are: diversity of talents, trust across social barriers, motivations that rise above short-term rationality, and social norms that promote rapid, “promiscuous” collaboration and experimentation among individuals. This is the culture of the Rainforest.

Rainforests depend on people who actively bridge social distances and connect disparate parties together, like the role of *keystone species* that tie biological ecosystems together. Honeybees and hummingbirds are among the commonly known ones. People in Rainforests are motivated for reasons that defy traditional economic notions of “rational” behavior. We call these “extra-rational motivations” because they rise above simple concepts of rational or irrational. Rainforests function when the combined value of social norms and extra-rational motivations outweighs the human instincts to fear. The Rainforest theory therefore contradicts the notion that economic productivity is highest when the rational pursuit of selfish motives is greatest.

## The Rules of the Rainforest

People usually think of Silicon Valley as an anomaly in the otherwise “normal” history of the world, but what if we reversed that proposition? What if we envisioned Silicon Valley as the natural endpoint of a 50,000-year story? Perhaps it could be the latest stage in the evolution of human society, *from a culture based on tribes to a culture based on pragmatic individuals*.

The story began on the African savanna. Vast numbers of people then moved to the Middle East. From there, the genetic record shows that they migrated to Europe, Asia, and finally the Americas. The California coast is arguably the furthest point one can travel from the roots of human civilization, from the ties that bound people to the past, and from the rules of behavior imposed by our ancestors’ experiences. Silicon Valley happened exactly when and where it should have happened—at the end of the story so far. California today consists largely of people, or their descendants, who are such individualists that they could not even fit into an entire nation of rebels. It is the world’s ultimate non-tribe.

When we think of American individualism, we think of the frontier experience. The modern high technology industry of Silicon Valley would never have existed without the culture that developed on the frontier. But not just because of its emphasis on individualism, as most people assume. Silicon Valley is also the inheritor of the frontier spirit because of its unique collectivism. As historian Frederick Jackson Turner observed over a century ago, it is the tension between the individual and the collective that matters. The frontier was conquered not just by individualists, but by a culture of pragmatic cooperation. Rainforests have replaced tribalism with a culture of informal rules that allow strangers to work together efficiently on temporary projects. Silicon Valley is an extension of that culture: marked by social networks where individualism is always tempered by the need to participate within a community.

We have identified seven simple Rules of the Rainforest derived from the cultural norms that facilitated cooperation among pioneers in the American frontier. These Rules are woven into the invisible fabric of daily life in Silicon Valley.

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- Rule #1: Break rules and dream.
- Rule #2: Open doors and listen.
- Rule #3: Trust and be trusted.
- Rule #4: Experiment and iterate together.
- Rule #5: Seek fairness, not advantage.
- Rule #6: Err, fail, and persist.
- Rule #7: Pay it forward.

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Today and throughout human history—whether in the Gold Rush, the Dutch guilds, the diamond business, or the cotton industry—we see a similar process. People tend to create informal rules when formal laws are insufficient to govern the practicalities of real-world interactions. Similarly, entrepreneurial innovation, as it has developed in places like Silicon Valley, is built on its own set of unwritten laws. A successful Rainforest benefits from lower transaction costs because of unwritten behavioral norms that fill the gaps when traditional social structures don’t exist.

It is no coincidence that the two industries most identified with California—Hollywood and Silicon Valley—are both industries that are by definition impermanent. They both require an environment that enables people to band together quickly for a specific purpose—whether a movie, a television show, or a startup company—and then disband until they reunite for the next project. Or perhaps they never meet again. A major Hollywood film, for example, can require thousands of people entering into a temporary partnership, as evidenced by the end credits of most movies, when a seemingly endless list of people scrolls in front of the audience. Those people were assembled—like atoms organized out of the fast-moving chaos—to achieve a specific purpose. When that purpose is accomplished, the atoms are allowed to disperse back into the apparent chaos from which they came, enabling them to recombine later into something else. When Stanford researcher Ade Mabogunje observes that “a company is an event”—a transitory moment of human organization—he is describing essentially the dominant underlying framework of the California economy.

**Building Rainforests**

To build Rainforests, we must transform culture. Public attempts to foster innovation that do not focus on changing human behavior are doomed to fail. We can point to various tools for designing, building, and sustaining Rainforests by drawing from the track record of *cognitive behavioral therapy* in changing human behavior, both

individually and in groups. People learn culture not from top-down instruction, but through actual practice, role modeling, peer-to-peer interaction with diverse partners, feedback mechanisms that penalize bad behavior, and making social contracts explicit.

In addition, building and maintaining Rainforests requires specific forms of leadership and capital sources. Leaders must practice and enforce social norms, while bridging between social networks to bind greater communities together for common action. Public subsidies of venture capital are ineffective when fund managers are not culturally attuned to foster symbiotic relationships between investors and investees.

The Rainforest model is more than a metaphor. Innovation ecosystems are not merely *like* biological systems; they *are* biological systems. Talent, ideas, and capital are the nutrients moving through this biological system. Human systems become more productive the faster that the key ingredients of innovation—talent, ideas, and capital—are allowed to flow throughout the system. Measuring the velocity of such nutrients can provide us the tools with which to measure the health of an innovation ecosystem by observing dynamic activity over time, rather than static points in time. When particular social behaviors allow the movement of talent, ideas, and capital to be even freer—as they are in Rainforests—we find that human networks can generate extraordinary patterns of self-organization.

The Rainforest model explains the largely invisible mechanisms that underlie innovation ecosystems like Silicon Valley. It is not *creative destruction* alone that is sufficient. Far more important is *creative reassembly*, the ability of humans to combine, recirculate, and recombine into ever-increasing patterns of efficiency.

Traditional laissez-faire thinking (associated with the “Chicago School”) is unable to account for this process fully. When we examine the real-world behavior of practicing innovators, we discover that the basic ingredients of economic production do not readily mix, as free market theory assumes. However, a multidisciplinary analysis that examines human nature and the ways that humans interact with one another in complex social systems (associated with “Chicago Thinking”) provides significant explanatory power. Based on this perspective, we may be able to provide leaders an entirely new set of tools to stimulate economic activity and elevate human welfare.