

Interview Geoffrey West

Geoffrey West is a theoretical physicist whose primary interests are in fundamental questions in physics, especially those concerning elementary particles and their interactions and cosmological implications. *TIME* Magazine has called him one of the 100 most influential people in the world. His long-term fascination with general scaling phenomena led him to formulate universal scaling laws that pervade biology from the molecular genomic scale up through mitochondria and cells to whole organisms and ecosystems. How is this relevant to social organizations and social investors, Alejandro Litovsky of Volans asked him.

In 2007 you gave a talk at Google about universal scaling laws in biology and physics. Why does this matter to Google? And to social organizations more widely?

In physics and biology there are universal laws governing how things scale up, reflecting underlying generic principles and mathematical patterns. These surprisingly simple laws apply to almost every characteristic of living organisms, from individual cells all the way up to complex biological ecosystems. This results from universal properties of networks that distribute nutrients and energy throughout a system.

Take 'metabolic rate', one of the most fundamental quantities in biology. It represents how much energy you need per second to stay alive. A fundamental question is how metabolic rate changes as the size of an organism changes, say from a mouse to an elephant. Interestingly, the equation for this is the same across all forms of life; mathematically, metabolic rate scales as the mass of the organism to the $\frac{3}{4}$ power. This means, for example, that if mass is increased by a factor of 10,000 (*four orders of magnitude*), the energy needed to sustain the organism increases only by a factor of 1,000 (*three orders of magnitude*). Thus, there is an extraordinary economy of scale: because of universal network properties, each cell needs to work less hard as body size increases.

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To what extent can such laws be applied to social organizations and companies like Google? Understanding network structures and scaling laws provides insight into their growth, dynamics and viability. The preliminary findings are revealing.

We are now looking specifically at cities and corporations as two distinctive forms of organization. Our findings are preliminary at this stage so the conclusions should be viewed as speculative. Having said that, there are a few things I find fascinating.

The first is that very few cities have ever failed. Almost all survive – unless they fail for particular reasons like war or climate change. This is in marked contrast with businesses, all of which fail over time, no matter how powerful they may appear.

Can the parallels with biology explain this difference?

Perhaps. When you look at infrastructure in cities you find a similar economy of scale as manifested in networks of living organisms: the bigger the city, the less roads, electrical cabling, etc are needed per capita to sustain its growth. However, for socioeconomic quantities with no simple analogue in biology, those associated with wealth creation, innovation and creativity, the bigger the city, the more there is per capita. We call this super-linear scaling. In a big city, you generally get higher wages, are wealthier, and have more innovative people around you, but you also get more crime, pollution and disease, *all to the same degree*. The good, the bad and the ugly come as an integrated package!

In biology, because of network properties, not only are there greater economies of scale, but the pace of life gets systematically slower the bigger you are: hearts beat more slowly, oxygen diffuses more slowly across membranes, organisms live longer. In cities you find the opposite: the bigger the city, the faster the pace of life. While in biological organisms economies of scale occur over a finite lifespan, the wealth creation process in cities seems to lead to open-ended expansion.

As corporations grow, they eventually behave much like living organisms; death and decline are part of

the process. So here's the speculation: when a company is formed, it is driven by open-ended, innovative ways of thinking – not overly concerned with economizing – and many may die quickly because of that. But those that survive and flourish eventually become increasingly dominated by bureaucratic and administrative issues as they grow in size. Driven by economies of scale rather than ideas and innovation, the company eventually dies.

The major tension here is between economies of scale (spending less per capita as we get bigger) and open-ended wealth creation (getting more per capita as we grow). Google is an extraordinarily innovative organization but it's already struggling with economies of scale and inevitably becoming more bureaucratic. This tension might even be part of the very nature of building organizations; there's almost a kind of Darwinian evolutionary nature to this.

As a species we are eroding the earth's capacity to sustain us. Companies and governments seem slow to respond. What does evolution say about change at the speed that is required?

The challenge is that these complex, largely manmade problems, from global warming to financial markets, tend to be seen as independent phenomena. Institutions are being created to deal with them in isolation, while in reality they are deeply interconnected. We urgently need to develop more integrated, systemic solutions, and to engender a greater spirit of risk-taking, bolder experimentation, and innovative, bigger-picture thinking.

Who is best positioned to lead on this change agenda?

Al Gore's film had a profound impact on many people. But what was the outcome? We continued with the old way of deconstructing everything down into specialized areas, failing to address issues at a systemic level. Almost no one seems to be thinking big, whether in academia, corporations or governments.

Major behavioural changes are needed. A small glimmer of hope is provided by the examples of cigarette smoking and seat belt use. When I grew up, smoking was commonplace, the idea that you could ban it unimaginable. Yet look what's happened now. We need to think about how to create new cultural norms around the challenges we face. This requires serious leadership and, to be honest, I see scant evidence of it.

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If you could invest \$10 billion to move this agenda forward, what would you do?

Directly or indirectly, most of these problems originate in cities. The same network properties that determine how cities and organizations scale determine the dynamics of the problems they generate. But cities, as the hubs of creativity and innovation, also offer the possibility of solving these problems. I would strongly favour a major programme to support smart, passionate people dedicated to developing integrated ways of investigating these problems, reaching seriously across barriers and disciplines. We desperately need much more of this to complement traditional specialization.

What would this mean for the strategies of foundations and other social investors?

We should be encouraging more serious support from social investors for bigger thinking about systemic ways of dealing with these challenges. This probably means investments that are more risky and more speculative. In particular, we need to think more in terms of broad science-based ideas that can help change the way systems behave. We need to become more quantitative, more analytical and hopefully more predictive. It is marvellous that Bill Gates is tackling malaria on such an impressive scale, but his foundation should also consider supporting, on a smaller scale perhaps, research programmes dealing with the broader impact and potential unintended consequences of his project.

What's next for your work?

I believe cities are the key to understanding global sustainability so I'm passionate about developing a serious theory of cities and corporations. We understand where the $\frac{3}{4}$ law in biology comes from in terms of underlying properties of biological networks. We now need to understand the underlying principles of the social networks that constitute the structure, growth and evolution of cities and corporations, and how they relate to wealth creation, the pace of life and long-term sustainability. Can we use this to develop an integrated global strategy for change without leading to a planet of slums?

As population becomes more concentrated in cities, the pace of life will continue to increase. The rate at which we innovate will need to get faster. We are on an accelerating treadmill and we need to ask whether continuous growth is necessary to sustain quality of life on earth. @