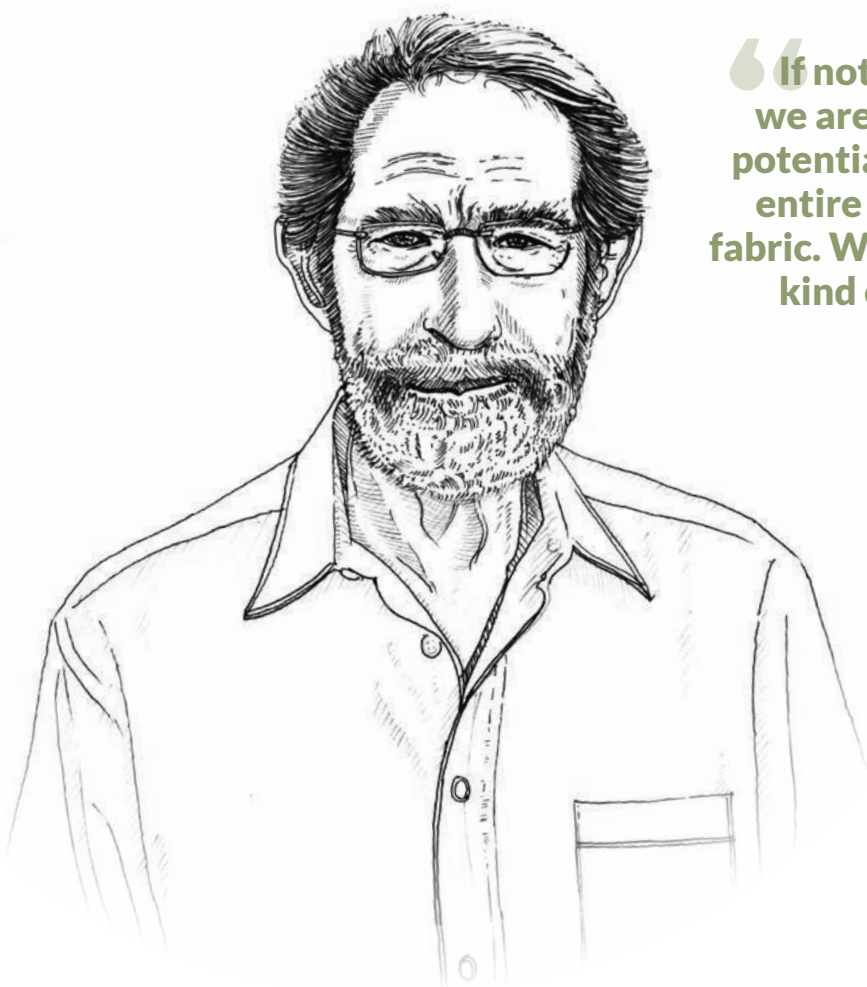




Geoffrey West

The Science of Sustainable Cities



“If nothing changes, we are heading for...a potential collapse of the entire socioeconomic fabric. We need a different kind of innovation.”

Climate change and sustainability are complex problems linked to cities. **Prof Geoffrey West** calls for a scientific theory of cities—a mathematical framework that explains how cities grow—as a first step towards a systemic strategy for sustainability. A Distinguished Professor at the Santa Fe Institute, he authored *Scale: The Universal Laws of Growth, Innovation, Sustainability, and the Pace of Life in Organisms, Cities, Economies and Companies*.

Cities have a dual nature. On one hand, they are the origin of our major challenges and, on the other, the generator of creativity and ideas, and therefore the source of solutions. The future of humanity and the long-term sustainability of the planet are inextricably linked to the fate of our cities.

Developing a Science of Cities—a quantifiable framework based on universal principles to understand and predict how cities grow—is crucial for devising a strategy for long-term sustainability.

The first step towards the Science of Cities is to ask if cities are scaled versions of one another, in a similar way whales, elephants, giraffes, human beings and mice approximately are in biology. In terms of their measurable characteristics, are New York, Los Angeles, Chicago and Santa Fe scaled versions of one another? If so, is their relative scaling similar to how Tokyo, Osaka, Nagoya and Kyoto scale, despite their varying appearances and characters?

My research says yes.

Underlying the extraordinary complexity and diversity of cities is an approximate simplicity. As a city increases in size, all of its various socioeconomic metrics scale in the same way no matter where you are on the planet. Through analysing data from thousands of cities in different countries, I found that when the size of a city doubles, there is an approximate 15% increase in its socioeconomic outcomes—from income, wealth and number of patents, to crime rate and number of flu cases. This scaling law is valid across the globe, although cities have evolved independently.

How is this possible? It is due to the universality of social network structures that undergird all cities across the globe. Cities are, in essence, people, and to a large extent, people are pretty much the same all over the world in how they interact with one another and cluster to form communities.

This network principle and the resultant scaling laws imply a potentially huge consequence: cities will reach a finite time singularity—a point in time where the mathematical solution to the growth equation governing whatever is being considered (population, GDP and so on) becomes infinitely large. This kind of growth is unsustainable because it requires an ever-increasing supply of energy and resources in the future to maintain it. Left unchecked, the theory predicts that cities will eventually stagnate and collapse.

A major innovation resets the clock by changing the conditions under which the system operates. This happened during the Industrial Revolution, where unforeseen technological advances in agriculture disproved the 18th century Malthusian prediction that humans would be forced to return to subsistence-level conditions when population growth outpaced agricultural production. The discoveries of iron, steam, coal, computation and, most recently, digital information technology are among the major innovations that have fuelled our continued expansion.

Unfortunately, the theory, too, dictates that the time between successive cycles of paradigm-shifting innovations has to get shorter and shorter to sustain growth, based on our understanding of disruptive innovations in the past. Not only does the general pace of life inevitably quicken, we must also innovate at a faster and faster rate!

This is surely not sustainable. If nothing changes, we are heading for a major crash and a potential collapse of the entire socioeconomic fabric. We need a different kind of innovation.

When we think of innovation, we usually think of it in physical and technological terms, but some are more cultural. I would say that capitalism and entrepreneurship were part of a cultural change that has been a major driver for the success of cities, society and economies in the last 200 years.

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The time has come for a major non-technological, cultural change for us to avoid collapse. We need to rethink our relationship with society and move away from a more individualistic and narcissistic culture guided by greed, to become more connected with and concerned for others around us. We need to get to a stage of having more of, for want of a better word, a kind of spiritual and cultural well-being.

Existing strategies have, to a large extent, failed to come to terms with an essential feature of the long-term sustainability challenge—the pervasive interconnectedness and interdependency of energy, resources, and environmental, ecological, economic, social and political systems. Almost all existing approaches to global sustainability focus on relatively specific issues, such as the environmental consequences of energy sources, economic consequences of climate change, and social impact of future energy and environmental choices. While such focused studies are important and should be where we direct most of our research efforts, they are not sufficient. They concentrate on the trees and risk missing the forest.

It is time to recognise that a multidisciplinary, multinational initiative, guided by a broader and more integrated perspective, is needed to address sustainability and inform policy. We need what I call a grand unified theory of sustainability—an integrated scientific framework to understand the relationship between human-engineered systems, both social and physical, and the natural environment. It is time to initiate a massive international programme to address global sustainability in an integrated, systemic sense.

This means bringing together all the stakeholders—academics across different disciplines, politicians, policy makers, planners, architects and administrators—to not just have dialogues, but to work together. From the people making the decisions to those on the ground, there must be collaboration at all levels.

Otherwise, we are doomed to be dealing with more and more complex, unintended consequences. And some of these will lead to a situation that is no longer sustainable, nor tenable. ○