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Cities as opportunity and threat

An Interview with Geoffrey West, Professor of the Santa Fe Institute

Introduction

Dallas' metropolitan GDP is roughly the size of Argentina's economy. The GDP of New York is a few hundred billion dollars less than Canada's. Chicago is likened to Switzerland, and so on, according to an *Atlantic* article. The growth of cities is somewhat predictable according to Professor Geoffrey West of the Santa Fe Institute. When West first analyzed the economic productivity of American cities, he and fellow researchers found that cities become more efficient as they grow.

The expansion of cities leads to expanding economies. Ever-increasing urban growth is capturing the imaginations of academia and government. In early 2009, the White House established the first Office of Urban Affairs. There is much that policymakers, firms and planners can learn from the laws that govern the growth of cities. But the expansion of cities creates a tension between growth and

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resources. This story is much deeper and complex. What is the impact of innovation, knowledge sharing, and how people behave to threats and opportunities? How fast is life in the city moving?

City size and scaling

When the size of a city doubles, on average, wages, wealth, the number of patents, and the number of educational and research institutions all increase by approximately the same degree, about 15 percent, according to research by Dr. West and co-authors. This systematic phenomenon is called “superlinear scaling.” The larger the city, the more the average citizen owns, produces, and consumes, in terms of goods, resources, or ideas.

... “The resource and energy networks that have evolved to sustain biological organisms and ecosystems are primarily

dominated by economies of scale or “sublinear scaling.” In contrast, the social networks that underlie the “superlinear scaling” of wealth creation, innovation, crime, and pollution behave in exactly the opposite fashion: The bigger the organization, the faster the pace of life. In big cities, disease spreads more quickly, business is transacted more rapidly, and people walk faster —all in approximately the same systematic, predictable way (the same ~15 percent rule).” *from Seed magazine, “Urban Paradox” by Geoffrey West, 2/2/2009.*

Dr. Geoffrey West of the Santa Fe Institute presented his work on cities at DCFR on January 30, 2012. This interview followed his presentation. The program on cities and growth is part of Series “D,” focusing on development issues. His colleagues Luis Bettencourt, Jose Lobo, Debbie Strumsky and Dirk Helbing are also part of the team discovering ground-breaking theory about cities.

Jennifer Warren: What has been the most striking revelation about your work that sought insight into the urbanization phenomenon of the 21st century?

Geoffrey West: One of the most striking revelations of the research is the scaling properties. Cities feel so individual. When you observe cities in a physical way, each one feels different, for good or bad. Actually I was less surprised at the infrastructure findings, such as gas stations and the length of roads, because that was a biological manifestation. I thought that would probably scale. As findings emerged, many socioeconomic quantities (innovation, wealth, crime, pollution) started to scale: They all scaled in the same way across the globe. That was quite a striking revelation. Literally there was something “universal” happening.

A realization arose. This comes from my translation of Jane Jacobs who wrote “The Death and Life of Great American Cities” in 1961. The idea is that cities are complex systems whose infrastructural, economic and social components are strongly interrelated and therefore difficult to understand in isolation. Cities are not the buildings, the roads, the companies, and the rest of it. They *are* the people.

Even if this work doesn’t succeed in providing a kind of “theory” of cities (though hopeful it will), the work in itself is sufficiently interesting and intriguing because it reveals that things aren’t

arbitrary. If you’re planning in a city context or want to change some aspect, then you better know about the characteristics of cities, their benchmarks, if you will. There is an underlying dynamic happening in cities that is independent of what we’re doing.

JW: Did the doubling of a city’s population and the 15% productivity boost that results surprise you? This is more similar to a return on investment than one might think.

GW: Yes, it did surprise me. I just assumed everything was going to scale in a manner similar to infrastructure. If I had thought about it from an economics viewpoint, I would not have been surprised. The existence of this universal quality in the scaling was extremely salient.

The savings on the economies of scale on infrastructure is the same 15% that you gain on the socioeconomic fronts: That is the key.

The infrastructure—the buildings, roads and power plants—hold a key. The infrastructure networks are, curiously, a physical manifestation of social networks. This I find unbelievable: a physical manifestation of something that isn’t physical. When you think about these subtleties however, it is not so

outrageous. After all, what’s the whole point of cities? The point of cities is to bring people together—to interact and create new things; it’s a facilitator. The infrastructure is actually a facilitator for human interactions. As a facilitator, it would be sensitive to the dynamics of that social network. It was a wonderful process as those ideas started to gestate.



Innovation and change

Over time scales that are enormous compared with human social time scales, biological systems are relatively stable and sustainable, with major changes taking place over thousands or millions of years. In social organizations where growth is driven by superlinear scaling, growth is unbounded, never reaching a stable state, and proceeding at a rate that is faster than exponential. To sustain such growth in light of resource

limitations requires continuous cycles of paradigm-shifting innovations such as the discovery of iron, steam, computation, and most recently, digital technology... There is, however, a serious catch: Theory dictates that the time between successive innovations must get shorter and shorter. So if we insist on continuous growth driven by wealth creation,

The United Kingdom doubled real per capita GDP from \$1,300 to \$2,600 in PPP terms in 154 years, from 1700 to 1854. Starting 120 years later, the U.S. achieved this feat in 53 years (1820 - 1973). In first half of the 20th century, Japan doubled its real per capita income in 33 years with a population of around 50 million. Now China and India, with a combined population of more 2.5 billion, are doubling real per capita incomes every 12 and 16 years, respectively. This is about ten times the speed at which the United Kingdom achieved this transformation—and on around 200 times the scale. Source: 2011 McKinsey *Resource Revolution*.

not only does the pace of life inevitably quicken, but we must also innovate at a faster and faster rate! (from *Seed magazine*, "Urban Paradox" by Geoffrey West, 2/2/2009)

JW: Given the speed with which innovation and change now occurs, in cases one generation and less, is this sustainable? Will there be a breaking point for urban growth and its city dwellers?

GW: There is an accelerating pace of life and quickened rate of innovation. This is an important issue to recognize and an extraordinarily interesting point. Until the end of the last half of the 20th century, the time scale between major changes

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and innovations was larger than a typical productive lifespan. With 19th century innovations, one often thinks of the coal era and the movements it facilitated. I was born in 1940, and grew up assuming alongside others,

that all the major innovations and support systems were fixed. Relatively speaking, they were until twenty-odd years ago with computers. It was a major shift. Since then, there has been another shift into IT (information technology), which is based

on using that computer technology to find new and different ways to operate.

Previously the time between innovations was thousands of years, to then hundreds of years, to perhaps a shortened period of 20 to 25 years. Simultaneously, the productive human life span has increased dramatically. Instead of working a productive lifespan of 35 to 40 years, one could work 50 years or more. We've had these two phenomena driving change, and it's dramatic. Life has never had this dichotomy. This is going to produce all manner of interesting social stress. We hear the often-cited platitude

about the need for retraining, to learn new skills and how to use new technologies. We all feel this pressure. In these equations suggested by the research, change has to become faster and faster. As I said earlier, I am pessimistic that this can be sustained.

With respect to cities, even if we want to change the future, we haven't left ourselves enough time. This is a real problem and the challenge. Incidentally, we should have been thinking about the drivers underlying cities 50 to 75 years ago. In the '60s and '70s, there was an awareness of these connections with the Club of Rome 'limits of growth' concept and the 'population bomb' discourse. These thinkers were



totally dismissed because, rightly, people said that ‘we innovate.’ Of course we do. We continue to discover resources. Societies can innovate, but it has to happen faster and faster. We haven’t allowed ourselves enough time to make the social and psychological changes to adapt to an effective no-growth kind of situation.

The global population was forecast to stabilize at around 9 billion in the middle of the century, mainly due to education, the economic empowerment of women and urbanization. However, the world’s population will keep growing and may hit 10.1 billion by the year 2100, the United Nations projected in a report released May 2011. Two-thirds of the 9 billion of 2050 are expected to live in cities.

Sustainability

Demand from the new middle classes will trigger a dramatic expansion in global urban infrastructure, particularly in developing economies. According to McKinsey’s “Resource Revolution” report, China could add floor space totaling 2.5 times the entire residential and commercial square footage of the city of Chicago every year. India could follow suit. Today’s 1.8 million middle class consumers will grow to 4.8 billion by 2030, largely owing to growth in China and India. Said another way, three billion middle-class consumers will be added to the global economy.

The world’s new middle-class consumers are likely to have more resource-efficient levels of consumption than past consumers with the same level of income, thanks to technology. Cities with populations of 150,000 to 10,000,000 in emerging markets deliver nearly 40% of global growth by 2025— with their prospective resource footprints in the hands of city leadership. Urban infrastructure demand will grow tremendously. Current choices can make a difference in resource demand and supply curves, for better or worse.

JW: Given resource limitations and urban centers as heavy polluters, shouldn’t the greening and enhanced efficiency of cities be a priority? Governments cannot seem to implement policy on a national level very well. Are cities not the perfect Petri dish of sustainability?

GW: There are bits and pieces happening everywhere regarding sustainability. But remember that change can take decades in cities. It’s going to take a long time.

JW: That’s why greener and more efficient infrastructure is a big deal because you build a power plant for 30 to 50 years.

GW: That’s exactly the way one should be thinking and one should be building green infrastructures right now. I was pleased to hear DCFR member-sponsor Mark Humphreys say that the buildings they now design and construct have allowances for electric cars.

Demography

JW: Given that population size distribution is stable across countries and time, how does demography play a role in your theory?

GW: The world population is still increasing at an exponential rate. While the rate of change is declining, the rate itself is still exponential (relative to the numbers). This is why we will likely have ten billion people by 2050. There was a nine billion figure, which I thought was totally low, and now analysts come back to ten billion again. That’s a 50% increase in 40 years, which is extraordinary. Almost all of the growth is in developing countries— the Middle East, Latin America, and India, for example.



Given the interconnectivity of the world, populations are predominantly moving to cities. This has an enormous impact on resources. As I said at the beginning, this is going to have a profound effect on us. I saw an article in the *London Times*, with a picture of a 19th century

Victorian statue in a beautiful garden. The article cited the trend of people stealing statues. Many municipalities and fancy country homes are replacing them with plastic facsimiles. Why are they being stolen? Not for the art—but for the metal to send to China for building. There was a graph of this trend's

exponential rise and frequency with which it is happening. This is tiny on a scale but it's the tip of this iceberg. Finite resources, population increases and fast change can lead to incredibly disruptive social forces.

Global demand grows...

From 2010 to 2030

GDP 89%

Primary energy 33%

Steel 80%

Food (cereals) 27%

Water 41%

Source: McKinsey *Resource Revolution*



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