JÖRG MÜLLER/FOCUS/EYEVINE

The operations centre that IBM designed for Rio de Janeiro in Brazil helps to coordinate the city's activities.

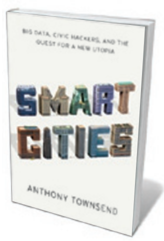
INFORMATION TECHNOLOGY

Slouching towards utopia

As interests vie for the soul of smart cities, **Melanie Moses** asks: "Smarter for whom?"

Some 3.5 billion people — half of humanity — now live in cities. Cities magnify human endeavours: they account for much more than half of humanity's pollution, energy consumption, crime and disease spread, while also incubating the lion's share of innovations, technology, art and entertainment. A sustainable, equitable future on our crowded planet will require fundamental changes in how cities operate. In *Smart Cities*, Anthony Townsend examines how information technology is shaping the development of 'smart' cities.

What makes them smart? Accessible and efficient services, transportation and infrastructure are essential to the mix. Bike-share programmes, for example, exemplify smart urban problem-solving by reducing traffic and pollution, encouraging exercise and providing cheap transport. Information technology makes it possible to adapt bike placement to the variable flow of riders, who use smart phones to find them. And smart cities need not reinvent the wheel: bike-share programmes have spread rapidly since the first large-scale launch in Paris in 2007, with now hundreds of thousands of bikes in cities from Beijing to Stockholm. Each scheme has evolved to meet local needs, leading to the emergence of solar-powered bike stations, stationless bike exchanges and new car-sharing schemes. Pricing, funding and management also evolve in partnerships between non-profit organizations, governments and, increasingly, corporations. (It's no secret who funds New York's Citi Bike.)



Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia
ANTHONY M. TOWNSEND
W. W. Norton: 2013.

But corporate involvement is a mixed blessing. Uproar greeted the recent revelation that the US National Security Agency has been monitoring communications across the globe, but Townsend cautions that city halls and their corporate partners may be intruding on your privacy at a more intimate scale. For example, in Rio de Janeiro, IBM's Intelligent Operations Center, which was originally designed for disaster management, has become a "mission control center for mayors" with "people looking into every corner of the city, 24 hours a day, 7 days a week" in order to reduce urban crime and ensure that buses run on time. South Korea has teamed up with Cisco Systems and invested US$35 billion in Songdo, a model city for energy conservation through ubiquitous computing. Millions of sensors are embedded in roads and power grids to track and predict people's movements. Townsend argues that a relentless focus on efficiency has been "engineering serendipity out of the urban equation", damping the creative spark that makes cities dynamic and adaptable.

Townsend contrasts top-down, corporate urban management with bottom-up action by civic hackers and engaged citizens who provide creative, but not always scalable, technologies to empower people. Among his compelling examples is Access Together, a crowdsourced online mapping tool that provides information on accessibility for disabled New Yorkers. Another example is from Nairobi, where in 2009 activists literally put the Kibera slum on the map by walking the streets with Global Positioning System receivers. The lives of a quarter of a million people suddenly became visible; before Google Maps had shown just a forest. Such crowdsourced cartography is a first step in demanding water, sanitation and other government services. This is real inclusivity, Townsend notes, whereas many smart solutions deemed successes are developed by, and largely for, the privileged. Bike shares are great for young commuters, but they don't do much for the elderly, disabled or struggling families with young children. ▸

With such caveats, Townsend conveys a cautious optimism that information technology might make cities smarter. But the book only nibbles at the edges of fundamental shifts in how data-driven cities might operate in future. Top-down versus bottom-up approaches to urban development are discussed anecdotally, neglecting a deeper analysis of cities that exemplify an organic "organized complexity", as social critic Jane Jacobs described decades ago.

Perhaps the history of failed top-down urban planning models has left Townsend sceptical of systematic and quantitative scientific analyses of cities. However, we need a scientific understanding of what makes cities adaptive, resilient and prosperous, as we create ever more, and ever larger, urban environments.

In *The New Science of Cities* (MIT Press, 2013), urban planner Michael Batty proposes a new approach based on models grounded in volumes of data that reveal fine details of how individuals behave in urban environments. Equally important is a growing understanding of cities as dynamic systems driven by top-down and bottom-up processes. The macroscopic analysis of cities led by Luis Bettencourt and Geoffrey West at the Santa Fe Institute in New Mexico reveals regularities in how cities are distributed and grow, and common patterns in how transportation, the pace of innovation and economic activity vary across cities of different sizes. This work, and my own, suggests that urban energy and information flow are governed by basic physical principles, even given cities' different histories, politics and cultures. To understand cities, we need not just the abundant data that sensored cities will produce, but also a new framework to understand how individual stories are woven into vibrant urban systems.

"Cities will need to be smarter than the sum of their parts."

On a rapidly urbanizing planet, smart cities will dominate the human cultural landscape and affect how we live, consume resources and manage the environment. Cities will need to be smarter than the sum of their parts and founded on more than routers, protocols and social networking apps. Townsend begins a conversation, but we owe it to ourselves to develop a quantitative, integrated science of cities to guide our vision of how we will grow, govern, live and work in tomorrow's smart cities.

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QUANTUM PHYSICS

Packet man

Graham Farmelo delights in a study of Albert Einstein's under-appreciated contributions to quantum theory.

Einstein and the Quantum: The Quest of the Valiant Swabian
A. DOUGLAS STONE
Princeton University Press: 2013.

In 1941, US physicist John Wheeler visited Albert Einstein, the arch quantum sceptic, at his home in Princeton, New Jersey. Wheeler was hoping that the beauty of the new version of quantum theory developed by his brilliant student Richard Feynman would persuade Einstein to accept that the theory was simply a natural development of well-founded classical ideas. The sage of Princeton listened in silence as Wheeler set out his case, but afterwards was no more enthusiastic. "Of course, I may be wrong," he said, "but perhaps I have earned the right to make my mistakes."

Einstein was by that time a semi-detached member of the physics community, admired much less for his current work than for his achievements. Many of his colleagues thought his views on quantum theory cranky — Robert Oppenheimer dismissed them as "cuckoo". That opinion is sometimes echoed today in popular books, many of which underestimate his contributions to the theory.

In *Einstein and the Quantum*, Douglas Stone attempts to put that right. He describes Einstein's work on the theory using few equations, combining scientific and biographical accuracy with wide accessibility. Stone, a distinguished condensed-matter physicist at Yale University in New Haven, Connecticut, brings a wealth of physical insight and — less predictably — an impressive familiarity with the work of leading Einstein scholars.

In 1900, Max Planck introduced the revolutionary idea of energy quantization in the interaction between matter and radiation in black bodies. But, as Stone explains, it was Einstein who first understood the implications. In 1905, the 26-year-old physics wizard radically suggested that the energy of electromagnetic radiation is transferred in the discrete amounts that Planck called quanta. For physicists of the day, long familiar with James Clerk Maxwell's wave description of light, Einstein's notion was beyond heretical. Few leading theoreticians took it seriously, least of all Planck.

Even Einstein wavered. He strove for years to understand radiation quanta, for example by tinkering with Maxwell's equations of electromagnetism. Eventually he abandoned this approach, having introduced the useful but murky concept of wave–particle duality.

Albert Einstein at his home in Berlin.

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Yet, more than any other scientist, Einstein ran with the quantum idea. Applying it to the vibrational energies of atoms, he used it to predict that the specific heats of solids should vanish as the temperature is lowered towards absolute zero. Quoting an early statement of Einstein's about atomic energy, Stone adds with characteristic pith that energy quantization "is not a mathematical trick; it is the way of the atomic world. Get used to it."

Each of the 29 chapters in *Einstein and the*