The Generative City

Great cities will be increasingly distinguished by their capacity to produce inclusive, sustainable and innovative outcomes. **Ayesha** and **Parag Khanna** argue that these cities will be driven by empowered citizens, ubiquitous technologies and policies that enable the actors of the generative city to collaborate on boundary-breaking projects that redefine the way we work, live and play.

In recent years, 'smart cities' have risen up the agenda as demonstration projects for sustainability and showcases for innovation in new industry clusters. At the same time, there is a growing realisation that most cities coping with rapid urbanisation, ageing infrastructure, and scarce finance struggle with the enormous challenge of retrofitting and modernising in an affordable manner. For both old and new cities, technology is only part of the solution; policy matters just as much.

As the price of technology falls, sensors become increasingly ubiquitous, and data analytics widespread, what will increasingly differentiate cities is not how 'smart' they are in terms of technology penetration, but the extent to which they leverage technology to bring about innovation, sustainability and inclusiveness. Why do these normative elements matter in evaluating the management of urbanisation? Historically, great cities of the world have been determined by geographic location, demographic diversity, infrastructure quality, industrial innovation, vibrant culture, and global connectivity. Yet in the age of mega-cities featuring not only large populations but also great stratification of incomes and disparities of access to essential services, the extent to which all of a city's population shares in technological progress and its material benefits becomes an important qualifier as cities benchmark against and learn from each other. Indeed, the rapid acceleration of urbanisation in recent decades correlates directly to the rise in income inequality within nations, even as it diminishes between them.

The essential approach to harnessing technology to serve the goals of innovation, sustainability, and inclusiveness is called *generativity*. Generativity is a broader property of systems that denotes the capacity of agents within them to connect to others and produce unanticipated outcomes and change. While the term's origins lie in psychoanalysis and linguistics, the Internet is now commonly understood to be a nearly universal and generative

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01 People cycling in Copenhagen during rush hour.

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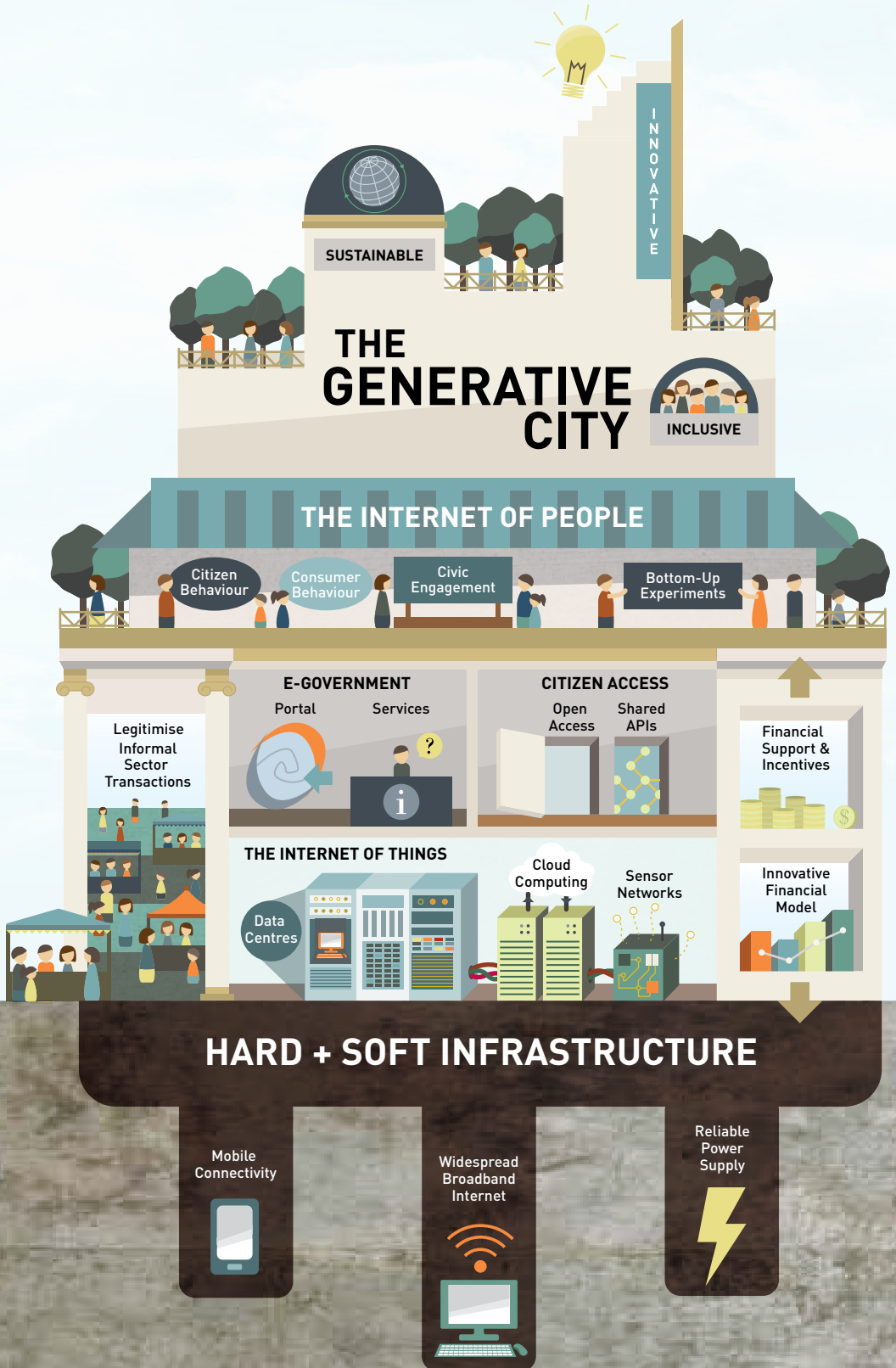
system. Jonathan Zittrain of Harvard Law School writes that the Internet is generative because of its "capacity to produce unanticipated change through unfiltered contributions from broad and varied audiences." Indeed, the Internet is open to all participants, technically accessible to users producing code and content, and amenable to extension in un-predetermined ways. Such generative characteristics have enabled the Internet to become a kaleidoscope of applications created by a global community of users.

Today we can witness how technology is advancing the generativity of a wide range of social systems. In our governance, economy, healthcare, and educational domains, new producers and users of services are emerging, as citizens are empowered to leverage modular designs, lower cost production, and peer-to-peer exchange to disrupt traditional hierarchies and patterns. From flip-teaching[1] in the classroom to virtual currencies[2] in the marketplace to citizen activist networks, human social organisation is increasingly generative in nature. As some have already observed, it is beginning to resemble the Internet itself.

Nowhere is this truer than in cities that are experimenting with new technologies to cope with the pressures of urbanisation.

[1] *Students view teacher-created videos online before class; teachers spend more class time interacting with students.*
[2] *Used to purchase virtual goods in online communities e.g. social networks, virtual worlds and online gaming sites.*

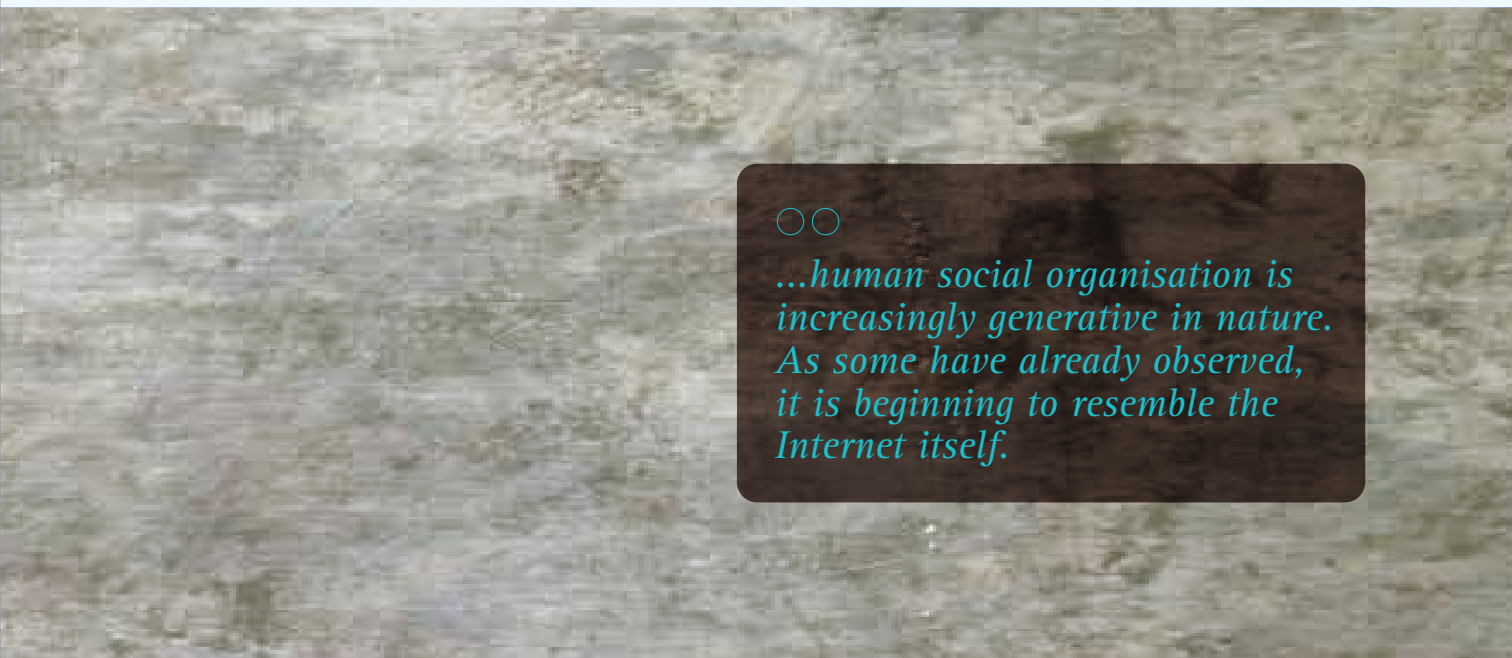

SUSTAINABLE
INNOVATIVE
THE GENERATIVE CITY
INCLUSIVE
THE INTERNET OF PEOPLE
Citizen Behaviour
Consumer Behaviour
Civic Engagement
Bottom-Up Experiments
E-GOVERNMENT
Portal
Services
CITIZEN ACCESS
Open Access
Shared APIs
Legitimise Informal Sector Transactions
Financial Support & Incentives
THE INTERNET OF THINGS
Data Centres
Cloud Computing
Sensor Networks
Innovative Financial Model
HARD + SOFT INFRASTRUCTURE
Mobile Connectivity
Widespread Broadband Internet
Reliable Power Supply

Increasingly we see these experiments led from both top-down and bottom-up. As MIT's Carlo Ratti puts it, "Technology today allows us to plan things in a much more collaborative, bottom-up way. People sync-up, do things and take action together." This is the essence of generativity, as it reflects the reality of increasingly complex inter-relationships among priority policy areas such as economic growth and job creation, transportation and sustainability, and technology access and social justice.

Both qualitative and quantitative metrics are required to appreciate the range of practices associated with urban generativity, and to assess whether they contribute to the goals of innovation, sustainability and inclusiveness. Here we will highlight some of the necessary foundations and leading best practices that have shown to be most promising.

The technology platform is itself a key underpinning of generativity, and needs to be designed in such a way as to enable government efficiency and public access to useful data. This can include cloud computing services, sensor networks and data centers, and traffic management systems for both road congestion management as well as public transportation systems such as subways and light rail. Policies built on top of these platforms include e-government portals such as data.gov and other e-government services that allow citizens access to data to shared Application Programming Interfaces (APIs) in order to create added-value programs. For example, Code for America, a private initiative backed by major companies and foundations, trains dozens of fellows who embed in government agencies and small companies to optimise their usage of information technology. Because U.S. state and municipal funding for IT has reached US$60 billion, which is half as much as U.S. federal spending, Code for America now has a special initiative for cities, expanding from three city partners in 2011 to 11 in 2012, in each case expanding the range of data services and digitising government request forms.

Importantly, such combinations of technology, policy and civic



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engagement bring us beyond the 'Internet of Things' to the 'Internet of People'. Only through such generative civic engagement with technology can successful programs such as 'See-Click-Fix' emerge across multiple American cities in which citizens respond to each other's inputs and problems as much as the government does. One sees such innovation in developing countries as well. One leading example is the Bangalore-based Map Unity, a civic initiative to geo-locate not only transportation services, but also information about heritage sites, educational institutions, agricultural sites and prices, and health clinics.

Successfully creating such an integrated information system fundamentally requires the presence of both hard and soft infrastructure elements, ranging from reliable power supply to widespread broadband Internet and mobile connectivity. As cities in developing country expand their basic infrastructure, their investment models should focus on sustainable technologies such as LED street lighting and low-emission building construction for commercial and residential real estate, while also ensuring adequate allocation for affordable public housing. Though the obstacles to major infrastructure finance include its long time horizon and high start-up costs, innovative financing models are emerging at the intersection of public and private actors such

01 The cable car system at the Complexo do Alemão in Rio de Janeiro.

02 Volunteers planting trees in the 'Trees Across Toronto' programme.

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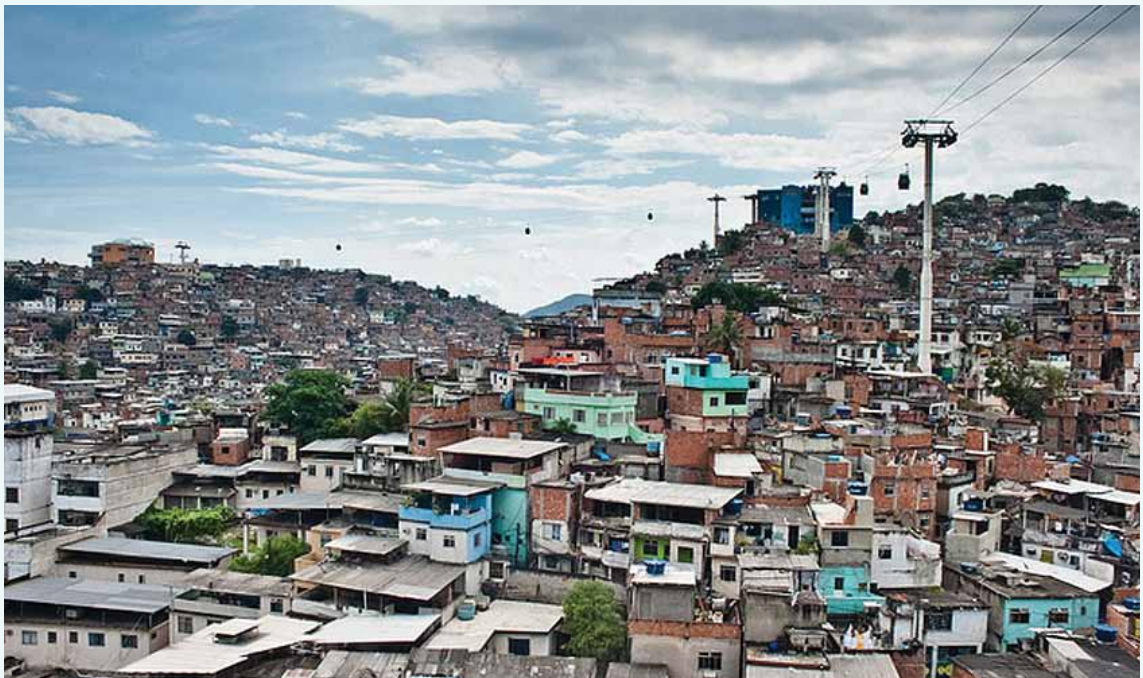

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as infrastructure banks[3], covered bonds[4], credit risk guarantees[5], and corporate financing arms.

Sustainable infrastructure is not only about technology but citizen and consumer behaviour. Even as Stockholm and Copenhagen strive towards zero-emission buildings and port facilities, they have also expanded public cycle access through schemes such as Copenhagen's 'bicycle superhighway'. As demand for private vehicles grows in emerging markets, cities such as Singapore are offering a rebate of up to 40% on the purchase of low-emission vehicles, and expanding plans to deploy a fleet of shared-use electric vehicles. The 'Trees Across Toronto' program has planted 300,000 trees across the city, while New York City authorities and citizens are halfway towards their goal of one million trees by 2017. New York also not only has mandatory energy audits for government, commercial and residential buildings, but is creating 'solar maps' that allow residents to measure the solar power potential of buildings in which they live and work, presenting opportunities for cost savings and entrepreneurial innovation. Similar initiatives are underway to promote vertical farming projects that can boost the resilience of food supply, and the use of biomass for waste-to-energy power sources. Especially given growing demand for fresh water supply, Singapore's distribution of do-it-yourself kits to reduce water leakage – earning it the lowest rate of home water leakage in Asia – needs to be replicated across the Middle East and South Asia as well.

Infrastructure innovation and job creation will be most necessary in precisely these highly populous regions where urbanisation rates are highest, property rights weakest, and social protections most fragile. Already one in five people in the world live in urban slums, a number that will only diminish if policies are designed with inclusivity as a priority. Here generativity implies approaches that legitimise the transactions of the informal sector and provide financial support and incentives for the provision of safe water and sanitation and adequate housing. In Mumbai, new housing is being developed to help shift residents of the city's largest slum, Dharavi, into permanent

[3] A bank that focuses on financing infrastructure projects.
[4] A bond that is backed by a pool of assets/collateral such as residential mortgage loans.
[5] To stimulate the economy, this protects lenders from defaults by high risk borrowers.

settlements. In Rio de Janeiro, new cable cars are in place to connect favelas to central districts, increasing both mobility and economic opportunity.

Many other facets of urban life will take on attributes of generativity in the years ahead. For example, an estimated three times as many workers will telecommute one decade from now as service sector employment grows and broadband Internet access spreads. Also, private vocational institutes in emerging markets are training thousands of potential entrepreneurs in critical fields ranging from programming to construction management. Such trends suggest the possibility of a virtuous circle of less congestion, greater employment, and more innovation.

While this scenario is one of many involving the intersection of urbanisation and technology, it reminds of the need to act with foresight in infrastructure planning. Here we have attempted to raise questions that must always be answered along this process: How transparent and co-governed are new technologies deployed in urban environments? To what extent are innovation, sustainability and inclusiveness strategically incorporated into new infrastructure investments? Ultimately, balancing the desire for control with the need for healthy chaos and experimentation are the essence of empowering a progressively generative city environment.

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We must remember that generativity is a value-neutral property. Systems that are open to all can become vehicles for egalitarian policies but also monopolistic actors. From the prevalence of upgraded security cameras with facial recognition technologies in major cities such as London and Beijing, to the fierce competition among 'Silicon Superpowers' such as Apple, Google, Microsoft, and Facebook to dominate hardware, software, search engines, and consumer data, it is far from certain whether cities in the future will more resemble the 'City of Control' or 'City of Trust' from David Brin's noted 1998 novel *The Transparent Society*. It is therefore most incumbent on the residents of generative cities themselves to harness their increasingly technological environment to shape urban life in directions that are innovative, sustainable, and inclusive.

Ayesha and **Parag Khanna** are co-directors of the Hybrid Reality Institute, a research and advisory group focused on emerging technologies and their economic, social and political implications. Ayesha is also CEO of Urban Intel, a digital education technology company. Parag is also a senior fellow of the Singapore Institute of International Affairs. They are co-authors of *Hybrid Reality: Thriving in the Emerging Human-Technology Civilization* (TED Books, 2012).