Smart cites: sustainable solutions for urban living
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New Songdo City, South Korea. (Copyright: SongdoIBD)

Architecture and infrastructure in cities is designed without much flexibility. But 21st Century living is changing, people are creating buildings and systems that react and respond to our shifting needs.

The urban revolution of the Anthropocene is not just remarkable in its scale, but also in the way cities are evolving. They are getting smarter.

One of the problems with city infrastructure and architecture is that they are designed without much flexibility. They need to meet certain structural and safety standards, to withstand worst-case weather and seismic challenges, for example, but not necessarily to operate effectively in the majority of circumstances. For buildings like lighthouses, this may not be a concern, but for most buildings and urban spaces, liveability under a range of weather conditions is also important. We adapt our clothing – why not our buildings?

The Media-TIC building in Barcelona, Spain is one example of what's possible. It has been designed with an inflatable plastic (ETFE) skin that is regulated by a solar-powered automatic digital light sensor. As the sun changes throughout the day, different air chambers in the skin expand or contract. Compared to glass, ETFE film is 1% the weight, transmits more light and costs up to 70% less to install. It's also resilient (able to bear 400 times its own weight, self-cleaning (due to its non-stick surface) and recyclable. The responsive skin allows light to filter through, but shades people inside from direct UV rays by 85%. Other buildings are incorporating light-reactive glass in a similar way to that used in sunglasses, to reduce heat and glare during hotter parts of the day (reducing the need for air-conditioning), while allowing the maximum light through during other parts of the day (reducing the need for electric lighting). Automatic light-responsive sunshades play a similar role in other buildings.

Sensors are also used to regulate energy and resources inside the building, operating lights when movement is detected, for example, or sensing when to divert people, water or heating. For example, if a regularly trodden route of carpet starts wearing out, subtle lighting changes can encourage people to walk a fresh route, or if activity is only detected in a portion of an office space, heating can be restricted to that area.

Architects are also looking at incorporating responsive, living materials into traditional buildings to make them more environmentally sustainable and adaptive. Many now have green roofs and walls, which filter air, keep the buildings cool, conserve water, invite biodiversity and look attractive. But what about making structures themselves out of living materials? Engineers have created self-repairing concrete that uses sunlight, or that is impregnated with bacteria. Any cracks that appear in the concrete and allow water in will activate the bacteria, lying dormant in nutrient-rich capsules, and the limestone released fills the cracks.

Other proposals include growing structural parts of buildings and street furniture around frames, using synthetic biology to prompt cells to produce useful materials. One futurist architect believes that the sinking city of Venice could be saved by programming cells to create a limestone reef underneath it. Other designers imagine living, responsive buildings that act as an immersive interactive installation, able to move and breathe alongside their occupants.

Even if these ideas seem unrealistic, what's certain is that engineers will be using ideas from biology and incorporating self-repair, light and heat response, and other adaptive features into the materials and structures of future cities.

Smart daredevils

Anthropocene citizens are likely to generate their own supplies of everything from water to electricity and fuels to supplement increasingly expensive municipal provisions as resources become scarcer. For example, many buildings will passively harvest their own rainwater, householders will filter, store and reuse "grey water" from showers and sinks for toilet flushing and watering the garden. Water conservation will become commonplace and regulatory in cities around the world, as it already is in arid countries like Australia.

Key to efficient resource use is metering, so that householders can see immediately how much water or energy they're using. One valuable advance would be to make meters reactionary. Rather than being passive users of municipal services, Anthropocene citizens – and the city itself – will generate real-time responses from providers, who can make continual adjustments to improve efficiency, minimise waste and generate a more intuitive personalised operation.

Taking this a level further, so-called "smart cities" have communication networks through sensors embedded in infrastructure, or through information sent by individuals or automatically generated by, say, programmed iPhones with GPS. These networked cities, including New Songdo City, currently being built in South Korea, or PlanIT Valley in Portugal generate intelligent adjustments to everything from street lighting to mass transit routes and times, based on real-time feedbacks. Other cities are using intelligent sensors for regulating utilities, designing flood defence systems, regulating traffic lights and flow, reducing emergency vehicle response times, speeding baggage flows through airports, optimising waste management, reducing peak load demand on electric grids and even cutting crime rates. The ability to track the world in real-time, using GPS and other systems, is generating a global nervous system, which can be used for social betterment (as well as sharing cat videos).

Rigging cities with sensors is just a first step. Designers and engineers planning smart cities a decade ago could not have predicted the way citizens themselves would become an integral part of the network.

In a Calcutta slum, a gang of 12-year-old children called the Daredevils is dramatically improving health outcomes in their area, using cheap and simple technology that wasn't invented 20 years ago. Like so many slum neighbourhoods, the notorious Nehru Colony doesn't officially exist, meaning it has no access to government services such as sanitation and electricity. The youngsters set out to literally put themselves on the map. They went door to door, taking photos with their mobile phones, registering residents and detailing each child born in the colony. Information is then sent by SMS text to a database that links the data to a map hand-drawn by the kids, which is overlaid to GPS coordinates. By registering their existence on Google Maps the group has doubled the rate of polio vaccination from 40% to 80%, decreased diarrhoea and malaria rates in the slum, and is lobbying for electricity.

The connectedness of citizens in the Anthropocene is key to more effective use of next-generation smart cities in all ways. Over the past few years, crowd-sourcing and collaborative mapping have revolutionised information generation online without the need for massive infrastructure projects to plant sensors across cities. For example, data points on Google Maps are built by a large network of hundreds of millions of anonymous phone-users whose devices continually send GPS-based status-updates. Its traffic app reveals how traffic is flowing in a city. In the aftermath of the 2010 Haiti earthquake, volunteers, citizens and government agencies were able to pinpoint aid flow through the island, where needs were most urgent and where disease was breaking out.

Fonte: BBC International. Disponível em:<http://www.bbc.com/future/story/20130502-how-to-make-our-cities-smarter/1>. Acesso em: 2 maio 2013.