

You have 557,000 city and local governments around the world, whose budgets represent 10 percent of GDP. They often have no way of learning what others have done. By giving cities the full portfolio of what's out there, we're first of all giving them amazing intelligence on what's possible and the different ways they can tackle a problem. Then we're connecting them directly to the company that has the solution.

Since the city is not specifying the solution it is buying, it allows different approaches to compete. You may have 50 companies competing instead of five. That brings the cost down, we estimate, an average of 5 to 10 percent.

What's an example of the kind of solution you are talking about?

In Moscow, 65 percent of the residents have traffic noise levels in their homes that far exceed what health regulations allow. Moscow was looking for ways of reducing that noise without reducing traffic, which is hard to do in a city of 12 million people. So we published a challenge for them to reduce traffic noise.

The city chose three promising solutions, but one of them is particularly groundbreaking. It's a small device you put on your window that completely cancels out the outside noise. It's a really early-stage technology, but its potential is so disruptive that the city of Moscow is now working with the company to help bring it to industrial scale using local technology, venture capital, and other resources in the city.

Do you feel this approach has the potential to change the way city governments operate in the future?

Probably the biggest opportunity lies in redefining the role of government from something seen as this protector and disburser of public money to a partner in aiding change. Human ingenuity will solve any problem, and if you can allow those solutions to reach scale quickly, and if you can tap into some of the financial resources, both in the community, like crowdfunding and crowdsourcing, and by making government a real and active

partner, I think you can deal with a lot of things.

When you imagine the city of the future, do you foresee a lot of new technology?

Probably everything that cities need for the next 50 to 100 years has already been invented.

What cities consistently tell us is they do not want to just buy technology. Cities are less and less interested in buying technology from generic vendors. What cities are looking for is a technology with an entrepreneur behind it, who is dedicated to applying that technology to their specific problem.

Case Study

Barcelona's Smart City Ecosystem

A big investment in data-driven city management starts to pay off.

Gardeners making their rounds through Barcelona's Parc del Centre del Poblenou these days are as likely to carry tablets as trowels. The city recently moved 178 of its irrigation points to an Internet-controlled system. While it is handy to manage watering at the keyboard instead of turning a knob on a pipe, much of the advantage

Like any city betting on technology, Barcelona must be careful to focus on genuinely beneficial projects.

is in the data that the new system sends back to a central software system the city has built.

The irrigation system is one of about two dozen smart systems that the city is building. Data from their sensors flows to three open software platforms, where it is collected and analyzed for insight into how the city could be run more effi-

ciently. In a remade industrial neighborhood called 22@Barcelona, which was financed with \$230 million of taxpayer funds, the data is put to further use creating apps and other programs to be tested

\$230 million

Cost of remaking an old industrial neighborhood into a laboratory for smart city technology

in a sort of urban laboratory for smart city technology.

Barcelona is often cited as the quintessential "smart city," but like any city betting on technology, it must be careful to implement genuinely beneficial projects and avoid foisting unnecessary digital investments on its citizens. "One of the dangers [of the fashion for smart city development is] a tech push and not a pull," says engineer Ramón Martín de Pozuelo, who leads the postgraduate smart cities program at Ramon Llull La Salle University in Barcelona. "The tech should come from needs."

In the case of Barcelona's irrigation system, sensors in the ground offer live data on humidity, temperature, wind velocity, sunlight, and atmospheric pressure. That means, for example, that gardeners can decide what the plants need based on that data and adapt their schedule to avoid overwatering. Curious citizens of the city, or anywhere in the world, can check the data on a map online. The city

invested around \$382,000 in building the first phase of the system, which began operations in March. As of this summer, the city council estimated that the system would cut water usage by about one-quarter for a saving of \$555,000 a year, a smart investment for a city that not too long ago had to import drinking water by ship. →

The software platform is a joint venture between the city of Barcelona and private companies. It also collects and displays data from other kinds of smart meters. The city chose to make the platform open so makers of future sensor networks or mapping or analysis software could use that data for their own purposes. The platform also allows city departments to share information and avoid repeating each other's work, explains city council spokesperson Laura Lahoz González. Today, nine other cities use it as well.

Would another platform, executed differently, have promoted more data sharing and more business uses? To try to answer that question, Barcelona is cooperating with an international organization called CityProtocol, which aims to promote common data-sharing standards for cities. That could allow data-sharing platforms from different cities to plug into the same data streams, enabling comparison and competition.

The infrastructure Barcelona is building, from publishing its data to offering physical space in 22@Barcelona, has fostered successful private enterprises. Worldensing is one example: it piloted a parking system called Fastprk by installing 100 parking sensors in the 22@Barcelona district. The company's product tracks parking and enables drivers to find available spots and pay for them. Barcelona provided Fastprk with office space and permits to test its idea on the city's streets.

In the end, Barcelona didn't install Fastprk across the city, opting instead for L'apparkB, a mobile smart parking system developed by the city's own software team. It's now issuing 4,000 parking permits a day after one year of operation. But Worldensing has found success elsewhere, installing a Fastprk system with 10,000 sensors in Moscow. This is one example of how the urban laboratory is beginning to create what Martín calls "a horizontal market," in which tools developed in one city are shared globally.

Outsiders have showered Barcelona with smart city awards, including the 2014 City Climate Leadership award for intelligent city infrastructure, the Euro-

pean Capital of Innovation prize from the European Commission last March, and the 2014 Bloomberg Mayor's Challenge. Businesses, too, are betting that Barcelona's plans will benefit them. Earlier this year, Cisco, Schneider, and Philips announced plans to occupy part of 22@Barcelona and begin installing sensors, wireless networks, and smart streetlights.

—Lucas Laursen

Case Study

Mapping Disaster in Jakarta

Open mapping tools help Jakarta plan for floods.

December to February is the peak of the rainy season in Indonesia—a time when severe flooding often hits its capital city, Jakarta, and its 10 million residents. In 2007's floods, 340,000 city residents had to evacuate their homes, more than 70 people died, and more than 200,000

outages. But the agency needed better information about where people lived and worked and where facilities such as roads, schools, hospitals, and fire stations were located. To make more detailed maps of the city, it connected with the Humanitarian OpenStreetMap Team (HOT), a charitable organization based in the United States that teaches communities how to edit an open map of the world. The system is free for anybody to use.

In 2012, with the support of other relief organizations in Indonesia and the Australia-Indonesia Facility for Disaster Reduction (AIFDR), HOT began teaching local university students how to map their cities. During that flooding season, AIFDR made other maps using data from the workshops to track rainfall patterns. Teams from HOT then joined them during last year's rainy season, mapping rainfall data provided every few hours from Jakarta's 267 villages to create more than 150 maps illuminating the rainfall in each area. The data came in many forms—phone calls, texts, instant messages, and faxes—and took several hours to process.

The HOT maps helped villages identify evacuation points and areas in need

On January 20, 2014, the Humanitarian OpenStreetMap team mapped the flood data reported by village leaders in Jakarta's subvillages, which typically include five to 10 neighborhoods of 30 to 150 people each.

▶ [Please click here to view the map, or visit www.technologyreview.com/news/532516/mapping-disaster-in-jakarta/](http://www.technologyreview.com/news/532516/mapping-disaster-in-jakarta/)

people suffered disease, according to the World Bank. The bank estimates the cost of those floods at \$900 million, a combination of financial aid and economic losses. Bad floods in 2013 caused another 29 deaths and displaced more than 37,000 people.

Jakarta's disaster management agency wanted to improve the software models it used to help plan evacuations and aid efforts during the flooding, often a time of blocked roads and power

of help. They became a way for citizens to show on social media how they were affected by the floods, and they helped communicate the overall scope of the floods so residents could avoid hard-hit areas of the city.

This December, HOT will deploy an Android application for recording rainfall, allowing for quicker analysis of the information. The team is also working on ways smaller divisions of the villages can report data. —Kristin Majcher