Cities of the Future: Chapter 3

"Finding ways to visualise and communicate all the information flowing out of cities would help people to see their own city in a new way – it would effectively make the invisible city, visible – and allow people to see both the consequences of their actions and the impacts of the changes they make."

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Making the invisible city, visible

How will technology and data change the way we live in cities, how we govern them and the nature of our environmental impact?

At a glance

The use of real-time analysis and large datasets generated by 'smart cities' has grown significantly over the last decade. The largest area of development has been in the control of traffic flow. Can smart cities, however, move beyond merely controlling traffic lights to positively impacting the environment and the lives of their residents? Can large scale deployment of sensors, an 'internet of things' and social media lead to appropriate technological and governance systems? We implicitly assume that collecting and analysing more data will lead to better decisions on the allocation of resources. But we need to extract information from the data to inform decisions and link this with city governance. How does a city exploit the internet and social media to enable and mobilise residents to take action, while avoiding the increased surveillance and erosion of civil liberties that become possible through the information in such large datasets?

Smart cities: making the invisible city, visible

The term 'smart cities' was coined to highlight the growing importance of ICT in enhancing the way in which people live, work and move around cities as well as their quality of life, impact on the environment and engagement with governance. Smart city technology is being developed by companies such as IBM, Cisco and Samsung and used in cities ranging from Rio de Janeiro to Beijing, Barcelona and one of the world's newest cities, Masdar in the United Arab Emirates.

Many of the smart cities initiatives focus on improving the material and energy efficiency of cities, particularly of transport systems. One of the most common uses of 'big data' is to monitor and respond to traffic flows at a city scale to help ease congestion and reduce pollution 'hotspots'. For example, the Greater London Authority (GLA) is combining 'geo-fencing' technology and mobile sensors to improve air quality. Monitoring systems in diesel-electric hybrid cars will create a real-time air-quality monitoring network and change the fuel they consume in response to the pollution levels in particular areas. These cars would run on electric mode in the dirtiest areas at the dirtiest times but automatically change to diesel mode in cleaner areas. Collecting data like this in an intelligent way and being able to use them in real time allows a city a very fine level of control over how to keep traffic moving and how to stop the development of pollution 'hotspots'. The GLA are also looking at the potential of electric vehicles to function as temporary energy stores: charging them when energy is abundant and feeding energy back into the grid if they are parked at peak times.

Key questions

Our discussions led to three more specific questions for which answers are surprisingly poorly developed at the moment:

- How can 'smart' data and 'smart' cities positively impact the environment and the lives of the people who live there?
- Is it possible to have too much data, or data that are so poorly organised they impede, rather than inform decisions?
- Can we transfer lessons learned from smart cities to cities without the resources to pay for information and communication technology (ICT) solutions?

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Data and technology also have the potential to 'make the invisible city, visible' because visualising and effectively communicating information about a city makes it easier for people to see patterns and better understand the consequences of their own actions on environmental and social conditions. For example, the GLA is currently building a 'triple jeopardy map' of London that looks at how the urban heat island creates hot spots within the city. This includes which buildings might be prone to overheating and where the most vulnerable people might be so that they can deploy extra resources there when needed. An experimental approach is already being taken in Singapore which uses the equivalent of London's Oyster transport card to collect data on where and how people travel, and randomised controlled trials also test how people respond to disruptions and changes in their normal route. These tests are improving the Transport Authority's sense of what people can do and what they might do under different circumstances. Bringing together different datasets can therefore be a powerful way to make previously unknown connections visible and then direct resources to where they have the greatest impact.

Swimming in a sea of data

We know how to create the ICT that makes smart cities possible. However, one of the greatest challenges is not necessarily collecting data but knowing what to do with them. Although 'big data' is collected from cities in real time, much of it stays in raw form and cannot be used in any practical way. This can be because it is not reaching the people who need it, they do not know it is there, there is simply too much of it to consider or because they do not have the institutional capacity to use it. Even when information can be collected, analysed and brought together in a systematic way, one hurdle to conveying information on a city-wide scale is the complexity and sheer volume of the data.

One remedy is to create a new style of 'atlas' that would help decision makers visualise the wealth of real-time data flowing out of cities. This atlas would generate millions of potential maps of a city ('layers' in Geographic Information Systems), each of which would contain and combine information about different aspects of the city tailored to specific decision problems posed by the user. An intelligent search facility would allow specific information to be extracted, helping to turn this 'sea' of data into a form that a city could use in real time to create a dashboard of sustainability indicators.

What new connections can technology make between people and their environment, drawing on the power of big (and intelligent) data? Cities are highly diverse, and so there are constantly 'natural experiments' going on in different parts of the city from which lessons can be learnt. For example, no police agency looks at the number of police patrols on the street at any given time, hour by hour, with any policy principles in mind. Yet if London had done so, it might have prevented or at least ameliorated the 2011 riots. Like a blood pressure monitor for humans, using real time data in this way could act as an hourly measure of pressure for cities. These data can also be studied annually, and the same natural experiment approach could be used for many other measures of city performance.

ICT systems and the internet of things may offer individuals a more direct role in governance because they can allow people to communicate rapidly as environmental and social changes take place, to mobilise actions that enhance sustainability and to provide a barometer to government on the opinions, values and concerns of citizens. Conversely, it could be argued that there is a need to recognise that much of the 'smart cities' rhetoric so far fails to connect with the concerns of city residents and city politicians. Some of these concerns relate to privacy. At its worst, the idea of a smart city can be perceived negatively and as a set of top-down technocratic 'fixes' in which city residents are at the end rather than the beginning of the process. In managing the urban system, the role of city leaders lies in promoting and supporting a smarter approach to urban growth through making the best use of new technologies. Good governance is crucial; when it comes to creating smarter, more sustainable cities, it is equally important for city leaders be accountable and maintain dialogue with city residents.

Making connections globally

Cities in the developed world are taking the lead in becoming 'smart' in the sense of ICT and developing countries may try to emulate them. This is good if such solutions truly are exportable, but could send cities down the wrong paths if the conditions that make ICT effective are not met, such as the availability of a reliable electricity supply or an effective governance system. Sometimes solving a problem does not require new technology but putting on 'new glasses' and seeing the system in a different way. Within a factory, for example, making an industrial system more sustainable does not necessarily rely on a single new technology and on brand new scientific solutions. Instead, it is often a transition and a change within the existing system that creates new connections, new architectures and new opportunities.

We have a tendency to think about sustainability from a Western perspective and to turn to new technologies when making infrastructure changes. Although these are potentially effective in the right context, we should caution against 'over engineering' sustainability. Simpler, cheaper solutions that use locally sourced materials, expertise and social processes would be easier to apply to a broader range of cities. There has been a huge wave of optimism over the past few years as African nations see their less high-tech way of collecting, assessing and transmitting information as the solution to their sustainability challenges. Furthermore, there is a growing belief that those solutions can be applied on a global scale. Many of these may be 'low tech' and low cost but still very effective when the right social systems are in place. In developing countries, it is therefore important to ask whether there are local analogues that build on existing social and information networks without trying to recreate the complex ICT systems of what is called a 'smart city' in richer nations. Conversely, could the richer cities have overlooked their own older solutions in a rush towards the latest technology? Could cities in less developed countries can provide solutions applicable in cities worldwide?

The research challenge on the horizon

So far, many of these technologies are more aspirational than transformative. A step change is needed to allow an ICT-enabled sensor and data system to improve sustainability beyond marginal changes in existing ways of collecting and analysing data and mobilising social action based on those data. We need to fully understand the human–technology interface between data, decisions and governance. One can imagine a city improved by these technologies, but also imagine a city in which banks of computer servers consume power that allows ever greater production of data and analyses that then sit in those servers and never reach a decision maker or that reach a decision maker who is incapable of interpreting them. Additional key questions are how the social structures underlying data use are to be matched with the increasing complexity of the disorganised sea of data produced by modern technologies, and whether older, less technologically advanced forms of information are sometimes sufficient to guide cities along the path to sustainability.