Chapter 21
Visualising Data for Smart Cities

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ABSTRACT

This chapter introduces a range of analytics being used to understand the smart city, which depends on data that can primarily be understood using new kinds of scientific visualisation. We focus on short term routine functions that take place in cities which are being rapidly automated through various kinds of sensors, embedded into the physical fabric of the city itself or being accessed from mobile devices. We first outline a concept of the smart city, arguing that there is a major distinction between the ways in which technologies are being used to look at the short and long terms structure of cities, and we then focus on the shorter term, first examining the immediate visualisation of data through dashboards, then examining data infrastructures such as map portals, and finally introducing new ways of visualising social media which enable us to elicit the power of the crowd in providing and supplying data. We conclude with a brief focus on how new urban analytics is emerging to make sense of these developments.

DEFINING SMART CITIES

The term 'smart cities' has emerged very quickly over the last five years[1]. First, this has been a consequence of the rapid spread of computation into public and open environments, into what Hardin (1968) and others have called the 'commons', spaces that are used and exploited collectively. Second, it has been spurred on by the miniaturisation of computable devices to the point where tiny sensors can be embedded into objects of many different sizes, from buildings to our own bodies, thus generating digital information concerning the status, the condition, location and so on, of the objects in question. This feature of the smart cities movement is often referred to as the Internet of Things (Sterling, 2005). A third force is the emergence of digital data in space and time, that is, in terms of how an object's status varies in real time and across different spatial locations, and this data is invariably orders of magnitude bigger than anything we have dealt with in the human domain so far. This 'big data' is providing a very different perspective on the way we might understand our cities while also revealing how new information tech-

DOI: 10.4018/978-1-5225-2589-9.ch021

nologies are changing the very behaviour patterns that make up the contemporary city (Kitchin, 2014a). Google Trends reveals that this interest concerning smart cities and big data is still rising exponentially, as an analysis of the relevant search terms demonstrates (Batty, 2013).

A smart city also implies some degree of intelligence, some set of computable and automated functions that act intelligently with respect to the way the city actually functions through its populations. In this sense, smart cities have been embraced as the new frontier by the world's largest IT companies whose products, which have evolved from hardware to software and data, are further evolving into systems that might be embodied in the public domain where the obvious applications involve making collective actions more efficient. To an extent, the smart city movement barely touches the traditional questions of equity and distribution which have dominated city planning for over a century, although some lip service is currently being paid to the fact that new information technologies might make cities more prosperous in terms of income and wealth and, as a consequence, perhaps more evenly distributed.

'Smart cities' is a label that is now being used generically to cover a very wide range of applications of computers, sensors, and related computation and interaction that has any link whatsoever to the city. It is such a broad domain that it is essential, in any discussion, to bound the area and define its scope. The focus here is on the immediacy of new data and functions that define the smart city with an emphasis on their use and understanding using visualisation, but to set this in context it is worth providing some overall structure for different approaches to the idea of the smart city. For more than a century, the general concern for cities as regards urban planning has been on how cities can be improved over relatively long time spans. In this sense, the knowledge that is brought to bear on cities can be somewhat abstract, conceived in terms of how locations and interactions through transport can be orientated to thinking of future forms and functions for cities that might optimise some quality of life. Every planning instrument, from new towns to green belts, has been predicated with these goals in mind, where the emphasis is not particularly on the routine but on the strategic. Insofar as planning has dealt with routine functions, this has tended to be subsumed under organisational and management structures that say little or nothing about how cities might become more equitable. The focus on short-term management goals is in fact more geared to improved efficiency. To date, many of these routines have not been informed by digital technologies, in contrast with longer-term plan-making which has been so informed, albeit crudely, but not without considerable debate and controversy.

There is thus a major distinction between digital technologies being used for the short-term routine management of cities and those for longer-term strategic planning, and this difference is reflected in much of the data, information and knowledge that pertains to the functions that smart city technologies are able to inform. Furthermore, there is a distinction between public and private use. In the past, data on individuals, insofar as they provided information about their own functioning in cities, was produced for aggregates of population using traditional surveys such as censuses. Individually specified data tended to be in terms of the role of citizens in participating in the decision process. This has changed radically in that individuals are now able to record their own behaviours passively or actively using multiple personalised devices which are extensively linked through digital networks. In turn, these provide massive amounts of data that can be mined to facilitate a better understanding of how cities function, at present mainly in the short term, but in time as this kind of data accumulates, in the longer-term too.

In fact, the term smart cities pertains much more to the routine management of cities in the very short term: with respect to how cities function in the next 5 minutes, the next 5 hours, the next 5 days rather than the next 5 years or 50 years. This is largely because smart city technologies which lie at the leading edge of current computable devices are strongly orientated to sensors with big data generated,