
Abstract

This chapter discusses the transformation of the public service provision model due to big data, and in particular due to public engagement in the context of open government initiatives. We outline the changing role of governments in societies, and the technological enablement towards direct online democracy and active citizen engagement, as well as the utilization of big data enabled governance as a competitive advantage for attracting resources and talent to maintain a global smart megacity status. To this end, this chapter discusses the utilization of (a) new sources of data, such as Crowdsourcing, Internet of Things, (b) engage public talent, (c) institutionalize private–public partnerships and (d) seeks for new models of value-for-money public provision, but also the challenges that big data present us with respect to data ownership, data quality, privacy, civil liberties, and equality, as well as public sector’s ability to attract big data analyst talent. We demonstrate different aspects of this discussion through two case studies: Barcelona Smart City and Haiti’s emergency support during the 2010 earthquake disaster.

2.1 Introduction

This chapter discusses the impact of big data in the public sphere on public service provision and new opportunities for public service organization and structure that may transform the role of governments in societies.

The utilization of ICT to improve public sector services has started with the whole e-government discussion. Transforming government services using ICTs has been a complex and costly task, often associated with the automation of public services and business systems integration. While e-government projects focused on operational efficiency, initiatives such as Open Government efforts sought to foster public service transparency, civic participation, and inter-departmental collaboration. This could be achieved by sharing public sector infrastructure, seamless information sharing with other agencies, bundling core competencies to improve

service delivery and engaging external entities, such as universities and businesses (Executive Office of the President of USA 2014).

While these changes definitely seek to effect efficiencies, they are also qualitative in nature, changing fundamentally the nature of the relationship between governments and citizens. Big data initiatives come to underpin their progress. Since 2012, both EU and the US are seeking ways, through legislative and policy changes, to remove obstacles in the use of big data which promise greater effectiveness with lower costs in the public sector (Nagy-Rothengass 2013). Civic participation via social media, for example, can also reduce the cost of public service delivery. Crowdsourcing information on potholes, for example, can cut down on inspection costs. Big data also promise clockwork provision of public service. Intelligent assets, such as intelligent traffic lights can notify a central asset management system about their state of maintenance ahead of time and larking issues in their working condition, so repair work can be streamlined without disruption of service (Thomas 2013).

Before we go on to elaborate on the role of big data in civil life, it is important to understand some underlying shifts in the role of Governments and its relationship citizens.

2.1.1 New Notions of Public Service: Towards a Prosumer Era?

Everything about civil service, even its very naming “service”, has emphasized the transactional relationship between citizens and government. The relationship is simple. Civilians pay taxes and in exchange they are served in various fields, health, education, road maintenance and the like.

Recently, however, a new understanding of public provision put citizens in the role of partners. The key idea is that the pursuit of public ends is the responsibility of everybody—private and nonprofit entities, the public, and government. Partnership with citizens and community involvement was a big part of the 2010 Manifesto of the Conservative party in UK under the auspices of the “Big Society” program (Conservative Party 2010). The US Open Government initiative, announced only a year before in 2009 also seeks foster civic participation (McDermott 2010). Both are premised on the idea of enabling people to take care of themselves and of each other. Social media and smartphones can facilitate the interaction between citizens and governments on the go. They can also amplify the communication and engagement of public through communities of interest. To combat crime, for example, citizens need to coalesce with police in monitoring and reporting suspicious activities. Recently, this is also happening in other areas too of civic responsibility.

Application developers, such as Citysourced.com have developed applications enabling citizens and residents to report and provide information to local government about all sorts of civic issues, from potholes to graffiti, fly tipping, broken pavements or street lights. People can do so anonymously or not, they can upload

photos, and pin them on a street map. The report is sent to councils and there is a tracking of progress on the issue online (CitySourced Inc. 2014). This is a typical example of how technology has facilitated citizens to play the role of council inspectors and this is a free service to the community and to the government too, as it minimizes inspection costs. Charities and interest groups work together to amplify the message. Cyclist communities, for example, have a big interest in potholes as it is a big nuisance for them, so pothole reporting is promoted by cycling charities and associations (The National Cycling Charity 2014).

2.1.2 Online Direct Democracy

And even more fundamental change might take place due to social changes and technology advancements; one that aspires to give citizens decision making power on social issues, much like the type of direct democracy of ancient Greece. PartyX (Nelson et al. 2015), is such an initiative. They seek to take advantage of developments in online collective decision making, to involve every stakeholder in political decision making. As this is currently on beta version and used only at local level for local issues, it does not fall under the big data agenda as yet. Should this kind of technology however go into adoption phase and used to debate global issues, then we can start seeing big data making inroads into the political and legislative sphere. Real-time, big volume, unstructured information aside, global political debating will add another dimension of interest in our discussion of big data; that of 'multilingualism'. Dealing with multilingualism is a dimension already high in EU agenda (Nagy-Rothengass 2013).

2.1.3 Megacities' Global Competition

Since 2011, more people live in cities than in rural areas for the first time in human history. Megacities, i.e. cities larger than 10 million people, are an emerging phenomenon. According to the UN, the number of megacities will have grown from five in 1975 to 26, with 24 of them located in the developing world (United Nations Department of Economic and Social Affairs 2006). Megacities are not a local or national issue. They will affect the future prosperity and stability of the entire world as they will shape the balance of power of national economies in a global world, affect population mobility and configuration of talent, and will influence the social and political dynamics of the world (United Nations Department of Economic and Social Affairs 2006). Megacities have a functional and a symbolic role. What would UK be without London? And what would The Emirates be without Dubai?

Megacities are not just key instruments of social and economic development at all fronts but also harbors of social innovation for the private and public sector due to their unique dynamics. Megacities are an attractive proposition for those seeking a better quality of life in terms of a higher standard of living, better jobs, fewer

hardships, and better education. In a globally competitive environment Megacities compete for capital resources including global talent. They typically face a 5 % population growth rate, which challenges the quality of living indices (such as security, cost of living, mobility, employment, environmental) that put pressure on urban infrastructure and public policy. To raise their attractiveness, megacities need to improve on those indices (United Nations Department of Economic and Social Affairs 2006; Mostashari et al. 2011). Hence, Megacity Mayors face unique dilemmas, primarily on how to raise standards of living across a number of well-being indices in the face of high population growth rates, while compete in the global environment.

Smart city infrastructure, the bundle of Internet of Things solutions for city infrastructure management and intelligent infrastructure-citizen interfaces are considered to provide a way forward. The quantity of data produced and the criticality of infrastructure management will raise the bar for big data analytics and management. We will discuss this opportunity as part of the content in the next section.

2.2 Public Service Advantages and Opportunities

2.2.1 New Sources of Information: Crowdsourcing

Crowdsourcing is becoming an increasingly common term and opens new avenues for creating free public value, civic engagement, and transparency. It can take many forms. ‘Crowdreporting’, for example, is a common form of crowdsourcing in the public sphere, at the moment, and in line with the new conception of citizen as a partner. The “SeeClickFix.com” is a typical example (SeeClickFix 2014). It is an online service designed to help citizens report non-emergency issues in their neighborhood, via a web interface, Facebook or smartphone apps. The issue handling process is tracked online. After the issue is reported, it is tracked online the same way logistics companies track the delivery of packages to their destination, only that information is published via Twitter and Facebook to inform the public (SeeClickFix 2014). “Nothing new” one might say, reporting issues like this could be done in the past using other means, like calling the council or writing a letter. What is so different after all? I guess the answer should be immediacy and transparency, and perhaps non-evasiveness.

The public does not need to go out of their way to report such issues anymore. There is an app for that or they can just log into Facebook. There is no wait on the telephone to reach an operator, there is no time consuming writing of memo. The process is blended into our everyday social life. Now everybody with a smartphone can go around and report civic issues. In addition, direct feedback and traceability can give people satisfaction and a sense of achievement that they have contributed to common good. In the past, reported information was not acknowledged and follow-up information was non-existent. So, direct interaction between public and government agencies in this civic reporting encapsulated three governmental goals:

(i) to engage the public into civic life, as citizens actively engage in the process; (ii) to decrease the cost of civil service, as citizen engagement is voluntary and free of charge; and (iii) to improve transparency of public service processes, as the issue handling process is now traceable online at par with private organizations (Vicini and Sanna 2012).

The creation of public goods via crowd reporting is not, however, the sole privilege of government agencies. Weather underground, for example, combines crowd-sourced human observation with weather station data to establish a new level of accuracy within weather reporting. Weather data is assimilated from 2,000 weather stations maintained by the Federal Aviation administration, 26,000 stations part of the Meteorological Assimilation Data Ingest System (MADIS) and a 16,000 of personal weather stations adhering to quality controls and standards. Coupled with crowd observations and meaning scientific analysis from meteorologists provide valuable insights for the co into the science behind the data and the relationship between weather and climate change (The Weather Channel Inc. 2014). This blend of human insight with private and public sensor systems, gives rise to the idea of the *Internet of Everything* (Danova 2014), the merge of structured and unstructured data in a variety of forms, from textual to pictures, videos and audio material.

Crowdreporting can also take the form of feedback. For example, the “Did You Feel it” service in the US surveys people on a number of earthquake parameters regarding their experience of particular earthquake incidents. Enriching numerical descriptors with empirical data can enrich knowledge of qualitative descriptors such as intensity (USGS 2014). Using crowd feedback to train intelligent Internet of Things (IoTs) technology utilizes the wisdom of the crowds in artificially intelligent public systems. We discuss this idea of public organization in the subsequent section, when we introduce the concept of *Cognitive city* as a potential domain for big data analytics application.

2.2.2 New Sources of Information: Internet of Things (IoTs)

While there is not a commonly agreed definition, the Internet of Things (IoTs) refers to the network of intelligent devices which include sensors to measure the environment around them, actuators which physically act back into their environment such as opening a door, processors to handle and store the vast data generated, nodes to relay the information and coordinators to help manage sets of these components (Zhang and Mitton 2011).

IoTs have made way into utilities, smart homes, healthcare and wellbeing applications, and they are expected to proliferate into other areas, such as commuting and transport (as shown in Fig. 2.1).

IoTs will push our data storage, connectivity and architecture limits to a new high. The socio-economic implications for how will live our lives might be huge. For example, McKinsey Global Institute (Manyika et al. 2011) reports a 300 %

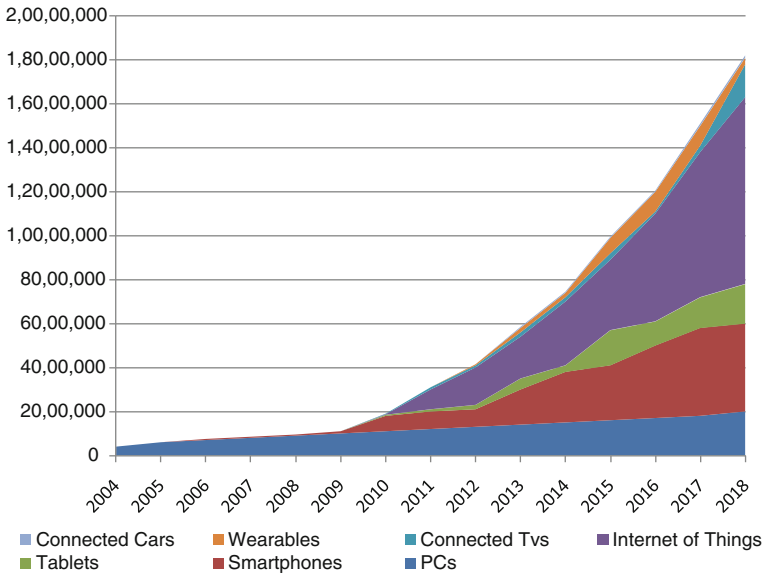


Fig. 2.1 The internet of everything adapted from Danova (2014). The number of devices in use globally are shown on the y-axis

increase in connected machine-to-machine devices over past 5 years and a sheer 80–90 % decline in microelectronics pricing which is anticipated to lead in 1 trillion more ‘things’ connecting to the Internet across industries such as manufacturing, health care, and mining with a potential \$36 trillion cost saving in operating costs (Manyika et al. 2011).

While big emphasis is given currently into the development of intelligent assets by equipping them with sensors that beam information about their properties and conditions, what really makes up the internet of things is their distributed, purposeful collaboration, and this requires architecture, i.e. organization and structure, in line with the ethics of transparency (Bentley et al. 2014). Hence most of such technologies are clustered around common purpose for example smart city technologies, or smart car technologies to denote what drives the logic of their architecture. One of the trendiest such clusters is, of course, Smart City, which suggests an advanced connectivity through a highly networked city infrastructure via intelligent assets. The promise of course is a fertile foundation and over time capable to attract new businesses and investments and further urban growth and socio-economic development (URBACT 2012).

While the Internet of things can provide efficient use of resources, it nevertheless lacks in responsiveness and agility. To instill responsiveness into city management, we may be required to take a step further into developing cognitive city systems. Decisions about cities need to be based on principles, values, and thereby qualitative metrics as to how people want to live their lives, and what well-being means

to them. Hence, a smart city is as different to a cognitive city, as a robotic arm is to social anthropoid. A platform that can combine citizens' active engagement into decision making about local government's decisions and community well-being.

Given that architecture is central to our notion of the Internet of things, we can view cognitive cities as providing the principles for humanizing their design. Not only sense and perceive but also learn, memorize, recall relevant experiences in order to adapt their responses accordingly. Almost like biofeedback, people can provide real-time feedback teaching the system how to behave. After all, cities seek to improve their quality of life of their citizens; and quality is in the eye of the beholder. People can train machines to include feature extraction, classification and clustering, all of which they can then be perfected through successive optimization of their algorithm (Warner 2011).

Smart city sensors can therefore be trained by people to learn, memorize, recall relevant experiences, who teaches them and who makes the final value judgment on things? This is an area of debate still in its infancy, but one that breeds big legal, political, and ethical questions about the future of social life. EU for example, supports initiatives that foster social innovation and inclusiveness together with economic innovation and environmental sustainability to engage citizens in public service co-creation and local authority support. Most critical to crowdsourcing success is the feeling by participants that their efforts were considered and that results came from the initiative (Evans-Cowley 2011). This requires moderators who are competent social networkers, able to used crowdsourcing tools that link and provide feedback easily, as well as a change in processes used to develop governmental services (Brabham 2009).

2.2.3 Public Talent in Use

Consultation is nothing new in public life. In developed nations it is actually institutionalized. City and regional planners are always looking for ways to engage the public in the process of planning. As a consequence Crowdsourcing of ideas and solutions has emerged as a web-based model to help in solving difficult challenges. This Section explores the use of crowdsourcing to support problem solving in planning. A case study of designing a planning curriculum using crowdsourcing is highlighted. In this case, crowdsourcing was a successful model for generating creative ideas to support curriculum revision (Evans-Cowley 2011).

The study discussed in Evans-Cowley (2011) that people chose to participate for altruistic reasons, such as an opportunity to contribute to the community, to contribute their knowledge, and that they wanted to be part of a conversation on the topic. Thus, public involvement is a central concern for urban planners. Considering the difficulties inherent in the typical public involvement process, the challenge for planners is how best to implement such programs. The Web can be used to exploit collective intellect among a population in ways one-to-one meetings (Brabham 2009).

Consequently, at the state of the art, for example, (Brabham 2009) argues that the crowdsourcing model is appropriate for enabling citizen participation in public planning projects. Starting with an exploration of the challenges faced by public participation in urban planning projects, (Brabham 2009) supports the argument of the Web as an appropriate technology for harnessing far-flung genius. Then, it concludes with an exploration of crowdsourcing in a hypothetical neighborhood planning example, together with a description of the challenges of implementing crowdsourcing.

Also, governments gradually use the Internet to aid in transparency, accountability, and public participation activities, and there is growing interest in innovative online problem-solving to serve the public good. The crowdsourcing model influences the collective intelligence of online communities for particular purposes. To develop better tools that engage the public, it is important to understand how and why people participate in these kinds of activities. In 2009, for example, the Federal Transit Administration in US used crowdsourcing for public participation in transit planning (The Next Stop Design project). Based on interviews with 23 participants, they analyzed the motivations of those participants to engage the project (OGP 2014).

Taking the above issues into account, it is worth noting that while data is the raw material of knowledge, it is really the interpretation of such data that can be acted upon by providing insights, foresight, knowledge or skill, etc. Interpretation of information requires a schema, a way of looking at data and drawing conclusions. In modern societies this was traditionally the job of experts. In the digital era, this is changing! Printing empowers individual ownership of ideas, the digital era empowers co-ownership. Wikipedia is a prime example of how data and information is organized and interpreted in a collaborative way online to provide an understanding on each subject matter through a constant ever evolving debate. The idea is premised on Marshall McLuhan motto that “the medium is the message”, in that a certain medium facilitates certain interpretations that other media do not (Bentley et al. 2014).

To this end, online communities have become an important source for knowledge and new ideas. Making “big data” available to a large number of analysts means that more ideas can converge on how to mine such data. A platform for doing so is Kaggle (2014), a world’s leading an online platform, which operates as a knowledge broker between companies aiming to outsource predictive modeling competitions and a network of over 100,000 data scientists (Kaggle Inc. 2014). Currently, clients include companies such as General Electric (GE), Ford, Facebook and Microsoft, and health service organizations, such as Heritage Provider Network, in California who seeks to develop a predictive algorithm that can identify patients who will be admitted to a hospital within the next year. Such predictive analytics in the service of health care provision can inform the development of more accurate Public health budgets and cost cutting plans (Pinsent Masons LLP 2013).

2.2.4 Private–Public Partnerships

Private–Public partnerships can be seen to emerge in almost every aspect of public service. With the privatization of most utilities and the trend towards outsourcing, much of the public sector in advanced societies is run by the private organizations. Countries in the periphery of Europe, such as Greece are going through the teething pains of making this transition now. With global competition on public service management, we are entering of course a new phase of relations between public and private organizations. That of partnership; the pursuit of a long standing mutually beneficial and loyal relation that will ensure long-term planning and prosperity (Miller 2013).

Big Data management has a core role to play in supporting decisions on all of these partnerships, which is why progressive governments are aiming to mobilize and support in the field. The event organized by the World Resource Institute on “Public–Private Partnerships for Open Government” in London 2013 is characteristic. It sought to share the task of mobilizing citizen engagement, developing more transparent and accountable governments (Stefan and Kisker 2011). This has implications for data ownership and data management at all public service fronts from healthcare and natural resources to publicizing data on contracting, government expenditure infrastructure, and government aid to third parties. One aspect that deems these partnerships fundamental is the lack of expertise within the public sector and the ability to vet and support them. Another, of course, is the upfront investment in infrastructure, big data clouds for example, that large organizations can afford with the view to recoup them through long-term government contracts. Yet another reason is the ability and urge of private companies to experiment with new technologies in less sensitive contexts and provide governments with ‘safe’ technology options that are not like to raise public criticism.

Due to the power to profile people and triangulate information about individuals, big data analytics offers deals with some fundamental concerns of public services. Identity management, for example, is a big issue for most public services, from tax collection to health provision to parking ticket collection. Big data analytic technologies may make it possible for public service organizations to combat fraud, improve data breach monitoring and authentication (Zhang and Chen 2010). On the other hand, getting it wrong may have some serious repercussions. We discuss this in more details in Sect. 2.3.

2.2.5 Government Cloud Data

Governments have slowly embarked on Cloud computing to tackle the much to be desired transparency, participation, and collaboration amongst its agencies but also with the public. The idea, the concept, and the term, that is cloud computing, have passed into common currency in an ambiguous manner. The very concept characterized by three main entities—Software, Hardware and Network to describe

the fusion of Virtualization, Grid computing, Utility computing and Web technologies that result in new models of IT service delivery (Clark et al. 2013).

Cloud computing permits central governments to uniformly cover the whole country with e-government solutions, independently of divergence of local administrative units that may be better or worse prepared to provide e-services. Service-oriented architecture facilitates provision of compound services covering whole customer processes, where a customer may be a citizen or an enterprise. The roll out of such systems can happen simultaneously and cost efficiently, as licensing and support can be negotiated on the whole.

By now consumers, corporations, and governments are used to store their data to “the cloud” so they can be accessed from any device, anywhere anytime. According to Lerman (2013) over 69 % of Americans now use webmail services, store data online, and utilize online applications. This trend is only going to continue, with industry analysts predicting clouds to be \$40 and \$160 billion over the next few years, not accounting for the internet of things applications (Lerman 2013). With the wider adoption of cloud computing, the term C-Government was coined to connote agility due to its virtualization, scalability due to grid computing and the simplicity of Web 2.0. Clouds need to be interconnected to make it easier for users to switch between cloud service providers as well as the providers to supply infinite resources (Yiu 2012).

While the relevance of clouds for governments and their potential, e.g., for voting information systems has been greatly welcomed, enthusiasm has been curbed by identify vulnerabilities involved in the digitalization of government transactions and the electoral process, thus surfacing issues with trust and transparency (Manyika et al. 2011; Al-khoury 2012). The issues will be dealt with in later sections.

2.2.6 Value for Money in Public Service Delivery

The whole move from paper-filling to e-government services was to facilitate cost cutting partially though integration across public services. Big Data offers Governments the possibility to do so without going through the pains of Business systems integration.

The UK alone, according to the Head of Digital Government Unit, Chris Yu, estimates that some 16–33 billion per year can be saved by taking advantage of big data in the public sector, which can lead to £250–£500 per capita gains. This is calculated based on a number of initiatives having to do with performance management to improve the overall efficiency of government operations, reduce fraud and error, and tax collection alone (Laney 2014). McKinsey Global Institute estimates the potential savings at a European level to mount up to €150–€300 billion a year (Yiu 2012).

A number of analytical tools can also mine data regarding citizen sentiment towards public services to provide feedback and highlight opportunities to

customize service delivery by helping employees better understand the needs of each citizen. This is no different to how commercial organizations use it to customize their service to paying customers. Providing quality service to citizens has been government agenda for most developed nations and in particular those who want to attract international talent. For example, predictive analytics in the area of health informatics, particularly epidemiology, can also be a huge help for governments who need to gear up for crisis management. The more accurately people can predict the spread of disease the more cost effective prevention and treatment is expected to be, the less the disruption to public life.

Such benefits accrue without further changes in the current public service structures, yet even more benefits may accrue if we consider the potential of adopting predictive analytics to advance crime prevention and reduce policing resources or introducing smart grid technology to improve the efficient use of utility resources, (gas, electricity and water).

2.3 Governmental Challenges

2.3.1 Data Ownership

With data ownership come great responsibility for its management, storage, use and misuse. But in the age of open (public) data who really bears such responsibility? Who is the legal guardian of it and what is written in the implicit contract between civilians and government regarding its use and protection? In one sense all public data is private data in that it is either civilians personal or lifestyle information or relates to the functioning of the public service which is nevertheless accountable to the public, at least in democratic settings. In that sense, governments and public organizations are custodians of our data, granted permission to use it in exchange of providing us with public services and promote public good (Gudipati et al. 2013). Take the United States Patent and Trademark Office online database, for example, which contains over 8 million patents and 16 million filings dating back to Samuel Hopkins's 1790 and receives 200,000 patent applications and 100,000 trademark applications each year (Hoffman and Podgurski 2013). Who does this information belong too? Obviously, the patent holders and submitters. Yet, such information would be useless for both the person and the country unless the US government safeguards its existence and integrity. Indeed, personal data can be created by a variety of sources from people, machines, devices, and the rightful owner of such data is the authority which can verify its veracity as being the 'True Owner' of the data (Al-khouri 2012).

This will bear interesting questions when devices will monitor our behavior and condition beaming information about our whereabouts and state. While devices are susceptible to error, people are susceptible to deception and self-deception. Governments and public agencies will have to make rules to decide how to handle the inconsistencies.

2.3.2 Data Quality

Big Data can amplify the repercussions and implications of poor data quality, and is a particularly important issue for governments and civilians alike. Recorded data can be flawed (erroneous, miscoded, fragmented, or incomplete) due to workload pressures and user interface workarounds (Junqué de Fortuny et al. 2013). Data should be checked for completeness, conformity, consistency, accuracy, duplication, and integrity, and good practices around data quality do exist. In private organizations, non-quality data can be ignored from consideration, without compromising the integrity of analysis or affecting the user. For example, if a retailer does their analysis only on the ‘clean’ data of their customers to profile and predict future sales, the customer is not greatly affected (Crawford 2013). The same cannot be true for the health service, for example, particularly if ‘unclean’ data are characteristic of a locality (e.g. a local hospital). Poor data quality can result from integrating data sources. Data issues can also emerge from the integration, federation or conglomeration of data, and given the variety and volume of big data, testing this data can be a big task. Various big data testing procedures have started to emerge, using grid processing technologies, such as Hadoop, to support a timely processing (Crawford 2013).

While, data stewardship and data testing procedures can deal with the “Garbage in” problem, another issue is lurking in the seams of public sector decision-making; and this is all forms bias [selection bias, confounding bias, and measurement bias (Kerr and Earle 2013)]. Confounding occurs when we correlate two phenomena, which has been studied independently (Howarth 2014; IQ Analytics 2014). For example, pulling together smoking habits from Facebook profiles and associating this with youth diabetes statistics, might erroneously speak of causal relationship that could be mediated by another factor, for example unemployment or heredity or the family’s economic status. Selection bias can come from all possible sources and most importantly due to differential device use amongst different countries, ages and socioeconomic groups. Kate Crawford principle research in Microsoft and Visiting professor of MIT, gives brilliant accounts on the hidden biases in big data in Harvard Business Review blog (Crawford 2013). Given the sensitivity of public services that can bear life threatening and legal implications, treating information with utmost rigor is fundamental. Thus, we need to outline and progress the conversations on regulatory and other interventions to address data analysis difficulties that could result in invalid conclusions and unsound public health policies (Microsoft 2014).

2.3.3 Privacy, Civil Liberties and Equality

Privacy and civil liberties are the two sides of the same coin. User profiling is the process of collecting information about a user in order to construct their profile. The information in a user profile may include various attributes of a user such as

geographical location, academic and professional background, membership in groups, interests, preferences, opinions, etc. More, ominous applications include cell-phone tracking and the proposed creation of a national biometric database.

As Kerr and Earle (2013) argue profiling individuals on the basis of their health, location, electricity use, and online activity raise risks of discrimination, exclusion and loss of control. When these involve access to public services, repercussions are exacerbated. The promise of big data is based on prediction with the view to preempt possible threats. If, for example, one can predict increased burglaries in an area, local government can increase policing of this area to preempt such incidents (Barcelona City Council 2014).

Preemptive action is based on prediction and prediction on predictive algorithm based on social information and this curtails civil liberties replacing proof with risk estimates. With increased predictive capability comes increased responsibility to avoid such threats that can make governments more conservative in how they approach social risks. To what extent can governments afford to let unemployed youth roam the streets freely, once we have established that it is highly probable to commit petty theft or drug dealing? On the other hand, shall we detain or curtail the freedom of youth to meet and socialize and lead them to isolation and depression? To what extent policemen should be informed about such correlations and would that lead to discrimination of every unemployed youth, who treated with suspicion may even turn to crime as self-fulfilling prophesy theory would predict?

Also, Professor Lerman (2013), for example, raises another issue; the issue of equality regarding public treatment of people and groups who do not fully participate in the information society, because they don't have the means, time or appetite for. Statistics about the digital divide show great variation in digital engagement from country to country, age group participation, socio-economic class, urban or rural living and, of course, between countries (Lerman 2013). Some interesting 2014 statistics about the global internet and social media use can be found at the social media community blog hub (Kemp 2014). The risk here is that governments may come to rely so much on big data that they forget to ensure that they engage people to understand their needs and considered these during decision-making.

2.3.4 Talent Recruitment Issues

Given the scarcity of data analysts talent in the market, the public sector will have a hard time attracting such talent as permanent staff. In the UK, for example, public sector organizations are obliged to recruit below market going rates to justify Human Resource (HR) expenses (PageGroup 2014). In addition, the once upon the time job security and fringe benefits of working for the public sector increasingly disappear, making public sector organizations even less attractive. With large organizations such as banks, insurances, large online retailers and consultancies competing for such resources, governments will have a hard time attracting and keeping such talent. On the other hand, governments could use University talent.

A resource much underutilized particularly in Europe, despite the depth and breadth of skills relevant to the public sector (Campos 2008).

On the other hand, there is always training as an option to up skilling public sector staff. In February 2014, for example, the UK government announcement that £150,000 of government funding would be dedicated to Open data training of more than 150 Public Sector employees (Gangadharan 2013).

2.4 Case Studies

Barcelona embarked on the smart city journey 10 years ago in an informal fashion resulting in many smart city projects now dispersed in various departments across the city, currently being collated under a single program. The 22@ Barcelona region, once in need of redevelopment, has been transformed into a living test site for piloting new technologies (Department for Business Innovation and Skills 2013).

Xavier Trias, mayor of Barcelona since 2011, has recognized the importance of digital technologies for the future prosperity of the city. In his words in outlining his commitment states that Barcelona "...should not waste the opportunity we have to apply these new technologies to improving people's quality of life, by generating a new "economy of urban innovation" based around smart cities. This is another of our future commitments" (Department for Business Innovation and Skills 2013).

To progress this agenda he formed Urban Habitat, a government wide management structure to promote collaboration across water, energy, human services and environment agencies. Whereas, housing and urban planning were also grouped together. To further cement cross agency collaboration, the Smart City Personal Management Office, oversaw all projects with a smart city aspect. While there are over 100 projects with a smart city angle, 13 are highlighted as strategic for the smart future of Barcelona, tackling the necessary infrastructure to support smart city applications, kit out city assets with intelligent sensors, and define smart city public services. To this end, the telecommunications network is revamped to integrate fiber optic networks, and Wi-Fi networking, public and a centralized management system enabling the interoperability and prioritization of mobility, public transport and urban infrastructure, applying concepts such as priority and intermodality to make more efficient and sustainable mobility in cities. This is underpinned with intelligent data project collating information from smart assets and public service organizations with the view to opening these up to the public. New public services are progressed such as energy projects relating to the urban lighting of Barcelona, creating microgrids to create local generation and consumption of green energy, telemanagement of irrigation urban green spaces and electric car mobility options, as well as, smart parking options to enable speedy parking avoiding unnecessary city traffic. Citizens will have contactless and mobile apps to use city services. Some projects focus more generally on a mentality change around smart city agendas. The O-Government project, for example, seeks to gain support for Open Government, strategy and roadmaps and improve transparency,

open data and civic participation. The “Citizen compromise to sustainability 2012–2022” seeks to gain definition and traction for a city roadmap that can provide a more equitable, prosperous and self-sufficient environment to its people (Department for Business Innovation and Skills 2013).

The regeneration of the 22@ Barcelona region was a public-private partnership where companies, universities, research, and communities work in close proximity with municipal leaders to exchange knowledge and streamline innovation, but also ensure inviting and engaging urban planning by subsidizing housing and developing green spaces. Local and international, private and public funding was used for infrastructure development and the testing of new public services. The government facilitated access to public funds by institutionalizing InnoActiva, a consultancy agency which supports private companies to make their case to public authorities and institutions. Following the Silicon Valley cluster model, it is setting up clusters in areas that they can develop a competitive advantage. Hence, 22@ is oriented to attracting talent and expertise in Media, Information and Communication Technologies, medical technologies, energy and design.

As to big data and analytics issues, open data is actually a core part of Barcelona’s smart city event. Public and business access to information such as election results, population, public facilities, or economy sits in a public repository called Open Data BCN. Microsoft for example utilized data relating to a town festival called “La Merce” as a pilot to providing improved crowd management solutions. To this end, data feeds from social media, credit card transactions, web site visits, customer service inquiries, GPS data, traffic status, weather data, and parking was collected and analyzed. These data sought to gain insights about people’s perceptions of the festival’s entertainment and food venues, citizen interests, people mobility patterns, and medical and crime incidents that can help the planning and management of the next event (Vienna University of Technology 2014).

The city also pilots the provision of services based on mobile identification technologies. Through a smartphone app, citizens can access information about parking tickets and car towing destinations, request public subsidies for nonprofit activities, and the like, providing a proof of concept and of technology and getting the necessary public engagement to move to the next level (Davenport and Prusak 1997). Consequently, public transport smart apps are ahead of their generation due to popular demand.

In Barcelona transport information is based on a hyper-reality app. Anyone can obtain information on bus stop locations, location, lines and even be directed to it by simply pointing a smartphone camera in any direction, working wonders for citizens new to an area, tourists and even blind people who can be oriented towards their target destination using voice directions or Microsoft (2014).

Public engagement also manifest in developmental work for the smart city. Sentilo, for example, is an open source sensor and actuator platform sponsored by the Barcelona City Council, and designed by an open community.

Point of Attention: Barcelona's open-source, smart city platform, engages local talent in smart city development, ensures technology and provider independence and data stewardship and remains with the public, under its stewardship and safeguards civil liberties.

With the view to establish the city's reputation as a smart city, Barcelona also drives the Smart City Protocol initiative which seeks to connect global cities in pilot projects to address common challenges (Bain and Sentilo 2014). Barcelona is a small cosmopolitan city with the vision to grow and an exemplar for smart city development that remains open, transparent, and democratic through an exchange of all capital resources from capital and infrastructure to knowledge and talent.

While for most, smart city applications are still considered a nice-to-have feature in our city life, crisis management is the acid test for any smart application. All emergency services share a common requirement, when it comes to information management. They need to accurately analyze life critical, real-time information from diverse sources, in order to deploy and manage emergency service workflows (Gangadharan 2013).

During the Haiti earthquake in 2010, emergency services needed to be dispatched to the area to support the government cope with the circumstances. InStedd, a company specializing in technology design for emergency services such as natural disasters and diseases, offered support to the emergency services and people. Within 48 h the company has set up the telecoms infrastructure and gain buy in for setting up an emergency response number. The company offered a message-integrated communications from two mobile network companies; incoming aid requests were received in Haitian Creole. These were routed to Riff/EIS for analysis (Alehegn 2010).

Riff has the capability to automatically extract features, classify data and tag data and their metadata (e.g. source and target geo-location, time, route of transmission) and before it can process it via algorithms. The analytics module can detect relationships between these extracted features within a collaborative space or across different collaborative spaces. Riff can also combine information from GeoChat, a collaboration tool geolocating human comments, observations and reports to make information richer and relevant. Riff then shared information with Crowdfunder another workflow provider, handling the distribution of tasks to a bilingual volunteer workforce for translation, tagging, and geocoding. Information was then forwarded to Ushahidi, a website initially developed to map reports of violence in Kenya now turned a global crowdsourcing platform with humanitarian goals. 'Ushahidians', as a community of interest helped to map, accurately geotag information to provide accurate coordinates to the search and rescue team on the ground (Meier 2012).

Point of Attention: Smart apps and open collaboration platform can become the critical infrastructure platform for the application of big data and analytics to disaster recovery.

The value of swarm intelligence-based approaches for workflow-based emergency management systems has been outlined as far back as 2007 (Bentley et al. 2014). This was an example par excellence for a bundle of crowdsourcing services combined to provide an emergency response information architecture working with the added complication of bilingualism. Data quality is of paramount importance to prioritize calls and minimize erroneous dispatching of scarce rescue resources. Timely and accurate information processing was life critical. International crowds of volunteers were utilized and important safety critical decisions had to be taken on the fly by the government and participating companies alike. The venture's success was based on companies' technical capability and social responsibility, and openness to collaboration with other companies and volunteers for the same cause.

2.5 Recommendations for Organizations

Governments will have to find their feet and strike the right balance between progress and the challenges of the big data era and redefine its relationship to the public and to private capital in a world of global competition. Smart city has become perhaps a pillar of competitive advantage for those who can grasp the opportunity, while others will lag behind. As to these issues, in what follows we point out some key factors for an effective application and exploitation of big data and analytics in public sector digitalization, particularly, for smart cities and service oriented initiatives.

2.5.1 Smart City Readiness

Each country will have to access the readiness of its cities to become and its positioning in a smart cities global landscape. The European Smart Cities initiatives, audits cities on the basis of the six factors shown in Table 2.1 (Vienna University of Technology 2014).

Smart city strategy at a national level is likely to be faced with budgetary tensions between rural and urban development and a nation should have a vision and a view of how to engage its people and private investors in the conversation. Moreover, both local and central governments will have a 'good cop, bad cop' role to play between role modeling the opening up information and effecting transparency and ensuring that information is safeguarded from abuse by involved parties.

In addition, smart cities will divulge responsibility for city services to machines, partnerships with private companies and the public and this requires not only educated citizens but also a change in mentality about civic responsibility from all these parties.

Table 2.1 Factors for smart cities initiatives audit

Factors	Description
Smart economy	Innovative spirit and entrepreneurship, productivity, workforce flexibility, ability to transform and international embeddedness
Smart mobility	Local and international accessibility, availability of ICT infrastructure, innovative transport systems
Smart environment	Attractive natural conditions, pollution, environmental protection and sustainable resource management
Smart people	Level of qualification, affinity to life-long learning, social and ethnic plurality, creativity, flexibility, cosmopolitanism and open-mindedness
Smart living	Cultural facilities, health conditions, individual safety, housing quality, education facilities, touristic attractively and social cohesion
Smart Governance	Participation in decision making, public and social services, transparent governance, political strategies and perspectives

2.5.2 Learn to Collaborate

Like most sociotechnical changes, to realize the benefits of big data and smart city initiatives we need to change the way we do things. In particular, these technologies require the diverse stakeholders collaborate. Government agencies and departments have been traditionally separated by internal rivalries and financial competition developing into an embedded silo mentality and culture. Information has been seen as power and it has been hoarded to make people indispensable in the face of downsizing, cost cutting, and other modernization attempts. Davenport and Prusak highlighted such issue as far back as 1997 (Davenport and Prusak 1997).

Focus on efficiency and years of recruiting people and managers focusing on cost cutting exercises have stripped the public sector from innovative human resources and know-how and practices (Parker 2014). Public sector practices in terms of renewing their staff and policies about paying their staff at the low end of market prices makes it difficult for them to attract human talent, or indeed to manage external associates who recruit such talent.

The public sector will need to rethink its internal recruitment processes to employ smart people who will focus on creating successful partnerships with the private sector and the public. If governments are to show the way of developing smarter cities, they should orient themselves to attracting people with high qualifications, affinity to life-long learning, social and ethnic plurality, creativity, flexibility, cosmopolitanism and open-mindedness. In addition, managing successful collaborations will require new managerial skills. High partnering skills involve:

1. creating rapport via openness and self-disclosure and feedback,
2. trust building through actions and words,
3. creative conflict resolution and problem solving,
4. appetite for change, and
5. welcoming interdependence (Dent 2006).

Furthermore, partnering in the sphere of emerging technologies will also require reviewing public sector procurement policies to allow wider participation in the supplier pool and perhaps even participation of newly established technology ventures that might be considered risky (Uyarra et al. 2014).

Finally, for Governments to continue to be relevant in a big data world, with limited resources, they need to become smarter and this means fostering public participation in decision making, public and social services, and making governance, political strategies and perspectives transparent and lean.

2.5.3 Civic Education and Online Democracy

The key aspirations of open government are the engagement of the public in the political processes and their involvement in self-service public services. This will require heightened levels of interest, knowledge, and maturity from the public, as well as new modes of participation by governments. One means to achieve the former is education. A United Nations review of such program in the US, showed that such program had changed both people's engagement levels and feeling of adequacy to engage in the political process, but not people's respect for different political viewpoints, social cohesion and trust (United Nations Publication 2010).

Online participation in democratic processes can provide an affordable ways to consult governments and take part in decision making in ways that it was not possible before. Relevant initiatives spring up slowly in different countries. In January 2014, California, for example, institutionalized the California Report Card, mobile-friendly web-based platform that encourages citizens to engage in the deliberative process via chat rooms where they would enter their own suggestions but also rate others' suggestions (Newsom and Goldberg 2014).

2.5.4 Legal Framework Development

Legal frameworks lag behind technological developments at all fronts of virtually enabled living. The persistence and rise of Cyberbullying is a testament to that. Big data profiling raises many issues regarding privacy, civil liberties, and equality, as they were described above. With on demand public services via smart applications entering the mix, such issues, particularly those of inclusion and exclusion from this virtual world, can achieve another level of inequality. Thus, Governments need to define new legal frameworks to regulate life and perhaps they even need to do so at a global level, as internet engagement is a global phenomenon. Big data analytics can be used as the tool to help international government bodies to analyze people's sentiments but also integrate best practices on such matters, but also to make law more understandable by its law enforcement groups and the public (Morabito 2014).

2.6 Summary

This chapter discussed the impact of big data in the context of public service provision and new opportunities for public service organization and structure that may transform the role of governments in societies. We started our analysis by discussing developments in public service provision, which treats citizens as *prosumers* (proactive consumers) of public service delivery, moves towards direct online democracy, and finally, to active engagement and a global smart megacities competition for resources and talent.

In this context, governments seek to gain an advantage by utilizing a) new sources of data, such as Crowdsourcing, Internet of Things, b) engage public talent, c) institutionalize private–public partnerships and d) seeks for new models of value-for-money public provision. Despite its potential, the adoption of big data and analytics are not without challenges, particularly for central governments. Of particular interest are the challenges regarding data ownership, data quality, privacy, civil liberties, and equality, as well as public sector’s ability to attract big data analyst talent.

We showcased two case studies demonstrating how new forms of public service provision. Barcelona Smart City provides an example par excellence of collaboration between the private and public sector for regional redevelopment. Haiti’s emergency support during the 2010 earthquake disaster demonstrates how big data in the hands of passionate volunteers can organize and support with life-critical emergency services, providing a life example as to what can be achieved through the blend of human intuition and available big data integration and advanced analytics. Like most sociotechnical changes, challenges reside in the social sphere of technology acceptance and use, as well as with the regulation of such technology, hence our recommendations are directed towards auditing readiness for Smart City development, reskilling public servants with partnership management skills, developing public’s mentality of civic participation and updating legal frameworks to cope with developments in the big data area.

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Strategic and Organizational Impacts

Morabito, V.

2015, XXVI, 183 p. 27 illus., Hardcover

ISBN: 978-3-319-10664-9