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Cities, Data, and Digital Innovation

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About IMFG

The Institute on Municipal Finance and Governance (IMFG) is an academic research hub and non-partisan think tank based in the Munk School of Global Affairs at the University of Toronto.

IMFG focuses on the fiscal health and governance challenges facing large cities and city-regions. Its objective is to spark and inform public debate and to engage the academic and policy communities around important issues of municipal finance and governance. The Institute conducts original research on issues facing cities in Canada and around the world; promotes high-level discussion among Canada's government, academic, corporate, and community leaders through conferences and roundtables; and supports graduate and post-graduate students to build Canada's cadre of municipal finance and governance experts. It is the only institute in Canada that focuses solely on municipal finance issues in large cities and city-regions.

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Cities, Data, and Digital Innovation

Mark Kleinman

Abstract

Developments in digital innovation and the availability of large-scale data sets create opportunities for new economic activities and new ways of delivering city services while raising concerns about privacy. This paper defines the terms Big Data, Open Data, Open Government, and Smart Cities and uses two case studies – London (U.K.) and Toronto – to examine questions about using data to drive economic growth, improve the accountability of government to citizens, and offer more digitally enabled services. The paper notes that London has been one of a handful of cities at the forefront of the Open Data movement and has been successful in developing its high-tech sector, although it has so far been less innovative in the use of “smart city” technology to improve services and lower costs. Toronto has also made efforts to harness data, although it is behind London in promoting Open Data. Moreover, although Toronto has many assets that could contribute to innovation and economic growth, including a growing high-technology sector, world-class universities and research base, and its role as a leading financial centre, it lacks a clear narrative about how these assets could be used to promote the city. The paper draws some general conclusions about the links between data innovation and economic growth, and between open data and open government, as well as ways to use big data and technological innovation to ensure greater efficiency in the provision of city services.

Keywords: cities, data, innovation

JEL Codes: H70, O38

Cities, Data, and Digital Innovation

I. Introduction: Data Innovation and City Governance

Worldwide, city governments are playing an increasingly active role in supporting city economic growth while responding to a wider and more sophisticated range of citizen demands. Rapid developments in digital innovation and in the availability and application of large-scale data sets create opportunities for new economic activities and jobs, and cheaper ways of delivering city services. They also offer new ways for government to engage with citizens, respond to citizen needs and demands, and act as a key driver of more “open” government.

At the same time, the collection, analysis, and application of data generated (sometimes unknowingly) by citizens raises concerns about data privacy. In this paper, I look at how these issues are being handled in London (U.K.) and Toronto, two cities with strong “knowledge economy” characteristics that are also growing rapidly.

Cities the world over face a similar set of issues:

- Demands for urban services and for infrastructure increase while budgets are fixed or shrinking. Grants from higher-level governments are reduced, but there is strong citizen resistance to tax increases.
- The public appears increasingly skeptical both of politicians and of government more generally, and traditional channels of communication between government and citizens are ignored or bypassed. Younger voters in particular are using digital means of communicating and organizing. Governments – at the municipal, provincial, and national levels – are failing to keep pace with the technological change in how citizen action can be mobilized. This may be seen as part of a broader process of *disintermediation* – the removal of intermediaries in the “supply chain” in political and economic spheres.
- Cities need to ensure that businesses – particularly, but not uniquely, start-ups, SMEs, and innovative firms generally – can take advantage of new economic opportunities derived from the application of digital technologies. Often this means removing barriers (e.g., to financing, to affordable premises, to training, etc.) as well as ensuring that the benefits of proximity and partnerships with universities and other knowledge providers are maximized.

From this, a number of policy questions arise, including:

- How can the use and release of government data act as a driver for innovation, economic growth, and ultimately jobs and economic opportunity in the city?

- How can data be used to improve the transparency and accountability of government to citizens and promote civic engagement? How can citizens' concerns over data privacy be addressed?

How can city governments move towards more digitally enabled services, using digital technology both to improve services and to drive down the cost of delivering services? This latter point is particularly important in an era of constrained public spending and ever-rising consumer expectations. What innovations in the structure of city government might be needed to further this agenda?

Developing and maintaining a strategic approach to city competitiveness, quality of life, and service delivery is difficult at the best of times. It is easy for day-to-day pressures to crowd out longer-term thinking and planning – the Urgent often wins out over the Important.

This general challenge for city managers and city politicians becomes even more difficult in the area of digital innovation, “smart cities,” and so on, since the level of technical and scientific knowledge within city government is often inferior to that demonstrated by activists, vendors of proprietary solutions, and sometimes other levels of government. Furthermore, the field of big data and digital innovation is characterized by rapid change, competing visions, and plausible advocates and detractors – seasoned with a large measure of hype, spin, and apocalyptic claims and counter-claims. To govern is to choose – but it should be an informed choice. In the absence of information, knowledge, and understanding, decision-makers lack confidence and can easily end up failing to make decisions at all, making them unwisely, or making them too late.

Hence the rapidly increased collection, analysis, and use of data is not only a key driver of urban change (economic, social, political), but also an indication that cities are a key locus for this development. My starting definition is to include (a) the availability of large-scale data sets, (b) the tools to interpret and use data in new and more accessible ways (e.g., city visualization); (c) the development of urban ecosystems of designers, developers, users, and marketers that provide rapid real-time feedback; and (d) the potentialities (often ill-defined but nevertheless real) opened up by the near-ubiquity and inter-connectivity of digitized information in homes, workplaces, energy and transit systems, universities, etc. (known as the Internet of Things).

In section 2, I set out a typology of the separate but linked issues of (1) Big Data; (2) Open Data and Open Government; and (3) “Smart Cities” and the Internet of Everything; and what these innovations mean for urban government generally.

In sections 3 and 4, I look at how London and Toronto are responding to this new agenda.

In section 5, I consider the broader context of national innovation policies, and in section 6, I draw some conclusions.

My purpose in this paper is to define the nature of the issue from the perspective of city leaders and senior officials. That is not to say that this perspective is more complete or better than that of major corporations, small and medium-sized businesses, start-ups, entrepreneurs, or universities. But it is the vantage point with which I am most familiar.

2. Naming the Parts: Big Data, Open Data and Open Government, Smart Cities

In the world of government policy and practice, the terms Big Data, Open Data, Open Government, and Smart Cities are all in vogue. We are at the stage of the hype cycle in which heat exceeds light. These terms are used vaguely and sometimes interchangeably. They do relate in important ways, but first it is important to name the parts separately.

2.1 Big Data

How big is big? “Big Data” is usually defined in terms of what is needed to analyze it. Hence some authors define Big Data as referring to data sets that are so large or complex that normal analytical or processing capability and tools are insufficient. A more complex definition is offered by Nathan and Rosso (2015) following Einav and Levin (2013): “big” datasets are those available at massive scale (millions or billions of observations); accessible in real time or close to it; have high dimensionality (many variables); and are much less structured than conventional datasets.

Where is all this Big Data coming from? Broadly, we can identify three main sources: first, large-scale scientific experiments and the adoption and diffusion of data-generating new scientific techniques; second, data generated from sensors embedded in cars, buildings, household goods, streets, and urban infrastructure – the Big Urban Data that are apparently essential to smarter cities; and third, unstructured data – what we would earlier have referred to as qualitative information generated by (often unknowingly) or attributed to individuals, but now searchable through social media, search engines, etc. Large administrative datasets – especially when linked together – can constitute a fourth category.

Big Data are not a “free lunch.” They do not exist just in virtual space, but also have a real-world impact in terms of energy use and consumption of resources. “The Cloud” is an effective marketing term, but the reality is far from wisps of cirrus or cumulus. The Cloud depends on a physical configuration of servers, data centres, cabling, and power supplies, which consume energy and leave a carbon footprint. This high level of consumption is leading to increased interest in “greener” ways of building and managing data centres.

Even more importantly, *data are not information*. A digital film contains about a thousand times more data than a digital book, but it does not have a thousand times the information. Information, and hence value, whether economic, social, or cultural, has to be *extracted* from data, and here size may be a disadvantage as

much as an asset. As the size of datasets increases, the signal-to-noise ratio is likely to deteriorate. Government, firms, and scientists are often overwhelmed by data, and express considerable interest in better, faster, and cheaper ways of extracting value from data. Traditionally, this has been the domain of statistical analysis, but traditional statistics is now being complemented or even challenged by the new paradigm of “data science.” By combining elements of statistics, computer science, and Artificial Intelligence, data science may offer better techniques and methods for how to learn from data.

However, this is very different from the mistaken argument that the era of Big Data somehow means the “death of theory” as the numbers can just “speak for themselves.”¹ Big Data “cheerleaders,” according to economist Tim Harford (2014), make four claims: data analysis produces uncannily accurate results; every single data point can be captured, so sampling is obsolete; there is no need to worry about causes because correlation is enough; and Big Data spell the “end of theory.” At best this is oversimplification and at worst, in the words of David Spiegelhalter of the University of Cambridge, “absolute nonsense” (Harford 2014). More data are not necessarily better data. For example, George Gallup correctly predicted the result of the 1936 U.S. election by ensuring that his sample was representative of the whole population. Meanwhile, the *Literary Digest* predicted the opposite result based on a much larger but biased (non-representative) sample, drawn from its own readership. More broadly, as Derman (2014) writes: “we must be careful not to get too enamoured of statistics and data science and thereby abandon the classical methods of discovering the great truths about nature...Science is a battle to find causes and explanations among the confusion of data.”

As far as policy advice is concerned, trusting the power of Big Data alone fails the “Lucas Critique” (Ljungqvist 2008): it assumes that the strategies of actors do not change with changes in the environment and thus statistical regularities observed in the past will continue to apply in the future, whatever the circumstances. If policy is based purely on observations, people will change their behaviour with changes in policy, and the data will therefore change also. Policy interventions need to be based on some underlying idea that explains observed behaviour.²

These methodological considerations are not just part of an academic debate, but relate directly to the question of how city and other governments

1. In a 2008 article in *Wired* titled “The End of Theory: The Data Deluge Makes the Scientific Method Obsolete,” Chris Anderson argued that we are now in a world “where massive amounts of data and applied mathematics replace every other tool that might be brought to bear. Out with every theory of human behavior, from linguistics to sociology... With enough data, the numbers speak for themselves” (Anderson 2008).

2. I am indebted to Max Nathan for this point.

can best use the data explosion. For example, as Harford shows, bias can be a factor in the current use of apps for monitoring and reporting city problems to government. Boston's Street Bump smartphone app uses a phone's accelerometer to automatically detect potholes and report the findings to City Hall. For the City of Boston, this provides useful real-time information. However, "what Street Bump really produces, left to its own devices, is a map of potholes that systematically favours young, affluent areas where more people own smartphones. Street Bump offers us "N = All" in the sense that every bump from every enabled phone can be recorded. That is not the same thing as recording every pothole" (Harford 2014).

Similarly, Kate Crawford of Microsoft Research points out that Twitter data generated by Hurricane Sandy peaked in Manhattan, creating the incorrect impression that Manhattan was the hub of disaster, rather than the coastal communities that were more severely affected. The reason, of course, relates to smartphone ownership, demography, and cultural attitudes to social media. Crawford calls this a "signal problem." "Data are assumed to accurately reflect the social world, but there are significant gaps, with little or no signal coming from particular communities" (Crawford 2013).

More generally, the hype around "Big Data" is creating a backlash in a similar way to the hard sell on Smart Cities. Gary Marcus wrote in 2013: "Five years ago, few people had heard the phrase 'Big Data.' Now it's hard to go an hour without seeing it." Moreover, as Mark Fox (2013) points out, "Big Data has rapidly become a catchall phrase for any type of data analysis. At one end of the spectrum are organizations that are looking for *any* data to work with. At the other end of the spectrum is the analysis of datasets measured in terabytes to petabytes."

Nevertheless, Big Data – or perhaps, the more effective use of *all* data – hold promise for public policy. Daniel Castro (2015) argues that "data-driven innovation has the potential to be a major part of the European effort to grow the economy" but that this will require a different approach to regulation by European policymakers that "encourages beneficial applications while narrowly targeting rules to address specific consumer harms." Helen Margetts (2013) says that "widespread use of digital technologies, the Internet and social media means both citizens and governments leave digital traces that can be harvested to generate Big Data. Policy-making takes place in an increasingly rich data environment, which poses both promises and threats to policy-makers."

On the promise side, there are possibilities for policy and implementation to be more citizen-focused, and for citizen data to be useful in improving government performance. But on the debit side, U.K. and other governments often struggle with big IT projects, and the association of the word "big" with government has had negative overtones. More importantly, the use of Big Data by government, particularly in sensitive areas such as policing or pupil performance, raises moral and ethical issues. Margetts (2013) correctly identifies that the public reacts differently to the use of their personal data by government as opposed to their

use by corporate business: “We (reasonably) happily trade privacy to allow Tesco and Facebook to use our data on the basis it will improve their products, but if government tries to use social media to understand citizens and improve its own performance, will it be accused of spying on its own citizenry in order to quash potential resistance?”

Think-tanks and consultancies in the U.K. and Canada have explored these opportunities and risks. In the U.K., Chris Yiu (then of Policy Exchange) argued that “an abundance of data and computing power gives the public sector new ways to organize, learn and innovate” (Yiu 2012). This opportunity is real: smarter and more personal public services can bring citizens’ interactions with government agencies up to the quality of experience that consumers now expect, and often receive, in the private sector. Yiu also argues that Big Data can help improve efficiency in the public sector, with estimated gains amounting to £250 to £500 (about \$500 to \$1,000) per person. To realize these gains, government will need to be an intelligent customer for data – senior policymakers and leaders will need to be literate in scientific method and confident in “combining Big Data with sound judgment.”

A further report by Eddie Copeland for Policy Exchange looked at how local government could make better use of data, specifically in the context of continuing austerity and declining resources available to local councils to provide services: “The sector therefore has a choice: either it must stop providing some services altogether or fundamentally reinvent the way it works” (Copeland 2015). Copeland argues that the latter outcome can be achieved by using technology and data to do more and better with less.

The major barrier for Copeland is the fragmentation of local government, with 375 local authorities in England and Wales (18,500 elected councillors), each with its own leadership and priorities. He argues that most current digital initiatives are unlikely to have a significant impact, because of this fragmentation, and because of a narrow focus on the technology rather than on engaging citizens and others in the design and delivery of public services. The report makes a number of recommendations: the new Government Chief Data Officer should work with others to define open standards for data across the whole public sector; a single set of compliance standards should be developed; an Office of Data Responsibility should be created; citizens should have access to the data that the public sector holds about them (except in cases of extreme sensitivity); and an Office of Data Analytics, based on the New York model, should be established in all U.K. cities.

Rightly in my view, Copeland (2015) emphasizes citizen access to data: “Until citizens are given control of their own data, government is likely to come unstuck time and time again when it tries more advanced data initiatives.”

Nordicity’s report for the Intergovernmental Committee for Economic and Labour Force Development in Toronto (ICE) takes a similarly positive approach, arguing that Big Data can serve the public good and bring potential benefits of

2.5 to 4.5 percent in efficiency savings. Like Policy Exchange, Nordicity identifies fragmentation as an issue – most organizations have different ways of processing and analyzing data, and interoperability is essential. The report examines key policy challenges – urban transportation, democratic participation, urban planning, scientific and technical collaboration, and economic development – and finds that Big Data can play a useful role in each. Issues arising from Big and Open Data include security, interoperability, standards, and privacy and trust.

2.2 Open Data and Open Government

In a remarkably short space of time, the principle of Open Data has gone from being a campaigning demand of a small group of people, to becoming accepted at least in practice by many governments at different levels, to almost the default position for public authorities. “Open Data” is now seen as a key driver of more open government in general.

In March 2006, *The Guardian*'s Technology section began a “Free Our Data” campaign, calling for the raw data gathered by the Ordnance Survey (as well as other publicly gathered and publicly financed data) to be made freely available for reuse by individuals and companies (Arthur and Cross 2006).

In April 2007, Ed Mayo and MySociety director Tom Steinberg were commissioned to draft a “Power of Information Review” on how the U.K. government could serve the public's information needs better, leading to the creation of a Power of Information Task Force. In March 2009, Tim Berners-Lee gave a TED talk in which he argued for better public data provision and led the audience in a chant of “raw data now” (Arthur 2010). Later that year, Prime Minister Gordon Brown announced that Berners-Lee, together with Nigel Shadbolt of Southampton University, would be appointed to help open up access to government data so that “government information is accessible and useful for the widest possible group of people” (Guardian 2009).

The following year, this work led to the creation of a new government website, data.gov.uk. Professor Shadbolt commented, “A lot of this is about changing assumptions...If [the data] can be published under an FOI (Freedom of Information) request why not publish it online?” (BBC News 2010).

Similar developments were under way in the U.S. In December 2007, a meeting in Sebastopol, California brought together a working group of 30 thinkers and activists of the Internet, to define the concept of open public data and to have the definition adopted by the U.S. presidential candidates.

In 2007, it sounded like a dream. But the result has exceeded by far their expectations. A little over a year later, President Barack Obama took office in the White House and signed three presidential memoranda. Two of them concern open government, of which open data is one of the pillars. These presidential memos explicitly set the culture of open source at the heart of public action by claiming its founding principles: transparency, participation and collaboration (Chignard 2013).

The working group offered a definition of what constitutes Open Data:

Government data shall be considered open if it is made public in a way that complies with the principles below:

1. Complete

All public data is made available. Public data is data that is not subject to valid privacy, security or privilege limitations.

2. Primary

Data is as collected at the source, with the highest possible level of granularity, not in aggregate or modified forms.

3. Timely

Data is made available as quickly as necessary to preserve the value of the data.

4. Accessible

Data is available to the widest range of users for the widest range of purposes.

5. Machine processable

Data is reasonably structured to allow automated processing.

6. Non-discriminatory

Data is available to anyone, with no requirement of registration.

7. Non-proprietary

Data is available in a format over which no entity has exclusive control.

8. License-free

Data is not subject to any copyright, patent, trademark or trade secret regulation. Reasonable privacy, security and privilege restrictions may be allowed.

Compliance must be reviewable. (Open Government Working Group 2007).

These eight principles are widely quoted in the Open Data movement to determine whether data are open or not (Coleman 2013).

Simon Chignard (2013) argues: “This shift to a default open mode represents in itself an important cultural change of paradigm for most public and private entities. ‘Letting go’ is one of the main traits of open innovation. It isn’t a natural reflex in many organizations because they are concerned about the use – or rather misuse – that can be made of open data. Isn’t there a risk of denaturing them by interpreting them? Some data are difficult to grasp if you don’t know the context of their primary use: isn’t there a risk to open them?... Transparency is perceived as a response to a period of mistrust, or distrust, towards institutions and their representatives.”

In 2009, Tim Berners-Lee established the World Wide Web Foundation, with a mission to advance the Open Web as a public good and a basic right. The Foundation publishes the Open Data Barometer, tracking progress across the globe of Open Data initiatives. Its most recent report (January 2015) finds that the “global movement to make government open by default” picked up steam in 2013, when the G8 leaders signed an Open Data Charter – “promising to make public-sector data openly available, without charge and in re-useable formats.” However, it also found that there is still a long way to go to “put the power of data in the hands of the citizens” (Open Data Barometer 2015). The World Wide Web Foundation suggests the following key steps: high-level political commitment; sustained investment in training; Open Data tools; support for city as well as national initiatives; and legal reform to ensure that Open Data initiatives are supported by the right to information and the right to privacy.

The Barometer divides countries into four groups: high-capacity; emerging and advancing; capacity constrained; and one-sided initiatives. Within the high-capacity group, the U.K. ranks first, followed by the U.S., Sweden, France, and New Zealand.

In its “Open Data Roadmap for the U.K.,” the Open Data Institute (2015) argues that Open Data have become a core component of the U.K. commitment to open policy-making, and key to the digital transformation of government. The Institute defines Open Data as “data that is published under a licence with express permission to reuse, share and modify.” It identifies preparing U.K. cities for the next seven million people as a key 21st- century challenge, along with making U.K. public services more efficient and adjusting services to an unpredictable climate.

Citizen attitudes are changing fast. As Charbel Aoun (2015) puts it, “For hundreds of years, cities have been run on paper and information has been stored in specific ways with rules about who has access to what. Today, with smart phones in nearly every pocket, there is a major change going on about how we can open up engagement and data sources to give citizens fast, convenient and transparent ways of interacting with government and/or city services.”

Achieving these fundamental and principled goals for Open Data will also require solving technical and process issues. Mark Fox (2013) argues that to achieve data that are genuinely “Big, Open and Linked,” data from different sources can be used only if they share common vocabulary and semantics. Fox argues that the Open Data movement at the city level is composed of three elements. First, and most commonly, publishing datasets on city websites. Many Canadian and U.S. cities (as well as London) do this, including datasets on 311 and 911 calls, building permits, traffic flow counts, etc. Datasets are published in many formats, spreadsheets and XML being the most common. New York City goes even further in that the data are dynamic (continuously updated), available in a variety of formats including RDF (Resource Description Framework), “the dominant format of the Semantic Web,” and increasingly presented visually.

Second, cities publish “public APIs [application program interfaces] through which applications such as smart phone apps or web sites can both retrieve and post data.” By doing so, cities are releasing the energy and expertise of the developer communities in these cities: “Hack-a-thons are taking place on a regular basis across the world where smart app developers over a period of days build new apps based on open city APIs” (Fox 2013).

The third element, which is as yet less developed, is the adoption of standardized definitions for models of city data. Fox (2013) defines the problem this way: “Almost every example of Big City Data combines data from multiple datasets. With the availability of Open Data, how do we unify (or merge) data from multiple open datasets?” Answering this question will require the introduction of standard vocabularies, shared across cities, so that data can be linked. This is an “arduous” process, but tools are now emerging to simplify the process. Fox (2013) quotes Berners-Lee’s five-star rating scheme for Linked Open Data:

* Available on the web (whatever format) but with an open license, to be Open Data

** Available as machine-readable structured data (e.g., Excel instead of image scan of a table)

*** [Available] as above, plus non-proprietary format (e.g., CSV instead of Excel)

**** All the above, plus: Use open standards from W3C [World Wide Web Consortium] (RDF and SPARQL) to identify things, so that people can point at your stuff

***** All the above, plus: Link your data to other people’s data to provide context (Berners-Lee 2006)

Much of the city data currently being published are only at the two-star level. New York City is at the four-star level – but few other cities can match it. According to Michael Flowers, former Chief Analytics Officer for New York City, the challenge in becoming a “data-driven city” has more to do with leadership and organization than with technology: “A focus on outcomes is often lost in the discussion of Big Data because it is so frequently an afterthought...what really matters is not the CSV file, the map, or the traffic patterns, but the outcomes” (Flowers 2013). This means overcoming the silos or “stovepipes” that frequently bedevil city administrations and other large organizations, and recognizing the difference between *collecting* and *connecting* data. Data may be collected in large quantities, but different agencies record data in different ways:

Each agency has its own ontology of terms and data that have all been created through reasonable, rational evolution of services, but which sometimes make it nearly impossible to connect that data. One department may use a GIS identifier for the location of [a] downed tree, whereas another may refer to it by its cross streets (Flowers 2013).

In New York City, Flowers and colleagues used the borough block lot/building identification number (BBL/BIN) together with a bespoke geocoding program, such as the “Rosetta Stone,” to connect the city’s operational intelligence (Flowers 2013).

Fox (2013) also stresses the importance of ontologies. Distinguished from simple vocabulary, ontology “adds definitions of the terms and constraints on their interpretation using a computational language.” Grounding the definition in terms of lower-level, more concrete terms is critical. For example, the definition of student/teacher ratio has to be grounded in simpler definitions of the terms “student,” “teacher,” “full-time,” etc.

Ontologies, according to Shadbolt, Hall, and Berners-Lee (2006) are “attempts to more carefully define parts of the data world and to allow mappings and interactions between data held in different formats... The next wave of data ubiquity will present us with substantial research challenges. How do we effectively query huge numbers of decentralized information repositories of varying scales... How do we establish trust and provenance of the content?”

Flowers (2013) sums up the learning from the New York City experience as follows:

You don’t need a lot of specialized personnel.

You don’t need a lot of high-end technology.

You don’t need “perfect” data (but you do need the entire set).

You must have strong executive support.

You must talk to the people behind the data, and see what they see and experience what they experience.

You must focus on generating actionable insight for your clients that they can immediately use with minimal disruption to existing logistics chains.

Open Data thus represent a necessary but not a sufficient condition of open government. Achieving Open Government means a culture change within government, in which politicians and officials recognize that they do not own the data that citizens have supplied to them. It also means changes to processes, protocols, record-keeping methods, and so on, and sustained outreach to and engagement with citizens. From a policy perspective, “open government is a laudable democratic value. Open government means more than ‘open data’ but it is difficult to imagine effective open government without concomitant open data policies” (Nordicity 2014). Moreover, Open Government or Digital Government is not a fixed concept, but one that continues to evolve as citizens’ demands and expectations of government change. The brand and marketing agency WPP (Citron 2015) argues that government is on a digital journey that began with the simple provision of information on websites; developed with the online delivery of transactions such as taxes, benefits, and licensing; and is now on the threshold of initiatives that provide citizens with personalized digital experiences – what WPP

terms “me.gov.” In this new phase, quality of user experience will be as important as functionality and cost.

2.3 *Smart Cities and the Internet of Things*

Aside from Big Data and Open Government/Digital Governance, the third policy issue is how digital and data innovation might be harnessed to deliver better city services at lower costs – how mayors and other leaders can make their city a “Smart City.” Technological innovation, according to many public-sector service providers, offers the enticing prospect of delivering city services that are more tailored to individual needs and demands, at a lower cost.

In the literature, we find a sharp distinction between advocates of top-down solutions – mainly suppliers – and those arguing for the greater public benefits of community-led, bottom-up initiatives. Major firms are often accused of providing top-down, expensive, and one-size-fits-all solutions for cities from Birmingham to Bangalore, Shanghai to Saskatoon. This conflicts with the bottom-up approach taken by many digital entrepreneurs and start-ups, which is rooted in the specifics of a particular city, and often with a background of community involvement and citizen activism. Nevertheless, many bottom-up innovations quickly discover a global marketplace, and both “disruptors” and capitalist incumbents often find ways to work together.

Many key terms were developed by large corporate firms. Cisco came up with the phrase “Smart and Connected Cities” and later “The Internet of Everything,” while IBM has trademarked the term “Smarter Cities,” along with Smart Traffic, Smarter Energy, Smarter Planet, Smarter Water, and many others.³

For businesses, “Smart” represents an economic opportunity. Both start-ups and major corporate firms see themselves as problem-solvers or solution providers. The intelligent application of digital technologies and the application and analysis of data provide new ways of solving consumer or citizen concerns.

The Smart Cities Council, representing most of the major large corporate firms active in this field (such as Cisco, IBM, Intel, Qualcomm, etc.), defines the “Smart City” as follows:

A smart city gathers data from smart devices and sensors embedded in its roadways, power grids, buildings and other assets. It shares that data via a smart communications system that is typically a combination of wired and wireless. It then uses smart software to create valuable information and digitally enhanced services (Smart Cities Council 2012).

The “Smart City” proposition is thus the possibility of new and cheaper solutions to urban issues, based on crosscutting, integrative approaches. This approach is portrayed as essential, given the widespread and rapid global trend towards greater urbanization of the world’s population. The city is often envisaged

3. IBM has an impressive list of trademarked words, including Concert, Jazz, and Orchestrate.

as a collection of separate and often disparate systems for providing mobility, water, utilities, waste disposal, clean air, etc. Harnessing the power of data and technology permits a “system of systems” approach in which the inter-connectivity of these systems is acknowledged and solutions are optimized, thus reducing costs as well as providing benefits.

As Roland Busch, Global CEO of Siemens, puts it: “Cities are currently experiencing a transition driven by technological advances which will bring the citizen closer to the city. Digitalization is changing the way people live their lives, giving them a voice and an opportunity to participate in the delivery of public services. Citizens are no longer just consumers of energy, transport, and other city services, but they are also at the heart of the production process” (Busch 2014).

Hitachi’s vision for Smart Cities refers to changing lifestyles, in which renting is valued over ownership and demand is shifting from products to services. Hitachi believes that “Smart City management” can balance supply and demand across city infrastructure using software and data (Yoshikawa et al. 2012).

Batty et al. (2013) argue that cities are becoming automated, “turning into computers with enormous and unprecedented effects” on how we behave and function. The size and scale of cities is intrinsically linked to their technology. Ancient Rome had 1 million inhabitants; Nanjing and Beijing reached a similar size in the 6th and 7th centuries; London reached 1 million residents in 1800. With mechanical technologies, we grew further – first through mass transit and then the automobile. Cities reached 10 million in the mid-20th century, starting with New York City, where steel-framed skyscrapers with elevators were developed. What will electronic technologies do?

London – a global city for more than 200 years – is now, according to these authors, rapidly becoming a city-state, spreading beyond its borders. The city as a city of flows is manifest at many scales – flows are the new currency rather than locations or hubs. At the same time, computers are becoming “miniaturised to the point where they can be embedded in any object” (Batty et al. 2013).

Rick Azer (2015) argues that a series of technological innovations have come together to provide momentum for a Smart City Era:

- Pervasive wireless coverage.
- Transformation of public carrier business plans to accommodate the Internet of Everything.
- Miniaturization of processors and the integration of communication modules into intelligent devices.
- Abundant cheap data storage and processing power.
- Rise of cloud computing and edge computing.
- Access to vast data streams enabling potential for rich analytics.
- Extensive improvements in application development and visual display capabilities.

Similarly, Dave Evans (2012) states that the “IoE [Internet of Everything] brings together people, process, data, and things to make networked connections more relevant and valuable than ever before.” According to a white paper prepared for Cisco, the Internet of Everything could generate \$4.6 trillion for the public sector worldwide over the next decade, and \$14.4 trillion for the private sector (Bradley et al. 2013).

The supply side – that is, vendors with a commercial interest – have taken the leading role so far in defining both the problem and the solution. What has been lacking are city, regional, or national governments with sufficient expertise, authority, and technical and strategic capacity to act as intelligent clients, define their own specific needs, and specify the type of solution being sought.

Moreover, the paradigm of total interconnectivity coupled with passive data generation and constant real-time data analysis for some paints a picture of a new Panopticon, a system of surveillance and control of citizens by government, in which concepts of privacy, freedom of thought and expression, and the right to be anonymous are gradually eroded. Robin Hambleton (2014) says that digital enthusiasts treat “Smart Cities” as a panacea, claiming that technology will transform society in the 21st century as electricity did in the 20th, but that there is little evidence to support this assertion. “Unfortunately, much of the literature on smart cities is dominated by case studies that appear to be little more than place-marketing literature.”

Architect Rem Koolhaas (2014) argues that while the city was formerly the domain of his profession, it has now become the domain of the Smart City theorists: “We stopped thinking about the city at the exact moment of the explosion of urban substance in the developing world. The city triumphed at the very moment that thinking about the city stopped. The ‘smart’ city has stepped into that vacuum.” However, he is unimpressed with this development. Major urban challenges, such as climate change, aging populations, and the provision of water, energy, and other infrastructure are “all presented as problems for which smart cities have an answer. Apocalyptic scenarios are managed and mitigated by sensor-based solutions... Everything saves millions, no matter how negligible the problem, simply because of the scale of the system that will be monitored.” Mayors are specifically targeted as clients, and visually Smart City solutions are represented “with simplistic, child-like rounded edges and bright colours. The cities the smart city claims to serve are treated like infants” (Koolhaas 2014).

Anthony Townsend, who has analyzed the current Smart Cities movement, argues that in the aftermath of the 2008 financial crisis, corporate IT departments cut spending, while governments often received stimulus spending. So technology that was originally developed for multinational firms was repurposed for local government. But cutting and pasting solutions is difficult, and local government does not operate in the same way as enterprises do (Mathis 2014).

Townsend is skeptical of top-down solutions: “I think that there are opportunities to do that in greenfield sites, like in Songdo, for the most part the

infrastructure is there to have a sort of IT clearing house for the city that will do things like authenticate people when they're trying to get through buildings or process transactions or share data with utility networks. But the vast majority of city-dwellers do not live in cities like that right now. And for the most part, the cities that we'll be building won't look like those places, either. It took 10 years to build Songdo and Masdar, which each house maybe 100,000 people, and in the same period, we've added hundreds of millions of people to the next big cities of the global south" (Mathis 2014). For Townsend, the real Smart City is more likely to emerge in an incremental, ad hoc manner.⁴

2.4 Conclusions

The "digital revolution" is a real phenomenon and the use of more and larger data sets will have profound implications for government and governance. Despite the hype, overpromotion, and exaggerated claims, it would be wrong to dismiss the key issues discussed here and their importance for city governments. But it is important to be clear what one is talking about. Big Data, Open Data, and Smart Cities are linked but separate phenomena, and Open Government is a wider debate that includes data issues, but also much more. It is vital to bear this in mind as we turn to look at how these issues are playing out in two major cities.

3. London: Fall and Rise of a Global City

3.1 London's Governance

The dominant challenge for London is how to manage the current, unprecedented population and economic growth rates amidst declining levels of public resources to deliver infrastructure and to provide city services. Against this background, there are opportunities and challenges for city-wide government to make use of digital technologies and the Big Data to address three separate but related issues – economic growth and development, citizen engagement, and efficiency in providing services.

Before getting into the detail of the impact of data and digital innovation, we need to look briefly at the governance arrangements in London – which have an important bearing on how the issues are addressed.

City governance in London is made up of a two-tier subnational governance system. The Greater London Authority (GLA) forms the upper tier, with 32 boroughs, and the City Corporation of London forms the other tier. The GLA comprises the Mayor and the London Assembly, both elected on four-year terms. In the academic literature, this is a "strong mayor" system. However,

4. As Batty (2015) points out in a review of Townsend's book on Smart Cities, the world has moved on at surprising speed, even in the two years between the first and second editions of the book. Townsend writes in his Epilogue, "With smart cities, trends that only recently appeared small on the horizon now loom larger and larger. Everything seems to be speeding up, getting bigger, or getting worse than was expected."

city governance in London is complex: there are important roles for the tiers of government both “above” and “below” the GLA.

The national government plays a major role, not just in terms of determining the legislative and regulatory framework, but also in the provision of public services in London. Health services are provided by an integrated National Health Service. Education services are delivered by the lower-tier boroughs, but within an increasingly prescriptive national framework, with school spending effectively ring-fenced by the national government. In addition, there are increasing numbers of “Academy” schools, which are publicly funded, but outside the local education authority (the boroughs).

Boroughs provide the majority of locally delivered services, and collectively spend about the same in total as the GLA and its agencies (including the “functional bodies”). Borough budgets have come under increasing pressure in recent years, along with the rest of local government in England. Under the coalition government’s public spending (austerity) plans, some areas of spending, such as health, education, and overseas aid, have been protected from cuts. But local government spending is not protected, and has borne the brunt of the planned reduction in spending.

After 14 years in which London did not have an upper-tier metropolitan authority, and following a white paper and a referendum, the GLA was created by Act of Parliament (the *Greater London Authority Act*, 1999) and came into being in 2000. Much of the work is delivered through the GLA’s functional bodies (i.e., arm’s-length agencies). The role of the GLA has evolved over the last 15 years. Two further pieces of legislation, the *Greater London Authority Act* of 2007 and the *Localism Act* of 2011, extended the remit of the Authority.

Under the *Greater London Authority Act*, the Mayor is responsible for developing strategies for transport, for planning, for the environment (air quality, ambient noise, waste management, and bio-diversity), for economic development, and for culture. The Mayor is also responsible for setting a budget for the GLA and its (then) four functional bodies: Transport for London (TfL); the London Development Agency (LDA); the London Fire and Emergency Planning Authority (LFEPA); and the Metropolitan Police Authority (MPA). The Mayor was given power to promote the economic and social development of London, the health of Londoners, equal opportunities, and sustainable development in London.

The Mayor must consult the London Assembly during the preparation of each of the GLA’s strategies. The Assembly considers the budget for the GLA and for each of the four functional bodies and can overrule the Mayor with a two-thirds majority. The Assembly scrutinizes the exercise of the Mayor’s functions and conducts investigations into London issues.

The Mayor of London’s role is hence strategic. The London Plan is first among equals of the statutory strategies for which the Mayor is responsible. By setting out a long-term spatial vision linked to the Mayor’s transport and economic

development strategies, and by identifying opportunity areas for economic and population growth linked to transport investment, it is hugely influential in investment decisions, not just by the public sector but also by developers and other private-sector actors too. Similarly, Transport for London runs one of the largest, most integrated, and effective urban transit systems in the world, with a reputation both for investment and for innovation. Now under the authority of the Mayor, it functions as both a service delivery organization and as an economic development enabler.

Having abolished nine Regional Development Agencies, the coalition government that came into power in 2010 saw the need for economic intervention to operate at a level below the national government, but at a larger scale than most local authorities. It invited proposals for local authorities and business to create Local Enterprise Partnerships. Reflecting London's specific governance arrangements, the Mayor and the London boroughs proposed a single local enterprise partnership for the whole of London with the support of leading business organizations. In February 2012, the Mayor of London formally established the London Enterprise Panel (LEP). The Panel has an advisory role to the Mayor and works within the framework set by the London Plan and the Economic Development Strategy.

Other parts of the economic development landscape include London and Partners, the London Legacy Development Corporation, and the Old Oak/Park Royal Mayoral Development Corporation. London and Partners is the Mayor's promotion and inward investment agency, created in 2011 by bringing together three previously separate organizations: Visit London, Think London, and Study London. The *Localism Act* of 2011 allows the Mayor to create Mayoral Development Corporations (MDCs) to regenerate specific parts of London. MDCs can acquire land, provide infrastructure, and take over some planning functions from the local authority. The first MDC, the London Legacy Development Corporation, took over the Olympic Park in Stratford from the Olympic Delivery Authority in 2012. A second MDC for Old Oak and Park Royal in West London was created in 2015.

The Mayor supplements these formal powers with various informal powers. He or she coordinates a wide range of public- and private-sector agencies in London. The Mayor can "speak for London" as the elected representative with a London-wide mandate. He or she represents London in a variety of settings, through the media and internationally. Perhaps most importantly, the Mayor can set the agenda and change the terms of debate and use the convening authority, media presence, and power of the "bully pulpit" that goes with the position to intervene in areas where his or her powers are limited or non-existent.

The London Assembly comprises 25 elected members, 14 of whom represent constituencies, with the remaining 11 being elected on a city-wide (at-large) basis to create proportionate representation. The Assembly members examine the Mayor's actions and decisions and investigate and champion issues important to the capital. The Assembly can amend the Mayor's budget if two-thirds of its

members agree to do so, and it can reject a statutory strategy if there is a two-thirds majority. The Assembly hence performs a scrutiny function, not a legislative one.

By 2012, the Mayor had a sufficient range of formal powers to exercise strategic authority, but this was combined with very limited fiscal powers compared with the mayors of most other large cities around the world. The GLA has no general revenue-raising powers. It can raise income through an identifiable “precept” (property tax) on the local authorities within the London area, but this is subject to the same powerful centralized control on taxing and spending that applies to all other British local authorities.

Other main sources of the GLA’s income are government grants and the “congestion charge” on drivers in the central area, instituted in 2003. In addition, TfL has substantial fare revenue against which it can borrow, and the GLA is part of the national business rates retention scheme, under which it will retain a percentage of any rise in business rates revenue between 2013 and 2020.⁵ Finally, a supplementary business rate was introduced in February 2010 to help pay for Crossrail, a major new west-east transit line, as part of the levies on new development.

In July 2012, the Mayor set up the London Finance Commission to examine potential additional sources of revenue for the GLA. The Commission published its report, *Raising the Capital*, in May 2013. The Commission reviewed the evidence on urban fiscal powers and found that existing academic evidence was inconclusive about the impact of devolving fiscal powers. “There is no consistent and certain evidence that either centralized or, on the other hand, devolved models of government have measurable effects on economic growth” (London Finance Commission 2013). Nevertheless, drawing on comparative research commissioned from the Institute on Municipal Finance and Governance at the University of Toronto, the Commission concluded that “London, and by implication other British cities, have very low levels of fiscal autonomy. The Toronto research suggested that although fiscal devolution can entail risks, London would benefit from having more revenue streams under its control” (London Finance Commission 2013).

The Commission recommended that all property taxes in London, including business rates, council tax (residential property tax), capital gains tax, and stamp duty (similar to land transfer tax) be fully devolved to the GLA, and that the GLA be granted powers to change council tax band levels and re-evaluate domestic property. Under this approach, 100 percent of business rates would be retained. These additional revenues would be offset by an equivalent reduction in central government grants (Sandford 2015).

In addition to the formal institutions of government, an informal network of partnerships also plays a role in the governance of London. Key economic

5. In the U.K., unlike in Canada, business property taxes are levied by the national government at a uniform rate and distributed roughly on a per-capita basis to local governments.

development institutions include London First, representing the major corporate businesses in London, as well as the London Chamber of Commerce, the Federation of Small Businesses, and the London CBI (Confederation of British Industry).

3.2 *The Fall and Rise of 20th-Century London*

For much of the 20th century, and in particular after 1945, London's story was one of decline. Manufacturing activity and employment fell sharply, and London's docks, previously the centre of the world trading system, declined and then closed entirely, as new technology, new ports, and new supply chains took over. London's population peaked in 1939, on the eve of the Second World War. After the war, the government policy of industrial and population dispersal, particularly to New Towns and Garden Cities, led to further economic and demographic decline. London's population fell from 8.6 million in 1939 to 6.8 million in the mid-1980s.

Then the process began to reverse. Population decline first slowed, and then gave way to population increase. London successfully negotiated a complete transition from a manufacturing and goods-handling economy to one of the most successful service-led economies in the world, increasingly focusing on advanced producer services. Manufacturing employment in London fell from over 1 million jobs in 1971 to just 245,000 in 2004 (Prothero 2007), while business services rose from 457,000 to 1.07 million, and "other services" from 156,000 to 364,000 over the same period.

London became a global city – both in financial services, ignited by deregulation in the City of London and also in other professional and business services such as law, accountancy, architecture, as well as theatre, film, publishing, media, and other creative and cultural sectors, and then in science and technology. In early 2015, London passed a significant milestone as the population for the first time exceeded the previous 1939 peak. As Barney Stringer (2015) in the *New Statesman* asked, "Has any other city in history bounced back from losing two and a quarter million people?"

Furthermore, this economic and demographic transition from "city in decline" to one of only two "Alpha ++" world cities – along with its twin, New York City (GaWC 2012) – had been accomplished at a time when the United Kingdom was adjusting awkwardly to relative decline at the national level, and was no longer a world power. How had this happened?

The answers are many and complex. London's deep assets helped the transition and positioned the city to take advantage of the globalization of financial and other business services. A diversified economy, a fortunate time zone – overlapping with the U.S. at one end of the day and China, Japan, and other emerging Asian economies at the other – and the English language also helped. London's relative openness – to ideas, people, goods, and services – was another asset. Finally, the completion of the single market in the European Union (E.U.) and the expansion of the E.U. to the south and then the east made London the *de facto* business capital of the new integrated Europe.

The U.K. economy officially went into recession (that is, two consecutive quarters of falling economic output) in the third quarter of 2008. This was symbolized, more than any other event – and in London just as much as in New York City – by the Lehman Brothers' bankruptcy in September of that year. Iconic pictures of well-dressed professionals exiting the Lehman building in Canary Wharf carrying cardboard boxes of personal items filled the news.

In London, the city's response to the recession focused initially on immediate measures to provide help. In December 2008, the Mayor produced an Economic Recovery Action Plan detailing 50 mostly short-term actions to help get Londoners and London business through the recession. These included help for small and medium-sized enterprises through the still-extant London Development Agency, promoting inward investment and exports to take advantage of the falling value of the pound, freezing the GLA's "precept" (property tax), providing 1,000 apprenticeships a year through the GLA group, halving the payment time to GLA group contractors to 10 days, and promoting the London Living Wage.

With regard to longer-term measures, the Mayor continued to press government on the key infrastructure projects in the capital, particularly those relating to transport, including funding for the East-West regional railway Crossrail and for the 2012 Olympic and Paralympic Games. In addition, national policy responses such as bank bailouts and quantitative easing arguably helped the London economy specifically as well as benefitting the U.K. as a whole (Overman 2011; Gordon 2015).

Over the next few years, these short-term measures were complemented by an increasing focus on economic diversification, and in particular, leveraging London's science and technology strengths as an economic driver. This approach sought to make the best use of what I call the "deep assets" of the London system, supplemented by specific institutional strengths and legacies and targeted initiatives, both from private enterprise and from government.

Two key "deep assets" are London's centuries-old role both as a knowledge economy and as a global hub. The coffeehouses of Georgian London and the incubators and co-working spaces of the modern city have much in common: shared, safe spaces in which people with interesting haircuts (mostly male, mostly young) can get together to share thoughts, develop new proposals, discuss, argue, provoke, gossip, and steal each other's best ideas, and in doing so, spread knowledge, know-how, and innovations. More generally, London's prosperity and success in the manufacturing and goods-handling era was built on knowledge and innovation linked to deep labour pools, skilled workforces, and shared resources.⁶

As Jane Jacobs, Ed Glaeser, and others have argued, it is proximity – that is, the economic effects of agglomeration and the concentration of people and

6. For a theoretical discussion of the micro-foundations of urban agglomeration economies, see Duranton and Puga (2004).

ideas in cities – that creates economic advantage. Over a long period, London created a network of institutions that generated and shared knowledge across what we would now term an “economic ecosystem.” Some of this sharing happens informally, through family and friendship groups and through unplanned and often unmediated interactions. But institutions are also important – learned societies, industrial organizations, royal colleges, public institutions, trade unions, livery halls, worshipful companies, charities, colleges, universities, and many others – not only in providing formal mechanisms for the transmission of knowledge and innovation, but also and perhaps most importantly, as vectors for building trust.

Of course, a dense web of institutions, received wisdom, and accepted ways of working can work against innovation and adaptation if the prevailing system remains closed to outsiders and to new ideas. This is perhaps where the second “deep asset” of London is relevant – the city’s role as a global trading hub. As a major port and a trading city for centuries, London has long been open to goods, services, ideas, and people from around the world. London’s role as the fulcrum of world trade and as the hub of perhaps the largest of all empires has passed, but the institutions, habits, and global linkages that were created became available in new contexts.

London also has some very specific assets. It has a number of world-class universities, with four institutions (Imperial College, University College London, the London School of Economics, and Kings College London) in the *Times Higher Education Supplement*’s ranking of the top 40 universities globally in 2014–15. The universities of Oxford and Cambridge are about an hour’s travel time from Central London. Alongside this are numerous world-class research institutes, specialist teaching institutes, museums, art galleries, and other cultural institutions as well as clusters of expertise in broadcasting, journalism, advertising, publishing, film, television, and animation. In addition to the knowledge and value these institutions generate in their core activities, they bring large numbers of talented, ambitious, and sometimes entrepreneurial young people to the capital from the rest of the U.K., Europe, and (visas permitting) the rest of the world.

3.3 London in the 21st Century: Growing Smarter?

From 2010 onwards, a number of developments occurred that, while not part of an explicit digital strategy, had a collective and cumulative impact. In January 2010, the Mayor announced the launch of the London Datastore, “a website hosting hundreds of sets of data” to improve the city’s transparency and accountability. It claimed to be the first city Datastore in the U.K. and was launched just before the U.K. Government’s new digital data platform, data.gov.uk.

The Mayor’s statement clearly referred to the need for the U.K. to catch up with the U.S. and to the importance of open data for economic development and citizen engagement: “The U.S. has led the way on this idea of setting their data free for anyone – students, campaigners, software developers – to use. Now it’s time

for Britain to get up to speed and I want London, as the greatest city in the U.K., to be at the forefront of this revolution, that will not only increase democracy, but also provide a potential money-spinner for the city's hugely important software development sector" (Boris Johnson, quoted in GLA 2010).

In October 2010, the GLA appointed a Director of Digital Projects. Emer Coleman had previously been project director for London Alliances, a joint GLA/boroughs initiative that had helped develop the London Datastore. The GLA invited developers to an open workshop on a Saturday, drawing 60 people to City Hall. This engagement between senior officials at City Hall and the wider open data and digital community was supported by the creation in September 2010 of a Digital Advisory Board for the GLA. Chaired by the Mayor's economic adviser at the time, Anthony Browne, it included a number of entrepreneurs, activists, academics, and developers closely involved with the Open Data and digital start-up scene. The Digital Advisory Board was an informal body – it had neither specific funding nor statutory powers. But it represented recognition by the Mayor and his advisers that technical expertise and specific industry knowledge was necessary for London to move forward and catch up with – let alone exceed – other global rivals.

These efforts by the city administration were complemented by the high-profile launch of "Tech City" by the Prime Minister in November 2010. Shoreditch in East London was already known as a "cool," post-industrial district in the 1990s, and a centre for creative individuals and entrepreneurs, drawn by relatively cheap rent and attracted to the "grungy" feel of the district. But by the turn of the millennium, it was becoming a centre for digital technology companies, as an article in *Management Today* in October 1999 made clear: "There is an area just north of the City – specifically Hoxton and Shoreditch – that is fast establishing itself as the hub of Britain's e-design industry...some are already comparing the place to New York's high-tech hub known as 'Silicon Alley'" (Rigby 1999).

Recognizing the strength of the East London digital cluster that had grown up around the un-lovely Old Street Roundabout just north of the financial district, the Prime Minister set out the government's ambition for "London's East End to become a world-leading technology city to rival Silicon Valley... Vodafone, Google, Facebook, Intel and McKinsey & Co are among the leading companies that have said they will commit to invest in the long-term future of the area" (David Cameron, quoted in gov.uk 2010). The Prime Minister also said that the press and broadcast centres being readied at the Olympic Park would be transformed into an "accelerator space" which would offer flexible office space, facilities, and expertise after the 2012 Olympic Games.

With the U.K. still deeply in recession, Prime Minister Cameron promised this would lead to new jobs, economic growth, and a more diversified economy. "Our ambition is to bring together the creativity and energy of Shoreditch and the incredible possibilities of the Olympic Park to help make East London one of the world's great technology centres" (gov.uk 2010). Specific measures were announced: an Entrepreneur Visa to balance (to some extent) the tightening

up of the immigration system, and an East London presence for U.K. Trade & Investment.

The following year, a new organization designed specifically to promote and help nurture the sector was created: Tech City Investment Organization, led initially by entrepreneur Eric van der Kleij, and later by Joanna Shields, recruited from Facebook Europe.

Government intervention in the East London cluster, and the very name “Tech City” itself, prompted a mixed reaction from the high-tech sector. Many in the community continued to prefer the ironic or self-deprecating term “Silicon Roundabout.” But the initiative put the cluster on the map and in the media, with important consequences for visibility, access to finance, and self-confidence. A review two years later by The Centre for London broadly backed the government’s approach:

We believe the Government is right to be ambitious for the U.K.’s digital economy. The future of advanced economies like Britain lies, in important part, in growing research-intensive, innovative, high-value digital companies. Britain’s digital economy already takes the biggest share of national GDP in the G20, and may increase that share by a third by 2016.

As a world city, London is well placed to take advantage of these trends. Digital economy firms tend to cluster in large, skilled, economically diverse, well-connected urban environments – the capital already has the U.K.’s biggest concentration of digital activity.

Inner East London plays an important role in London’s digital ecosystem. Our research demonstrates that a vibrant cluster of small and medium-sized digital businesses has grown in the area. With over 3,200 firms and 48,000 jobs in the area in 2010, we show that the cluster is larger than generally appreciated (Nathan, Vandore, and Whitehead 2012).

However, the authors expressed some concerns. They recommended that government activity be focused more on supporting the growth of the existing cluster and encouraging the development of high-performing firms, and less on attracting inward investment. They were also skeptical about the idea of a link to the Olympic Park, arguing that this link risked dispersing the current concentration.

A later review by Max Nathan (2015) showed that the digital industries in London have gone through several phases over the last two decades: slow growth in the late 1990s, a spike in the dotcom boom, further expansion in the 2000s, instability from 2008 with a strong dip from 2010, and recovery from 2012. The number of firms in London’s digital industries grew from 33,200 in 1997–98 to 91,000 in 2014–15, with employment rising from 324,000 to 550,000. There is a genuine cluster in East London, but there are many hotspots across London.

Nathan stresses both the links to London's existing sectors, and also new and innovation-led hybrid sectors. "London's digital industries... look quite a lot like the capital's existing industries, but with new, sometimes disruptive digital layers... But we are also seeing the emergence of new hybrid sectors." Hybrid sectors include fintech (financial technology services) and online retail, with emerging sectors in making Smart City products. The development of hybrid or "hyphenated" sectors is in part a direct result of the sector's growth – facilitating both specialization and a larger number of interactions with other economic sectors.

The challenges for the sector include getting access to skilled workers, to finance, to broadband connectivity, and to affordable office space (Tech London Advocates 2015). These issues are common to most business sectors, but perhaps most acute in the tech sector (Nathan 2015).

Alongside the work of the Tech City Investment Organisation, London's own promotion agency, London & Partners (which is supported financially by the Mayor), rapidly made digital technology and science one of its main areas of activity – not just bringing tech foreign direct investment into London, but also providing an aftercare service. In 2014, it instituted London Technology Week (now an annual event) working with UBM (United Business Media) and other partners.

By 2014, the GLA estimated that the Datastore has led the creation of more than 200 apps, such as the Citymapper travel app, which has now been exported to some of the biggest cities in the world, and the Centre for Advanced Spatial Analysis's Bike Share Map, which shows bike hire usage and docking station availability in London and a range of cities globally. The site was attracting 30,000 "unique" visitors a month. But as with most innovations, what was radical and cutting-edge only four years ago was rapidly becoming run-of-the-mill. In October 2014, Datastore 2 was launched – according to the GLA, "vastly improved from a technical perspective and [marking] a significant step in London's journey towards using data to improve city services and quality of life" (GLA 2014). Datastore 2 now contained almost 600 datasets, related to objectives set out in the Mayor's Smart London Plan.

Whereas Datastore 1 necessarily focused on getting the data "out there" to see what developers and others might do with it, by the time Datastore 2 was launched, the emphasis was moving towards how data could be harnessed and used to solve some of the city's most pressing problems. As Mayor Boris Johnson put it: "The superb and much improved Datastore 2 aims to make the best use possible of an encyclopedic amount of information about our great city. I am sure that it will provide a wealth of material that the world's brightest minds will be able to use to develop new insight and apps that can be used to solve the big city problems that we face on a daily basis" (GLA 2014). The Mayor also announced that City Hall would host a series of City Data Challenges – events at which sophisticated analytics would be used to help solve problems affecting city services in a bid to generate economic or practical social value.

The pace of change has been rapid. Organizations such as the Open Data Institute and the Catapults (see below) did not even exist when the original Datastore was first launched, but by 2014 they were partners in the GLA's work. The GLA is committed to publishing all of the information under the Open Data Institute's open data certification scheme, so that users have confidence in its origin, when it will appear next, and in what format.

3.4 Other Governmental Drivers

Other government drivers were important at national and E.U. levels. In late 2013, the U.K. government set up a Smart Cities Forum, chaired by Ministers with representatives from industry and from the leading cities as members. The aim was unashamedly economic and competitive:

Government, cities, businesses and universities are joining forces to make sure the U.K. is leading the global race to develop smarter cities. A new forum led by government will see local authorities and businesses working together to ensure that growth opportunities are not missed in a market estimated to be worth more than \$400 billion globally by 2020. There is huge potential for the U.K. to be the world leader in smart cities. We are well placed to take advantage of up to a \$40 billion share of the market place by 2020, so we must make sure we do not miss this opportunity. The new Smart Cities Forum will bring the best minds together on a regular basis to establish a clear plan to exploit the exciting technologies that we have at our disposal (gov.uk 2014).

Through its Technology Strategy Board (later renamed Innovate U.K.), the U.K. government was already investing in a series of "Catapults" or Technology Innovation Centres, designed to maximize the opportunities for bringing new technologies and innovation to market, and inspired (through quite a long lineage) by Germany's Fraunhofer Institutes.⁷ The Future Cities Catapult, a national organization based in London, opened its doors in 2013.

Funded by government with up to £50 million (close to \$100 million) over five years, but expected to triple through private-sector investment, Catapult's mission is to "help make cities become smarter and more forward thinking... [looking at] ways in which services across areas such as health, transport, energy and public safety can be integrated, helping to boost the economy and benefit citizens" (Innovate UK 2013). Another Catapult – for the Digital Connected Economy – also opened in London in 2013.

Meanwhile, the European Commission was increasingly funding projects in the "Smart" area, generally conceived of in terms closely relating to sustainability and environmental objectives such as carbon emissions reduction, lower resource use and impact, and urban mobility. For example, Horizon 2020, the European

7. Fraunhofer Institutes are centres of applied science, funded through a mix of public and private finance.

Union's multi-billion-euro Framework Programme for research, includes a €107 million (\$156 million) strand on "Smart Cities and Communities."

3.5 The Smart London Plan

In March 2013, the Digital Advisory Board evolved into the Smart London Board, "a top line of experts including leading academics, businesses and entrepreneurs to help advise on how London can put digital technology at the heart of making the capital an even better place to live, work and invest" (GLA n.d.). The Smart London Board is chaired by a leading academic and includes people from academia, industry (Arup, Intel, BT, IBM, Huawei, Telefonica, etc.), and agencies such as the Catapults and the Open Data Institute.

The starting point of the Smart London Plan (2013) is the city's rapid growth – 1 million more people are expected to arrive over the next 10 years, 640,000 more jobs will be created by 2031, and there is a pressing need to create new jobs as well as ensuring Londoners have the appropriate skills. The Plan defines a "smart" approach as "using the creative power of new technologies to serve London and improve Londoners' lives." The Plan sets out seven key themes of which the first is to put "Londoners at the core" – if Londoners and London businesses do not see the benefits, then there is no point to the initiative. Six further themes are set out: access to open data; leveraging London's research, technology, and creative talent; bringing people and ideas together through networks; enabling London to grow sustainably through use of technology; making City Hall serve Londoners' needs better; and offering a "smarter" London experience for residents, through open ideas platforms, better Wi-Fi and connectivity, and better ways for residents and visitors to navigate the city. On the data side, activities emphasize the importance of working partnerships – in particular with the London boroughs.

3.6 Conclusions

In London, the emergence of "Tech City" was an unplanned and largely bottom-up process, in which public policy played a relatively minor, or at least enabling function. But in hindsight, the Tech City phenomenon was nourished and supported by some key assets of the city: a strong university and scientific base; a creative cultural milieu; and a global economic orientation and connectivity to ideas, people, and markets around the world. Hence, the digital industries sector is an important part of London's economy. Through cross-fertilization with other sectors, this sector will have increasing influence on London's future economic direction.

In parallel with its economic development, London has been one of a handful of cities at the forefront of the Open Data movement, and has demonstrated good practice both in terms of setting up the Datastore and in its engagement with developers. As with other cities around the world, it is now moving into the next phase of this process.

The use of "Smart City" technology to improve services and lower costs has lagged behind other developments, although some demonstrator projects have been launched.

Launching initiatives at both national and city levels and ensuring alignment between these levels of government were an important part of the policy response by the city government. In the next phase, policy may need to be more proactive and strategic. As Max Nathan (2015) puts it: “To date, London’s digital industries have evolved under their own steam to form the leading high-tech ecosystem in Europe. To keep growing, and to play a bigger role in improving the city, those businesses and entrepreneurs will probably need help from London government... It won’t be the next Silicon Valley: neither will it be a cloned Shoreditch. But it will be something dynamic, home-grown, successful, which feeds good ideas back to the city that helped nurture them.”

The GLA’s role as a strategic body, the upper tier of a two-tier governance system in London, has both advantages and disadvantages. It has enabled the GLA to be proactive in promoting the economic benefits of data and digital innovation. The GLA has played a leading role in making data available and accessible to the public. However, the GLA’s role in promoting technologies to (a) improve the delivery of urban services and (b) reduce the cost of city services is less developed. This may in part be due to GLA’s delivery mechanism – urban services are delivered indirectly through GLA’s “functional bodies” (agencies) or by the boroughs.

4. Toronto: Accidentally Global

4.1 From “Toronto the Good” to world city

Toronto today is a fast-growing, dynamic, and cosmopolitan world city. It is one of the most diverse cities on the planet – the 2011 Census showed that half the population in the city were immigrants, of whom one-third had arrived in the previous 10 years. In the rest of the Greater Toronto Area, almost two in five residents were immigrants (City of Toronto 2013b).

More generally, Toronto tends to score well in many “global city” surveys, through its unusual ability to earn high (although not top) marks *both* for economic dynamism *and* for quality of life and livability. Tim Moonen and Greg Clark (2013) reviewed 150 city indexes and benchmarking studies and identified a “Big Six” of London, New York City, Paris, Tokyo, Hong Kong, and Singapore: “These six luminaries are now set apart from the rest due to raw economic size, per capita income or rate of growth. Where they have outshone all comers is in coordinating cross-border business services’ exchange. Collectively they have continued to drive transnational service provision as the most popular locations for international offices of financial services, accountancy, management consultancy, legal and advertising firms.” On a composite of five benchmark indicators, Toronto lies in seventh place, jointly with Sydney, just outside the Big Six.

Indeed, in the view of the *Economist Intelligence Unit* in 2015, Toronto was quite simply the best city in the world to live in, according to its “index of indices” (*Economist Intelligence Unit* 2015; Hopper 2015). *The Economist* came to this conclusion by comparing (fairly crudely) cities across several categories: safety, livability, cost of living, business environment, democracy, and food security.

While Toronto did not top the table in any single category, it was consistently ranked high across all the categories.

No less impressive, for a city that 50 years earlier had been characterized by the absence of street life, was *Vogue's* verdict that Queen Street West was the second coolest neighbourhood in the world: "Toronto is currently enjoying newfound prominence – and desirability – amongst globe-trotting tastemakers. Queen Street West is a verifiable artery of indie patisseries, homegrown labels, and hidden-from-view galleries – hallmarks of hipness, if ever they existed" (Remsen 2014).

But it was not always so. In the 19th and for much of the 20th century, both the perception and the reality of Toronto were very different. At the beginning of the 20th century, Toronto had acquired the nickname "Toronto the Good." It was a city of churches, which embodied the Protestant virtues of hard work, a distrust of ostentation and self-promotion, and practicality above dreaming. In the early part of the 20th century, conservative Protestantism in general and Sabbatarianism in particular were major influences on municipal affairs. For example, on February 19, 1912, City Council passed a by-law outlawing tobogganing in public parks on Sundays, an ordinance that remained on the books until December 1961 (Plummer 2008).

As the urban planner Joe Berridge has pointed out, Toronto was once the largest Orange town in the world, and every Mayor from the founding of the city was an Orangeman until the election of Nathan Phillips in 1954 (Berridge 2015). The city is a very different place today, but provenance matters:

Toronto's Orange Lodge has now all but faded away. But the Protestants left a strong trace in our city's DNA. An unostentatious blandness, an enduring politeness, a pleasing reserve, a distrust of beauty, a personal generosity, a distaste for show. A relentless localism, a pride in community, a love of domesticity, a reticence regarding sex. Peace, order, and good government – and don't get too big for yourself (Berridge 2015).

In the words of cultural critic Northrop Frye, Toronto was "a good place to mind your own business" (cited in Fulford 1996). Journalist and editor Robert Fulford called his book about Toronto *Accidental City* and summarized Toronto in the late 1950s and early 1960s as follows:

Thirty or forty years ago, the most obvious quality of Toronto was reticence, which many mistook for a virtue. Toronto was a city of silence, a private city, where all the best meals were eaten at home and no one noticed the absence of street life and public spaces. Sidewalk cafes were illegal, and there were no festivals (Fulford 1996).

The writer and artist Wyndham Lewis, who spent the Second World War in Toronto, referred to Toronto as a "sanctimonious ice-box" amongst much other negative commentary on Canada in general and on Toronto in particular

(Hammond 2010). And yet, as Adam Hammond points out, Lewis paradoxically was a key influence in shaping Canada's and Toronto's more culturally advanced and globally connected future. Lewis wrote that "The earth has become one big village, with telephones laid on from one end to the other, and air transport, both speedy and safe." This passage from Lewis's *America and Cosmic Man* (1948) had a huge impact on the Canadian Marshall McLuhan, who had become friends with Lewis and went on to coin the phrase "the global village" in his 1962 book, *The Gutenberg Galaxy* (Hammond 2010).

In this emerging global village, Toronto has been able to fashion a very different future, aided by communication and connectivity, the economic, social, and cultural benefits of immigration from all corners of the world, and, as with all great cities, making the very best of serendipity and the accidents of history.

This is a remarkable transformation in the fortunes and relative positioning of the city, a transformation that has occurred over less than a century, and has intensified and strengthened in the last few decades. The reasons for this development are many and I shall look at the key assets supporting this transformation below. First, I shall look at how Toronto is governed, how its economy has developed, and how the city is being changed further through digital innovation and the use of data.

4.2 Toronto Governance

Like many major cities, Toronto has undergone several decades of internal debate about its governance arrangements. It has become a cliché, but a true one, that the current arrangement of a single-tier authority for 2.8 million residents is both "too big and too small."

From 1954 to 1998, Toronto was made up of a two-tier structure: a metropolitan tier and a number of lower-tier municipalities (initially thirteen but later reduced to six) (Slack and Bird 2013). The metropolitan level was assigned responsibility for planning, borrowing, assessment, transportation, and administration of justice. Later, further services were added, including police services, social assistance, traffic control, and waste disposal, while property assessment and the administration of justice migrated to the provincial level. Lower-tier municipalities provided a wide range of services including fire protection, garbage collection and disposal, policing, public health, and collection of taxes. Other services such as parks, sewage disposal, and water supply were shared between the two tiers. Metro successfully resolved the service and infrastructure gap between the city and the surrounding jurisdictions. But in the later decades of the 20th century, population growth outside of the Metro area (what was becoming known as the Greater Toronto Area) began to exceed growth in the Metro area (Taylor 2010).

The GTA Task Force (1996) recommended replacing Metro Toronto and the four other upper-tier governments with a new Greater Toronto Council, as well as further amalgamating the lower-tier authorities (Slack and Bird 2013; Taylor 2010). Another expert group, the "Who Does What" panel, recommended something similar later the same year.

In Canada, all cities are “creatures of the province” – that is, they can be amalgamated, de-merged, or re-formed at the fiat of the provincial government. The Province of Ontario had created two-tier regional governments around metropolitan Toronto in the 1970s, and later established coordinating mechanisms for the wider city-region, the Office of the Greater Toronto Area (OGTA) and then the GTA Task Force (Slack and Bird 2013).

However, the Province rejected these city-region solutions and instead opted to merge the authorities within metropolitan Toronto into one single-tier authority in pursuit of the chimera of reduced service costs through amalgamation. In Zack Taylor’s (2010) analysis, as growth and urbanization became significant across the wider region, not just in the Metro area, the Province “was the only actor capable of tackling the issue. In choosing not to expand Metro, the province assumed direct ownership of the response to metropolitan challenges.”

Since, as Enid Slack and Richard Bird (2013) put it, “in Canadian municipal affairs provinces get what provinces want,” a new unified City of Toronto was created on January 1, 1998. Neither expert opinion nor voters were in favour of amalgamation: opposition to the proposal in referenda varied from 70 to 81 percent of voters, on a turnout of 36 percent – a stark contrast to the favourable referendum result (72 percent for, 28 percent against) in London for the creation of the GLA at about the same time. Resistance to the proposal also came from opposition parties in the Province and even some elements within the governing party. Citizen opposition was related mainly to reduced access to local decision-makers and to perceived loss of identity (Slack and Bird 2013).

The potential cost savings from amalgamation were small, as the three largest expenditures were already at the metro level – welfare assistance, transit, and policing, representing 70 percent of all upper- and lower-tier expenditures (Slack and Bird 2013). Between 1998 and 2002, about 2,700 city jobs were eliminated, but 3,600 new ones were created, so there was a net increase in employment (Schwartz 2004). In the longer term, expenditures on fire protection, garbage collection, and parks and recreation all increased after amalgamation (previously, the costs of fire protection and garbage collection had been falling). Library costs continued to fall, although service levels increased. Higher costs are associated with service equalization, so this is not necessarily a bad thing. In addition, as with all government reorganizations, there were transitional costs, and there is evidence that local government became less participatory post-amalgamation (Côté 2009). The City was given broad permissive powers and the ability to use new revenue tools such as a land transfer tax in the 2006 *City of Toronto Act*. At the time this was seen as an important empowering development for the City, but in practice the impact has been muted (Mendleson 2014).

The new authority consisted of a Mayor elected city-wide and 44 councillors elected in wards. Council is the decision-making body; the Mayor is one vote among 45. There is some decentralization to local community councils. A Greater Toronto Services Board was established, but Province support was half-hearted and it was later disbanded. No regional governance structure currently exists.

Although amalgamation within the existing 1998 boundaries was an unlikely solution to the problem of city-region governance and the development of effective economic and social strategies, there is little or no appetite for further organizational reform:

Although amalgamation was unpopular when it came into force over a decade ago, there is little interest in dismantling it today. And although many observers continue to call for a regional authority for the GTA and beyond, there is little political interest in creating such a body at either the local or provincial levels. Provincial politicians may feel that creating a regional authority that would contain about half the provincial population and a much higher share of economic activity would constitute too direct a challenge to their interests and power base (Slack and Bird 2013).

Governance, of course, is about more than intergovernmental relations. However, in Toronto, the wider network of actors, partnerships, and stakeholders is relatively weak compared with other cities. Alison Bramwell and David Wolfe (2014) argue that “Toronto lacks some of the key institutional supports and administrative structures to co-ordinate various regional social and economic development strategies... The lack of a clear voice to represent the Toronto region is reflected in the competing range of definitions of what geographies it constitutes – the Greater Toronto Area (GTA), the Greater Toronto Area and Hamilton (GTAH), or the Greater Golden Horseshoe (GGH).” Bramwell and Wolfe find that institutional, policy, and leadership capacity to develop and implement metropolitan or regional strategies for economic and social development, transit, and planning are limited.

Why is this? In part this goes back to the lack of adequate fiscal resources, but it also relates to the lack of institutional capacity, including the means to bring separate networks together effectively. On fiscal capacity, Enid Slack and André Côté (2014) provided a comprehensive analysis of Toronto’s fiscal health ahead of the 2014 municipal elections. They found that the city does not have a “spending problem” – expenditures are roughly the same as a decade ago, adjusted for demographic change and for inflation. But it does have a resources issue. The largest single source of income to the city is the property tax, which accounts for nearly 40 percent of revenues. The next largest sources are inter-governmental transfers from the Province and user fees. Property taxes in Toronto have been growing at less than the rate of inflation, and Toronto residents pay less than those living in other Ontario cities, partly because of a higher burden on business.

In a steady-state world, this would already be problematic, but the problems are increasing, given the economic and population growth in the city. Slack and Côté are clear: without new revenues, the City cannot maintain investment in existing infrastructure, let alone pay for needed new assets. They estimate that

the maintenance shortfall will grow to nearly \$2.5 billion by 2020. As in other cities, housing and transit are the big-ticket items. There are no certainties about provincial and federal transfers to help pay for this.

So in narrow terms, Toronto is in relatively good shape fiscally and financially – it has a strong economy, solid credit ratings, low interest rates, and a manageable debt load. But this fiscal conservatism limits the ability of the City to plan and invest for the future. Slack and Côté (2014) liken the city’s fiscal condition to the health of an aging Maple Leafs defenseman: “he may be a solid performer on the ice and well cared for by training staff, but he is increasingly expensive and in need of major knee surgery.”

More generally, Toronto faces similar issues to London in that its rate of population and employment growth requires proactive investment in both hard and soft infrastructure – which has to be paid for – to maintain both quality of life and the competitiveness factors that underlie economic success. But institutional structures are not set up to provide proactive, systemic, and strategic funding, while national political pressures are all in the direction of “spreading the jam” across cities, and “balancing” urban and non-urban needs. For both Toronto and London, a successful global city is essential to national economic growth and welfare. In neither case is this recognized and articulated sufficiently by higher-level governments, but the problem appears to be somewhat worse in Canada and Ontario than in the U.K.

On institutional capacity, commentators point to a lack of shared vision across stakeholders, leading to dysfunctional intergovernmental relationships and an absence of effective economic development and planning strategies at the regional level (Bourne 2001; Bourne, Britton, and Leslie 2011). Bramwell and Wolfe (2014) argue, “The challenges of scale are clearly reflected in the areas of a regional economic development strategy, global marketing and investment attraction... Rather than striving to improve regional governance, local actors have opted to pursue the economic development goals of their individual municipalities.” One of Bramwell and Wolfe’s interviewees refers (in confidence) to the economic development field in Toronto being “strewn with the bodies of failed initiatives.” This has been shown in the partial success – or lack of success – of initiatives such as the Greater Toronto Marketing Alliance, or Metrolinx, the regional transportation authority.

Bramwell and Wolfe (2014) argue that Toronto is characterized by fragmented networks and weak civic leadership. While networks exist around specific issues and interests, they act mostly in isolation, with “few regularized interactions within social or economic development networks in the Toronto region, and certainly even fewer coordinating mechanisms to facilitate ongoing strategic collaboration between them.” They point to a number of issues highlighted by their interviewees – the lack of a single voice for a large and growing city; the lack of engagement of

the business community with debates about economic strategy; and the absence of civic entrepreneurs. One possible exception has been the Greater Toronto Civic Action Alliance (CivicAction) which grew out of the Toronto City Summit Alliance, founded in 2002. CivicAction brings together multi-sector leaders across the region to improve the region's economic, social, and environmental future.

As a result, strategy documents with an analytical base and a clear vision, such as the City of Toronto's *Agenda for Prosperity* (2008) and *Collaborating for Competitiveness* (2013a) have been produced – depicting Toronto as a global business city and a hub for environmental innovation, with an emphasis on creativity, diversity, and technological excellence. However, such documents lack a connection to the key levers of city and provincial government, and have little traction with the wider non-governmental actors needed to implement and deliver economic change.

Major governance challenges remain, and the Toronto region continues to struggle with weak municipal policy capacity, a perceived lack of concerted and visionary leadership and strained multilevel governance relations, but the extent to which these obstacles are structural, constitutional, cultural, political, or simply a function of geography is unclear (Bramwell and Wolfe 2014).

Three legacies from the 1998 amalgamation impair the ability of elected officials working with others to provide economic leadership, vision, and strategy for the city and the wider region: first, the failure of the 1998 amalgamation to address the need for leadership, accountability, and strategy for the wider Toronto region; second, the abolition of the two-tier system, which means that Toronto City Council must juggle responsibilities for strategic issues (transit, economic development, planning) with the delivery of a wide range of urban services; and third, the continuance of a “weak-mayor” governance model in which the Mayor, with limited powers, is the only political representative for the (now much larger) city elected on a city-wide mandate.

4.3 The Economy of Toronto and the Region

As with all major cities, we need to understand the “Toronto economy” at more than one spatial scale. The narrowest definition refers strictly to economic activity within the city boundary – containing about 2.8 million people and 1.5 million jobs in 2011. The Greater Toronto and Hamilton Area (GTHA) consists of the four neighbouring two-tier regions of Durham, York, Peel, and Halton, as well as the single-tier City of Hamilton – with about 6.9 million people and 3.6 million jobs. Finally, the Greater Golden Horseshoe (GGH) comprises the wider mega-region of more than 9 million people and 4.6 million jobs.

In the absence of a metropolitan or regional strategic government, the Province of Ontario plays a major role in land-use planning and the management

of growth. As Taylor (2010) puts it, “As the scale of urbanization increased in the 1960s, a new policy choice emerged: between local and provincial management of metropolitan policy. The creation of the regional municipalities and the rejection of Metro expansion settled the question in favour of the provincial option.”

The Province has issued a *Growth Plan for the Greater Golden Horseshoe* under the *Places to Grow Act* 2005. The Growth Plan describes the GGH as “the destination of choice for many people and businesses relocating from other parts of Canada and around the world. They settle here because of the high quality of life and the economic opportunities” (Ontario Ministry of Infrastructure Renewal 2006). The GGH economy is described as diverse, with key industries including manufacturing (of which automotive is the largest), financial and business services, hospitality and tourism, education and research, life sciences information services, and agriculture; it is also an economy in transition towards service and knowledge-based industries. The workforce is highly educated, and social and economic diversity is a key strength.

The Growth Plan forecasts that jobs will rise in the GGH from 4.64 million in 2011 to 5.56 million in 2031. For the GTHA, the numbers are 3.63 million to 4.33 million, and for the City of Toronto, from 1.54 million in 2011 to 1.64 million in 2031. These estimates represent 46,000 net jobs each year for the GGH, 35,000 net jobs for the GTHA, and 5,000 for the City of Toronto.

In terms of population, the Growth Plan forecasts increases of 120,000 a year for the GGH over the same period, from 9.1 to 11.5 million, increases of 88,000 a year in the GTHA (6.86 to 8.62 million) and 16,000 a year in the City of Toronto (2.76 to 3.08 million). Later population projections for 2011–2041 by the Ontario Ministry of Finance (2014) give a higher rate of increase for the GTHA of about 107,000 a year – the 2041 population is estimated to be over 9.4 million.

In the short term, the economic prospects for Toronto are good. Employment growth in the Greater Toronto and Hamilton Area is forecast at 1.5 percent in 2015 and 1.7 percent in 2016, compared with 0.3 percent in 2014 (Credit Unions of Ontario/Ontario Chamber of Commerce 2015). The Conference Board of Canada (2015) sees Toronto, along with Vancouver and Halifax, as the fastest-growing metropolitan economies in Canada this year, while “long-standing economic leaders” Calgary and Edmonton will fall into recession, affected by the collapse in oil prices. However, TD Economics (2015) sees the western provinces “returning to the head of the growth pack once oil prices return to somewhat higher levels.” They argue that Central and Eastern Canada as well as British Columbia will fall behind as a result of weak population growth, which does not appear to be the case in the GTHA or GGH.

Hence the economic fundamentals of Toronto and the wider region are strong, with several key growth points, including the area around Pearson airport, Mississauga, Markham, Guelph, and Kitchener-Waterloo, as well as downtown Toronto. However, regional economic governance is weak. There is no overall

body in charge of the economic region. The City of Toronto covers only a part of the built-up area, let alone the wider economic region. The Province's growth plan is focused mainly on land use planning and housing, with relatively little leadership or direction on economic development, beyond ensuring the provision of "employment sites."

Toronto's economic strength and global orientation is also shown in the development of its main airport, Pearson International, where annual passenger numbers have risen from 10.5 million in 1974 to 38.6 million in 2014, with a further rise to 64 million projected by 2033. The proportion of international passengers has risen from 48 percent in 1985 to 60 percent in 2014, and is projected to reach 67 percent by 2033 (GTAA 2015). For several years, Toronto has been the leading North American city for high-rise construction, with 130 projects in place in 2014 to second-place New York City's 91 (Emporis 2015).

Compared with other global cities, there is arguably a lack of global champion firms, and of a shared narrative across all levels of government and business organizations about the strengths of Toronto and the region. Toronto has a successful, secure, and stable financial services industry, which has avoided most of the problems that have plagued other major centres in the last 10 years – surely a competitive asset. "Fortunately, Toronto was better able to weather the impacts of the economic downturn and recession than most cities around the world. In large part, this was due to the strength of the Canadian financial services sector, headquartered in Toronto, and the diversity of the city's economy" (City of Toronto 2013b). However, some commentators would argue that stable banking is mostly a by-product of a wider culture of risk aversion and inability to "think big," along with protectionist national economic policies.

The City of Toronto clearly recognizes the challenges as well as the opportunities for Toronto, and the importance of a cross-government and joint private-public approach. "Sustainable economic growth cannot be achieved by any one order of government, organization or agency acting alone... [it] can only be achieved through ongoing cooperation among all stakeholders, including external as well as internal organizations. Cities need collaborative and systematic approaches... this Plan [*Collaborating for Competitiveness*] recognizes that it is the private sector, not governments, that generate economic growth and create jobs" (City of Toronto 2013a).

Offsetting these perceived weaknesses are some huge strengths: world-class universities, hospitals, and research institutes; a successful public education system generating a highly educated workforce; the economic benefits from global migration over the last few decades; generally successful integration and settlement policies; and a burgeoning and globally connected digital, creative, and media sector. I shall look at these assets in more detail below.

More generally, there appears to be a lack of recognition at the higher levels of government of the importance to the national economy, and to Canada's economic future, of nurturing and supporting successful cities (in general) and Toronto – as Canada's only candidate global city – in particular. Although the Canadian national economy is relatively diversified, it is hard to see sectors such as fisheries, manufacturing, and agriculture providing much growth impetus in the next few decades, while the resource sector, as in many other parts of the world, will remain a rollercoaster tied to world prices for oil, gas, minerals, and other commodities, with all the instability (and undoubted benefits) that entails. Therefore, it would seem entirely rational for both the Province and the federal government to do all they can to ensure the continuing economic success of the Toronto Region and to support and enhance its global role. Yet this does not currently seem to be the case.

Speaking at the University of Toronto in 2011 on the theme “The Next Urban Economy: Can Toronto be a Global Leader?” Greg Clark identified several key features of the next global economic cycle: productivity rather than consumption; a distinctive rather than “me-too” city approach; specialization in knowledge-led activities; emphasis on entrepreneurship and innovation; orientation towards growing markets globally; human capital, talent, openness; quality of life and quality of place; and resource efficiency and low carbon emissions (Clark 2011). In this new cycle, leadership rather than “government” will be key, and assets rather than cash. Toronto has many of the qualities to succeed in this new cycle, but will it complete the set by also addressing its difficulties?

4.4 Toronto: Intelligent City

In 2014, the Intelligent Communities Forum (ICF) voted Toronto “Intelligent Community of the Year.” The ICF is “a think tank that studies the economic and social development of the 21st century community.” The ICF emphasizes the importance of broadband, and connectivity more generally, arguing that for “the 21st century community, connectivity is a double-edge sword: threatening established ways of life on the one hand, and offering powerful new tools to build prosperous, inclusive and sustainable economies on the other” (ICF 2014a).

This was the third year that Toronto had reached the final stages of the competition, and followed the success of Waterloo, Ontario, in 2007. According to the ICF, Toronto performed well on a wide set of criteria, including bringing together its academic, creative, and private sectors with City Council leadership. Specifically mentioned were the “waves of Toronto start-up companies coming from tech incubators and places like the Digital Media Zone at Ryerson University, innovations and research for the film and media industry from Pinewood Studios, the remarkable recovery and artistic output of Regent Park and the city's sustainable new Waterfront development.” In summary, the ICF's view was that “Toronto offers a glimpse of how to flourish in the new economy and of how to adjust to the changes of the digital era” (ICF 2014b).

WATERFRONT TORONTO

By the early 2000s, Toronto's (unsuccessful) bid for the 2008 Olympic Games had drawn attention to the city's failure over many decades to realize the huge potential of its waterfront. Separate land holdings by the three levels of government and the failure to agree on joint plans meant that for many decades, very little had happened. Toronto's demographic growth indicated there was plenty of interest in building condo towers by the water but not as part of a coordinated long-term plan. In 1999–2000, Waterfront Toronto was created to manage and sell the land collectively owned by the three governments, who each put in an initial \$500 million, with future asset sales intended to be the motor for further development. "Waterfront Toronto's business model is based on strategic investment in enabling infrastructure, transforming brownfields and other underutilized lands to attract development opportunities and reinvesting land sale proceeds into further revitalization" (Waterfront Toronto 2013).

Waterfront Toronto is an ambitious project, with a mission not only to regenerate 2,000 acres of land, and add tens of thousands of new residents and jobs, but more broadly to "[t]ransform Toronto's waterfront for the people of Toronto, Ontario and Canada, to foster economic growth and to ultimately re-define how the city, province and country are perceived by the world" (Waterfront Toronto 2013). It is the largest urban redevelopment organization in North America, funded mostly from private investment; bigger than Canary Wharf and Battery Park City combined. It is also intended to be the world's leading intelligent community, with a focus on the economic "long game" – attracting talent and capital to the waterfront and thereby extending Toronto's talent pool.

There is a strong emphasis on livability with public parks and public space and also a commitment to provide broadband/connectivity, seen as a driver of jobs as well as a key component of the residential offer. An iWaterfront Advisory Council was set up, bringing together partners from the ICT community, with sectors including arts, libraries, police, and transit – the aim being to create one of the world's most advanced broadband communities.

Waterfront Toronto adopted an open-access model for broadband provision, selecting a local company rather than one of the small number of national firms to provide the fibre through a competitive process. This is only the second open-access model in North America. Eventually, 500 Mbps upload/download speeds will be provided to all residents, at a cost of \$60 a month with no data caps. The network is capable of upgrading to 1 gigabit service to every unit if required, and can be adapted to supply 10 gigabit service in the future. Businesses are promised access to 1 gigabit and 10 gigabit Internet connectivity (CNW Newswire 2014). The contract is build/own/operate; the contractor (Beanfield Metroconnect) has to show that it remains among the seven leading intelligent community network services in the world for at least 10 years beyond the occupancy of the last building in the new communities. Service fees are capped for 10 years, and the contract specifies performance and openness.

Developers pay an amount per door for the agreed connectivity, on the expectation that the sales value will be buoyed by at least this amount because of the top-of-the-range connectivity offer. Monthly service costs are in addition. Tenants of affordable housing will pay a reduced (or, in some cases, zero) monthly service cost to ensure 100 percent availability. Waterfront Toronto is still in the early stages, but the first households have moved in, and more are doing so now that the Athletes Village has been released as general housing after the Pan Am/Parapan Games in summer 2015.

MaRS

Another significant government-funded innovation initiative is the MaRS Discovery District (MaRS stands for Medical and Related Sciences), one of 18 Regional Innovation Centres. MaRS launched in 2005, and is now one of the largest innovation hubs in the world, a 1.5m-square-foot complex in the heart of the “Discovery District,” that is, the research cluster that has grown up close to the universities, hospitals, and other facilities in downtown Toronto.

MaRS’s mission is to drive “economic and societal prosperity by harnessing the full potential of Canadian innovation.” It focuses on entrepreneurship and innovation, collaboration and convergence, helping start-up ventures grow, and working with partners to make existing systems more receptive to new ideas, products, and companies. MaRS concentrates on the key areas of work, learning, health, and energy “because we feel that our future will be defined by where we work, how our children learn, our ability to access quality healthcare, and how we power our homes and cities. We also believe that economic and social considerations must be evaluated together in order to drive real change. As our society is disrupted by increased globalization and technological change, we believe the key to leading this change is entrepreneurship. After all, the innovative products & services that help us shape our future are typically developed by startups – the same companies that also create the majority of new knowledge economy jobs” (MaRS 2015).

There are about 100 tenants in the MaRS building as of mid-2015, ranging from small start-ups to wet labs to digital giants such as Airbnb. There is a strong emphasis on fostering collaboration – between small and large firms, between start-ups and business services such as law and accountancy, between innovators and major corporations, between university researchers and the commercial world generally. MaRS has become controversial in recent years because of the financial difficulties encountered in building its ambitious (critics would say overambitious) second stage, necessitating additional government support. In a familiar argument, critics of MaRS argue that public-sector initiatives should not attempt to “pick winners” or intervene extensively in the property market aspects of innovation and what should be private-sector decisions about the provision of workspace, while MaRS robustly defends its record in terms of impact both on the innovation ecosystem and the city’s economy more generally.

If initiatives such as Waterfront Toronto and MaRS succeed (see boxes) it will be not just because of the specifics of the initiatives and projects themselves, but also because they can channel and hopefully augment both the potential of the emerging ecosystem and also the strengths of the more fundamental assets on which the ecosystem rests. By this, I mean Toronto’s “deep assets” in terms of its universities, libraries, advanced life sciences research institutes, school and college system, and commitment to learning and advancement. Specific initiatives such as these can also raise the profile of Toronto as a place to invest in innovative digital and tech-based firms.

Given the university and research base in Toronto and the region, it is clear that this is a world-class city in the knowledge economy. The University of Toronto is globally ranked in the top 20 (Times Higher Education Supplement

rankings), one of only five institutions outside the U.S. to be in that group. Reputationally it is ranked 16th in the world. In Engineering and Technology it is ranked 24th. According to the ACWU rankings (the Shanghai Index), Computer Science at UofT is one of the top 10 departments globally, the only university outside the U.S. in this elite group. Moreover, there is strength elsewhere in the tertiary sector in Toronto.

In the wider area, the region of Kitchener-Waterloo stands out. The region has long been a centre of manufacturing, playing a role in most technological advances, including automobiles, processed food, biotechnology, and computing (Bramwell, Nelles, and Wolfe 2007). More recently, technological leadership continues in wireless communications, software, robotics, and other fields. Formalized cooperation locally, particularly through Communtech, and the local high-tech firms' association Canada's Technology Triangle⁸ (an inward investment agency joint-funded by the region and the municipalities) is also important.

The University of Waterloo (UW) plays an important role – it has been ranked Canada's top university for innovation for 23 years in a row by *Maclean's* magazine. Its engineering school is in the top 50 globally on the Shanghai Index. Waterloo is best known as the birthplace of Research in Motion/Blackberry, but its technological strengths and role as an innovation cluster have much deeper roots. The university was established in 1957 by two local businessmen, with a focus on “engineering, mathematics and science, at a time when these weren't especially prized” (Gillmor 2012). Hence the current high-technology cluster grew out of a combination of the region's existing strong industrial base in advanced manufacturing, combined with the new university's focus on engineering, math, and computer science (Vinodrai forthcoming). Early university spin-offs that became established firms were WATCOM and Dantec Electronic, followed by Dalsa, Virtek Vision, and Open Text in the 1980s. RIM/Blackberry, while technically not a university spin-off, later became an iconic global brand.

The university's role in the economic cluster has several aspects: through spin-offs and commercialization activities, by providing a strong pool of local talent, and through transferring cutting-edge knowledge to local firms through R&D consulting and joint research (Bramwell, Nelles, and Wolfe 2007). UW has adopted a laid-back approach to intellectual property rights, allowing students and staff to retain the rights to what they develop through their association with the university.⁹ Other postsecondary institutions in the region – Wilfrid Laurier University and Conestoga College – also play important roles in the ecosystem.

For many observers, UW's “co-op program,” whereby students enter the workplace for several four-month stints as part of their degree, is seen as a particularly important linkage between the university and the local economy.

8. In 2016, Canada's Technology Triangle will be folded into a new organization with a wider mandate – the Waterloo Region Economic Development Corporation.

9. The University of Cambridge in the U.K. uses a similar approach.

Bramwell, Nelles, and Wolfe (2007) report three benefits: a steady source of new hires locally; co-op students acting as an important source of knowledge transfer; and because of the university's international reputation, local firms' having to compete with global firms to attract the best students.

On the back of these intellectual and entrepreneurial strengths, nationally and globally successful spin-offs were generated, including Open Text, which became Canada's largest software company, and of course Blackberry, which at its height was a multibillion-dollar global major player, estimated to have brought 7,000 to 8,000 highly talented people to the region. Moreover, early research suggests that even with Blackberry's current woes, talent has stayed in the region, potentially fuelling another round of innovation and economic growth (Vinodrai and Spiegel 2015).

Mike Lazaridis, RIM's co-founder, has reinvested substantial amounts in his former university to establish both the Perimeter Institute for Theoretical Physics, and the Institute for Quantum Computing, both working at the leading edge of scientific discovery and innovation and attracting top global academic talent. Lazaridis's view is clear: Canada was a bystander in the silicon revolution and had to play catch-up; now there is an opportunity to establish a world-leading cluster on the next scientific and technology cycle – Quantum Valley: “There is a quantum revolution coming, an industrial revolution,” he believes (Brean 2013).

The Region has taken steps to develop and promote its economic and residential offer. The City of Kitchener in 2004, witnessing the decline of the region's manufacturing base, took the decision to set up a \$110-million investment fund, focused on downtown regeneration and repurposing the core of the city. The Region has promoted a light-rail transit system connecting Kitchener, Waterloo, and Cambridge, and when co-funding from the provincial and federal governments fell short of the full amount, went ahead anyway, funding the project in full.

While the Waterloo story is at times “over-hyped,” it is undoubtedly a successful hi-tech region with an increasing global presence that has been able to survive and continue to prosper despite the travails of Blackberry – evidence that it is the region rather than any single firm that is significant (Vinodrai and Spiegel 2015). The next important step both for the Waterloo Region and for Toronto is to improve the connections (physical, promotional, intellectual, commercial) between these two places and to harness their complementary strengths, as a future driver of Ontario's and indeed Canada's economic future.

Toronto is strong also in the film, media, and the emerging gaming and related sectors (digital convergence). Toronto is the third-largest film production centre in North America with an estimated \$1.23 billion annually spent on crews, talent, and related services and an overall economic boost of about \$3 to 5 billion from the entertainment sector. In terms of the city's economy, this is the second-largest sector after financial services.

The success of the Toronto International Film Festival (TIFF) means that Toronto is seen as being more than just a production hub, but one of the global

capitals of, and showcases for, film and related cultural products. There are other regular film festivals too – “Hot Docs” is the second-largest documentary film festival in the world.

Digital technology is at the heart of these developments, both in terms of the process by which film and TV is produced, edited, and created, and also in terms of the convergence of talent, process, and product across the previously separate sectors of film, television, animation, and gaming – and the synergies with many other sectors across the city. The commitment to digital connectivity on the Waterfront will be significant for investment and the future of the sector.

Underpinning these competitive factors is the strength of the education system. Canada has one of the best education systems in the world, as shown for example in OECD PISA (Programme for International Student Assessment) scores,¹⁰ and moreover, educational outcomes have been relatively equitable across the nation and across the city. In addition, Toronto has probably the best library system in the world. While it would be hard to demonstrate a direct link to economic success, the economic impact of the Toronto Public Library (TPL) has been estimated to be of the order of \$1 billion to the city (Martin Prosperity Institute 2013). TPL also functions as a visible commitment of the city to learning and advancement – a key part of the city’s brand – as well as providing front-line services to promote integration and settlement of new immigrants.

4.5 Open Data in Toronto

The City of Toronto sees Open Data as a key part of its commitment to open government. City Council established an Auditor General in 2002 and an Integrity Commissioner in 2004. The 2006 *City of Toronto Act* established mandatory functions, including the Auditor General, Integrity Commissioner, Lobbyist Registry, and authority to appoint a Lobbyist Registrar and an Ombudsman. Led by the City Manager’s Office and the City Clerk, the City is in the process of extending this openness to the release of data to citizens and to the way in which data are used and managed at City Hall and by the City’s agencies.

More broadly, Jennifer Keesmaat, the City’s Chief Planner, has stated her ambition for Toronto to be “the most engaged city in North America.” Survey research by Ipsos Mori shows that those participating in city planning processes in Toronto are primarily white, over 55, and homeowners, while the city itself is mostly foreign-born and non-white; 40 percent are tenants rather than owners; and the fastest-growing demographic in some parts of the city is those under 35. Keesmaat goes on to say that social media is becoming “an essential tool...for communicating engagement opportunities with the public, but also for engaging people who might not otherwise feel comfortable (or able, due to physical, financial, family, or work constraints) participating in a community meeting.”

10. There is currently concern about a decline in Canada’s scores in mathematics in the latest round of PISA tests.

Working with the City Manager's Office, the planning department is piloting IdeaSpaceTO, a social media tool for facilitating high-quality online discussion between residents and the city. These virtual tools are intended to complement, rather than replace, in-person engagement (Keesmaat 2015).

As far as engagement is concerned, the aim is to broaden relationships beyond the app development community by making data not just available but also useful to a wider group of people. The City is looking at how the city portal can be more relevant to users, for example through users' defining and thereby more easily accessing relevant information.

This approach needs to be matched by a culture change in the attitude of City Hall and its agencies – as well as other local, provincial, and national governments – towards data. Rather than seeing data as “belonging” to a particular department or even individual, the aim is for all data held by the City to be seen as a corporate asset, belonging ultimately to citizens and held in trust for them by officials.

To that end, the City is engaged in a cross-department process, and has set out an information management framework with a strong emphasis on accountability. This process, it is hoped, will help to break down inter-departmental boundaries and bureaucratic silos. One of the challenges for the City is working with systems that were never designed to be open or compatible with other systems, with the aim of making them just that – open, accessible, and interoperable.

In moving towards Open Data and Open Government, Toronto, like other cities around the world, is both responding to and stimulating citizen activism relating to accountability and transparency. The city now puts considerable information about its budget online. The civic initiative Better Budget Toronto reviewed the process of budget setting in 2015 against four key principles: participation, accessibility, vision, and the use of evidence. It concluded that “While the City of Toronto is making progress on all four of these principles, there remains considerable opportunity to improve, especially when compared to other cities globally that are at the leading edge of open, democratic budgeting.” Among its recommendations were greater provision of interactive online tools for residents to provide input on the budget, and continuing “to improve budget data on the Open Data portal, making data more detailed, current, and machine-readable, providing a codebook to define expenditure and revenue categories, and engaging the open community on creative ways to use the data” (Better Budget TO 2015).

In terms of improved service delivery, Toronto's Mayor John Tory has said he wants to harness the power of Big Data and technology to solve the city's key challenges – particularly mobility and transit. The Mayor said: “We're going to get us out of the clicker and clipboard business and into the 21st century” (Rider 2015). The City's Transportation Services announced that it was setting up a Big Data Innovation Team, which will partner with McMaster University to analyze travel data on city expressways and streets, develop a Big Travel Data strategy,

and vet products and services that can assist the City in better decision making and investments.

“Learning about how we can better use travel data – by all modes – is a huge step forward,” said Toronto Councillor Jaye Robinson, Chair of the City’s Public Works and Infrastructure Committee. “We need to be investing in projects that tap into the power of Big Data. This type of work will serve as a foundation for improving commutes for all Torontonians, whether you travel by transit, bike or car” (City of Toronto 2015).

Other municipalities in Ontario (although not Toronto) have begun to use Internet voting. By the 2014 municipal elections, 97 communities were using Internet ballots as a voting alternative, the largest city doing so being Markham in the Toronto region (population 300,000). While there is no evidence that Internet voting increases turnout, it is popular, suggesting evidence of “a public desire for greater access” (Goodman 2014).

4.6 *The Narrative Around City Assets*

Major cities are now engaged in global competition. To be successful, city leaders need to understand the unique strengths of the city; support and enhance the specific assets of the city; and construct and promote a narrative around those assets. Ideally, narrative and assets are closely aligned.

Many cities around the world have developed convincing narratives for which the evidence base and city assets appear to be lacking. Toronto perhaps provides a rare example of the reverse. The assets of the city and the objective metrics both for its global city status and for its successes in terms of economic and social development seem to exceed the capacity of the city to weave these facts into an overall narrative that can be shared across all levels of government, as well as between the public and private sectors. There is no lack of assets to build on.

First, as the preceding sections have shown, Toronto is very strong on “Eds and Meds” – it has excellent universities, hospitals, and research organizations. The University of Toronto is in the top 20 universities worldwide according to the *Times Higher Education Supplement* rankings, and the UofT Computer Science department is in the top 10 globally according to the Shanghai Index. There is also strength elsewhere in Toronto’s higher education sector and across the region.

Second, and despite recent concerns about Canada’s slipping comparative performance on math scores, Canada does well on international comparisons of educational performance. Moreover, Canada has generally done better than most countries at compensating for income inequalities in achieving educational outcomes (CMEC 2012).

Third, Canada in general and Toronto in particular continue to attract people with talent, energy, skills, and entrepreneurship from across the world. Its approach to immigration and integration is widely and correctly admired. Half the population of Toronto is foreign-born, and the city has been transformed in the

last 50 years through the impact and influence of immigration. Moreover, the city and the country seem to have found a balance between immigrants' retaining their ethnic and cultural identities while at the same time becoming "New Canadians." In addition to its social and community benefits, this successful balance also has major economic benefits. Not only does it bring talent, ideas, and energy to the city, but it also contributes to vital global connections to cities, countries, and communities all over the world. These global connections are a vital asset to any city that has them – encouraging a two-way flow of people, money, ideas, and services – and a key aspect of being a genuinely global city.

Fourth, Toronto scores well in international rankings for security and livability (EIU 2012, 2015).

Fifth, the city has a commitment to social equity, although there is evidence that this commitment has eroded over the last couple of decades (Hulchanski 2010).

Sixth, the city has a stable banking system that has mostly avoided the crises that have plagued other global centres of financial services.

These and other assets strongly support the view that Toronto is a genuine world city. What has been lacking is a clear and compelling overall narrative, shared by government and non-government actors, which draws on these strengths and the city's history to present a compelling vision to the rest of Canada and the world.

It would be easy to attribute this lack of a shared, compelling narrative purely to the governance arrangements for the city, and the lasting legacy of the 1998 amalgamation, for a number of reasons. Toronto's administrative boundary is too small relative to the size of the built-up area and the economic footprint of the city. The city has to deliver a wide range of services on a one-tier model. And the city's "weak-mayor" system inhibits bold long-term and city-wide decision-making. However, this would be an over-simplification. Whatever the governance arrangements – and in no large city in the world are they ideal – it is possible for public and private actors to develop a shared vision, agree on strategic long-term targets, and work together to achieve common goals.

Both Ontario and Canada have much to gain and nothing to lose from a successful Toronto, but this goal is rarely if ever made explicit. The more general point is, as Sir Peter Hall put it (in a public lecture in Toronto): "Every city can try... The chances are not equal. But the disadvantages are no longer of the permanent, immutable kind: they can be changed by public and by collective private action" (Hall 1999).

4.7 Conclusions

Toronto has benefited from three key political-historical facts. In the 18th (and 19th) century, the city had the good fortune not to become part of the U.S. Instead, it eventually became the largest and most economically important city in an

independent Canada. In the latter part of the 20th century, it benefitted greatly from both the liberalization of federal immigration policies and also from the exodus of investment and talent from Montreal in the wake of fears of Quebec separatism.

While some of Toronto's strengths may have an "accidental" origin, the city has been able to build on those accidents. Regional economic success often results from the ability to "lock in" specific advantages (that may have originally arisen through chance), but that become powerful economic benefits through the operation of increasing returns and the gains from trade. Toronto's current position is therefore not accidental in the sense of arbitrary – it rests on some fundamental assets, including strong educational institutions, livability, diversity, and a stable banking system.

However, fragmented governance arrangements and the lack of strong public-private networks across the wider Toronto region have hampered the development of a long-term regional economic growth strategy, both in general and specifically with regard to the potential of data and digital innovation. Conversely, the City of Toronto's role as a single-tier authority with wide service delivery responsibilities may mean that it is well placed to realize the benefits from the introduction of "Smart City" technologies to the delivery of city services in the future.

5. Data and Digital Innovation: National Policies

What role can and should the state play in "innovation"? How can policies be designed and implemented to achieve desired outcomes? A detailed answer to these questions is outside the scope of this paper, but it is important to recognize that city responses to digital innovation and the data revolution take place in a context of national innovation policies and institutions. Equally important is to recognize that understanding the drivers of innovation is a complex task, with an elusive goal, and policy responses will need to be nuanced and subtle – not an easy task for government. As Dan Breznitz puts it, "It is a cardinal sin of innovation policy not to have a vision. It is a second cardinal sin not to be flexible and experimental in turning this vision into reality" (Breznitz 2014b).

Ideological positioning – private sector good, public sector bad (or the reverse) – is unhelpful. Fundamentally, innovation (in the economic sense) is an activity by individuals, firms, and markets. But the state has a huge influence – through its own research and development activities, through its procurement policies, through its shaping of markets, through its funding of universities and other education institutions, through its taxation and spending decisions, and in many other ways. This is not about trying to create the next Silicon Valley (a pointless activity), but rather about recognizing and understanding the strengths and weaknesses of the national or regional innovation ecosystems and taking appropriate action to support and promote these strengths, and to modify or remove weaknesses. Not everywhere can be an innovative milieu, and the places that are will require different types of support and initiatives depending on their characteristics.

So it is helpful to think about the role of specific regions or countries in the context of the wider system of global production, and the role that firms located in a specific place play within this. As Breznitz (2014a) notes, “The rise of the new system of global production... means that *different modes of innovation are needed in order to thrive in different stages of production... different nations can achieve rapid and sustainable growth by focusing their innovation activities on various stages of production.*” Hence, for example Taiwan, Israel, and Ireland, the focus of Breznitz’s earlier book (2007), developed distinctive strategies at the state level for innovation.

How can policy best support innovation and economic growth? Nathan (2015) identifies two main schools of thought. Policy minimalists “argue that digital ecosystems are self-organizing and government should get out of the way,” while others contend that behind many tech successes is a long trail of state support. In practice, most governments have opted for a compromise, “funding basic research, encouraging R&D, de-risking early stage finance via tax breaks for investors and, in some cases, developing active sector support strategies which bring these elements together, as in the U.K.’s 2013 *Industrial Strategy*.”

While support for entrepreneurialism is important, national policy needs to be about more than just encouraging start-ups and leaving everything else to the market. Mariana Mazzucato (2011, 2014) and others have criticized the British “infatuation with small and medium enterprises...based on the idea that economic growth is created by ‘entrepreneurial’ small firms” (Mazzucato 2014), arguing that there is little empirical evidence to support such policies. Certainly, it is the case that traditional broad-based business support to small and medium-sized businesses over many decades has shown relatively little economic return. This fact is broadly recognized, so that policy in the U.K. (and elsewhere) is increasingly focused on a hunt for the elusive “gazelles” – the small minority of innovative and fast-growing firms – among the much larger herds of steady-state or declining small and medium-sized businesses. In addition, the U.K. state also invests both in university science and technology research, and in R&D support for firms.

Mazzucato (2014) argues, “innovation-led ‘smart’ growth has occurred mainly in countries with a big group of medium to large companies, and a small group of SMEs that is spun out from some of those larger companies or from universities.” She points out that much of this innovation and growth rests on earlier government-funded research and the development of new technologies in the government-funded sector on the basis of which new and hugely successful products and services are developed in the private sector. Venture capital with its need for short-term returns, plays a minor role in developing radical long-term innovation.

Martin Wolf (2013) in the *Financial Times* is broadly supportive of this argument. The state is not an obstacle, but a partner in driving innovation, and innovation determines the growth of output per head and hence living standards.

Where government funds the risks of innovation, but leaves the rewards to the private sector, the result is not a symbiotic innovation ecosystem, but rather “a parasitic one, in which the most lossmaking elements are socialized, while the profitmaking ones are largely privatized” (Wolf 2013).

A report in 2015 by the Atkinson Foundation and the Broadbent Institute (Sas 2015) applied this analysis to the Canadian context, with the explicit aim of challenging “inaccurate or incomplete perceptions about public investment in innovation,” and raising questions about current innovation policy, tax regimes, and growing inequality. The authors, along with other commentators, are concerned about Canada’s current comparative performance in innovation, part of a more general worry about Canada’s “falling behind” economically.

Stian Westlake (2014) is broadly supportive of Mazzucato’s analysis, but disagrees with many of her specific policy proposals. The “core argument that government has a role to play in backing new technologies is surely correct”; innovation is not solely the work of “heroic entrepreneurs alone.” However, Westlake makes the point that even though the technologies embodied in the iPod and iPhone (an example used by Mazzucato) were developed mainly in the government sector, Apple was nonetheless responsible for “integrating these technologies with one another; improving them to make them usable, reliable and portable rather than clunky prototypes; brokering deals with cellular carriers and record labels so iPhones could make calls and download songs and be affordable; and even marketing iPhones in a way that people would be willing to buy them.” These were, as Westlake says, “risky, difficult undertakings” – in other words, innovations.

In terms of policy, Westlake supports Mazzucato in advocating for more government investment in R&D and human capital formation; expanding and reforming Innovate U.K. (formerly the Technology Strategy Board); scrapping the Patent Box regime;¹¹ and looking hard at subsidies to small businesses. But he is opposed to one of Mazzucato’s main recommendations – that the state should share directly in the gains from innovation, for example, through golden shares, income-contingent loans, and equity and development banks, the various ways in which the government can retain a financial interest in the companies developing the innovations. Westlake raises a series of objections both in principle and in practice, and points out that where the state has fostered innovation, it has often been in “oblique” or even “messy” ways. Conversely, many strategic attempts by the state to foster innovation have failed.

In both the U.K. and Canada, concerns have been raised about the comparative performance of each country’s innovation system, particularly in comparison with the U.S. There is a sense in both countries that talent, knowledge,

11. A tax incentive for U.K. companies with income from patented inventions, introduced in 2013.

and institutional strength in universities and elsewhere is not being translated effectively into economic activity and employment. One particular perception is that even successful start-ups, spin-offs, and innovative small firms rarely if ever become genuine global companies on the scale of Google, Facebook, or Apple. The small number of exceptions – for example, the companies ARM and Autonomy in the U.K., or RIM/Blackberry in Canada – point to the lack of a general trend.

The report of the U.K. House of Commons Science and Technology Select Committee (2013) is one of the latest to analyze the problem and make recommendations:

There exists the concept of a valley of death that prevents the progress of science from the laboratory bench to the point where it provides the basis of a commercially successful business or product. The future success of the U.K. economy has been linked to the success of translating a world-class science base to generate new businesses with the consequent generation of U.K. jobs and wealth.

One “troubling feature” the Select Committee emphasized was how many technology companies are acquired by foreign owners so that the subsequent jobs and wealth are generated outside the U.K. The Committee pointed to a domestic financial culture focused on quick returns and less-risky investments as one reason for this trend. The Committee also noted that the current R&D tax credit scheme did not support SMEs adequately, and further, that innovation policy should distinguish better between small and medium-sized enterprises. The Committee supported the idea of the Technology Strategy Board (now Innovate U.K.) becoming the focus of government innovation policy, but was concerned about access by SMEs to the large-scale test and experiment production facilities financed by the TSB/Innovate U.K. It also wanted more funding for the Small Business Research Initiative (which enables innovative small companies to bid for government contracts) and Smart Award initiatives.

Similar concerns are apparent in Canada. The Munk School’s “Creating Digital Opportunity” Research Project (Munk School 2014), which brings together a partnership of 16 universities and 11 other organizations, takes as its starting point that Canada lacks sufficient insight into how to seize the digital opportunity, and hence, global competitive advantage. The primary aim of the research is to help frame policy to strengthen Canada’s international competitiveness.

Although Canada has had some success in digital technology, the rapid pace of global innovation has weakened the competitive position of some leading companies. Relatively few of the largest global firms are headquartered in Canada. As in the U.K., there is a continual drain of talent, ideas, and innovation outside the country, mainly to the U.S. Successful start-ups and small firms are taken over or bought out by overseas competitors and talented graduates from Canada’s

universities are recruited by leading firms in Silicon Valley and elsewhere. The Information Technology Association of Canada has commented in a white paper:

Tech entrepreneurs are clearly alive and well in Canada. But while we create a lot of new technology start-ups, we do not get many of these companies to a size that has the potential to anchor a new cluster or to impact the economy in a major way. For a variety of reasons, including bankruptcy, liquidation, merger and acquisition, many of the start-ups launched in Canada disappear (Information Technology Association of Canada 2013).

Similarly, although more stridently, Jim Balsillie, one of the founders of RIM/Blackberry, has criticized the lack of government policy support for tech entrepreneurs compared with that enjoyed by competitors in some other countries:

Canada's terrible record of commercializing its ideas won't change until we build proper infrastructure to help our entrepreneurs succeed on the global stage, where the real money is made... Countries that owe their prosperity to innovation rely on sophisticated engagement between entrepreneurs and policy-makers... If Google, Apple and other U.S. tech companies get help from all branches of government to advance their collective prosperity, why are we insisting that Canadian entrepreneurs do it alone? (Balsillie 2015).

The "Creating Digital Opportunities" Research Project also highlights the role of digital infrastructure in building intelligent communities. Despite a strong early performance in Canada, the country has now begun to lag behind other developed nations, and a study from the Berkman Center at Harvard rated Canada 19th worldwide in Internet access (CBC News 2010).

The project's leaders argue that Canada's future competitiveness and its prospects for economic growth are inextricably linked to its ability to seize the "digital opportunity" being created. This would seem to be correct. Other economic sectors, such as manufacturing, agriculture, and fisheries, are likely to decline over the coming decades (despite the temporary boost to manufacturing from the falling external value of the Canadian dollar). Canada's resource economy, based mainly in the West, has been a source of strong economic growth in recent years, but more recently we have seen that, like all resource economies, it is vulnerable to sudden and sharp movements in world prices. Hence a digitally enabled technology sector is a crucial part of Canada's developing a stable, sustainable, diverse, and competitive economy, and as such requires consistent support from all levels of government.

Similarly, in the U.K., there has been much talk in the last few years of "rebalancing" the U.K. economy, generally taken to mean reducing a presumed overdependence on financial and related business services, while also reducing growing inequality in economic performance and productivity between the Greater South East and the rest of the U.K. Supporting the knowledge economy

and seizing the opportunities afforded by digital innovation should be a major part of such a strategy.

At the same time, it is vital to recognize that digital opportunity is not evenly distributed across a whole country, and policy positions must be based on a realistic and thorough assessment of the competitive positions of different city and region economies in each country. In both countries, supporting the leading city-regions that have strengths in digital technology is key. In London and Toronto, these digital, technology, and scientific research strengths are allied to other global city assets – world-class financial services and other advanced producer services; high-quality universities; an international air transport hub; and a national and international media, publishing, advertising, and marketing centre – that make it a magnet for talent of all kinds.

In both countries, concerns are regularly expressed about the failure to produce globally huge firms from start-ups along the lines of Google and Facebook (and now Uber and Airbnb) in the U.S. This may be asking the wrong question. It is clear from both the theory and practice of regional economics that once specific places develop competitive advantage in a particular sector (e.g., Silicon Valley in technology; London in financial services), these advantages are often then locked in through the operation of increasing returns to scale, institutional depth, brand reputation, and even psychological “me-too-ism.”

Perhaps a better question to ask is why neither country has yet developed a larger number of middle-sized companies,¹² trading with each other as well as with global suppliers and customers and forming the basis of a tech-driven *Mittelstand* that provides a stable and sustainable economic driver to complement the activities both of global giants and of start-ups and micro-firms. If the reasons for this gap can be identified, then policy can be directed towards helping to establish just such a group of medium-sized firms to balance the current focus on start-ups alone, which may not be successful, and if successful, may not stay in their country of origin.¹³

6. Conclusions: Data Innovation and Cities

City government in London and Toronto, as well as in many other places, has had to respond and adapt quickly to the challenges and opportunities from digital innovation and the data revolution. While the data revolution was at first a technological development, it quickly acquired economic, political, and social consequences. The typology I set out at the beginning of this paper has proved useful in examining the experiences of London and Toronto – that is, to look separately at digital innovation in relation to innovation and economic growth; transparency and accountability to citizens; and delivering city services of higher quality at lower cost.

12. There is also an industrial organization question implied here: what is the optimal size of firms in the tech sector – or tech sub-sectors and hybrids?

13. See for example Coutu (2014).

The responses of London and Toronto – and other cities around the world – in part reflect the nature of the city governance systems in each place. A recent review of urban governance arrangements around the world (Slack and Côté 2014) found that no one model of governance stood above the rest. Some form of region-wide authority is essential for larger cities. Despite international evidence promoting the advantages of formal regional or metropolitan structures, fragmentation accompanied by voluntary cooperation and special-purpose bodies are still very common. For the success of city-region partnerships, civic capital – the willingness of stakeholders to engage in partnerships, linked to the strength of the “metropolitan idea” in the particular city – is a key factor in determining “governance capacity” (Nelles 2013).

There is no template or ideal solution for how to cope with these issues. Powers, capacities, political ideologies, and political resources and constraints will differ greatly across cities and nations. Moreover, there is a sense in which the governance structure of large cities is always inadequate or “wrong” – to put it another way, each possible governance arrangement has benefits and costs, because the economic and political scales of cities (and city-regions) are different. The urban economy functions over a relatively large area, such as a labour market or commutershed. The economic definition of the city is dynamic, while city administrative boundaries are usually historically defined. Political identity is at a more local scale than economic reality. Hence there will always be a disjunction between the economic/functional and political/administrative definitions of the city, whatever the governance structure may be. Whatever the structure at the city level, it will form part of a wider pattern of network governance. The strength or otherwise of partnerships and formal and informal ties, and the presence or absence of leadership (political, business, civic) will all matter.

Furthermore, higher-level governments have a critical role in enabling the success of cities. Many countries now recognize the central place of cities in national economic prosperity. Capable and visible city leadership is critical: “For large cities and city-regions especially, models with a directly elected mayor appear to have greater potential to provide coherent city vision, mobilize coalitions of stakeholders, and provide profile and accountability for citizens” (Côté 2014). There is a trade-off between one-tier and two-tier models, with one-tier models being easier to understand and more transparent, while a two-tier structure may achieve greater efficiency (Slack and Côté 2014).

The economic crisis that began in 2008 had two important consequences. The first was a greater policy interest in economic diversification, away from dominant financial services (London, New York) or in response to a declining manufacturing sector and the volatility of the resource economy (Toronto). The crisis demanded a political response at both the city level and at higher tiers of government.

Second, the easier availability of data, digital innovation, and the consequent empowerment of citizens led to a rapid increase in pressure for more “open

government.” Demands for Open Data form an important strand within this wider trend.

Data and digital innovation affect all three of the issues set out at the beginning of this paper: economic development, citizen engagement, and efficient service delivery. All three issues matter in both cities. In London, the link from digital innovation and data to economic development and support for future growth sectors was probably stronger than in Toronto, while the link to Open Government and transformation of the city administration was probably stronger in Toronto.

These differences may largely reflect differences in the governance structures of the two cities. London’s two-tier model, with an executive mayor focused on strategic city-wide issues, is arguably more amenable to influencing, developing, and implementing region-wide economic development initiatives. Toronto’s single-tier model means that the connection with service delivery is arguably stronger than in London, where the boroughs deliver the bulk of local services. As for service delivery, while both cities are aware of the Smart City/Internet of Things agenda, there is ground to make up in both places for the cities to become genuinely “intelligent clients” of the products and services that vendors are currently developing to sell to city and region authorities.

In the sections that follow, I draw from the evidence in this paper some general conclusions for both London and Toronto, and for other cities worldwide at similar stages of economic and social development. My focus here is on actions at the city level; to be most effective, these would need to be combined with appropriate actions by higher-level governments.

6.1 Data Innovation and Economic Growth

In order to exploit fully the potential benefits of digital innovation and data availability, cities need to develop effective strategies, based on an understanding of how their economies are changing, and of the role their city and the economic agents within it play in a global production chain. More specifically, this means:

- **Strengthening and deepening relationships with universities** and other research facilities (for example in health/life sciences) and benchmarking performance against world leaders. This will necessarily mean looking beyond the city boundary and dealing with the political complexities of developing a regional approach that brings all the regional assets into the discussion – for example, Kitchener-Waterloo for Toronto; Cambridge and Oxford for London.
- **Supporting scale-up as well as start-up.** What is the ambition for the city? Developing a group of intertrading and globally competitive middle-sized companies – a digital *Mittelstand* – is as or more important than chasing unicorns or “the next Google.” Both countries have become reasonably proficient at supporting start-ups in the last few years, and higher-level government resources support this approach.

The greater challenge now is to grow these companies after they launch and enable them to move sustainably into the mid-sized category.

- **Linking digital innovators to city problems and challenges.** Both cities now have a wealth of digital, data, and entrepreneurial talent. This wealth of talent in each city could be better linked to the practical and pressing issues of city government and city life. As well as contributing to economic and social welfare in the home city, this link will sharpen the offer of digital and tech companies in exporting solutions to other similar cities around the world.
- **Developing, deepening, and extending a shared narrative and actions with other levels of government and with key business leaders in the city.** Having a story to tell and telling the story consistently are vital for mobilizing energy and enthusiasm, attracting inward investment, and building support among stakeholders and voters. It is important to get the whole business community aligned with the needs of the tech sector and the knowledge economy more generally.
- **Promoting digital skills** at all levels of education from primary through to postgraduate school. In both cities, the supply of high-level skills through immigration plays an important role, but this effort must be complemented by ensuring that all young people have access to the skills needed for a 21st-century economy.
- **Leadership** at the city level is vital, but in addition, leadership from **business and from the university** sector is also important. These initiatives also need to be backed by **higher levels of government**. A globally competitive Toronto is good for Ontario and for Canada, and a successful London for the U.K. (and for Europe).

6.2 Open Data and Open Government

Building trust in an era of disintermediation – that is, the end of deference, and decreasing faith in established channels – is not easy. Open Data must become the default position. City governments have to work both with activist and leading-edge groups and with the public more generally to build trust.

Open government needs more than Open Data – it requires a culture change within the administration, clear leadership, and a more flexible organizational approach. It means overcoming governance challenges, including both fragmentation and overlap. In both cities, service delivery is not monolithic, but requires coordination across a range of agencies, and across different levels of government. Once again, it is important to have a consistent narrative. More specifically:

- Digital inclusion is essential for **efficient service delivery** as well as for equity reasons. Delivering services digitally and using new tools to communicate with and listen to citizens lead to both cost savings

and greater accountability. But neither can be achieved if a substantial minority is digitally excluded and unable to participate.

- The pioneering Open Data initiatives in both cities need to be complemented and upgraded into comprehensive and consistent **Open Data strategies**. These strategies must be integrated across all city services, including agencies, with clear priorities, objectives, metrics, accountability, and leadership. As Open Data becomes the default position, city governments will have to become more proactive in identifying which datasets to focus on first in terms of ensuring reliability and consistency. Consistency with regard to definitions, methodology, and aggregation (ontologies) are essential to enable comparisons with other cities nationally and internationally. As this effort will consume more and more resources, one question will become prominent: should data continue to be provided for free or should a charge be levied?
- **The dialogue must be widened** to include more (and eventually all) city residents; digital approaches and demonstration projects should be mainstreamed with existing forms of communication.

6.3 *Efficiency: Smarter, Better, Cheaper?*

Cities need to become **intelligent clients** for Smart City technology. A “cookie-cutter” approach (“insert name of your city here”) will offer no lasting solutions. This means overcoming the current asymmetry in knowledge and talent between city governments and vendors, and ensuring a coordinated approach across the city, other levels of government, and agencies.

City leaders should review the **technical and institutional capacity** of their administrations. and see it as part of their mission to ensure the appropriate skill sets are present in City Hall, through recruitment and training. It may be necessary to co-design courses with universities and colleges to ensure a supply of adequately trained staff.

The approach to vendor solutions should be positive, but not naive. There are no magic bullets. Structural organizational changes may be necessary, and new posts created (e.g., Chief Data Officer, Chief Innovation Officer), but these should follow rather than precede agreement on specific goals and strategy.

6.4 *The Role of City Government is Key*

Whatever the city, the nation, and the government structure, harnessing the power of data and digital innovation presents a huge but exciting challenge. It will be one of the key issues for city governments and city leaders in the years to come.

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