SMART CITIES and CLIMATE CHANGE:

The Evolution and Curation of Knowledge

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Contents

Abbreviations

AWS	Amazon Web Services
Barcelona (City of)	Ajuntament de Barcelona
BP	Bloomberg Philanthropies
CDR	Cities for Digital Rights
C40	C40 Cities Climate Leadership Group
CRF	Common Reporting Framework
EC	European Commission
EIP-SCC	European Innovation Partnership for Smart Cities and Communities
EU	European Union
GCoM	Global Covenant of Mayors for Commission Climate & Energy
GHG	Greenhouse gas
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
ICLEI	Local Governments for Sustainability (International Council for Local Environmental Initiatives)
ICT	Information and communication technology
IoT	Internet of Things
Living-in.EU	Living-in.EU: The European way of digital transformation in cities and communities
Metropolis	World Association of the Major Metropolises
OASC	Open and Agile Smart Cities
TCNs	Transnational city networks
TNCNs	Transnational networks of city networks
UCLG	United Cities and Local Governments

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Abstract

This paper focuses on knowledge sharing and the curation of knowledge for climate change, smart cities and digital technologies at a metropolitan scale. By curation, it is meant that diverse institutions collaborate to produce roadmaps for cities that comprise recommended policies and programs.

The first half of the paper traces the evolution of this knowledge. It is postulated that the forces underlying this evolution are fourfold: the dissolution of the Soviet Union and the seeming hegemony of neoliberalism; the invention of the World Wide Web and the development of the Web and digital technologies; globalization and cities seeking to be competitive on a global stage; and the multi-generational climate change crisis.

The second half of the paper argues that city-led climate change mitigation and adaptation policies are being curated by city networks, often in collaboration with other institutions such as the World Resources Institute, and prominently supported by Bloomberg Philanthropies. Smart city strategies are following a different route. The notion of smart cities is supported by many city networks, by the Smart Cities Council and by vendors of digital technologies. In Europe there are many EU initiatives promoting the digital transformation of cities along with data and technological sovereignty favoring cities and their citizens. In contrast, the emphasis of Bloomberg Philanthropies and the institutions associated with Bloomberg Philanthropies is on data-driven city management without attention to smart cities.

Throughout the paper, there is close attention to dates and decades. It has proven informative to chart the evolution of events and trends for both climate change and smart cities for the 1990s, 2000s and the 2010s. In addition, the paper has tracked the diminution of democracy as citizens of representative city governments morphed into clients of companies providing hitherto public goods and services. A further concern for democracy is the application of opaque algorithms for which city governments and other service providers cannot provide a plain language and causal explanation.

The intended audience for this paper is more mayors, city managers and urban professionals than it is academics. This is already evident in the words used, for example knowledge sharing as opposed to policy transfer and policy mobility. The former is the language of professionals; the latter is the language of academics.
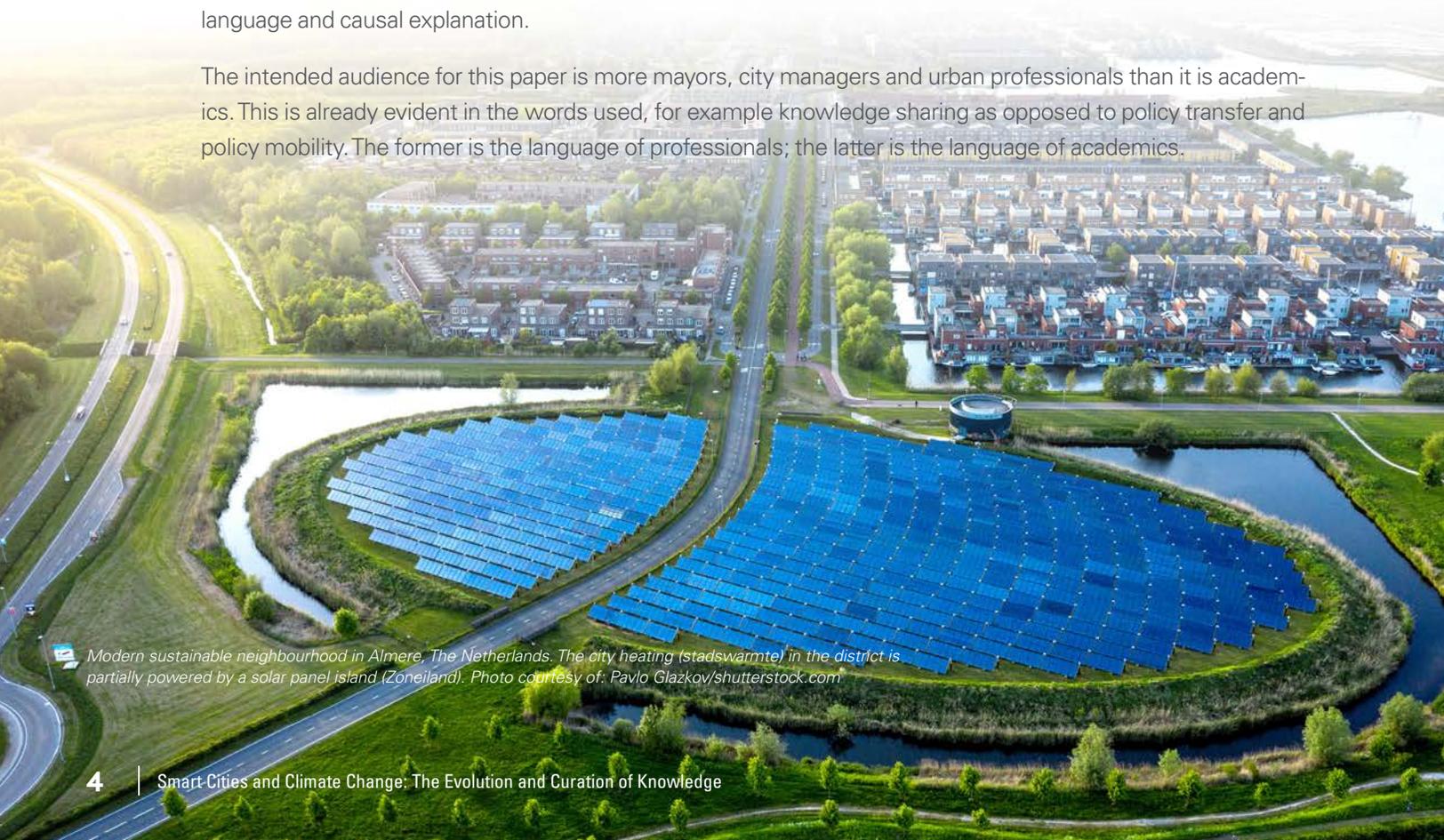
Modern sustainable neighbourhood in Almere, The Netherlands. The city heating (stadswarmte) in the district is partially powered by a solar panel island (Zoneiland). Photo courtesy of: Pavlo Glazkov/shutterstock.com

Introduction

This paper, first, traces the evolution of knowledge sharing and the curation of knowledge for climate change, smart cities and digital technologies at a metropolitan scale. Climate change and smart cities might seem like distant topics, but crosscutting digital technologies are needed for climate change mitigation and adaptation and their application is a means by which a city brands itself as being smart.

The evolution of both knowledge and policies for cities between the 1990s through to 2020 begins with the dissolution of the Soviet Union and the seeming hegemony of neoliberalism; and also, with the invention of the World Wide Web (Web) that has spurred the globalization of ideas and provided a remarkable platform for knowledge sharing. An issue of still greater moment is the multi-generational climate change crisis, with the role of cities in climate change mitigation and adaptation strongly asserted. Academics were influential in shaping the urban agenda, most notably Saskia Sassen and global city strategies and Richard Florida and creative cities. As influential as academics were, so too were IBM and Cisco in promoting the notion of smart cities, the Rockefeller Foundation in drawing attention to the need for cities to be resilient and Michael Bloomberg and Bloomberg Philanthropies (BP) in the causes of data-driven city management and planning and city-led climate change mitigation. All the while, city management, planning and service delivery have become increasingly reliant on digital technologies – the Internet of Things (IoT), big data analytics, cloud computing and advanced telecommunications (Mosco, 2019). The rollout of 5G networks and the adoption of blockchain technologies have come to be viewed as essential components of a city's global competitiveness. Economic competitiveness is an unquestioned objective. Increasingly, civil society and some city governments are organizing against the application of digital technologies that infringe upon privacy and seek to manage the impacts of the sharing economy. For example, the shift to short-term rental (e.g. Airbnb) has reduced the availability and increased the price of long-term rental. In so complex an environment, cities have been viewed as both wanting and needing roadmaps (a word that is displacing best practice), with the knowledge they contain being curated by networks whose members are prestigious and viewed as credible. Contributing to this mix of imperatives and interests has been city challenges, city awards and "winning cities" intended to serve as replicable models for, and to shape the agendas of, other cities.

In other words, there is a jumble of crises, events, trends, beliefs and disbeliefs, and more confronting mayors and city managers, and urban professionals and researchers. This paper seeks to make sense of this jumble and is advanced through an assessment of the forces underlying metropolitan policies pertaining to climate change and smart cities. The forces are four-fold: urban neoliberalism, the invention of the Web and the evolution of digital technologies, the multi-generational climate change crisis, and globalization.

This paper, second, argues that climate change policies for cities are being curated by transnational city networks (TCNs) and transnational networks of city networks (TNCNs) and other institutions with which they collaborate. Further, in Europe, support for the notion of smart cities and their digital transformation at a metropolitan scale is being curated by TCNs, TNCNs and by initiatives of the European Union (EU) that are funded by the European Commission (EC). By curation is meant that members of networks collaborate to produce roadmaps for cities that comprise policies and programs and sometimes also recommended sources of funding and investment.

This undertaking – the forces underlying the evolution of knowledge and the networks shaping roadmaps for cities–includes two propositions. The first is that the intertwined evolution of policies, the emergence of preeminent TCNs and TNCNs and the evolution of digital technologies can usefully be traced as decadal phenomena. The paper pays close attention to the 1990s, 2000s and 2010s. The second is the decline in metropolitan-scale representative democracy and accountability following the implementation of neoliberal urban policies and now also the use of opaque algorithms.

The focus on the metropolitan scale is because, since the early 1990s there has been a "global trend" (Warner, n.d.)[1] of intergovernmental decentralization and a metropolitan "renaissance" (Lefevre, 2018). The economic rationale has been explained by Neil Brenner. The metropolitan rescaling of urban regions is viewed as necessary for the "global structural competitiveness of a given urban region" (Brenner, 2019).[2] The digital rationale is that optimally these technologies scale. For example, Anna Gerber, writing for IBM, notes that "Connected cities emerge when IoT technologies are applied across an entire metropolitan area" (Gerber, 2018). For metropolitan areas comprising many local governments with different data standards and proprietary algorithms, the future is an algorithmic and data Babel. The climate change rationale is that the delivery of services central to climate change mitigation and adaptation – energy, water and sanitation, waste management and public transport – is generally most effective when planned and delivered within a functional metropolitan area. The same is true when the attempt is made to plan and build compact cities. The social rationale is that politics and budgeting at a metro-politan scale will likely better serve the interests of low-income households and neighborhoods than local governments with unequal resources.

After consideration of the research methodology, the paper first looks at the forces underlying climate change and smart city policy and then at the role of BP and the EU/EC as funders of TCNs and TNCNs in shaping that policy, with attention also to the roles of IBM, the Smart Cities Council and the Ajuntament de Barcelona (Barcelona). However, before proceeding to the research methodology, it should be noted that the paper focuses on the West.

The digital technologies considered in this paper have global application. In addition, the TNCs and TNCNs have formulated roadmaps that are global in scope and intention, and they have members in the East. Nonetheless, there are significant contextual differences between East and West. How does one respond to Alibaba's employing "City Brain" digital technologies to correct "defects in urban operations," where the characterization of defects and appropriate responses do not include city residents? (Alibaba Cloud, n.d.). The foremost differences are the power and role of government relative to citizens, government's interest in digital surveillance compared to Western governments and citizens seeking to safeguard digital privacy, and the close relationship between corporations and government. For example, in the midst of considerable opposition, Alphabet Sidewalk Labs backed away from the 12-acre Quayside property development in Toronto. The Toronto development would have constituted, in a quote referring to China, "a place with a brain controlled by artificial intelligence, where almost all of

the infrastructure and everyone in the city is monitored and linked to some kind of software" (Keegan, 2020). In this vein, Tencent proceeds with the development of the Net City project in the Dachanwan port district of Shenzhen. Like Alphabet, in a context of community opposition, Google backed away from a planned campus in Berlin and Amazon from a second headquarters in Queens, New York City. No doubt there is much that can be learned from the East, with attention repeatedly drawn to Singapore as exhibiting smart city best practices (Singapore brands itself as a "smart nation"), but the scope of this paper does not extend Eastwards. Symbolically, the fall of the Berlin Wall and the Tiananmen Square massacre, both in 1989, chart the way for citizens having or not having digital rights.

ROADMAPS

Reference to roadmaps has increased rapidly from the mid-1990s, indicating the presumption that city managers and urban professionals both want and need explanations of policy issues and the way forward. Examples of roadmaps are:

- ICLEI - Local Governments for Sustainability (International Council for Local Environmental Initiatives) that has prepared a Local Government Climate Roadmap;[3]

- Smarter London Together. The Mayor's roadmap to transform London into the smartest city in the world (Greater London Authority, 2018);

- New York's Road Map for the Digital City (City of New York, 2011); and,

- Barcelona Digital City Roadmap (Ajuntament de Barcelona, 2017).

The word roadmap is replacing claims regarding best practice and references to roadmaps exhibit the same prescriptive character of references to best practice, international best practice and evidence-based best practice (Tomlinson, 2013). It is to be expected that when city managers consider policy options and find roadmaps provided by some combination of the institutions discussed in this paper, they will be influenced in thinking a certain policy is best and, perhaps also, that adopting a policy recommended by these institutions will protect them from criticism if the policies fail. It was John Maynard Keynes who wrote that "it is better for [one's] reputation to fail conventionally than to succeed unconventionally" (Keynes, 1936).

Methodology

The paper has its origins in personal experience (Tomlinson, 2002). First, in 1995, as an urban policy consultant located in the Ministry of the Office of the President in South Africa, I managed a team that worked with a World Bank Urban Mission on infrastructure and services programs for households lacking "basic" level of services, for example, in respect of water and sanitation. When the Mission arrived in South Africa, I asked the members, which included academics as consultants, what preparation they had undertaken. "None" was the response. "We know what best practice is." This paper is shaped by skepticism regarding the presumptions underlying notions of best practice and roadmaps (Tomlinson, 2013; 2010 et al.; 2002; Taheri-Tafti and Tomlinson, 2015).

Second, in 2008, as an academic teaching slum upgrading at Columbia University, no academic references were allowed. The course was slum upgrading and it entailed the students assuming the mantle of urban professionals and their recommending how best slum upgrading might be undertaken. It was postulated that urban professionals would not be much interested in academic articles behind paywalls and by academic books and that both articles and the books offer less applied insight than World Bank, UN-Habitat or USAID documents and other material freely available on the Web. The students found identifying what was best was easily done using Google. Using hyperlinks, the students discovered a policy supply chain. A Web search for 'slum upgrading' favored the World Bank and provided hyperlinks to 'urban land markets,' 'public private partnerships' and the Public Private Infrastructure Advisory Facility that, together, provide detailed explanations of why there are slums, the policies that might best be employed to upgrade slums, appropriate upgrading programs and how these might be financed (Tomlinson et al., 2010). The searches and the hyperlinks provided knowledge.

These experiences are replicated in this paper, which similarly makes use of the views of professionals and Web searches.

The timing of the research at the Wilson Center coincided with the arrival of Covid-19. Initially, some academics and professionals were interviewed personally. Later, there was the opportunity to consider the relative merits of Skype and Zoom. I was invited by interviewees to attend webinars, which are listed along with the interviewees. I also received a few written comments on aspects of this paper. It is the case, though, that BP and C40 Cities Climate Leadership Group (C40) were not available.

In regard to Web searches, as evident from the many endnotes, searches concerning the organizations and the knowledge they generate and share were many and ongoing throughout this study. In addition, some of the tables are based on Google Scholar because the search results can be periodized.

A necessary observation concerns my choice of words and expressions. The terms "knowledge generation," "knowledge management," "knowledge sharing" and "knowledge exchange" (practitioner wording) are employed in preference to "policy transfer" and "policy mobility" (academic wording). An explanation of the reasoning behind categorizing the words as for practitioners or academics is contained in Annex 1. From the outset this paper draws on material relevant to city managers and urban professionals.

The implication of the choice of words and expressions concerns the use of academic literature. Academic sources are frequent, but the attempt has been made to not let them burden the paper. As was the case with the course at Columbia University, from the point of view of a city manager greater applied insight is to be found in, say, EU or C40 documents that are available on the Web.

Finally, the organizations included in the paper were selected following much reading, academic and non-academic, endless time on the websites of prospective institutions searching for knowledge sharing documents, events and relevant hyperlinks, and interviewee suggestions. Scope constraints gave rise to a certain amount of angst regarding, for example, discussing Barcelona and not also New York City, or discussing IBM in some detail with only passing attention to Cisco. The organizations considered are certain TCNs and TNCNs, BP, some EU initiatives, IBM, the Smart Cities Council and Barcelona. There is also consideration of the academic work of Saskia Sassen and Richard Florida.

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Fall of the Berlin Wall, 1989. Image source: AP Photo/Lionel Cironneau, File

Forces Underlying the Evolution of Metropolitan Policies

As a reminder, while reviewing neoliberalism, the invention of the Web and the evolution of digital technologies, climate change and globalization, where relevant, I trace the decadal evolution of policy and interject with commentary on the implications for democracy. Discussion regarding smart cities is included in brackets as it logically follows the discussion of digital technologies but should not be taken to be one of the forces underlying the evolution of urban policy.

Neoliberalism

The neoliberal underpinnings of urban policy are to be found in the Margaret Thatcher (1979-1990) and Ronald Reagan (1981-1989) era that is distinguished by an enhanced role for markets, restrained government spending and tax cuts. The globalization of neoliberalism followed the dissolution of the Soviet Union in 1991 (wonderfully captured in the 1989 image of East German soldiers standing where a panel of the Berlin

Wall had been torn down). With weighty wording, Neil Brenner wrote that "[I]t was not until the early 1990s that a genuine post-Keynesian, neoliberalized global rule-regime was consolidated" (Brenner et al., 2010). The dissolution of the Soviet Union did away with the perceived viability of the socialist alternative and removed the brakes on neoliberalism.

For cities neoliberal changes consisted of:

- deregulation, public private partnerships and privatization in the delivery of infrastructure and services;

- public tendering and competition among companies to deliver the infrastructure and services;

- where the public sector continued to deliver infrastructure and services, the delivery being fashioned on business principles;

- expanded role for nongovernment organizations in the delivery and management of not-for-profit assets and services, for example, public housing; and,

- measurable performance indicators of service providers.

This conception of the role of government was famously expressed in 1992 as government's job is "steering not rowing" (Osborne and Gaeble, 1992). Rowing should be outsourced. This represents the commodification of citizenship, in other words, a shift from elected representatives being accountable to citizens for service delivery to citizens becoming clients of companies and interacting with algorithms and FAQs (frequently asked questions).

In the case of climate change and the application of neoliberal policies, these now serve to constrain a city's role in climate change mitigation. Three of the "four primary [climate change] action areas—decarbonizing the electricity grid, optimizing energy use in buildings, enabling next-generation mobility (including better land use planning), and improving waste management ..." (McKinsey Center for Business and Environment and C40, 2017) involve services that, prior to the neoliberal orthodoxy, most often were provided by the city governments or some other public agency. The constraints arising from neoliberalism have not led BP and the EU to suggest that government, again, assume responsibility for the delivery of formerly public services, but rather that they should commit to climate change mitigation and adaptation in partnership with the private sector and civil society.

The neoliberal framework for urban policy, battered, but remarkably adaptive to changing circumstances and to crises of its own making, notably the 2007/2008 financial crisis (a result of which has been to accentuate fiscal austerity policies) (Theodore, 2020), persists in the seeming absence of alternative frameworks. Where there is a reversion from private to public responsibility for delivering services, there one finds the absence of profit.

Invention of the Web and the evolution of digital technologies

It was in 1991 that Saskia Sassen published *The Global City: New York, London and Tokyo*. She refers to the digitalization of markets as a precondition to the emergence of global cities. The date of her book serves as an intergenerational reminder of their being a digital life before the Web and the importance of the internet in shaping the economies and geographies of cities.

The most important features of evolution of ICT and the Web and digital technologies and other developments relevant to cities have been summarized in Table 1. Table 1 is organized decade by decade and serves as a point of reference for the discussion that follows.

INFORMATION   COMMUNICATION   TECHNOLOGY
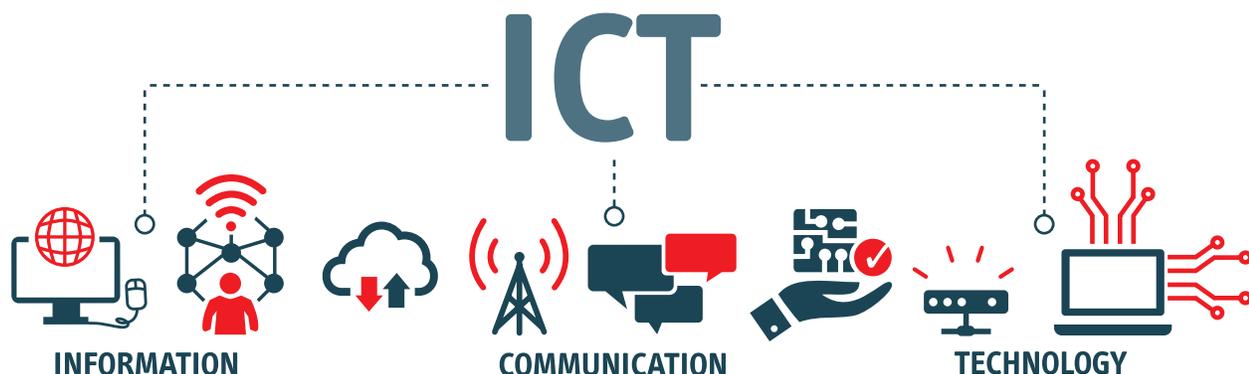
TABLE 1. Evolution of ICT, the Web, Digital Technologies and Other Developments Relevant to Cities

Period	ICT	Web	Corporations, products & services	Data	Policy
1990s	1991—2G launched (1G was analog) 1993—HTML hyperlinks steer the user from one webpage to the next 1994—browser that made the Web user-friendly IoT devices enter use	1990—invention of the Web, with a Web server & operational browser Web 1.0—read only web	1994—Yahoo founded 1998—Google founded	Rapid increase of unstructured data	1996—World Bank represented as a "knowledge bank"
2000s	Scarce wireless bandwidth is a constraint to simultaneous use of multiple IoT devices & leads to low latency 2001—3G launched 2009—4G launched	Web 2.0 – facilitates interaction between web users	2004—Gmail, Facebook 2005—YouTube, Reddit 2006—Twitter 2006—Amazon EC2 platform 2007—iPhone 2008—Blockchain, Airbnb 2009—WhatsApp, Uber 2010—Instagram	Exponential growth of unstructured data 2004—Apache Hadoop, with MapReduce, means of computing big data into actionable knowledge	Communication between users enables digital governance Use of Web for knowledge sharing becomes ubiquitous Initiatives to ensure data security
2010s	IoT devices adopted in the billions Mobile technologies increase connection between sensors, autonomous vehicles, individuals using smartphones & other devices Machine learning to optimize data applications 2019 – 5G rollout begins Increasing sophistication of IoT device associated with roll out of 5G IoT devices exponential growth	Web 2.5 – evolution in mobile technologies Web 3.0 – computers can interpret information via machine learning & can generate & distribute data	Cloud computing services competition among corporations Sharing economies become ubiquitous	Exponential increase in social media data & use for city management Data privacy, security & ownership key issues	Adoption of smart city strategies Cities appoint Chief Digital / Technology / Information Officers Greater attention to digital privacy & data security Protests against the sharing economy & for digital privacy

World Wide Web. Image: "1990-00" by ITU Pictures. CC BY 2.0.

1990s—The invention of the Web and the creation of search engines

It was the invention of the Web, in 1990, with a Web server and an operational browser that makes this paper's discussion of knowledge sharing possible. First, though, we should note that this was the Web 1.0, which delimited the forms that knowledge sharing could take. Web 1.0, also referred to as Syntactic web or read only web, was the era (1990-2000) in which "the *role of a user was limited to reading information provided by the content producers.* There is no option given for [the] user or consumer to communicate information back to the content producers" (Madurai, 2018).[4]

An important feature of the use of the Web is hyperlinks. It was in 1993 that HyperText Markup Language made it possible to move from one webpage to the next and, in effect, for organizations to link topics and to develop a policy supply chain. The earlier example of students being steered by hyperlinks when researching slum upgrading is illustrative.

This paper is premised on being able to search policy issues on the Web. Without equivocation, in Wikipedia it is written that "Mosaic [1994][5] is the web browser that popularized the World Wide Web and the Internet" (Wikipedia, n.d.). Mosaic was soon displaced by Netscape Navigator that was then displaced by Internet Explorer that was then displaced by Google.

It was as early as 1996 that the president of the World Bank, James D. Wolfensohn, represented the institution as a "knowledge bank" that would use the ever-expanding reach of ICT to provide city managers, policy professionals and others "with the right kinds of knowledge," (Riggirozzi, 2007)[6] with the apprehension that poor access to the Web will lead to "knowledge gaps" (Tomlinson and Harrison, 2018).

Yahoo was founded in 1994 and Google in 1998. Nowadays, to search is to google. Google's search engine using Page Rank as a means of locating documents on results pages biases research to important and influential institutions (Tomlinson et al., 2010). Once the website is opened, hyperlinks steer the researcher along a knowledge pathway.

A technological development beginning in the 1990s, IoT expanded to, perhaps, a million devices by the end of the decade.[7] At the end of 2020, reports regarding the number of devices varied by the tens of billions and no reliable source was found. Perhaps 20 billion

or so IoT devices are applied in cities. The number and sophistication of IoT devices is increasing rapidly along with the rollout of 5G.

2000s—The social Web, big data and the means of computing that data

The use of the Web changed in the 2000s due to the ability of users to communicate with other users. It was in 2002, that blogging first came to be seen as an alternative to traditional media (Zantal-Wiener, 2016). In the same year, digital exceeded analog storage capacity.

"Web 2.0, also referred as Social Web or read-write web, is the era (2000-2010)… which facilitates *interaction between web users and sites which in turn allows users to communicate with other users.* In this era every user can be a content producer and content is distributed and shared between sites" (Madurai, 2018). Web 2.0 enabled the growth of the global social media sites listed in the table.

The potential for the use of the internet and the Web for city management and control is made possible by 3G and then 4G that increase data transmission capacity and lower latency (response time). This potential also made possible the extraordinary increase in the number and diversity of products and services between 2004 and 2010, as evident in the table. The impacts on cities and their citizens of social media and the sharing economy are now hotly debated.

The ability to manage the exponentially increasing amount of unstructured data was made possible by the evolution of Apache Hadoop since 2004. The Hadoop framework, using MapReduce (Wikipedia, n.d.) with the cloud, provides the means of computing this data into the form of actionable knowledge and facilitates predictive analytics, an important tool for city planning.

Amazon Web Services' (AWS) Elastic Compute Cloud (known as EC2) computing platform, launched in 2006, was the breakthrough platform that serves the rapidly increasing volume of data and enables enhanced computing. Cloud computing services are now ubiquitous. The word cloud has benign connotations, but the technology requires a considerable amount of energy and is a significant source of CO_2 emissions.

With fanfare, the iPhone was launched in 2007, and soon smartphones became a global necessary accessory. The use of smartphones and apps contributes to both the generation and use of big data, and shapes how we view and use, and get used by, the city.

Blockchain, launched in 2008, has been slow to take hold for the purpose of city management. The experimental DECODE project in Europe, using blockchain technology to ensure digital privacy, IoT applications and open democracy, is being trialed in Barcelona and Amsterdam, starting in 2018 and 2019 respectively (DECODE Project, n.d).

The application of digital technologies is leading to the reconfiguration of metropolitan governance – emphasizing networks, partnerships and voluntary mechanisms of cooperation rather than the managerial and hierarchical approaches of new public management, a concept attributed to Christopher Hood and his influential 1991 academic publication (Hood, 1991). Starting in the early 2000s, reference to new public governance began to replace reference to new public management. New public governance refers to multiple interdependent actors involved in both policy processes and in contributing to the delivery of public goods and services. A formidable problem arising from multiple interdependent actors is that they obscure the accountability of elected representatives.

2010s—Chief technology officers, sharing economies and opposition

In the 2010s, there were two further Web developments. Web 3.0 introduced machine learning to the practice of city management. Advances in mobile technologies with Web 2.5 are especially relevant to IoT devices and other anticipated products, most significantly autonomous vehicles.

DATA

Structured data is relational data as in a table with rows and columns. **Unstructured data** has no predetermined format and is accumulated from the contents of emails, searches, tweets, and so on. It enters what is referred to as a 'data lake' and algorithms are needed to identify patterns and correlations.

Big data used to be defined in terms of three Vs: volume of data refers to the amount of data, which is increasing rapidly; velocity of data refers to data streams such as traffic flows; and variety of data refers to its many different forms. To these Vs has been added veracity, whether the data is accurate. The most consequential V is the value of the data.

Open data standards are "specifications (or requirements) for how some sets of data should be made publicly available. Generally, open data standards describe data about a particular subject, for example service requests…"[8]

Data standards are a defining issue for the evolution of digital technologies. Annex 2 describes the important role of epistemic communities in the formulation of data standards.

Web 2.5 mostly focuses "on mobile computing and evolution in *mobile technologies*."

Web 3.0 also referred to as Semantic Web, or the read-write-execute era (2010 and above), which refers to the future of web. In this era, "*computers can interpret information... via... Machine Learning," which helps* to intelligently generate and distribute useful content tailored to a particular need of a user (Madurai, 2018).

Machine learning involves a computer revising or developing its own algorithms to assess data, identify patterns, make projections, and optimize recommended actions, or autonomously implement optimal actions. Training data may be employed at the outset in order that algorithms learn to recognize what is optimal and acquire "predictive power" (Bathaee, 2018).[9] Examples of the application of machine learning are the autonomous monitoring and redirecting of traffic, and the autonomous management of power-sharing and smart grid performance.

Markers of the evolution of digital technologies and their use in cities are the *for Dummies* books: *Big Data for Dummies* (2013), *Hadoop for Dummies* (2014), *Data Science for Dummies* (2017), *Blockchain for Dummies* (funded by IBM, 2017, 3rd edition 2020), *Blockchain Data Analytics for Dummies* (2020) and *Smart Cities for Dummies* (2020).

It was in the mid-2010s that the cities leading the digitalization movement started to appoint Chief Technology/Digital/Information Officers. New York and Amsterdam appointed Chief Technology Officers in 2014 and Barcelona did the same in 2017. London employed a Chief Digital Officer in 2017.

The roll out of 5G began in 2019 and will continue well into the 2020s. The defining features of 5G are bandwidth and data rates, lower latency, the capacity to connect to many more devices, and reliability. 5G enables distributed cloud computing closer to the user/the city, in contrast to the present large, distant data centers typical of Amazon, Google and Microsoft.

The 2010s saw community protests against Airbnb, Uber and other sharing economy platforms. This, subsequently, led city governments to seek means to mitigate the harm done by, for example, Airbnb and Vrbo to communities and neighborhoods and an affordable long-term rental market. In 2020, 22 European cities, including Barcelona and Amsterdam, called on the EU competition commissioner for an "EU-wide rule framework for short-term rentals, rather than the existing system in which cities impose their own rules," to thereby regulate Airbnb and competitors (BBC News, 2020).

A more wide-ranging threat to the public realm, or missed opportunity, depending on one's point of view, has already been mentioned, namely Alphabet's Sidewalk Labs, the 12-acre Quayside district property development in the City of Toronto. Alphabet abruptly cancelled the project in 2020, citing economic uncertainty that made plans no longer feasible. In actuality, Sidewalk Labs was widely criticized, including by the Canadian Civil Liberties Association and through #Blocksidewalk, in respect of data governance and ownership of data, with the lack of digital privacy termed "surveillance capitalism," a recently popular expression.

Digital technologies are essential for climate change actions. They potentially serve the management of

cities and service delivery well. The EC is funding the digital transformation of cities and attempting to build a city-led, city-friendly market for digital services. Concerns regarding digital privacy and data security rank highly in the transformation efforts. Apprehension about digital technologies is that one's circumstances and behaviors will have to fit into the drop-down list of possibilities imagined by software engineers and emerging from opaque algorithms.

Algorithms and democracy

An **algorithm** comprises "sets of defined steps structured to process instructions/data to produce an output" through which "many aspects of everyday life are increasingly being mediated, augmented, produced and regulated by digital devices and networked systems" (Coletta and Kitchin, 2017). A **transparent algorithm** can be explained in plain language. Transparency is essential since coding and algorithms and the data they employ incorporate the preconceptions of software engineers and the interests of their clients and may represent de facto public policy decisions. An **opaque algorithm** is one whose explanation and understanding requires differentiated expertise. Opaque algorithms employed to deliver city services whose explanation is inaccessible to most city politicians, officials and residents compromise accountability. An example is when a city social worker, employing predictive analytics inexplicable to the social worker and her or his administration, finds a child to be at risk and removes the child from her or his parents (Valentine, 2019). A **proprietary algorithm** may be explainable in plain language or may be opaque. It can only be investigated by city managers and local experts and others with the consent of the owner. This was typical of smart city services in the first half of the 2010s, but is now recognized as bad practice, that is, from a city government's point of view. A **Black-Box algorithm** refers to algorithms that are the product of machine learning and have been revised, or new algorithms developed, and whose workings may be inaccessible even to experts. This "can be defined as

an inability to fully understand an AI's decision-making process and the inability to predict the AI's decisions or outputs" (Bathaee, 2018). It is difficult to envisage the digital transformation of cities that does not, in respect of some services or stages in the delivery of those services, employ machine learning.

An example of the need to be able to interrogate an algorithm arises from an unintended, incorrect and context-free algorithm that incorporated racial bias and that contravened Fair Housing laws in the United States. In a submission to the Department of Housing and Urban Development, the AI Now Institute at New York University, wrote that

> Algorithmic tools are also subject to the biases of individuals and institutions that create and design them. Individual and institutional bias can be introduced at many different stages, including framing the problem that the algorithm is designed to solve, choosing what metrics to optimize for, collecting and preparing the data, developing the model

that guides the performance of the tool, and deciding how to present that information to practitioners (AI Now Institute, 2019).

In the case of opaque algorithms and of Black-Box algorithms, whose internal workings cannot be explained, "When a government agent implements an algorithmic recommendation that she does not understand and cannot explain, the government has lost democratic accountability, the public cannot assess the efficacy and fairness of the governmental process, and the government agent has lost competence to do the public's work in any kind of critical fashion" (Brauneis and Goodman, 2018). In contrast, "An algorithmic process is accountable when its stakeholders, possessed of meaningful transparency, can intervene to effect change in the algorithm, or in its use or implementation" (Brauneis and Goodman, Ibid). Democracy within a city requires transparent and non-proprietary algorithms. Cities for Digital Rights (CDR), discussed later, declares that digital rights have the same standing as human rights.

Declaration to protect and uphold human rights on the internet at the local and global level.
Image courtesy of: https://citiesfordigitalrights.org/ (CC BY-SA 4.0)

(Smart cities)

A Google search for "what is a 'smart city'" had 41,500,000 results.[10] Vincent Mosco attributes interest in smart cities to be a direct consequence of IBM, following the 2008/2009 financial crisis, seeking to diversify its market and, in 2009, formulating the notion of smarter cities (Mosco, 2019). In 2010, IBM issued the Smarter Cities Challenge, with the first winning city announced in 2011. Anthony Townsend (2013) explains that IBM had to develop its understanding of cities and to determine its most profitable consulting and software "solutions." While cities boast about having been selected for the Challenge and IBM technical experts visiting for a couple of weeks, Townsend holds that cities were being used by IBM to develop their understanding of cities and the services it should offer them.

The relevance of IBM's smarter cities challenge is evident from Table 2 that demonstrates both the sharp increase in academic interest following IBM's challenge and the link between research into smart cities and IBM and Cisco. Searches with a word or words enclosed in ".." identify only those results that include the word or combination of words. Following IBM's Smarter Cities Challenge academic interest in smart cities increased suddenly and very rapidly. While Cisco is not a focus of this paper, it would be amiss to not draw attention to the company's influence. At the outset of the smart city idea, in 2009 Cisco announced a "holistic blueprint for Intelligent Urbanisation," which later became "Smart+Connected Communities" (Sadowski and Bendor, 2019). Together, IBM and Cisco advanced the cause of smart cities, envisioned as a single company providing smart city services with proprietary algorithms and ownership of the data; a vision that nowadays is referred to as "vendor lock-in."

So, what is a smart city? Ellen Goodman simplifies matters defining all that most mean by a smart city: "The term 'smart cities' describes the growing role of data analytics and sensors in urban life" (Goodman, 2019). Robert Kitchin and Sung-Yueh Perng provide a more complete definition. A smart city is

> densely instrumented urban systems that can be monitored, managed and regulated in real time,… whose data can be used to better depict, model and predict urban processes and simulate future urban development,… and whose deployment facilitates new forms of digital subjectivity, citizenship, participation and political action (Kitchin and Perng, 2016).

In the case of smart/digital/e-governance, here one risks a "conceptual swamp" (Meijer and Bolivar, 2016). Robert Kitchin writes of "new forms of e-governance, new modes of operational governance, improved models and simulations to guide future development, evidence-informed decision-making, better service delivery, and making government more transparent, participatory and accountable…" (Kitchin, 2015). Whereas most of the definition and the use of words such as "improved models," "evidence-informed," "transparent" and "participatory" are what

TABLE 2. Google Scholar Search Results for Smart City

Decade	"smart city"	"smart city" "IBM"	"smart city" "Cisco"
1981- 1990	46	2	2
1991- 2000	275	22	7
2001- 2010	2,360	223	80
2011- 2020*	47,400	15,400	9,830

* Search: August 21, 2020

Image source: Shutterstock.com

one would expect and are simple to interpret in intent, if not in practice, "new modes of operational governance" have far-reaching implications. These include building a digital urban platform for managing service delivery and replacing other features of governance based on data silos. Urban platforms are central to the EU conception of the digital transformation of cities.

In regard to digital governance, the claimed benefits are self-evident when it comes to, for example, clients paying bills using the internet, sending a photograph of a pothole together with its location to a city app, and sensors identifying where and when trash needs to be collected. The benefits for security are less clear. In feeling more secure on a street, would one class surveillance and facial recognition as beneficial to the public?

Not at all self-evident are the claimed benefits for participatory planning. In Melbourne, online participation drew the city's attention to the difficulties disabled persons confront when trying to navigate downtown streets and led to the city addressing this issue (City of Melbourne, n.d.). This is a laudable example of participation yielding results. However, participation in the form of clicking an icon risks serving as a means of legitimizing policies, programs and projects. Let claims regarding participation never disguise powerful interests.

Ultimately, one should view smart cities as a notion whose longevity will be determined by its usefulness to companies selling their wares and cities selling themselves. It is noteworthy that IBM no longer includes smarter or smart cities on its website. The IBM Smarter Cities Challenge is more easily found using Google. Reference to Cisco makes the same point. The Smart+Connected digital platform became Cisco Kinetic for Cities, a product line for which it stopped sales in late 2020 (Cisco, n.d.). Further, in 2016 Barcelona dropped reference to a smart city in favor of a "digital roadmap." The notion of smart cities has become "tired" while digital technologies and related policies are evolving ever more rapidly.

Barcelona transition from a smart city to a digital city. Image courtesy of Francesca Bria

An underlying problem for smart city policies is what the European Innovation Partnership for Smart Cities and Communities (EIP-SCC) describes as a "Sitting on the Fence" phenomenon, which arises from cities lacking confidence and capacity, departments working in silos, and cities facing budget and funding constraints (EIP-SCC, 2016).[11] Added to these problems is that it "is clear that the same technology will be cheaper and better—in terms of spec, functionality, performance—in a few years, so it is difficult to know when to make the initial investment" (Kitchin et al., 2017).

Yet, it is premature to write a eulogy for smart cities. The size of the market for "smart city technologies" explains why. The most extreme estimate is provided by the EU: "Analysts are generally converging at an estimated market of around $1.3 trillion by 2020, and at a growth rate (CAGR) of ~20%. ... The major areas of growth are in transport, energy, water, and buildings… " (EIP-SCC, 2016). The McKinsey Global Institute's *Smart Cities: Digital Solutions for a more Liveable Future* (McKinsey Global Institute, 2018) makes it clear that there is money to be made using the smart city label. The word "solutions" is used without introspection by the smart city and digital technology industries. All too often, the impression is one of a solution in search of a problem.

Climate change and the city

The share of global CO2 emissions attributed to cities varies from 80 percent (Robert Zoellick, 2011), to more than 70 percent (C40, n.d.) and to more than 50 percent (Intergovernmental Panel on Climate Change) (IPCC, 2014). It appears that the C40 estimate is the most widely accepted estimate.

Countering ambivalence about the role of cities in climate change mitigation, experts make the case that municipalities are the key to fighting climate change.

"Cities can contribute significantly to bridging the global emissions gap–with emissions reduction potential of up to two-thirds the impact of recent national policies and

actions…" wrote Michael Bloomberg, in 2014, while serving as the UN Special Envoy for Cities and Climate Change (Bloomberg, 2014).

"Cities will decide the future of climate change…. it is no stretch of the imagination to believe that cities will take the lead in overcoming climate change." said Robert Zoellick when President of the World Bank in opening remarks to a 2011 Cities Climate Summit (Robert Zoellick, 2011).

A 2017 McKinsey Center for Business and Environment and C40 report acknowledges "There is now widespread recognition in the international community that the commitments made by national governments under the Paris Climate Agreement in 2015 cannot be achieved without concerted action by cities" (McKinsey Center for Business and Environment and C40, 2017).

In order to chart the increasing interest in the role of cities in climate, a Google Scholar search was undertaken for "climate change" and the "city"; in "climate change" "city" and "mitigation"; and in "climate change" "city" and "governance." Table 3 shows a dramatic increase in interest in all three topics. The link between cities and climate change and mitigation and to climate change and governance likewise is apparent. The relevance of city governance to climate change is reflected in a spate of publications on cities and climate change in 2010 by the OECD, the World Bank (2010a) and its *World Development Report 2010:*

Development and Climate Change (2010b) and among academics, most prominently by Harriet Bulkeley.[12]

Also relevant to the engagement of cities in climate change mitigation the Kyoto Protocol was adopted in December 1997 and put into force in February 2005. Castan Broto and Harriet Bulkeley write that climate change "experiments" in 100 cities around the world increased rapidly after 2005 and that membership of a city network is the most common variable explaining a city's interest in undertaking experiments (Broto and Bulkeley, 2013). By 2018 "…there has been a good deal of consolidation around transnational city-networks as the primary vehicle through which cities participate in the global response to climate change" (Gordon and Johnson, 2018).

In a context where countries are singularly failing to meet their targets and the United States temporarily withdrawing from the Paris Climate Agreement, cities and state/provincial governments are playing an important role and are expected to continue to do so when the United States rejoins the Paris Climate Agreement. Cities around the world are addressing climate change mitigation, with the USA gaining particular attention. "[T]housands of cities and business have come forward to affirm their commitment to helping the U.S. meet our Paris goal" (Oceana, n.d.). With BP funding and working with Arup, C40 proposes *How U.S. cities will get the job done* (C40, n.d.).

Most city strategies initially focused on mitigation (Bulkeley, 2010; Bulkeley et al., 2012). Climate change

TABLE 3. Google Scholar Search Results for Climate Change and the City

Decade	"climate change" "city"	"climate change" "city" "mitigation"	"climate change" "city" "governance"
1981- 1990	3,360	330	265
1991- 2000	18,300	4,360	3,050
2001- 2010	188,000	21,400	25,700
2011- 2020*	633,000	80,300	104,000

* Search: August 6, 2020

adaptation followed. Perhaps influenced by the Rockefeller Foundation's 100 Resilient Cities program (2013-2019), attention was drawn to the centrality of adaptation to a city's resilience strategy.

In respect of mitigation, the ability of cities to actually implement climate actions depends on whether:

- the climate change action is located inside or outside the city's jurisdiction and regulatory authority;

- the city owns buildings, provides transport services, generates electricity and undertakes waste management;

- the city has the capacity to finance its own climate actions and also to attract investors; and

- the intergovernmental divisions of roles and responsibilities within metropolitan areas and between metropolitan areas and other levels of government enables climate actions by cities.

It is appropriate, at this point in the discussion regarding the role of cities in climate change mitigation, to provide a sobering quote from the Coalition for Urban Transitions, which is an initiative of the New Climate Economy that is jointly hosted and managed by the World Resource Institute Ross Center for Sustainable Cities and C40. What cities can, of their own account, achieve is limited.

> [W]orldwide, national and state governments have primary authority over 35% of urban mitigation potential (excluding decarbonisation of electricity), including from improved cement production processes and more stringent efficiency standards for appliances, lighting and vehicles. Local governments have primary authority or influence over 28%, including compact urban form, travel demand management and waste disposal (Coalition for Urban Transitions, 2019).

With climate change leaving regions of the world uninhabitable, starvation, poverty and warfare are outcomes that will drive millions to cities in search of livelihood opportunities. While climate change mitigation and adaptation strategies are certainly necessary, so, too, are strategies to assist cities cope with migrants. Making matters worse, increased risk of climate change-related disasters arising from flooding, heatwaves and fires threaten many millions in cities, the poor in particular.

Image source: By kwest / Shutterstock.com

Globalization and cities

Saskia Sassen's enormous influence arises from her books, *The Global City New York, London, Tokyo* (1991, 2001 revised edition), *Cities in a World Economy* (1994, 2019 5th edition) and *Globalization and its Discontents: Essays on the New Mobility of People and Money* (1998). Simplifying considerably, Sassen's 1991 book reflects on the 1980s, advances in ICT, the "financialization" of the world economy – between 1980 and 1990 "cross-border bank lending [increased] from $324 billion to $7.5 trillion" (Robinson, 2009) – the global dispersal of corporate economic activities and the growth of producer services. The more complex a corporation's operations become, the more complex are managing, servicing and financing those operations. Producer services refer to ICT, accounting, legal, advertising and other services whose market is the corporation, not the public. Corporations outsource complexity to producer services providers that require proximity, giving rise to agglomeration economies, and also to be networked with providers of producer services in cities elsewhere in the world. Competition to be the site for producer services translates into inner city business, living and leisure opportunities for globally mobile enterprises and highly skilled personnel and their families; and also connectedness in the form of 5G, international airports, transport terminals, public transport, and so on.

Sassen shapes city policies globally. Image courtesy of: THE GLOBAL CITY: New York, London, Tokyo, Second Edition by Saskia Sassen. Copyright © 2001 by Princeton University Press. Reprinted by permission.

Often incorporated within a global city strategy is the attraction of a creative class and cultivating the creative city label. Richard Florida developed these concepts in a series of influential publications in the 2000s, including *The Rise of the Creative Class* (2002), *Cities and the Creative Class* (2004) and *The Flight of the Creative Class: The New Global Competition for Talent* (2007).

Florida holds that there is a creative class that is central to driving the economies of post-industrial cities. But who is the creative class and what is a creative city? Florida includes software engineers, scientists, engineers and, yes, in addition, artists, composers and writers. There is also deemed to be a class of knowledge professionals, some proportion of whom may be creative. Here, one finds medical practitioners, lawyers, accountants and others.

Competition to create global cities, a city's livability ranking and its categorization as a creative city aligns with livability and urban upgrading strategies, and soon was incorporated within them. A rash of books from the United States followed, celebrating the role of cities, for example, *The Metropolitan Revolution: How Cities and Metros Are Fixing Our Broken Poli-*

*tics and Fragile Economy (*Katz and Bradley, 2014). The triumphalist nature of *If Mayors Ruled the World: Dysfunctional Nations, Rising Cities* (Barber, 2014) and the *Triumph of the City* (Glaeser, 2011) create skepticism, but in different contexts around the world claims are made that cities are becoming both ever more influential relative to national governments and necessarily so in a context of dysfunctional national and global governance (Curtis, 2018; Leffel and Acuto, 2018). While these books, written more for the public than for academics, may influence public perceptions, the power of persuasion lay with TCNs, TNCNs, international organizations and corporations.

City agendas: city challenges, city awards and city ranking industries

With an eye on global agenda setting for cities, TCNs, TNCNs, philanthropies, corporations and government have promoted city challenges and city awards for both climate change and digital transformation. The climate change and smart city challenges and awards identified during this research are listed below. All originated in the 2010s. It appears that global city challenges and awards were uncommon before the IBM Smarter Cities Challenge.

2011/17	IBM Smarter Cities Challenge
2011 –…	Smart Cities Expo World Congress, hosted by Barcelona
2012 –…	Guangzhou International Award for Urban Innovation (the Guangzhou Award) is co-sponsored by UCLG, Metropolis and the City of Guangzhou
2013/19	100 Resilient Cities Challenge, Rockefeller Foundation
2013 –…	Mayors Challenge, BP
2013 –…	C40 Cities BP Awards
2014 – ...	City on a Cloud Innovation Challenge, AWS and, in 2020, AWS and Intel
2017 –…	Smart Cities Council Readiness Challenge
2017/18	Digital Cities Challenge, rebranded as the 100 Intelligent Cities Challenge
2018 –…	American Cities Climate Challenge, BP
2018 –…	Global Cities Climate Challenge, European Investment Bank and Global Covenant of Mayors
2019 –…	100 Intelligent Cities Challenge

The *Bloomberg Philanthropies Mayors Challenge* is unique in that, in different years, it is located in different continents and intended for cities on that continent.

The questions are why do institutions offer awards and challenges, why do cities undertake an often rather arduous process of seeking to win and what does this mean for knowledge sharing?

To the extent that there is a shared motivation for those issuing challenges and awards, it is likely that of agenda setting; of motivating a city to focus its resources on either, or some combination of, digital technologies, data-driven governance or climate change actions. In a context of limited resources, agenda setting serves to shift resources from one outcome to another and is decidedly political.[13]

An explanation for the challenges and awards has to differentiate between the issuing institutions. IBM used, and AWS uses, challenges as a means of marketing their services. In the case of AWS, in the context of an extremely rapid increase in the volume of data and the need for cloud computing services, cities adopting digital technologies represent a significant market.

Amazon Web Services city challenge. Image courtesy of: https://aws.amazon.com/blogs/publicsector/announcing-the-2019-aws-city-on-a-cloud-innovation-challenge-winners/

Why TCNs, TNCNs and philanthropies, foundations and EU institutions issue challenges and awards is puzzling. Why bother? They offer a wealth of applied knowledge. The issue, it appears, is the slow-take up of climate change actions and the slow adoption of digital technologies. Should one surmise that the challenge or award is, in the first instance, intended to make things happen?

In the case of the Rockefeller Foundation and BP, the winning city learns and adopts a particular approach to, respectively, resilience and data-driven city management and planning, and also to climate change mitigation. The challenges and awards are intended to nudge cities to commit to an approach. In turn, winning cities serve as case studies for other cities as examples of best practice. As case studies they also draw attention to the criteria used to select a winning city. The hypothesis is that the criteria for the challenges and awards causes other cities to shape their programs and projects with those criteria in mind.

What winning cities win varies. IBM and AWS provided/provide technical expertise and their products and services. They also place a spotlight on the city. Cities winning the *Global Cities Challenge* similarly win technical assistance with the preparation of both technology and financial project details and win European Investment Bank assistance in being able to finance a project, including assistance in obtaining investors. The cities also win expert support to craft a digital transformation strategy.

For all winning cities, there is a measure of crudity in the offer of a spotlight on the city being an outcome. For example, the *European Green Capital Award* is presented as leading to an "Increase in tourism, Positive international media coverage worth millions of euro, Increase in international profile, networking and new alliances [and] New jobs – a Green Capital is more attractive to foreign investors" (European Commission, n.d.). In some instances, the vanity of the mayor is a consideration. Mayors are offered a more visible international role by promoting climate actions.

From the point of view of a city manager, what is the priority: winning a challenge or being highly ranked by *The Economist Intelligence Unit* as a livable city? The issue is not a trade-off, for one accolade supports the other.

City ranking industries are significant in a context of cities competing globally and *The Economist* or *Forbes* or McKinsey (Manyika et al., 2018) or some other credible source ranking a city as "global," "most smart," "most connected," "most innovative" and other "mosts." It is to be expected that city managers will pay attention to the criteria used for ranking purposes and this will influence their policies. Certainly, in 2018, when *The Economist Intelligence Unit* replaced Melbourne with Vienna as the world's most livable city, a ranking that was published on news media around the world, there was attention to the criteria used and why Melbourne had fallen behind.

Shaping Metropolitan Policies for Climate Change and Smart Cities

Chronicling when the TCNs and TNCNs were started, their partners and their funding, Tables 4 and 5 describe the roles of the TCNs and TNCNs and are organized into three categories:

- governance and advocacy;

- climate change mitigation and adaptation; and

- digital transformation of cities.

The discussion continues through reference to the agendas and funding roles of BP and the EU, then proceeding to the TCNs and TNCNs according to the three categories. Thereafter IBM, the Smart Cities Council and Barcelona are considered.

Transnational city networks and networks of city networks, and European Union initiatives

The common understanding of the role of TCNs is to facilitate collaboration and knowledge sharing among cities. Combining TCNs and TNCNs, additional modes of knowledge sharing are:

- knowledge generation and sharing collaboration with other TCNs and TNCNs, often as partners;

- knowledge sharing websites that constitute a global library;

- extensive use of social media;

- "winning cities" as replicable models of best practice identified through city challenges and awards;

- conferences, events, seminars, training both in-person and online, including webinars;

- issue-related policy advocacy;

- lobbying by C40, EUROCITIES, ICLEI, Metropolis, UCLG to enhance the role of city governments and city networks relative to higher levels of government; and

- study tours by the same organizations.

One would expect the funding of TCNs to arise from member cities. Metropolis and ICLEI are independent of BP and EC funding and, it is claimed, are largely or wholly funded by membership dues. For the other TCNs considered here, the common circumstance is one of funders having disproportionate influence. Being funded by BP is to be committed to data-driven city management and to city-led climate change mitigation. (BP has two funding partners, CIFF[14] (Children Investment Fund Foundation) and Realdania,[15]

a Danish philanthropy focused on the built environment). EC funding embraces the notion of the digital transformation of cities and refers to smart cities as an objective. BP is a major funder of C40 and the Global Covenant of Mayors for Climate & Energy (GCoM), and Michael Bloomberg is President of the Board of C40 and co-chair of GCoM. The EC funds EUROCITIES, the Covenant of Mayors, EIP-SCC, Living-in.EU: The European way of digital transformation in cities and communities (Living-in.EU) and Open and Agile Smart Cities (OASC), and also funds the GCoM.

Table 4 shows when the TNCs and TNCNs were formed and also their partners and funders. UCLG, C40, Metropolis and ICLEI typically overlap as partners. Competing as they might be for influence, it appears that both their effectiveness and their influence is enhanced if they work together.

The digital transition category of Table 4, where EU digital initiatives are located, refers solely to the 2010s and does not include UCLG, C40, Metropolis and ICLEI. What is striking about Table 4 is the absence of TCNs and TNCNs formed in the 1990s, that is, after 1990 itself. This observation extends to organizations that are not included in this paper. Energy Cities, which is concerned with the energy transition of European cities, was formed in 1990. The Climate Alliance, which was formed by 12 municipalities in Austria, Germany and Switzerland and indigenous peoples in the Amazon River basin, also was formed in 1990. The Climate Chance Association was formed in 2015. In regard to the TCNs and TNCNs in Table 4 that were formed in 2004 and afterwards one sees the presence of either BP and/or the EU.

Table 5 serves to clarify the "markets" of the various organizations and the delineation of turf. "A proliferation of networks working on similar issues, and potentially at cross-purposes, risks redundancy and 'network fatigue' among the sub-national actors, and the governments at home and abroad who work with them" (Institute for the Study of Diplomacy, 2019). A Working Group at Georgetown University identified 54 city networks. Table 5 identifies agencies that serve cities regardless of size (ICLEI, the Covenant of Mayors and GCoM) and others that serve large cities (UCLG, C40 and to some degree EUROCITIES). While network fatigue is no doubt an issue, these are preeminent agencies and they collaborate in the curation of knowledge.

TABLE 4. Transnational City Networks and Networks of Networks, and European Initiatives

Metropolitan governance and advocacy			
Year	**Organization**	**Partners**[16]	**Funders**[17]
1985	Metropolis	UCLG, C40, ICLEI, OECD, UN-Habitat, UNHCR, MIT, LSECities, Centre for Liveable Cities Singapore, Smart Cities India, South African Cities Network & many other	Membership dues (+/- 50%), European Union & other lesser sources
1986	EUROCITIES	Cities Today, Committee of the Regions (EU), Employment & Social Innovation (EU), European Metropolitan network Initiative, European Enterprise Awards	EC
2004	UCLG	C40, ICLEI, World Resources Institute, Clinton Foundation, EC, World Bank, UN-Habitat	EC; programs funded by European Climate Foundation, International Labor Organization, Barcelona Provincial Council & French Ministry for Europe & Foreign Affairs (UCLG, 2018)

Climate change			
Year	**Organization**	**Partners**	**Funders**
1990	ICLEI	None identified on website. Elsewhere partners identified are C40, Climate Chance, Metropolis, UCLG, OASC, Global Smart Cities Alliance & other organizations	Membership dues. No other funders identified on website or during interview
2005	C40	UCLG, ICLEI, World Resources Institute, Clinton Foundation, World Bank	BP, CIFF, Realdania
2008	Covenant of Mayors	European city networks: Energy Cities, CEMR,[18] Climate Alliance, EUROCITIES & FEDARENE[19]	EC
2014-2016	Compact of Mayors[20]	C40, ICLEI, UCLG, UN-Habitat	BP
2016	GCoM	Covenant of Mayors, Compact of Mayors (C40, ICLEI, UCLG, UN-Habitat) EC, World Bank, EUROCITIES & other organizations.	EC, BP

Digital transition – European initiatives			
Year	**Initiative**	**Partners**	**Funders**
2012	EIP-SCC	"… brings together cities, industry, SMEs, banks, research & other smart city actors"(EIP-SCC, n.d.)	EC
2015	OASC	Not partners but working relationships with C40, UCLG, ICLEI & GCoM	EU Horizon 2020 research & innovation program & governments of Switzerland & South Korea
2018	CDR	"Promoted by" Barcelona, Amsterdam, New York	"Supported by" UN-Habitat, EUROCITIES, UCLG, UN Human Rights
2019	Living-in.EU	N/A	EC

TABLE 5. Membership of Transnational City Networks and Networks of Networks

Metropolitan governance and advocacy	
Organization	**Member cities & other organizations**
Metropolis	138 member cities; knowledge sharing & lobby for enhanced role for cities—serves as metropolitan department of UCLG
EUROCITIES	45 partner cities; works with 140 of Europe's largest cities to provide assistance & to influence EU policy & legislation pertaining to cities
UCLG	Network of networks "committed to representing, defending & amplifying the voices of local & regional governments"
Climate change	
Organization	**Member cities & other organizations**
ICLEI	1,750+ cities, towns & regions around the world – focus on sustainability, climate change, ecosystem degradation & inequality – works in association with UN
C40	96 megacities sharing knowledge of climate change, with a global climate change agenda
Covenant of Mayors	9,000+ local & regional authorities from 57 countries committed to EU climate & energy objectives
Compact of Mayors	ICLEI, UCLG, C40 & UN-Habitat prior to the creation of GCoM
GCoM	Commitment from 10,000+ cities & local governments from 135+ countries to address climate change
Digital transition—European initiatives	
Initiative	**Member cities & other organizations**
EIP-SCC	"EIP-SCC Market Place has been designed for those who are active in the challenging area of Smart Cities" (EIP-SCC, n.d.)
OASC	"International smart city network that has the goal of creating & shaping the nascent global smart city data & services market" (OASC, n.d.)
CDR	Declaration to protect & uphold human rights on the internet at the local & global level, signed by 42 cities
Living-in.EU	EU initiative seeking to promote digital transformation of cities – 70 cities & other levels of government have signed on

Bloomberg Philanthropies

BP was formed in 2006. As noted, BP did not respond to requests for an interview. The failure to obtain responses, including from interviewees in respect of BP, are problematical because Michael Bloomberg and BP are extraordinarily influential. BP "invests in 510 cities and 129 countries around the world, and in 2019 distributed $3.3 billion" (Bloomberg Associates, n.d.).

The *2019 Bloomberg Philanthropies Annual Report* lists 13 urban commitments. The commitments differ in nature and are shown below. In addition to the three challenges, "Beyond Carbon" includes a challenge to the 100 largest cities in the United States "to propose bold plans for cutting carbon emissions."

American Cities Climate Challenge	Global Covenant of Mayors for Climate & Energy[21]
America's Pledge	Innovation Teams
Beyond Carbon	Mayors Challenge
Bloomberg Harvard City Leadership Initiative	Partnership for Healthy Cities
C40 Cities Climate Leadership Group[22]	Public Art Challenge
Cities of Service	What Works Cities[23]
CityLab	

What Works Cities is indicative of the principles underlying BP's approach. BP holds that the "What Works Cities Certification is the National Standard of Excellence for Well-Managed, Data-Driven Local Government" (Bloomberg Philanthropies, n.d.) Rather than question the presumptions of BP, cities take the certification seriously. Six weeks after the program was announced, over 100 cities had applied. The process of applying, being accepted and the evaluation of eligibility for certification is arduous (Brody et al., 2016). What does the certification consist of?

Results for America, largely funded by BP, has published, online, "Local Standard of Excellence: The What Works Cities Standard" (Results for America, 2017). The standards provide the basis for the certification of cities. Cities are provided with a *Technical Assistance Framework* to assist with their applications. The Framework has sections on:

Open Data	Data Governance	Performance Analytics
Evaluations	Repurpose for Results	Results-Driven Contracting

The focus is a commitment to making data and evidence-based decisions as well as measuring and learning from progress whilst engaging citizens (Results for America, Ibid.). Excellence in management arises from an approach to governance.

There is no implied rejection of digital technologies. The Ash Center at Harvard University and the National League of Cities are on the panel involved in the certification process and both promote smart cities. Code for America also serves on the panel. "Code for America uses the principles and practices of the digital age to

improve how government serves the American public ..." (Code for America, n.d.).[24] Support for the adoption of digital technologies is probable but, from a BP point of view, the application of these technologies is better cast as integral to the process of effective governance; as a means to an end framed by city government, not by the vendor of the technologies.

An assessment of the BP approach harks back to 1997 and Tony Blair's New Labour manifesto that included "what matters is what works" (BBC News, 2010). A video on the Bloomberg Associates, the philanthropic consulting arm of BP, proclaims, "We know what the problems are. We know what works. We know what hasn't worked" (Bloomberg Associates, n.d.). There is reason to question a context-free knowledge of what works. Data-driven governance is problematic because claims regarding what works presumes knowledge of the data that is relevant and suggests an objective neutrality to power and influence. However, the reality is that those with power and influence determine what the problems are and what constitutes relevant data.

One can easily imagine a debate between economists. What counts as facts? Whose facts count? What weighting should be given to a fact? What proxy should be used when the item concerned cannot be measured? Seldom do economists agree and not too often do they correctly foretell changes in the market. And so, one returns to data-driven governance for public policy issues. What counts as facts? Whose facts count?

Essential issues may not be amenable to measurement. At the time of writing, a defining issue for cities in the United States concerns relations between a protesting citizenry and police that have harassed and committed violence against citizens. How this issue is defined, who defines it, and how government seeks to fix the issue reflects power and influence. What should be measured? A city that works is one in which the relationship between a citizenry and authority is characterized by trust.

European Union

Since the 2016 Pact of Amsterdam, the *Urban Agenda for the EU* promotes multi-level and multi-stakeholder governance in three dimensions: top-down, bottom-up and horizontal. The top-down levels include the EU, national, regional and Urban Authorities. The bottom-up view is that cities should lobby the EU regarding policies and funding. The horizontal dimension is that this is best done in partnership with other Urban Authorities.

The context for these efforts is the "Europeanisation of cities or 'urban Europeanisation' [that] entails a fundamental transformation in which local decision-making becomes an integral part of the EU, while European ideas and practices find their way to the centre of local decision-making… " (Verhelst, 2017). EUROCITIES is called upon to assist Urban Authorities with their lobbying, providing information regarding EU legislation and funding opportunities and promoting knowledge sharing.

The "Priority Themes and cross-cutting issues of the Urban Agenda for the EU" include "Circular economy," "Jobs and skills in the local economy," "Climate adaptation (including green infrastructure solutions)," "Energy transition," "Sustainable use of land and Nature-Based solutions," "Urban mobility" and "Digital transition" (European Union, 2016). The themes and issues speak to both climate change and digital cities.

The EU has overlapping, coordinated research initiatives and implementation programs for smart cities and climate change. The initiatives, discussed later, are the EIP-SCC, the OASC and Living-in.EU, and also CDR that is in large part a European city undertaking. They capture the attempt to speed up the adoption of digital technologies, to build a city-friendly market for these technologies and ensure a citizen's data privacy and security.

Metropolitan governance and advocacy

Metropolis and UCLG seek to promote the role of cities in national and international institutions of governance. EUROCITIES is funded to do this at the scale of the EU.

Metropolis

The formation of Metropolis follows from Habitat I, the United Nations Conference on Human Settlements held in Vancouver in 1976. Discussions among Barcelona, Paris and Montreal regarding the formation of Metropolis were first held in 1984 and primarily concerned urban planning matters, the needs of mayors of large cities and the desirability of knowledge sharing. Metropolis was established in Montreal in 1985[25] and, at the time of writing, had 138 member cities.

Metropolis' agenda combines climate change mitigation and adaptation and the digital transition of metropolitan areas, and does not promote smart cities per se. In a 2019 survey by Metropolis of 28 member cities, a common finding was anxiety about the digital transition in a context where the municipal systems providing services did not employ the same data standards and IoT technology and data were not interoperable, where data privacy and security were a concern and, in this light, what open data standards actually mean. Metropolis' addressing of such issues is indicated by the resources provided to its members, and to the public on its website.[26] These include the Issue Papers below that focus on resilience and digital transformation.
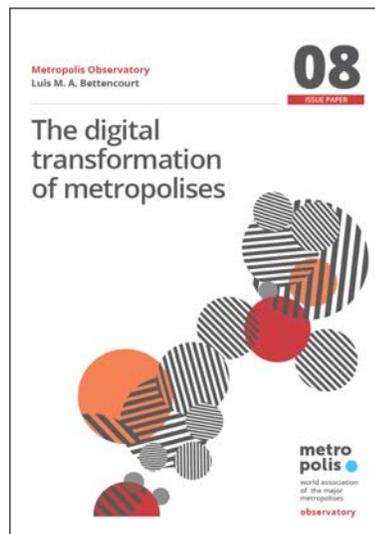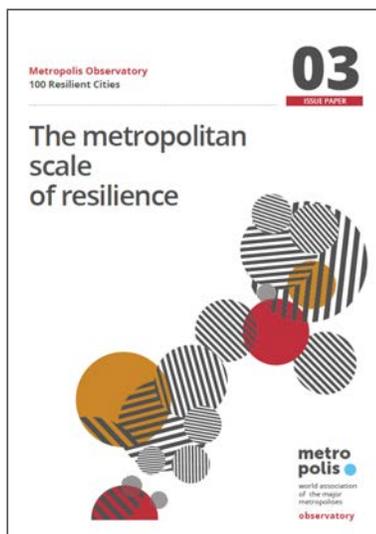
Two among many Metropolis Issue Papers Images courtesy of: Metropolis. https://www. metropolis.org/projects/issue-papers

EUROCITIES

EUROCITIES was formed in 1986 by six cities – Barcelona, Birmingham, Frankfurt, Lyon, Milan and Rotterdam. Like other agencies EUROCITIES provides a platform for "sharing knowledge and exchanging ideas," but unlike other TCNs, the role of EUROCITIES is shaped by its contribution to the EU's *Urban Agenda* and its funding from the EC.

The *Urban Agenda* "ambition [is] to actively and structurally involve cities in the development of an EU urban policy on the basis of the partnership principle. EUROCITIES is thereby formally acknowledged as one of the

privileged partners to represent the urban interest" (Verhelst, 2017). EUROCITIES seeks to "reinforce the important role that local governments should play in a multilevel governance structure" (EUROCITIES, n.d.). The Agenda includes both green and smart cities.

United Cities and Local Governments

UCLG declares that it is "the largest organization of local and regional governments in the world," (UCLG, n.d.) tracing its history back to 1913 and the launch of the international municipal movement "with the creation of the Union Internationale des Villes ... and the decision to maintain permanent relations between municipalities from all over the world to better serve their citizens" (UCLG, n.d.). The history of the movement between 1913 and 2004, when UCLG was formed, is complex. Suffice to write that UCLG was formed by the fusion of the two largest networks, the International Union of Local Authorities and United Towns Organization, with the support of Metropolis.

UCLG's agenda is to increase the role and influence of local and regional governments in institutions of national and global governance.

Climate change

The TCNs and TNCNs partner in the preparation of climate change mitigation and adaptation strategies. Together, they represent a formidable body of knowledge and influence. It cannot be assumed that their collaboration is without its difficulties. BP-funded TCNs and TNCNs base their authority on the claimed role and significance of cities. EC-funded TCNs and TNCNs base their authority on their role within the EU (Gesing, 2018).

ICLEI—Local Governments for Sustainability

ICLEI was formed in 1990 at the United Nations World Congress of Local Governments for a Sustainable Future. The timing is associated with the hole in the ozone layer. ICLEI morphed to having a focus on climate
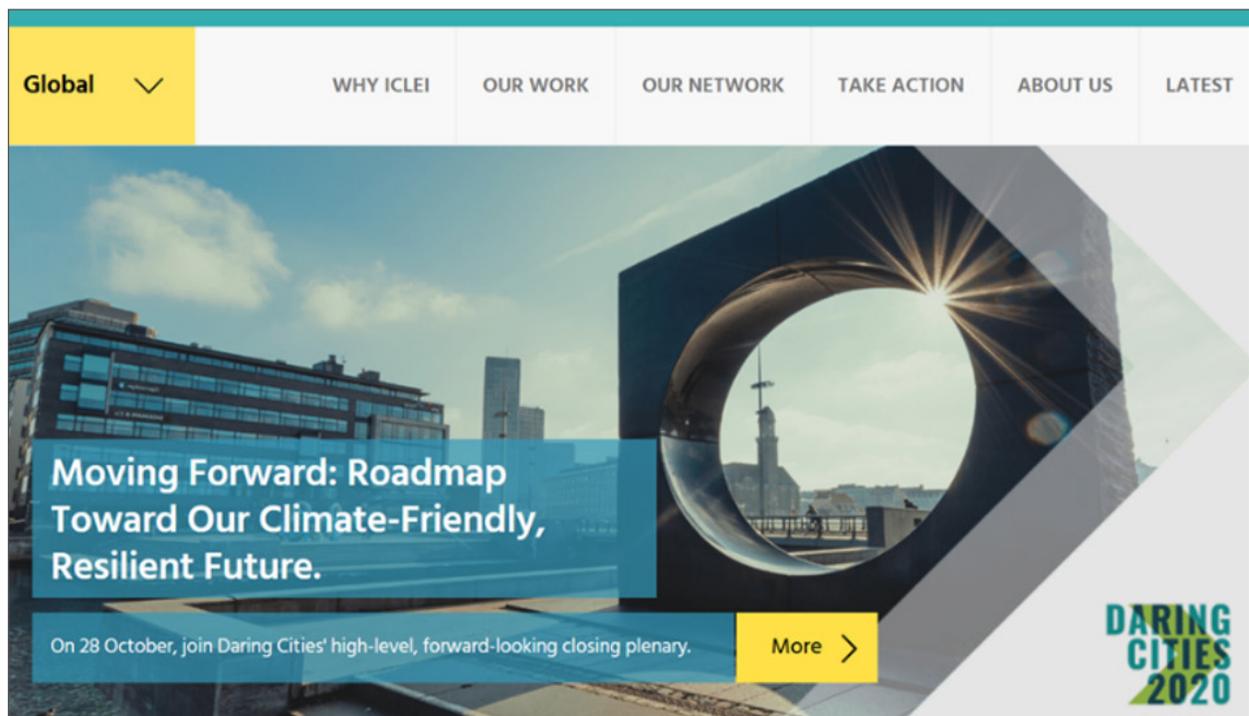
ICLEI climate resilience roadmap. Image courtesy of ICLEI, https://iclei.org

change and, in 2003, to a broader focus on sustainability. (This explains why ICLEI remains the abbreviation for a renamed Local Governments for Sustainability).

ICLEI promotes knowledge of, and the use of, digital technologies in mitigating the effects of climate change. For example, ICLEI has collaborated with academics to, in 2020, publish "Assessing the potentials of digitalization as a tool for climate change adaptation and sustainable development in urban centres." Later in the year, ICLEI hosted a virtual event, *Daring Cities,* intended to "help to set the course to COP26 (the 2021 United Nations Climate Change Conference)." As a virtual event, it was free and open via Zoom, with the roadmap discussion available to all.

An important role for ICLEI is that of the custodian of the *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories* (GPC), a tool used to standardize city emissions data. GHG emissions inventories are very significant. If a city is to have a baseline and then to be able to assess its effectiveness in achieving its climate mitigation and adaptation goals, then the GPC is essential.

The GPC was prepared by the Compact of Mayors and its preparation was supported by the World Bank and UN-Habitat. The GPC is employed by cities that are linked to the World Resources Institute, C40 and ICLEI and, as of June 2020, was being "refined."

C40

C40 was established in 2005 at a meeting convened by the Mayor of London, Ken Livingstone. The C40 under discussion here is that which post-dates Michel Bloomberg becoming Chair (now President) of the Board in 2010 and after the period when C40 was partnered with the Clinton Climate Initiative. C40 has sought to "be recognized as an official voice of the world's megacities that are committed to real, measurable climate action" (City of Sao Paulo, 2011).

Examining the governance of C40, it cannot be said that C40 is city-led. Whereas the C40 agenda had

previously been developed within a Steering Committee, Bloomberg began to "centralize agenda-setting" upon taking over as Chair in late 2010 and was able to "govern in the absence of explicit coercion" (Gordon, 2016). Central to the C40 agenda is cities addressing climate change mitigation.

C40 provides a considerable depth of knowledge to member cities and to the world through documents available on its website. The few bullet points below headline the knowledge made available by C40. It is important to understand the scale and scope of the knowledge products, which are listed in more detail in Annex 3.

C40 has:

- GOOD PRACTICE GUIDES;

- C40 Research, Measurement and Planning;

- The C40 Knowledge Hub;

- Featured Knowledge;

- Spotlight Series; and

- Research Library (C40, n.d.).

Source: C40

Two C40 reports are discussed below: *Deadline 2020* (published in 2016) and *Climate Emergency / Urban Opportunity* (published in 2019). They depict the maturation of C40's understanding of the prospective contribution of cities to climate change mitigation.

Deadline 2020

Deadline 2020 was prepared by C40 and Arup and is presented as "How Cities Will Meet the Paris Agreement… the first significant routemap… outlining the pace, scale and prioritization of action needed by the C40 member cities over the next 5 years and beyond" (C40 Cities and ARUP, 2016). The *Deadline 2020* title arises from the view that "The overriding and deeply significant finding of the work is that the next *4 years will*

determine whether or not the world's megacities can deliver their part of the ambition of the Paris Agreement. Without action by cities the Paris Agreement cannot realistically be delivered" (C40 Cities and ARUP, Ibid.).[27]

C40 is collaborating with "17 other sector-specific networks," including UCLG and ICLEI, and this collaboration is described as the "bedrock" for "ramping up direct support" for "City Actions" (C40 Cities and ARUP, Ibid.). City Actions refer to "direct actions taken by city governments [and] to interventions and changes that they can influence within their city boundaries ..." (C40 Cities and ARUP, Ibid.).

Deadline 2020 begins with the usual hoopla that cities "have demonstrated their agility and the speed by which they can act," the claim that mayors of member cities "have the experience and capacity to tackle climate change" and that "C40 cities can build on the huge momentum created to date" (C40 Cities and ARUP, Ibid.).[28] Later in the report, these views are directly contradicted. It is noted that mayors alone lack the power to undertake most of the necessary climate actions, but, instead, are forced to depend on collaboration. Then, most strikingly, the report states, "It is crucial to note that the ability of C40 cities to achieve their trajectories relies entirely on one major action at the national level: decarbonisation of energy, primarily as electricity. *Without this, every C40 city will miss its target*" (C40 Cities and ARUP, Ibid.).[29]

In *Deadline 2020,* C40 assumes the role of enabling cities to undertake climate change actions:

> HOW C40 WILL UNLOCK ACTION IN CITIES
>
> C40 will support member cities to achieve their targets by engaging mayoral leadership; providing technical assistance to set and deliver robust emissions inventories, targets and plans; facilitating peer to peer exchange of best practice; removing barriers to action; and achieving a strong collective voice (C40 Cities and ARUP, Ibid.).

It appears that C40's view is that most of what a city can hope to achieve depends on politics and influence, with many or most C40 cities dependent on C40 to make city-wide climate actions possible.

Climate Emergency / Urban Opportunity

The subtitle to *Climate Emergency / Urban Opportunity i*s *How National Governments Can Secure Economic Prosperity and Avert Climate Catastrophe by Transforming Cities* (Coalition for Urban Transition, 2019). The report was published in 2019 by the Coalition for Urban Transitions. C40 and the World Resource Institute take a sobering look at the dependence of cities on national government policies, legislation, funding and the intergovernmental delineation of roles and responsibilities; and then write that with the right conditions in place, cities can contribute very significantly to climate change mitigation. The impression is one of C40 taking a step back from *Deadline 2020* and, instead of vaunting what cities can do, identifying the preconditions to cities undertaking climate actions. This report is detailed and practical and tremendously important.

A theme in this paper is that TCNs and TNCNs seek to insert the role of cities into the policy agendas of state/provincial, national and global institutions and themselves as representing cities on the policy-making bodies of those institutions. The question here is the extent to which the World Resource Institute and C40 can influence national policy. The research underlying the report and the report itself was funded by the English, German and Swedish governments and the GCoM. It appears that in Europe there will be an attentive audience.

Covenant of Mayors for Climate & Energy

The Covenant of Mayors was formed in 2008 and is funded by the EC. Its partners include a multitude of European climate change agencies. The Covenant

"gathers 9,000+ local and regional authorities across 57 countries drawing on the strengths of a worldwide multi-stakeholder movement and the technical and methodological support offered by dedicated offices" (Covenant of Mayors for Climate & Energy, n.d.). As of 2017, regional Covenant offices have been located in North America, Latin America and the Caribbean, China and South-East Asia, India and Japan (Covenant of Mayors for Climate & Energy, n.d.).

In the case of European cities, when officially joining the Covenant of Mayors, signatories "commit to developing a Sustainable Energy (and Climate) Action Plan within two years" (Covenant of Mayors for Climate & Energy, n.d.). This includes "reducing emissions of CO2 and other greenhouse gases, of at least 40 percent by 2030 and preparing a baseline inventory of GHG emissions (Covenant of Mayors for Climate & Energy, n.d.). The Covenant of Mayors prepared the *Common Reporting Framework* (CRF) that, like the GPC, is used to standardize city emissions data. The CRF was "refined" in 2019 and is employed by the GCoM and by EU-linked networks and cities. The GPC and the CRF co-exist.

Compact of Mayors

The Compact of Mayors was launched in 2014. It was formed by UN Secretary-General Ban Ki-moon, Michael R. Bloomberg, in his capacity as the U.N. Secretary-General's Special Envoy for Cities and Climate Change, as well as ICLEI, C40, UCLG and UN-Habitat. The Compact of Mayors proclaimed itself as the global representative for cities for climate actions.

The defining features of the Compact of Mayors was that cities should prepare an inventory of GHG emissions, prepare climate change action plans in a manner that is data-driven and undertake climate actions. In 2016, the Compact of Mayors joined with the European Covenant of Mayors to form GCoM. The Compact of Mayors website now steers the searcher to the GCoM[30] and to the C40 Compact of Mayors (C40, n.d).

Global Covenant of Mayors for Climate & Energy

The GCoM is concerned to make the point that it "is the largest global alliance for city climate leadership, built upon the commitment of over 10,000 cities and local governments. These cities hail from 6 continents and 138 countries" (Global Covenant of Mayors for Climate & Energy, n.d.).

The GcOM seeks "– in alliance with partners – [to] accelerate ambitious, measurable climate and energy initiatives that lead to a low-emission and climate-resilient future" ((Global Covenant of Mayors for Climate & Energy, Ibid.). The GCoM comprises a partnership between the former members of the Compact of Mayors and the Covenant of Mayors. In all, the GCoM's Founding Partners or Data and Reporting Partners are UN-Habitat, the EC, the World Bank, C40, ICLEI, UCLG, EUROCITIES and other organizations in addition. Michael Bloomberg and Frans Timmermans, EC Executive Vice President for the European Green Deal, co-chair the GCoM.

The GCoM has three substantive initiatives – Innovate4Cities, Data4Cities and Invest4Cities – whose intent is to assist cities prepare, finance and undertake climate change mitigation and adaptation strategies. To this end, GCoM knowledge resources include a library with case studies, webinars and technical material; funding initiatives; adaptation support and an Urban Adaptation Support Tool; and EC funding to address Energy Poverty.

Digital transition— European initiatives

It is apparent that the EU is both committed to the digital transformation of its cities and frustrated by the slow pace of the transformation. The initiatives detailed below are all intended to hasten the transition. CDR is not an EU initiative, having been formed

by New York, Amsterdam and Barcelona, but certainly is supported by the EU. Common to the initiatives is data and technological sovereignty, by which is meant "open technology (software, hardware, computing, data)" and citizens having greater control over their data (Ajuntament de Barcelona, 2015).

European Innovation Partnership for Smart Cities and Communities[31]

The EIP-SCC focuses "on the intersection of energy, ICT and transport [and]… builds on the engagement of the public, industry and other interested groups to develop innovative solutions and participate in city governance" (European Commission, n.d.). It is intended to "to overcome bottlenecks impeding the changeover to smart cities, to co-fund demonstration projects and to help coordinate existing city initiatives and projects, by pooling its resources together. It ultimately looks to *establish strategic partnerships between industry and European cities to develop the urban systems and infrastructures of tomorrow*" (European Commission, n.d., emphasis in original). The EIP-SCC is especially concerned to hasten the adoption of urban platforms that are a defining feature of the EU's intended digital transformation.

Graham Colclough, a consultant to the EIP-SCC, defines urban platforms as:

> …the implemented realisation of a logical architecture/design that brings together (we say "integrates") data flows within and across city systems
>
> …and exploits modern technologies (sensors, cloud services, mobile devices, analytics, social media etc.)
>
> …providing the building blocks that enable cities to rapidly shift from fragmented operations to include predictive effective operations, and novel ways of engaging and serving city stakeholders

…in order to transform, in a way that is tangible and measurable, outcomes at local level (e.g. increase energy efficiency, reduce traffic congestion and emissions, create (digital) innovation ecosystems, efficient city operations for administrations and services) (Green Digital Charter, 2017).

Urban platforms represent the transformation of cities from siloed service delivery bureaucracies to an integrated, data-driven digital means of managing cities. An example of what this means for citizens is provided by the curiously named "single source of truth." The citizen's identity and data will be stored once only and all service delivery, paying of bills, participation in planning decisions and so on will be based on the citizen's details that are found only once on the urban platform. It is apparent why city governments in Europe and community activists emphasize digital privacy and security and a citizen's control of their data.

A significant feature of Colclough's view of how cities should proceed with their digital transformation is in the form of demand aggregation, which means that cities collaborate in the digital market in order to enhance their bargaining power. Typically, the emphasis in the adoption of digital technologies is that they be replicable and that they can scale. Replicable means the ability of one city to follow the example of another, which is the objective of the city challenges and awards. Demand aggregation displaces replicability, that is, unless the example is one of cities acting together to negotiate with vendors.

The EIP-SCC's *100 Intelligent Cities Challenge* is intended to encourage cities to undertake the digital transition. "ICC cities will receive high quality and tailored guidance and expert support, access to advisory and city peer networks (European and international), and capability building tools, to drive priority policy goals and the uptake of advanced technologies" (European Commission, n.d.). The challenge seeks to "develop modern ecosystems that catalyse business

transformation in a sustainable way, upskill their workforce and create new marketplaces for smart products and services" (European Commission, 2019). Again, there is reference to the marketplace. Getting cities to press the GO button is envisaged as demand-led city engagement with the private sector.

Open and Agile Smart Cities

The OASC is a non-profit, international smart city network with a membership of more than 150 cities, not all of which are from Europe. The OASC was created due to the slow progress of European cities in the digital transition. Slow progress is explained as being due to budget constraints, "inflexible procurement models… and siloed, bureaucratic and risk-averse environments" (OASC, 2019). The OASC is included in this paper because of the intended contribution of *A guide to SynchroniCity: A universal approach to developing, procuring and deploying IoT- and AI-enabled services* to the digital transformation of cities (European Union, 2020).

In addition to SynchroniCity, the OASC, along with EUROCITIES and some other organizations, are described by the EC as having "taken the initiative to find a common 'European way' for the digital transformation of sustainable cities and communities by ensuring data and technological sovereignty in the European Union" (European Commission, 2019). The emphasis on a European Way gets one's attention. It is presented as "respecting European values and diversity, as well as individuals' digital rights" (Living-in.EU, n.d.).

The Synchronicity guide assists cities understand and adopt minimal interoperability mechanisms that are central to the digital transformation of cities. Minimal interoperability mechanisms:

> …outline the minimum technical requirements needed for technology providers to interface their IoT solutions with local authorities' digital systems.

The interoperability of these mechanisms enables impactful IoT solutions to be easily deployed and replicated in any local authority experiencing the same challenges.

If adopted across Europe and beyond, the SynchroniCity framework could set the foundations for a new digital single market, where local authorities and technology providers of all sizes can easily exchange data and digital goods and services in a fair data economy.

With this digital market in place, local authorities will have access to a catalogue of digital services, allowing them to easily test and procure the best solutions for their citizens' needs and place demands on the market based on their strategic goals.

The image is one of a digital marketplace where city governments can shop around, evaluate the products and services of all vendors, and then select technologies and configure them much as one configures blocks in a Lego set.[32]

Cities for Digital Rights

As noted, CDR was formed by New York, Amsterdam and Barcelona. As of July 2020, in addition to these three cities, it is being "promoted" by EUROCITIES, UCLG and C40. Most of the 52 cities that have signed the declaration are from Europe, but there are a number of signatories from the United States and some from elsewhere in the world. CDR exemplifies the understanding that, in Europe, it is intended that cities should actively seek to protect the human rights of their citizens where these rights take a digital form. Thus, "We strongly believe that human rights principles such as privacy, freedom of expression, and democracy must be incorporated by design into digital platforms starting with locally-controlled digital infrastructures and services" (Cities for Digital Rights, n.d.). *Signing the Declaration is to commit a city to the*

specific climate actions indicated on CDR's website (Cities for Digital Rights, n.d.).

Living-in.EU: The European way of digital transformation in cities and communities

The objective of *Living-in.EU* is presented as a "movement" and, again, as a "'European way' of digitally transforming cities and communities" (European Union, n.d.). *Join, Boost, Sustain,* the movement is described by Living-in.EU as "the deployment and scaling up of open, interoperable, cross-sector and cross-border platforms as a means to boost digital transformation [and] ensure technological sovereignty in the EU and the co-creation of digital solutions that do not lock our cities and communities into specific technologies" (European Union, Ibid.).

Cities are invited to sign a Declaration committing themselves to the European way of digital transformation. EUROCITIES, the OASC, the EU, the EC and some other organizations are shown as promoters of the Declaration, with the same being true for cities signing the declaration. The Declaration provides a very useful guide for cities that seek to undertake the digital transition.

IBM

The IBM website foretells the demise of the notion of a smart or smarter city, mention of which has been removed.

IBM presented the company's vision for a "Smarter Planet" in a 2008 speech (Sadowski and Bendor, 2019). In the early 2010s the "Smarter Planet" and "Smarter Cities" imagery were described as having a "transformative impact" on IBM and being profitable (Paroutis et al., 2013).[33] Between 2011-2017 winning cities for the Smarter Cities Challenge benefitted (one assumes) from:

> …grants of IBM expertise and technology to address their top strategic challenges. Winning cities receive a team of IBM experts deployed full-time for three weeks, with all

costs assumed by IBM Citizenship. Teams leverage IBM cognitive computing, cloud platform, mobile and social analytics and extensive weather data capabilities to provide deep, data-driven insights that help improve policy development and decision-making in cities (IBM, n.d.).

Winning cities trumpeted the news on their websites. A "city can also use IBM to sell a positive image of itself as an attractive place for private investment regardless of whether the smart initiative actually solves its intended problem" (Sadowski and Bendor, 2019). For winning cities, it was a matter of aligning their smart city programs as IBM would have it.

The Challenge was a global triumph in both marketing the concept of smart cities and then in marketing the consulting services and software provided by IBM. With interest in the smart city label waning, IBM markets its smarter services in AI, blockchain, cloud computing, and so on; and does so to cities seeking to undertake the digital transition. It has always been the case that the technologies could be used for more purposes than those labelled a smart city technology.

Smart Cities Council

Whereas IBM and Cisco can be viewed as having sought to build a smart city market, the Smart Cities Council seeks to sustain the smart city market. The "Smart Cities Council is a member-driven network of the world's leading companies providing smart technologies to the public sector" (Smart Cities Council ASEAN, n.d). The "Council has become an expert on roadmaps"[34] as "cities need a trusted, neutral advisor. The Smart Cities Council provides that help" (Smart Cities Council, 2017).

I first heard of the Smart Cities Council when I was conducting an interview with a local government in metropolitan Sydney, Australia. Discussion concerning the lack of data standards led to the question whether the Federal government, instead of funding a few local

government smart city projects, would better spend the money formulating data standards for metropolitan areas. (The metropolitan area of Sydney has 35 local governments and that of Melbourne 32 local governments.) The interviewee thought that data standards were a good idea and the Federal government being involved was a bad idea. He suggested that this was a task for the Smart Cities Council, taking into account that the International Telecommunication Union (ITU), the International Organization for Standardization (ISO) and the Institute of Electrical and Electronics Engineer (IEEE) are advisers to the Smarts Cities Council. (See Annex 2.) The Smart Cities Council has global reach except, according to an interviewee, for the EU.

The Smart Cities Council definition of a smart city is one that adopts digital technologies.

> A smart city uses information and communications technology (ICT) to enhance its livability, workability and sustainability. First, a smart city collects information about itself through sensors, other devices and existing systems. Next, it communicates that data using wired or wireless networks. Third, it analyzes that data to understand *what's happening now and what's likely to happen next* (Smart Cities Council, n.d.).[35]

The Smart Cities Council offers, inter alia;

Smart Cities Readiness Program

Vendor-neutral guidance and workshops for cities, states, provinces, and electric companies.

Smart Cities Readiness Network

A global knowledge exchange for experienced public sector practitioners.

The *Smart Cities Readiness Guide* is a substantive roadmap that provides a "collaborative and comprehensive framework for a smart city, against which cities can assess their readiness to innovate – iden-

tifying a path, taking next steps and measuring their progress. The Guide is a conceptual roadmap to address growth strategies by focusing on universal principles that unite key areas such as energy, transportation, water and public safety" (Smart Cities Council, n.d.).

Barcelona

Barcelona has already been mentioned when referring to the creation of Metropolis, EUROCITIES and CDR, respectively in 1985, 1986 and 2018. This observation arises from the discussion of Barcelona largely reflecting on the period after the election of a leftist government in 2015. Barcelona has long been a leading city in respect of governance and knowledge sharing. An earlier and still current Barcelona Model arises from its success in using the 1992 Olympic Games to promote urban renewal. The Barcelona Model referred to here has to do with smart cities, until 2015, and citizen-centric digital technologies since then.

Prior to 2015, "Barcelona [had] fully embraced the smart city gospel" and presented itself as, indeed, it was referred to as (Charnock et al., 2019), the world leader in the "smart city 'transformation'" (March and Ribera-Fumaz, 2019). Apparently, as a result of the austerity measures introduced in 2011 (Blanco et al., 2020), the social movement, Barcelona en Comú, won the most votes in the 2015 elections and formed a coalition government. Barcelona en Comú held that

> Barcelona is today synonymous with the Barcelona Model: a way of making a city that has been dominant for almost three decades and that, beyond its democratic beginnings, has ended transforming Barcelona into the Mediterranean paradise for neoliberal urban policies;

> We want to close the wounds of a Barcelona that has been too long in the hands of a large-scale urbanism that has only benefited large hotel and housing lobbies and that now only knows how

to sell mass tourism, luxury consumption and the misleading idea that is hidden behind the smart city (Blanco et al., 2020).[36]

Rejecting smart cities, Francesca Bria, former Chief Digital Technology and Innovation Officer for Barcelona, famously said, "We want to move from a model of surveillance capitalism, where data is opaque and not transparent, to a model where citizens themselves can own the data" (Mosco, 2019).[37] In 2016, Barcelona launched the *Barcelona Digital City 2017–2020* plan. Barcelona retains its ambition of being a word leader and "is positioning itself as a reference example in open digital transformation" (Bria, 2017).

Vincent Mosco discusses how Barcelona has changed its relationships with corporate service providers and increased the value of contracts going to local small and medium enterprises, all the while implementing at scale what, a few years earlier, would have been termed smart city technologies (Mosco, 2019). The striking feature of Barcelona's digital transformation is the use of data "... to re-politicize the smart city and to shift its creation and control away from private interests and the state toward grassroots, civic movements and social innovation" (Cardullo and Kitchin, 2019). This represents a challenge to data-driven governance and the BP notion that data is objective and can form the basis for a city's allocating resources. Nonetheless, a case study of Barcelona would continue with how a radical movement, governing in coalition and in practice, has adopted less radical policies. Despite this being the case, Ada Colau, leader of Barcelona en Comú, was re-elected mayor of Barcelona in 2019.

One waits to see whether Barcelona can sustain the mayor's commitment to the "politics of the majority" (Russell, 2019).[38] I anticipate that it will be a bit like participatory budgeting in Recife in Brazil, that prevailed for a short period under specific socio-political conditions and, as it faded, gained global popularity and was advanced by institutions like the World Bank, except that the meaning and practice of participatory budgeting had been sanitized (Peck and Theodore, 2015).

Smart City Expo World Congress

The Smart City Expo World Congress bills itself as "The world's leading event for cities."[39] The 2019 Expo had 24,399 Visitors, 1,010 Exhibitors, +400 Speakers, 700 Cities, +146 Countries and +90 Side Events.[40] The Expo is an initiative of the Fira de Barcelona that is a consortium of Barcelona, the Catalan Government and the city's Chamber of Commerce. The initiative was begun in 2011 and is hosted by Barcelona. The role of the Expo is described as "to empower cities and collectivize urban innovation across the globe."[41] The Expo combines both knowledge and hyperbole.

The Expo's sponsors and partners are extraordinary in regard to the number and variety of institutions. In 2019 these included networks e.g., C40, ICLEI, UCLG, Metropolis, EUROCITIES; philanthropies and foundations e.g., Rockefeller Foundation, but not BP; corporations e.g., AWS, Cisco, Microsoft, Huawei, Siemens, but not IBM; knowledge institutions e.g., the McKinsey Global Institute; and international organizations e.g., EC, UN-Habitat and the World Bank.

The Expo makes awards in seven categories. The category, 2019 winning city and the essential feature of each category underlined, are:

- City Award... adds value to the **smart cities vision**: Stockholm, Sweden

- Innovative Idea Award... concepts contributing to the successful **transformation** of our cities: Barcelona, Spain

- Digital Transformation Award... solutions **digitally transforming** the urban environment: Yingtan, China

- Urban Environment Award... **sustainability** field: Madison, WI

- Mobility Award rewarding initiatives to better **move around** the city: La Paz, Bolivia

- Governance & Finance Award... improving urban **governance**: Los Angeles, CA

- Inclusive and Sharing Cities Award... collaborative practices and **inclusive** initiatives: Buenos Aires, Argentina

Source: Smart Cities Expo World Congress, 2019

The key words are those commonly found in smart city documents – inclusive, mobility, sustainability, transformation and the ability to finance the transformation. It is the smart city vision that, after so much reading, draws the eye. What might this be? First, I tried the Smart City Expo World Congress, but its vision statement is an advertisement for the Expo.[42] The *Barcelona Digital City 2017-2020* plan, while visionary, did not contain a vision statement. The Smart City Council offers a vision: **"**We envision a world where digital technology and intelligent design have been harnessed to create smart, sustainable cities with high-quality living and high-quality jobs" (Smart Cities Council, 2016). This bears no relationship to Barcelona's "digital policies that put citizens at the center and make Governments more open, transparent, and collaborative" (Ajuntament de Barcelona, n.d.). I thought of searching other sites, but by the time this paper is published, a *Smart City for Dummies* will have been published. If in need of a vision, the reader is referred accordingly.

Smart City Expo World Congress, 2019. Image courtesy of Smart City Expo–Fira de Barcelona

Conclusion

This paper has charted the evolution of forces shaping metropolitan policy for climate change, smart cities and the digital transformation of cities. There has been close attention to dates and decades and this has contributed to the ability to periodize and understand the forces shaping the evolution of urban policy. The early 1990s, in particular, set the stage as a result of the dissolution of the Soviet Union and, during the period covered by this paper, neoliberal hegemony; the invention of the Web and Sassen's global city and related books. Climate change, already a crisis, was recognized as an urban crisis a decade later.

Neoliberalism has been viewed as being in retreat, especially following the 2007/2008 financial crisis, but the most obvious effect of the crisis was to emphasize fiscal austerity in the neoliberal agenda (Theodore, 2020). A few cities have sought alternatives to neoliberalism, with Barcelona being a leading light. However, UCLG and EUROCITIES, BP and the EU and its various digital transformation initiatives all proceed with the market in mind, including when it comes to addressing crises. The EU seeks to shape the digital market to advantage the bargaining power of cities and also to advantage local small and medium enterprises. There is no neoliberal revisionism.

Climate change has been the arena for much boastfulness on the part of TCNs and TNCNs and BP. They have persistently overstated the extent to which cities, alone, can implement climate change actions. Only recently has there been a more sober assessment of what cities, acting alone, can achieve. The multi-generation climate change crisis is upon us. One can only hope that, as we enter the 2020s, national governments, the United States in particular, will create an environment within which cities can more effectively undertake climate change mitigation and adaptation.

City sobriety reflects on the BP commitment to city-led climate change mitigation and data-driven governance. Were these causes nuanced, they would generate much enthusiasm, but, at the moment, they can be caricatured as the products of a New Yorker: assertive and brash.

Digital technologies have been welcomed because they contribute to climate change mitigation and adaptation actions, promise more efficient systems of management and control of infrastructure and services, and serve the purposes of digital governance and citizen participation. The use of the word 'citizen' should be noted. Neoliberalism morphed citizens in a context of representative democracy into the clients of companies providing services. Barcelona's ambitions include morphing clients into citizens in a context of participatory democracy.

Globalization is an enigma. It has been suggested that globalization is in retreat. Even if this is the case, it does not mean the same for cities competing on a global stage. How might they best respond if, indeed, the production of, and trading in, goods and services shifts to a more regional focus centered on the United States, Europe and China? The conclusion most relevant to this paper is that unlike, say, climate change or digital technologies, globalization no longer carries the force it once did in shaping urban policy.

Turning now to the issue of policy curation and the roadmaps prepared by TCNs and TNCNs, and with them BP and the EU initiatives; the representation of the causes of, and responses to, urban issues are generally aligned, that is, except insofar as the EU wholeheartedly embraces the digital transformation of cities. The TCNs and TNCNs partner with one another and they partner as well with the World Bank, UN-Hab-

itat and other prominent organizations. It would be a brave mayor or city manager who says, "Yes, but with our local experts, we have formulated different policies and have committed to alternative programs."

The EU initiatives represent an extreme form of policy curation. Were it not so, the EU would be doing a poor job. It is not that the EU prescribes the policies cities adopt, but the knowledge backdrop and the digital market being created by the EU shape the programs that have financial credibility and create investment opportunities. It is fortunate that the EU is attuned to the need for data and technological sovereignty.

Seeking to advance the smart city cause are, of course, the Smart Cities Council and vendors of digital technologies, whether or not these are accompanied by a smart city label. Cities appear to be gaining greater ability, especially when acting together, in their procurement specifications to negotiate the terms under which vendors provide digital technologies. *Demand aggregation* – cities collaborating in the market – is a different message to *replicability*, cities winning challenges serving as models for other cities acting alone.

So much depends on how the digital transformation takes place. Opaque and Black-Box algorithms that include unintended but de facto public policy decisions, and that include decisions that affect individuals without the potential for recourse, represent a nightmare for citizens as much as they represent a quagmire for city managers. Open data standards, data privacy and security, and transparent algorithms are preconditions to a city's politicians and officials being accountable citizens; to the democratic governance of cities.

About the Author

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ANNEXES

ANNEX 1. Knowledge sharing or policy transfer

Academics commonly refer to policy transfer and, more recently, policy mobility. Practitioners commonly refer to knowledge sharing and knowledge exchange. Research into policy transfer is academic. This point is confirmed when googling "knowledge sharing", "knowledge exchange," "policy transfer" and "policy mobility" combined with the "World Bank," the word "city" and "C40," and comparing the results.

	"World Bank"	"city"	"C40"
"knowledge sharing"	916,000	8,320,000	18,100
"knowledge exchange"	271,000	2,000,000	28,500
"policy transfer"	52,000	122,000	3,950
"policy mobility"	4,410	22,000	706

Google search: June 1, 2020

"World Bank" "knowledge sharing" occurs 17.6 times more frequently than does "World Bank" "policy transfer." The point is similarly made when replacing the "World Bank" with "city" and "C40." Knowledge sharing occurs 68 times more often than policy transfer when looking at cities and 4.6 times more often when looking at C40. The multiples are far greater in the case of policy mobility. It is ventured that academic research on policy transfer had best begin with research on knowledge sharing.

ANNEX 2. Epistemic communities and data standards

Data standards are a defining issue for the evolution of digital technologies. You take it for granted that you can use your Apple iPhone to search the *New York Times* and forward an article to your Samsung computer and the Apple computer of a colleague and that the article can be printed on a Canon, and then commented on in PDF format. Agreed upon standards among vendors of hardware and software from different countries matters. Similarly, standards are needed for data, interoperability and so on.

The Table below identifies epistemic communities whose remit includes data standards for smart city technologies. Their relevance to smart cities is indicated by arbitrarily selected publications or publication series.

ITU: ITU-T, Smart Sustainable Cities[43]

National Institute of Science and Technology (NIST): NIST Smart Cities and Communities Framework Series[44]

ISO: ISO standards: the starting point for smart cities[45]

IEEE: Standard for a Reference Architecture for Smart City[46]

Open Geospatial Consortium (OGC): OGC Smart Cities Spatial Information Framework (OGC, 2015)

Organization	Year founded	Membership
ITU	1865	Global membership, sets standards for ICT
NIST	1901	U.S. Department of Commerce, promotes U.S. competitiveness, including setting of standards for smart cities
ISO	1947	"ISO is an independent, non-governmental international organization with a membership of 164 national standards bodies. ... shares knowledge and develop voluntary, consensus-based, market relevant International Standards..."(ISO, n.d.)
IEEE	1963	419,000 professionals, sets technology standards (and much else)
OGC	1994	International consortium – geospatial information and services; "Member-driven consensus process creates royalty free, publicly available, open geospatial standards" (OGC, n.d.)

Aside from NIST, which is located in the U.S. Department of Commerce, these organizations can be described as epistemic communities. "An epistemic community is a network of professionals with recognized expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area" (Haas, 1992). Importantly, they do not profit from investment in digital technologies and, reportedly, for this reason are trusted by city managers. However, one interviewee, when asked about possible overlap between these organizations and also EU initiatives, commented that national standards organizations tended to block one another and international standards organizations, and foresaw three sets of standards: United States, Europe and China.

The EU has two data standard directories that serve the same purpose as the epistemic community endeavors. First is *The Open Data Standards Directory: A global initiative to boost data interoperability (*European Data Portal, 2017)*. Second, there is the INSPIRE Directive and the INSPIRE Knowledge Base.

> The INSPIRE Directive aims to create a European Union spatial data infrastructure for the purposes of EU environmental policies and policies or activities which may have an impact on the environment. This European Spatial Data Infrastructure will enable the sharing of environmental spatial information among public sector organisations, facilitate public access to spatial information across Europe and assist in policy-making across boundaries (European Commission, n.d).

The website for the Directive contains a library with a number and diversity of knowledge sharing topics equivalent to that provided by C40.

ANNEX 3. C40 knowledge products

Good Practice Guides

C40's Good Practice Guides offer mayors and urban policymakers roadmaps for tackling climate change, reducing climate risk and encouraging sustainable urban development. With 100 case studies taken from cities of every size, geography and stage of development around the world, the Good Practice Guides provide tangible examples of climate solutions that other cities can learn from. The Good Practice Guides identify nearly 70

categories of good practice for climate change actions in <u>energy</u>, <u>transport</u>, <u>solid waste management</u>, <u>urban planning</u>, <u>adaptation</u> and <u>finance</u> (C40, n.d.).

C40 Research, Measurement and Planning webpage provides documents on:

A. Defining Carbon Neutrality for Cities & Managing Residual Emissions

B. Urban Climate Action Impacts Framework: A Framework Describing and Measuring the Wider Impacts of Urban Climate Actions

C. Municipality-led circular economy case studies

D. Understanding Infrastructure Interdependencies in Cities

E. Constructing a New Low Carbon Future: How Chinese cities are scaling ambitious building energy efficiency solutions

F. Toward a Healthier World

G. Deadline 2020

Source: C40

The C40 Knowledge Hub has categories titled "Featured Knowledge " and "Spotlight Series " and both have Sub-Topics (C40 Knowledge Hub, n.d.). The Sub-Topics for Transport and Urban Planning illustrates the links to still further knowledge, with Sub-Topics having Implementation Guides such as "How to drive a modal shift from private vehicle use to public transport, walking and cycling" (C40 Knowledge Hub, n.d.). The text from the Spotlight Series on Clean Air Cities perfectly captures how to explain knowledge sharing.

Featured Knowledge

Adapting to Climate Change	Transport and Urban Planning
Air Quality	Land Use Planning
Buildings and Construction	Mass Public Transit
Clean Energy	Strategies to Reduce Vehicle Miles
Climate Action Planning	Sustainable Freight
Collaboration, Coordination and Outreach	Urban Planning
Food	Walking and Cycling
Inclusive and Equitable Climate Action	Zero Emission Vehicles
Sustainable Finance and Economics	Waste

Spotlight Series

Spotlight On: 1.5C Cities	Spotlight On: Buildings and Data
Spotlight On: Cities Divest-Invest	Spotlight On: Cities100 climate solutions
Spotlight On: Clean Air Cities	

Source: C40 Knowledge Hub

The above documents overlap with what is contained in the Research Library, yet another resource for urban professionals

Acknowledgements

WEBINARS ATTENDED

IEEE – May 12, 2020 – IEEE SC Standard P2784 Webinar Series – Smart cities: Resiliency Strategies in a challenging world

Meeting of the Minds – 27 May – Governments' Response to COVID-19: From Pandemic Crisis to a Better Future

ICLEI – June 12, 2020 – GPC 2020 refinements

ICLEI – June 19, 2020 – Rebuilding More Sustainable, Resilient, and Healthier U.S. Cities Through New Insights

Meeting of the Minds – June 16, 2020 – Financing Smart Communities in the New Reality: Removing Barriers for Digital Modernization

Meeting of the Minds – September 9, 2020 – City Champions of Open Source: How It Works Within and For Cities

Meeting of the Minds – September 30, 2020 – Transportation Equity in a New Era

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Endnotes

1. See Mildred Warner (Cornell University) website on *Restructuring Local Government*. http://www.mildredwarner.org/restructuring (accessed 29 January 2016)

2. Here Brenner is referring to the European Union.

3. http://old.iclei.org/climate-roadmap/home.html (accessed May 3, 2020).

4. The references to Web 1.0, Web 2.0, Web 2.5 and Web 3.0 are taken from Madurai (2018). Grammatical errors have been corrected and emphasis added.

5. "Mosaic was the first to show images in line with text, and it offered many other graphical user interface norms we've come to expect today (like the browser's URL address bar and back/forward/reload options for viewing webpages)." Fitzpatrick (2017).

6. Cited in Riggirozzi.

7. An IoT device refers to sensors and actuators, data storage and control, communicators and user interface software, together with a source of power. The purpose of IoT devices is data acquisition, communication and computing.

8. "https://datastandards.directory/glossary (accessed July 6, 2020).

9. There are different methods of machine learning. See Zaib Ullah and colleagues (2020).

10. Search conducted May 20, 2020.

11. Emphasis on the original.

12. See, for example, Broto V and H Bulkeley (2013), Bulkeley H (2010), Bulkeley H, V Broto and G Edwards (2012).

13. Philip Harrison has to be thanked for this observation.

14. Children's Investment Fund Foundation, https://ciff.org/ (accessed May 17, 2020).

15. https://www.realdania.org/ (accessed May 17, 2020).

16. Metropolis uses the words "Work with."

17. Metropolis refers to "Sponsors."

18. Council of European Municipalities and Regions.

19. European Federation of Agencies and Regions for Energy and the Environment.

20. Compact of Mayors, Goals, Objectives and Commitments. www.c40.org › researches › compact-of-mayors (July 3, 2020).

21. Bloomberg serves as co-chair of the GCoM.

22. Bloomberg serves as board president of C40.

23. What Works Cities is run "in collaboration with Results for America; the Behavioral Insights Team; Harvarwwd Kennedy School's Government Performance Lab; Johns Hopkins University's Center for Government Excellence; and the Sunlight Foundation" (Bloomberg Philanthropies Annual Report 2019, 5).

24. Emphasis in original.

25. Interview with Octavi de la Varga, Secretary General of Metropolis. (May 19, 2020).

26. Ibid.

27. Emphasis in the original.

28. C40 and Arup (2016, respectively pp. 5, 4 and 40). Page 4 is attributed to Eduardo Paes, Chair of C40 and Anne Hildago, Chair elect of C40. Page 5 is attributed to Gregory Hodkinson, Arup Chairman.

29. Emphasis in original.

30. https://www.globalcovenantofmayors.org/

31. The EIP-SCC was formed in 2012. In 2019 the Smart Cities Information System merged with the EIP-SCC. At this time the *Digital Cities Challenge* was renamed the *100 Intelligent Cities Challenge*. https://e3p.jrc.ec.europa.eu/articles/european-innovation-partnership-smart-cities-and-communities (accessed May 8, 2020).

32. The Lego analogy was suggested by Graham Colclough.

33. Ginni Rometty in 2013, cited by Paroutis et al.

34. Email comment by Philip Bane, February 21, 2020.

35. Emphasis in original.

36. Barcelona en Comú, 2015, para.1 and 4, cited by Blanco et al.

37. Cited in Mosco.

38. Cited in Russell.

39. https://www.smartcityexpo.com/en (accessed April 10, 2018).

40. https://www.smarter-together.eu/events/smart-city-expo-world-congress-2020 (accessed August 22, 2020).

41. Ibid.

42. http://www.smartcityexpo.com/en/the-event/about-scewc (accessed July 17, 2020).

43. https://www.itu.int/en/ITU-T/ssc/Pages/default.aspx (accessed July 6, 2020).

44. https://www.nist.gov/el/cyber-physical-systems/smart-americaglobal-cities/nist-smart-cities-and-communities-framework (accessed July 5, 2020).

45. https://www.iso.org/sites/worldsmartcity/ (accessed July 6, 2020).

46. https://standards.ieee.org/project/2413_1.html (accessed March 30, 2020).

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