Unskewing the Data Value Chain
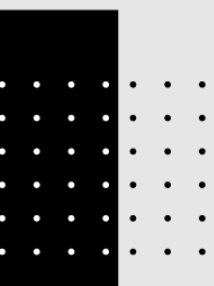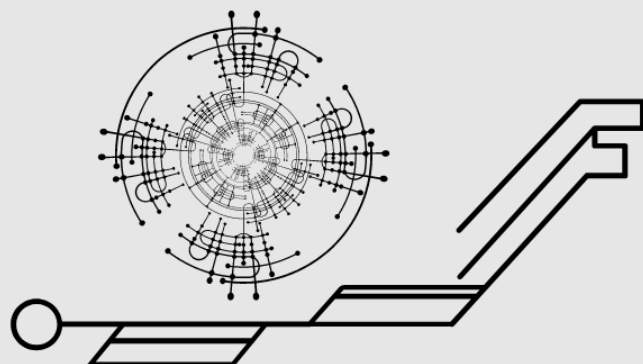
Citynetics in the South: A Blueprint for a City Data Commons

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IT for Change

Acknowledgments

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1. Introduction: A Post-Smart City Era of Citynetics

As procurers of all the civic tech that surrounds us, municipal authorities today find themselves in a unique position – they have become the custodians of personal and aggregate data generated by the world's largest human concentrations. Cities are increasingly where we all live. The UN estimated that half the world's 7.7 billion people lived in cities or urban areas in 2019 (United Nations, 2019), and by the end of this decade, two-thirds will. This paper focuses on the potential beyond isolated programmatic practices in any single city – it aims to highlight the power of federated city data as a global commons across all of them.

As cities race to compete on smartness and sustainability, the paths they are taking are tending towards the oversimple, the techno-solutionist, the privatized, and the extractive. The historic investment drive in Smart City tech is largely directed not at strategic, evidence-based policy interventions, but desperate, poorly planned technical responses to complex societal problems. Rich or poor, large or small, democratic, autocratic, or otherwise, cities – mostly in the Global South – are spending vast sums of public money on ephemeral systems – both software and hardware. The latter is mainly in the form of cameras and sensors – deployed everywhere, wastefully and without the necessary oversight mechanisms for democratic control. Vast troves of data will be generated by the residents of these cities for years to come, and with the present data governance regime quietly privatized this decade, utilizing their limited, often precious, public funds will belong to a few, mainly Western companies that own the datasets and infrastructure.

We propose an evolution of this model of foreign data extraction with a situated, cybernetic system resting upon a federated commons for data generated in the city, a City Data Commons, governed by citizens at the local level, the municipal level, and the trans-municipal, diplomatic level of collaboration with neighbor cities. The objective of this paper is to analyze how this new, commons-based governance model for digital infrastructure, which we call Citynetics, could slow and subvert the trend of data extraction, instituting and sustaining a power balance in which the scales tip towards,

not away from, citizens. Our departing point in this paper is the question of whether data can open and democratize collective creation in the digital age. Our thesis is that Global South cities, especially those late to digitize, could turn the tide towards a commons-based model of data governance.

Below, Section 1 will depart from a diagnosis of the main obstacles before a data commons to some establishing conversations conducted remotely with city officers, experts, and data activists. It will set basic definitions for a common terminology. Section 2 will look at experiments by European cities testing possible alternatives to municipal data governance, and analyze their contributions and shortcomings. Section 3 will analyze the strengths and opportunities in middle- and low-income Global South countries, and their strategic ability to contribute to digital commons governance and innovation, updating those ancestral practices that have proven effective in governing natural and cultural commons. Finally, Section 4 will propose an agile, experimental policy roadmap for the Citynetics evolution of the Smart City that fuels local digital economic and social innovation.

> "The historic investment drive in Smart City tech is largely directed not at strategic, evidence-based policy interventions, but desperate, poorly planned technical responses to complex societal problems."

The approach of the paper is holistic and pragmatic, aiming for actionable points for cities regardless of income or digitization level. While 'data' is often equated to digital data, it is cities with fewer data assets that especially should start to think about a data strategy as an inevitable next step. We will further explore strategies for turning policy experiments such as the City Data Commons into more than a resistance strategy against big platforms, but a viable third way of data governance.

2. Understanding the Problems of Implementing a City Data Commons

The first year of the pandemic will be remembered as an inflection point in the digitization of urban centers and their surroundings (Kapoor & Chandrashaker, n.d.). In fact, 2020 was the year that neglected digital public infrastructures, as sharp digital divides and neglected literacy were fully exposed across the world, but especially in the Global South, where cities were largely at the beginning of the process of digital transformation, and hence more vulnerable to the current technological paradigm of privatized Smart City infrastructure.

In this paper, we seek to understand the obstacles these cities will face in unlocking the power of their citizen data, and then provide steps and measures, a blueprint, for a City Data Commons. Undigitized cities in the Global South face some identified obstacles:[1] availability of and accounting for data, the privatization of digital infrastructure by

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[1] A series of interviews and surveys were conducted online by the authors with staff from 10 local governments in Africa and Latin America in August 2021.

providers due to failed procurement guidelines in contracts, and data extracted and held by transnational service providers due to a lack of sharing mandatory rules. We do not ignore the related problems common to many fragile states – structural inequalities, such as overall country literacy, electrification, trade rules, public service and public procurement regulatory frameworks, international aid, austerity measures forcing budget cuts, and even free-trade agreements restricting vendors.

Related to the problems of accounting data and data availability, our interviews with practitioners confirmed that many municipalities do not even count data as an asset and let potentially highly useful datasets go to waste.[2] In highly corrupt contexts, policy decisions are taken intuitively and the provision of services is more guided by electoral gains than facts.

But the recent pandemic and emergencies have shown a younger generation of public officers that data, indeed has relevance and impact in city management and service provision, and that most data is trapped in private hands, its value ignored, and that efforts to develop data strategies are emerging, often pushed by teams inside public administrations.[3]

Data was a casualty of the social-protection privatization wave and austerity. In the last decade, before even accounting for it, municipal data was de facto privatized all over the world in exchange for digital services. As explained by Bria and Morozov (2018), "Data is something they do not account for or measure and thus can easily give away in exchange for nominally free Wi-Fi offered to inhabitants, or advanced traffic analytics software provided to city planners."

> "While 'data' is often equated to digital data, it is cities with fewer data assets that especially should start to think about a data strategy as an inevitable next step."

This leads us to the second problem: the digital provision or mediation of public services being delegated to private actors. The transnational companies providing Smart City services to a city collect and store data, and then claim ownership over it simply as a factor of this service provision, thereby exclusively control data collection, analysis, storage, and further use. This 'digital surveillance as a service' approach bundles infrastructure installation, collection of data, and provision on a 'need-only' basis to local enforcement agencies in pre-agreed collaboration schemes, without warrants. Companies make multiple businesses out of providing cities with real-time surveillance systems: from cameras to software, maintenance to storage, to later providing analysis and selling back only the data cities need, keeping the majority to potentially train other services and systems.

Huawei's Safe City surveillance system installed in hundreds of cities, including Belgrade (Huawei, n.d.), exemplifies the situation above. Moscow, instead of installing thousands

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[2] The authors interviewed Paola Villareal, former Head of Data of the Federal Government of Mexico, in July 2021.
[3] Ibid.

of its own cameras, authorized private companies to install their own, then bought back whichever datasets it needed (Rosenbaum, 2017). Meanwhile, Latin American cities are partnering with credit card companies for their mobility systems (Mastercard, 2018), linking data about consumption with data about mobility that is not further shared. Countries like Guatemala, where there's no comprehensive data protection law, pave the way for unlimited data extraction (Mejor movilidad para todos los vecinos con la Tarjeta Ciudadana, 2020).

The exclusive relationship arising from the public-private partnerships of companies, like credit card companies or hardware providers, ensures an unfair advantage if they gain quasi-monopolistic access to key datasets which they are then unwilling to share. Procurement and service contracts are at the epicenter of the problem (Renata, 2020). Procurement rules are often designed from a simplistic set of criteria based on price and time for delivery, often disproportionately benefiting the private interests of powerful actors in the tech domain (Brandusescu, 2021). Given the dominant position and vast competitive advantages few tech giants wield, it is inevitable that their bids will be cheaper and faster when competing with local industries with no governmental support or investment.

Procurement rules are not being used to their full potential to level the playing field, as they could effectively include mandatory provisions to share non-personal data in usable formats, and include citizens in the prototyping and piloting of the models they implement. The situation is more dramatic when local governments need to improve public policy using datasets held by private transnational service providers, for example, data about air quality, supply chains, or water levels. Through local and procurement rules such obstacles could be removed.

When a surveillance-tech company is hired to deploy systems, cloud services, sensors, and other digital infrastructures in a city, the high-quality, real-time data it collects about the inhabitants is frequently routed to its servers abroad, and tends to definitively remain there in its possession, vulnerable to sanctions or changes in terms of service. The transportation of the aggregate knowledge of those people's actions becomes displaced and dishabituated from its source, and the public sector loses any leverage it had over it. Precious urban datasets — relating to infrastructure use and maintenance, intense transit during peak hours, or high energy consumption levels — that could generate social and economic value go into private hands, or onto data brokers. Not incidentally, the global Smart City market, dominated by US firms like Cisco, IBM, and Microsoft is expected to double from USD 410.8 billion in 2020 to USD 820.7 billion by 2025. It is one of the most attractive data sources for corporate giants operating globally (The Insight Partners, 2017). But the value of such datasets is beyond the economic one: it is one possibility of a locally rooted digital economy.

2.1 A commons vision to overcome the problems

We've seen that there is an urgent need among public administrations to create a common understanding of data value, to account for it, and decide the rules of the game for it in a participatory, citizen-led process. Dictating a top-down governance model and centralizing control of city databases away from communities can cause irreparable damage and mistrust in technologies (Klippenstein & Sirota, 2021), neutralizing their democratic power.

Citynetics attempts to address the described problems of availability, ownership, and governance of data. Our definition of digital commons builds on Ostrom's concept and principles (Ostrom, 1990) of "the commons", as applied to the digital. We adopt the following definition (Dulong de Rosnay & Stalder, 2020): "The digital commons are a subset of the commons, where the resources are data, information, culture, and knowledge, which are created and/or maintained online. They are shared in ways that avoid their enclosure and allow everyone to access and build upon them."

Our definition of data commons refers to a subset of the digital commons. A data commons is a democratic, collective governance system for data collection and reuse. It differentiates itself from open data in that it can be more restrictive in its access, use, and shareability to the members of a specific community. It is not a common pool of resources but a data ecosystem that is continually maintained, experimented with, and studied for the benefit of the community[4] (Purtova, 2021).

The City Data Commons, the blueprint we propose in this paper, governs and experiments with data generated by and for a city in its interactions with its citizens, from the personal data derived from a form, a parking payment, a driving lesson, or a survey, to the sophisticated, real-time data collected by Internet of Things (IoT) sensors, CCTV cameras, and any other technology deployed by the municipality as infrastructure, including data on air quality, electricity consumption, or mobility. Such data is generally collected and stored using public funds or power. We concur with Dulong de Rosnay and Stalder (2020) that "the digital commons cannot succeed on their own, but are part of a comprehensive vision of a participatory, democratic, and ecological society", and those are precisely the dots Citynetics aims to connect.

A City Data Commons seeks to make city data available to small actors, beyond just the private sector, to both unlock possibilities to compete and collaborate in building necessary future digital infrastructure. It aspires to define city data as commons, instead of property, and enable a space – a data commons space, as opposed to a 'data marketplace' – where collectives can access and benefit from the high-quality datasets collected with public funds. This includes data central to improving quality of life: relating

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[4] For this, the authors took into account the differentiations made by Dr. Nadezhda Purtova during a discussion on 'Socializing Data Value' conducted by IT for Change in 2021, available at: https://itforchange.net/sites/default/files/2021-06/Nadezhda-Purtova-Socializing-Data-Value-Provocation.pdf

to water and air quality, biodiversity, soil health, public transport, energy systems, GPS and GIS, availability of materials, products and services, and all the data collected by privately-managed bike and ride-sharing systems, water sensors, and taxi platforms.

Creating a City Data Commons can boost digital social innovation and ultimately improve the variety and quality of city services, generating social and economic value to the community (Avila & Weress, 2021). It is only when we overcome literacy and accounting barriers and unlock the power of public interest data held in private hands that this can truly happen.

3. Experimenting with a City Data Commons in Europe

In the previous section we defined the City Data Commons and its potential, combined with other community-driven digital commons, to unlock a democratic urban future. This section explores how in the past five years, cities in Europe have seeded viable prototypes and pilots for technologies that give citizens decision-making power over data use, and have thus opened the doors to the idea of a people-driven City Data Commons.

All urban European centers are going through an aggressive digitization process. Propelled by the approval of the General Data Protection Regulation (GDPR) in 2018 and the imminent deployment of 5G, municipal governments in countries with high digitization rates are starting to understand their role and responsibility to steer the governance of data generated by both public entities and citizens. Once governments account for data, the governance model is the defining factor for either a paradigm shift or a perpetuation of the status quo.

> "Undigitized cities in the Global South face some identified obstacles: availability of and accounting for data, the privatization of digital infrastructure by providers due to failed procurement guidelines in contracts, and data extracted and held by transnational service providers due to a lack of sharing mandatory rules."

While there are both pan-European and national efforts to regain control over data, most, such as the GaiaX project, (GAIA-X, 2021) are top-down. But, at least half a dozen European cities have prototyped and piloted a different methodology in which citizens participate directly with municipalities, in processes beyond just approving budgets, or volunteer collaborating. They actually intervene and decide the terms under which data is collected, shared, and reused.

Attempts by Amsterdam, Barcelona, Cambridge, Paris, and Helsinki tested dynamic forms of citizen participation in the realm of public data governance. In the following section, we will focus on the three more mature projects in the development of a City Data Commons: Amsterdam, Barcelona, and Helsinki. Notably, most of the projects described above endorsed Free Software and open content practices, which will enable

other cities, provinces, nations, and regions willing to continue to explore, adapt, and advance their proposals.

3.1 Decentralized citizen-owned data ecosystems (DECODE): Prototyping technologies and data-sharing models using a bottom-up approach

Funded by the European Commission's Digital Social Innovation program, a series of experimental projects at the municipal level took place with an investment of over EUR 50 million (Sestini, 2016), seeding consortia connecting municipalities, academia, activists, and SMEs. From these, the most publicized and probably the most successful was the Decentralized Citizen-owned Data Ecosystems (DECODE) project, run by an international consortium of 15 organizations, with the direct participation of the City of Amsterdam and the City of Barcelona.

Many of the efforts in Barcelona (as well as Amsterdam and Helsinki) were community-driven and took place prior to the 2015 election of progressive Mayor, Ada Colau. While analyzing the historical and political context of the most progressive cities experimenting with the commons, we identified an active technopolitical community as both the driver and key element of success.

All the pilots described in the section below found grassroots support from communities with a track record of activism at the intersection of technology, privacy, and citizen participation, including Xnet, Bits of Freedom, Guifi.net, and CCCB to mention a few. Academic institutions like the Open University of Catalunya (UoB) and the University of Amsterdam also rallied behind the efforts and have a long track record of digital activism, advocating for the digital commons and the right to privacy.

3.1.1 Amsterdam

The two Amsterdam pilots were focused on personal control of personal data and digital identities. The city successfully ran two pilots using 'attribute-based credentials'.[5] The DECODE pilot provided methods to minimize data collection by allowing verification of the data contained inside a document, e.g., a passport (name, nationality, birthdate, photo, etc.) so that an operator can decide to release a credential upon the verification of a condition bound to such data, without collecting it.

The pilots also advanced in educating the public about lean data practices and collection-minimization as vehicles for better privacy, including the development of a Digital Identity Lab (Tools Policy Lab, n.d.), which survived the project, and is today a source for learning and capacity-building, hosted by Waag, a leading Dutch digital-rights organization.

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[5] Attribute-based credentials are a way to have a trusted party 'vouch' for a person in a situation where they don't want to give away any more information than is absolutely necessary.

While the Amsterdam pilots did not explore data commons as such, they increased awareness among citizens of the importance of data and the possibility of a positive agenda for it in a longer-term commitment to a different relationship between cities, companies, organizations, and data, which is detailed in the next subsection.

Following the DECODE tradition of championing digital rights, Amsterdam aims to become a leading example for responsible data handling and usage. In 2017 a group from the Amsterdam Economic Board wrote a manifesto entitled, 'Tada – Data Disclosed' (Manifesto Tada - Clear about Data, 2021), and committed a voluntary coalition of government authorities, companies, and other organizations, including the City of Amsterdam, to its people- and community-centric principles of maximum disclosure and sharing of data.

Tada's 'From Everyone, For Everyone' principle emphasizes the idea of a data commons using the other non-binding principles as its basis: "Data that government authorities, companies, and other organizations generate from the city and collect about the city are held in common. Everyone can use them. Everyone can benefit from them. We make mutual agreements about this." The Tada principles have been embraced by almost 100 organizations and, notably, many individual citizens.

Figure 1. Tada principles
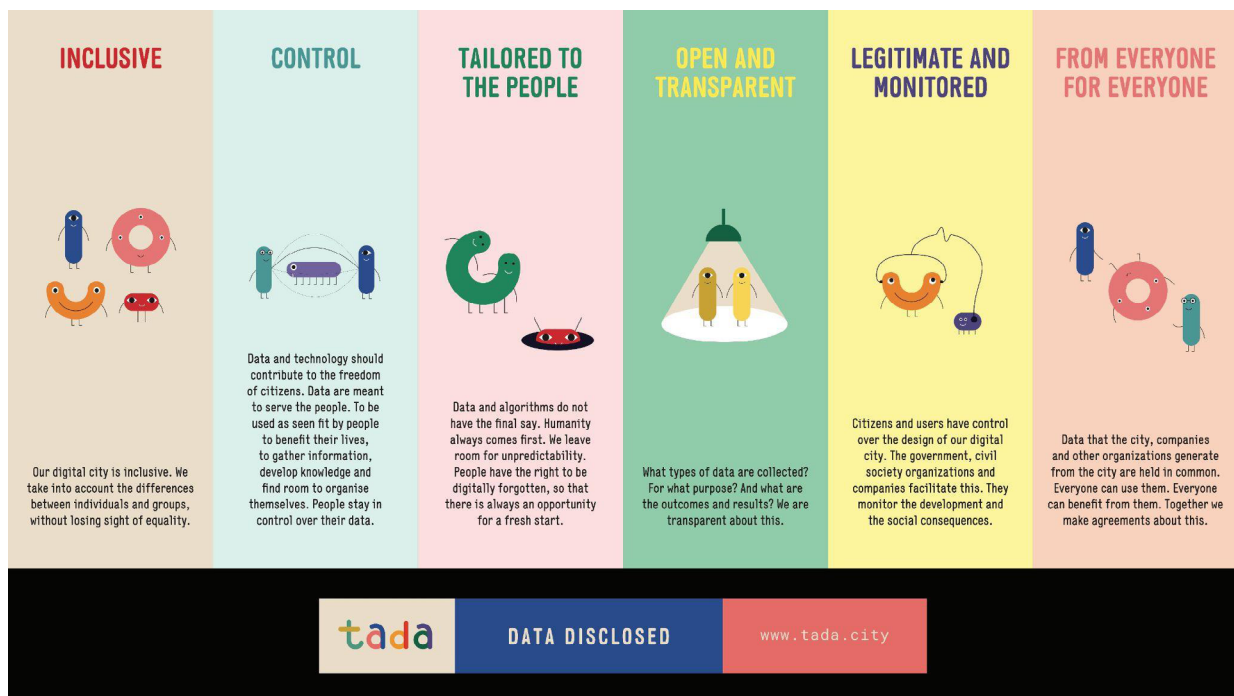
Source: tada

3.1.2   Barcelona

The most important and permanent development of the DECODE project in Barcelona was its citizen co-design, and related enactment of Ethical Digital Standards (Bria et al., n.d.) that considers "data as a commons" and equates it with public infrastructure. This process also gave birth to the 'Manifesto in Favor of Technological Sovereignty and Digital Rights for Cities' (Bria & Bain, n.d.):

"We believe that Open City Data is a necessary element of technological sovereignty and must be managed and provided in an ethical, transparent, accessible, and sustainable manner. As well as supporting local innovation, Open City Data empowers citizens and enables better data-driven decision-making in cities and, by providing visibility and accountability, induces more trust in local government and greater citizen engagement in policy-making."

The standards take into consideration all the city-data cycles, from collection to maintenance and sustainability, imposing some obligations on actors collecting data within public spaces, or on behalf of the municipality. If the data collected is personal, on top of its GDPR obligations, the municipality must provide the technologies that will give citizens more control over their personal data.

Procurement rules also take a central role in the digital standards: procurement creates incentives for Free Software, privacy, and mandatory data-sharing using open standards to avoid data silos or entrenchment. Vodafone shared anonymized data about mobility, for example, after the procurement contracts were updated (Graham, 2018). As the policy states, "The goal is to provide a public and open data infrastructure for the development of innovative data-driven applications aimed at better access to public services and improved quality of life while guaranteeing data sovereignty for the public" (Bria, 2017).

Another big step was the development of a sensor platform, Sentilo (Partners - Sentilo, n.d.), as a public-private partnership with the municipality and local companies. It is a leading platform in the connecting of sensors across different municipalities, with the possibility to federate such data.

The second Barcelona project was a collaboration with DECIDIM, a local participatory platform and software project. The first component was technical and focused on adding features to the DECIDIM software that increased citizens' privacy and personal control over personal data; it increased transparency about the interactions between the city and citizens, providing a dashboard, BCNNOW, where people could see the data collected from them in real-time.

The second component was the collaborative drafting of a Data Commons Manifesto, led by Tecnopolitica.net and Dimmons.net, research groups at the Internet Interdisciplinary Institute of the Open University of Catalonia. The process captured

Figure 2.   Slide from BCNNOW Dashboard Showcase
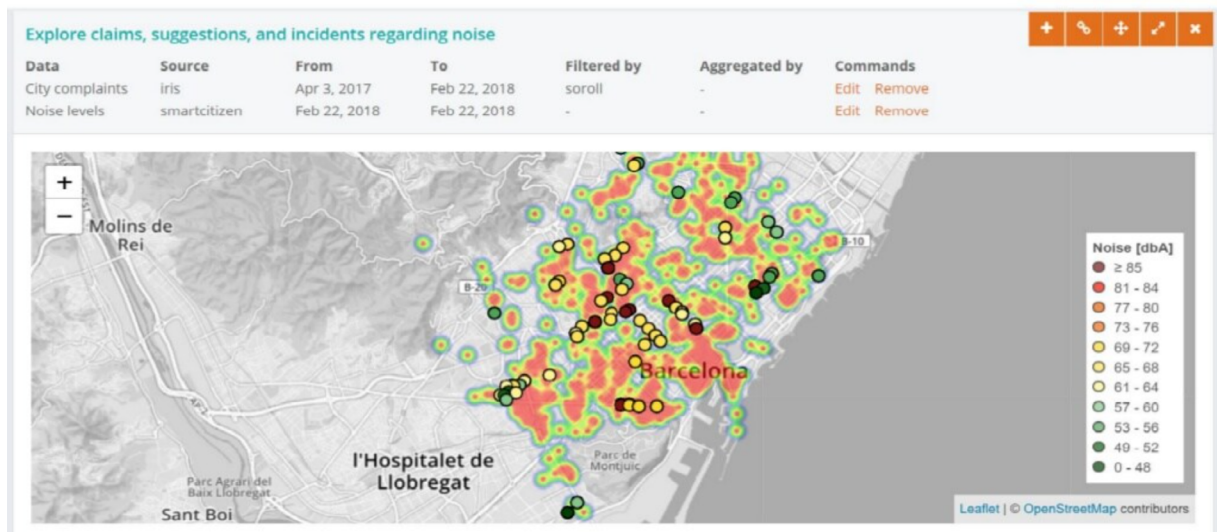
Source: BCNNOW

the ideas and proposals of dozens of people and collectives involved in a participatory process, called Digital Democracy and Data Commons, funded by DECODE over two years (Data Commons Manifesto, 2022). We share an abstract of it as a sample of the collective vision of data present in the Barcelona digital communities. The words in italics are ours:

"Towards data commons: Against data extractivism, open data and personal data control initiatives are a step in the right direction. However, we must go further. *A fairer data economy implies to advance towards a strong model of data commons, one that goes beyond open data by attending not only to the potential of open access to data but also to the conditions of its production, to the power over and the protection from it, to its governance as well as to the social responsibility for its impacts. It implies to avoid data-centric visions by looking not only at data but also at the technological, legal, economical, social, and other structures that define it.* Strong data commons go also beyond regulations and initiatives centered on individual control over personal data by pointing towards the centrality of the collective dimension. Resuming: there is a need to advance from open data to data commons, from "my data" to "our data". *Data commons means data of, by, and for the people.*"

From the government side, the Municipal Data Office (Municipal Data Office Description/ Objectives, n.d.), created under the Ada Colau administration, is heading efforts across municipal services to institutionalize data as integral infrastructure, and citizen control of personal data as an issue beyond privacy.

3.2 Helsinki data strategy

"The city is sitting on a true gold mine. If the city is able to increase the efficiency in the utilization of its data, then it will become a true win-win situation; the city will be able to save money and improve its services while, at the same time, the residents will enjoy a better quality of life." — Kimmo Karhu, Head of Data, City of Helsinki

Figure 3.   The City Strategy's vision and the strategic objectives of its digitalization program
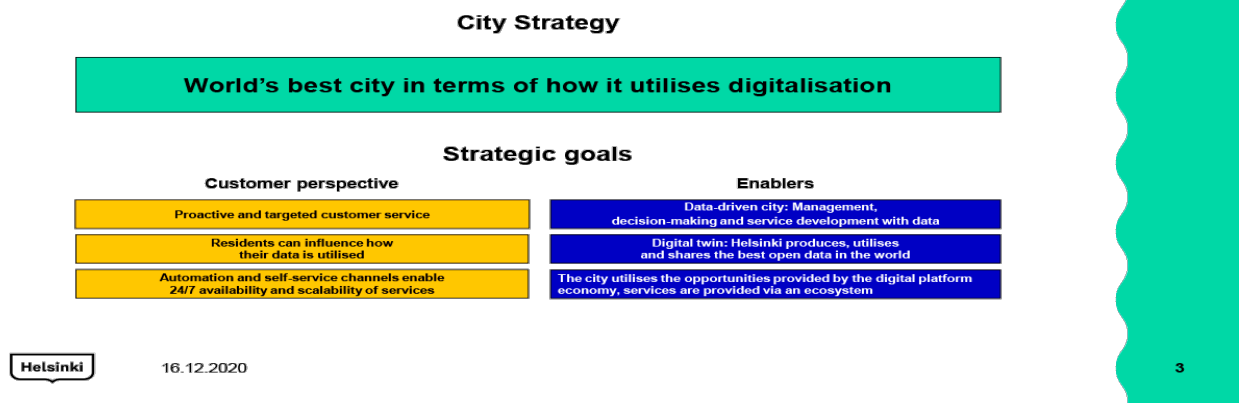
Source: The City of Helsinki Data Strategy

The City of Helsinki goes a step beyond personal control of data and fully digitizing the city, keeping data as a common resource (Data produced by Helsinki is world's most usable and used city data by 2025, 2020) for incremental improvement. It first adopted the MyData declaration (Declaration of MyData Principles, n.d.) as a mechanism for accelerating its digitization process while empowering citizens to take control of data and, with their public choices, influencing the way the city uses gathered data.

MyData is a pragmatic, people-centric approach to data collection and authorization, inspired by a binding declaration mediated by an operator or group of operators in a federated ecosystem. It enables the management and decentralization of personal data and other citizen-sourced information, with transmission between parties that avoids the production of unnecessary copies. Decentralization of information ensures it is not stored en masse in one place (Poikola et al., 2020).

From the MyData declaration:

"Today's data economy creates network effects favoring a few platforms able to collect and process the largest masses of personal data. These platforms are locking up markets, not just for their competitors, but also for most businesses who risk losing direct access to their customers. By letting individuals control what happens to their

data, we intend to create a truly free flow of data – freely decided by individuals, free from global choke points – and to create balance, fairness, diversity, and competition in the digital economy."
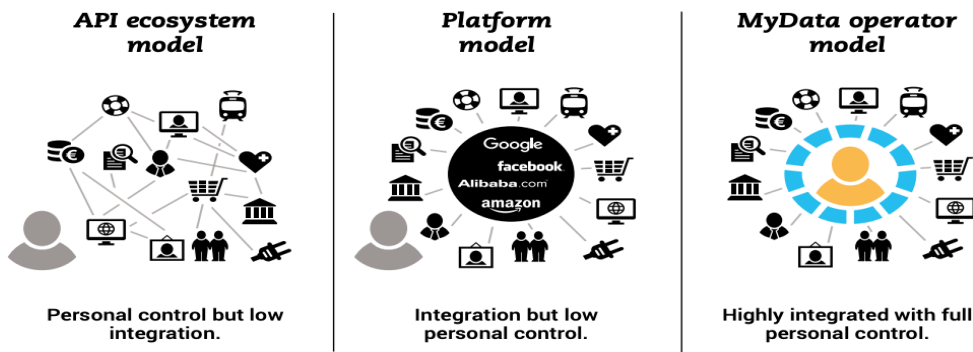
Figure 4.   MyData Operators Whitepaper

Figure 3.1 In the API ecosystem model (left), if the number of services increases, the number of connections will increase even faster. Centralising data management to platforms (middle) facilitates application development, but there is no incentive for different platform players to seek interoperability between platforms. Compared to the platform model, the MyData operators infrastructure (right) is robust and scalable because it is not dependent on any one organisation providing the infrastructure.
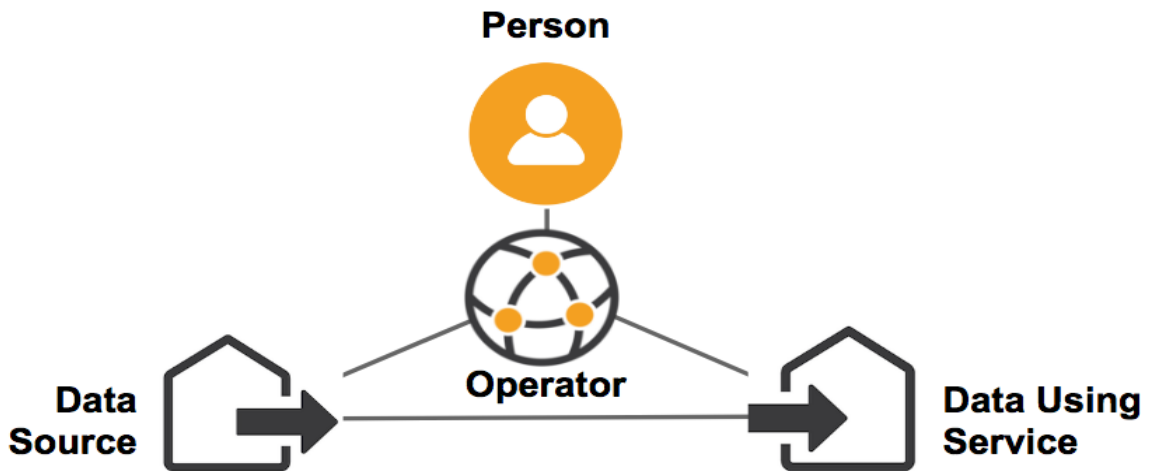
Source: MyData

The possibility of pooling data as a common resource is at the heart of Helsinki's data strategy: "The data managed by the City of Helsinki *should be made increasingly available for sharing and utilization, also on platform basis for use in ecosystems outside the city*. External players, such as communities, universities, and companies can use the city's data to conduct research and develop services that the city does not offer. This would be beneficial to all parties."

Other examples of collective-led, collaborative forms of data governance – such as platform cooperatives sharing both the products of their labor and their data, and specialized data cooperatives (Pentland, Hardjono, Penn, Ducharme & Mandel, 2019) – are worth exploring in the future, but their models go beyond the city scope.

4. City Data Commons in the South: Spaces of Learning and Opportunity

While the European examples are interesting prototypes for possible technological solutions, and a solid theoretical frame built through manifestos and declarations among the most knowledgeable and active academics and activists, they fall short in several factors pertaining to sustainability, community buy-in, and scalability that limit their ability to reach total grassroots awareness and adoption among both average and marginal citizens.

With the exception of Helsinki, most of the enthusiasm around data innovation evaporated with the departure of either the leadership of the project, in the case of Barcelona, or the conclusion of a funding cycle. With academic, expert and media attention moving to other areas, only projects with viable, sustainable business models continued their development. Somehow, the projects have failed to reach mass adoption, or even widespread awareness of their importance.

> "Data was a casualty of the social-protection privatization wave and austerity. In the last decade, before even accounting for it, municipal data was de facto privatized all over the world in exchange for digital services."

In this section, we will focus on South-based examples setting strong bases and indicating sustainable departing points towards a City Data Commons perhaps in combination with other elements found in the European cases, with added elements that are unpacked in Section 4.

4.1 Free Software

A robust movement towards digital commons was born in Latin America in the last two decades (Pinto, 2018), even if it has faded away as Silicon Valley has become too powerful to compete with. Countries such as Brazil (Benson, 2005) and Venezuela[6] (Decree No. 3.390, 2004) peaked even earlier, enacting laws in 2004 establishing Free Software migration of government data. Similar initiatives followed in Ecuador (Decree No. 1014, 2008), Uruguay (Law No. 19.179, 2013), and Bolivia (Supreme Decree No. 1793, 2013).

In all cases, the shift was combined with strategies to increase Free Software literacy among primary-school children, developing projects such as Plan Ceibal (Plan Ceibal - Sobre Nosotros, n.d.) in Uruguay and Canaima in Venezuela to fund software as a key public resource. Latin American countries had the human capacity to domestically produce at least part of the software they needed, even exporting some production, while simultaneously investing in building capacity both locally and in the public sector.

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[6] In Venezuela, a decree was approved in 2004 declaring Free Software and open standards the default for public administration. See, Decreto 3390, Software Libre. (2004). http://www.wipo.int/edocs/lexdocs/laws/es/ve/ve052es.pdf

As a way to circumvent the US embargo and also control its own systems, Cuba developed its own operating system, Nova, with its Mobile OS and Novadroid (NovaDroid: el sistema operativo para el primer celular cubano, 2021). Such adoption was and is vital, as the country is still suffering the longest economic embargo in history since 1962 and has restricted access to software licenses and security updates from the largest providers (Cuba Sanctions - United States Department of State, n.d.).

Many of the ideals and communities devoted to Free Software remain active at the local level in Latin America and, interestingly, software developed by the European projects described in Section 2 has been repurposed and used as core components by many local and national governments.

For an adequate appropriation of the City Data Commons by local communities, the presence of a robust Free Software movement in the region is a massive first step in terms of skills, community, and principles. While the Free Software movement is also present in Africa, the Balkans and the Middle East, our example is focused on Latin America, where its influence has registered in public policy, opening the door to a more ambitious Citynetics agenda.

The robust, well-coordinated software movement in Latin America debunks several superficial assumptions about the Global South: it demonstrates technical capacity, the ability to develop its own technologies, and the absolute regional gains of sharing digital infrastructure, within constraints. The presence and activity of several Free Software communities at the municipal level, even after the governments that supported their establishment are gone, also signal viable sustainability models even without generous subsidies equivalent to those enjoyed by Global North municipalities.

Free Software standards are part of municipal regulations in many cities, for example the Municipality of Montevideo, Uruguay (Montevideo abierto, n.d.), the Municipality of Córdoba, Argentina, the Municipality of Buenos Aires, Argentina, the Municipality of Jalisco, Mexico, and the Municipality of Porto Alegre, Brazil, which sponsors the largest Free Software festival in the world, FLISOL (FLISOL2021 - FLISOL, 2021). While one must not ignore global inequalities, disconnects, and knowledge gaps, the Free Software movement, solidly advancing in the region for almost two decades, is irrefutable evidence that poor and disconnected communities can code their digital destinies. From the Zapatista communities to the Rio slums, youth gain skills with bottom-up efforts and regional and transnational community support.[7]

Interviewing Free Software experts[8] who have volunteered and coordinated movements in Central America, the Caribbean, including Cuba and other low-income countries, one

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[7] Based on an interview by the authors with a former Free Software volunteer from El Salvador, conducted during September 2021.

[8] Authors conducted interviews with Jaime Gutierrez Alfaro, Carolina Flores Hine, Code for Africa, the Free Software Movement India, and anonymous Free Software activists from Cuba and the Dominican Republic in August 2021.

of the main trends to highlight is that the community-driven efforts have been incredibly successful in including women and marginalized communities for over two decades. Similar success stories can be found in Kenya, Ghana, and South Africa, and in Kerala, India. But the problem has always been the lack of real opportunities for emerging tech talents to find sustained roles in the public sector.

4.2 Open data and access to public information

The open data community in the Global South has remained stable and steady over the last decade, at the forefront of battles for access to information, even contributing to the enactment of access-to-information laws in several countries. It has played a fundamental role in accessible and updated digitized databases, improvement of the proactive disclosure of relevant public information, and increased awareness by the local and national administrations of the value of data.

Since 2011, the Open Government Partnership has played an important role in ensuring national commitments to open data, recently launching a means for local governments to engage. It now comprises 78 countries and 76 local governments, many in the Global South (OGP Local - Open Government Partnership, n.d.).

Technical teams inside local public administrations have meanwhile improved their data literacy, hence broadening their vision for technology and data value chains in the city. Open data is becoming an indispensable policy tool for many cities. The political pressure and incentives across countries and cities within the alliance have resulted in improved data skills and understanding in both governments and civil society, opening spaces for participation and data-driven action, often involving young professionals with a renewed and refreshed vision of bureaucracy (Davies, Walker, Rubinstein & Perini, 2020).

4.3 The Escazú Agreement and mandatory release of environmental data and the open environmental data ecosystem

The groundbreaking, binding Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters, the Escazú Agreement, entered into force in late 2020 (adopted on 4 March 2018 in Escazú, Costa Rica) and ensures every city releases its specific environmental open datasets. All the Latin American signatories will invest in coming years in municipal resources for generating, collecting, publicizing, and disseminating environmental data in a systematic, proactive, timely, accessible, and comprehensible manner. The Escazú Agreement could be a solid base for creating a federated commons of environmental data, as cities will have a duty to make data compatible, reusable, processable, and available in accessible formats dedicated to the public domain. It could also provide the legal basis for a practical blueprint for all cities, an 'environmental information' data commons for climate action, built from general norms

and a regional commitment in the Global South – however, it is also an interesting source of exploration of forms of meaningful community engagement. The agreement specifies which events and decisions require citizen participation. It articulates the high-risk events that could result in social conflict, and the importance of identifying stakeholders who need to participate (such as those affected by an extractive project, instead of civil society organizations based in a distant capital city), among others (Ara, 2021).

4.4 Indigenous data governance for digital commons

From all the learnings on digital community management, indigenous peoples could bring fresh thinking and innovation for more inclusive visions, concepts, and practices that they already apply to forest management, seed and food security, and cultural preservation (Stern, P.C., 2011). There are notable efforts already fully developed on data strategies led and governed by indigenous peoples.

4.4.1 The Māori Data Sovereignty initiative

For Māori people, indigenous data sovereignty states that data is subject to the laws of the nation from which it is collected (including tribal nations) and Māori Data Sovereignty refers to the inherent rights and interests that the Māori have in relation to the collection, ownership, and application of Māori data. It is a collective data governance model, in which people decide which datasets should be controlled (*tapu*) or open-access (*noa*), with a more advanced vision against extractivism and exploitation than the open data initiatives.[9]

A broader effort, of which this initiative is part, is the Global Indigenous Data Alliance (GIDA) network of researchers, data practitioners, and policy activists advocating for indigenous data sovereignty within nation states and internationally.

As the alliance states, "The current movement toward open data and open science does not fully engage with indigenous peoples' rights and interests. Existing principles within the open-data movement (e.g., FAIR: findable, accessible, interoperable, reusable) primarily focus on characteristics of data that will facilitate increased data sharing among entities while *ignoring power differentials and historical contexts*. The emphasis on greater data sharing alone creates a tension for indigenous peoples who are also asserting greater control over the application and use of indigenous data and indigenous knowledge for collective benefit" (Research Data Alliance International Indigenous Data Sovereignty Interest Group, 2019).

The GIDA enacted the Care Principles for Indigenous Data Governance, in which Care stands for "collective benefit", authority to control, responsibility and ethics, confirming a more advanced data commons frame than the examples provided from Europe. Of

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[9] See, Te Mana Raraunga. (n.d.). *Te Mana Raraunga*. https://www.temanararaunga.maori.nz/kaupapa

special interest is the principles' emphasis on collective governance of data: "Indigenous peoples' rights and interests in indigenous data must be recognized and their authority to control such data be empowered. Indigenous data governance enables indigenous peoples and governing bodies to determine how indigenous peoples, as well as indigenous lands, territories, resources, knowledge and geographical indicators, are represented and identified within data." More examples are emerging from the South and evolving the social norms in the governance of local digital futures (Emerging Digital Issues in the Global South Working Group, 2019).

It is our hypothesis that, in the Global South, more than data ownership and strict individual private control, citizens want to see fulfilled technological promises of better service delivery and improvement of quality of life. They want to take an active, participating role in shaping these futures, while embedding local values, skills, and vision in the technological interventions into urban spaces, as opposed to simply interacting with devices.

According to UN Habitat (UN, 2021) the key determinants of risk for urban residents are inequality, inadequate housing, and lack of access to clean water, affordable energy, sanitation, and waste management. Aggravating conditions such as extreme air pollution have also played a role in exposing marginalized communities to more severe impacts. Unless a very abstract idea of data commons is linked to concrete outcomes reflected in tangible improvements of people's lives, the City Data Commons will remain isolated projects with abstract ideas of data.

4.5 Lessons from the South for a City Data Commons: The departing point is the community

From the cases presented in this section, we collected five contributions that would help draft and deploy a robust blueprint for a digital commons. The factors identified below reduce the frictions and help make a local case for a City Data Commons, as contrasted with the Global North.

The first identified aspect is awareness and neutralizing of extractivism. Many of the community efforts identified below came as reactions to past exploitative and predatory practices, and at risk of being repeated in the new digital transition, with licensing or imposition of programs not fit for purpose, and built upon the experience of resisting colonialism and other foreign domination. These communities have a clear vision of shielding data from past cycles of exploitation. The principles that inspired the Global Indigenous Alliance described above, are a solid departing point for a community to draft their own data governance rules.

The second aspect is the political commitment of progressive governments towards a digital commons vision, especially in Latin America, which went beyond local efforts in Europe. For more than two decades, technological sovereignty has been the core of many political projects, especially in Latin America. In Cuba, for example, even with

sanctions and resource constraints, the community built its own operative system long before Europe had an active discourse about digital sovereignty.

Over the past two decades, as detailed in previous sections, a Latin American independent technology vision has been enshrined into law and translated into programs that, like Plan Ceiba in Uruguay (Plan Ceibal - Sobre Nosotros, n.d.) or the Linux distribution Canaima (Canaima (distribución Linux) - Wikipedia, la enciclopedia libre, 2022) in Venezuela, escalated to cover entire countries. One strength we identified in these Free Software projects that aspired to scale is the regulation of public-sector software procurement, production, and distribution. Authorities did not wait for increases in demand or for a robust local industry; rather, they took the ambitious approach of legislating first and thus accelerating other processes. We consider that this 'norm first, code later' is necessary to seed the digital city commons in the South. In the case of the Escazú Agreement, the normative aspect is regional and very specific to the commitment of creating the datasets the region needs to combat the climate crisis.

The last identified aspect is a transnational community collaborating across borders and cultures: many innovations are driven by volunteers with technical skills. Local technologists understand and are willing to serve local communities coding solutions for them. In interviews conducted across Central America, among the Free Software Network in the sub-region, one of the world's poorest, they highlighted how being connected with peers from different regions inspired them to volunteer on different projects. The case is similar with indigenous data initiatives.

5. In a World of Converging Crises, a Federated City Data Commons

In previous sections, we visited examples of public-interest efforts to advance citizen agendas in the digital age, tackling isolated issues. Some, like Free Software initiatives in Latin America, combined procurement rules with a long-term plan of digital sovereignty. Others, like the DECODE project, took an action-oriented approach, piloting technologies to give data autonomy to citizens. But none of the examples explored offers a comprehensive route to advance to a new model to govern data in the city with a futuristic view and an escape from Smart City entrapment. The prevalent Smart City model as the default for digital transition is rapidly removing not only agency but also the possibility of building a collective, collaborative future for citizens. Where there was public infrastructure, now there are privatized and opaque systems, impossible to audit, demanding constant updates and upgrades. More importantly, private, often foreign actors are racing to deploy, collect, and close relevant datasets that should belong to the community, the basic material for building a digital future.

> "The exclusive relationship arising from the public-private partnerships of companies, like credit card companies or hardware providers, ensures an unfair advantage if they gain quasi-monopolistic access to key datasets which they are then unwilling to share."

The departing point to undo such a process is data governance, but it cannot be tackled in isolation: digital transformation is penetrating every possible action a city can take, from climate, enforcement, and judicial systems, to social protection, and together with bringing the control of both personal and city data to the communities it belongs to, a critical process to regain control and optimize the digital commons, a broader term, as described in the first section, is necessary.

5.1 Citynetics from the South: A blueprint for City Data Commons as a departure point

Citynetics should displace the Smart City in foundational principles, technical architecture, and governance. It is a model that goes beyond a people-centric and rights-preserving approach, it also considers community. It advances the digital ambitions of cities, in plural, leveraging the power of the sum of all its data but also the importance of learning from similar experiences through the analysis and comparison of datasets.

To translate it into reality, we propose a blueprint to transition to Citynetics from the Smart City, taking a series of steps after learnings from the North and South.

1. **Movement rallying natural and cultural commons groups**

    Early policy developments in Latin America around Free Software carry an important lesson for governments yet to digitize: local authorities and communities need not wait for technology and connectivity to arrive to envision the values they want in contrast to the model of data extractivism. The first step is to seed the political demand and will to facilitate and fund a commons-based governance model for the digital future from communities already organized and sharing a commons vision: from those taking care of water resources, to groups advocating against gentrification, environmentalists, to the cooperative movement, all the communities who have worked in a 'commons' logic will naturally support, understand, and be better placed to apply the same governance values to the digital.

2. **Coding the City Data Commons into the municipal rules**

    The second step should be normative: the data governance model should become local law, granting additional protections to citizen data collected and produced in and by the city. Using public local-interest arguments, authorities can code mandatory data-sharing obligations with private city systems and also share, under fair conditions, city-generated data with other actors. Coding the data commons will also mean allocating municipal resources for management, maintenance, analysis, and sustainability. The rules can come even before the digitization process by the company so that all providers, including apps operating at the city level, will have to abide by the rules even before the municipality does anything with the data – even potentially funding part of the process with the fees from local taxes, licenses, and permits. The Latin American experience with norming and deploying Free Software

shows that norms arriving ahead of time can level the playing field for local actors that need to bid against the most powerful technology companies in the world.

3. **Taking back the digital infrastructure from privatized hands**

    Cities themselves are platforms whose core function is to provide services, and so regulation must constitute a series of steps that reclaim digital infrastructure as public and commons-governed, a platform of platforms where all digital services, public and private, operate. A series of simultaneous processes must take place: a review of all contracts and municipal authorizations of both third-party service providers and digital services authorized by the municipality to renegotiate terms when a new norm does not automatically update the rules; strengthening the municipality's resources, capacities, and funds allocated for digital is also strengthening procurement capacities; creating a digital independent structure must include a system to account for data and other digital assets, and adopt sustainability strategies for digital and hybrid repositories. But the municipalities should also aim at digital independence, investing in computational power and running their own hosting infrastructure and even their own digital platforms, as stated before.

4. **Investing and training the public sector, so a cultural shift is possible**

    Paola Villareal, a computer scientist who until recently led a federal data strategy for Mexico's public sector, identified the greatest obstacle in the creation of a City Data Commons as worker resistance; not a lack of funds but a lack of vision for the future, rigid bureaucratic forms, and an institutional culture that punishes innovation and resists change.[10] New technologies evidently require staff replacement and are seen as a threat to current state employees, not used to compete or reskill their functions. There is an inherent 'replacement' fear from employees to adopt novel tech innovations. For the public sector to ever catch up, a cultural shift, a norm shift, hard work, and investment is needed. Together with the normative aspect, injecting agility and reassuring workers will be a key element of a successful implementation of a City Data Commons.

5. **Knowledge before digital data**

    The most distinctive characteristic of Citynetics is the value it gives to all forms of knowledge embedded in the city, from the old empirical knowledge of elderly residents witnessing architectural, planning, functional. and climate change, to the knowledge of newcomers who introduce innovations transmuted from their native places. Powering digital with local and hyperlocal knowledge systems makes the difference in designing and deploying sophisticated technologies that serve people, but it will also play an important role in fixing data blind spots or contextualizing

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[10] The authors interviewed Paola Villarea on 20 July 2021.

datasets for smooth solutions combining the speed of data with the irreplaceable knowledge of members of a given community and all the ancestral knowledge that resides in communities as collectives. Activating and connecting local knowledge systems does not need a digital component initially and a process of accounting and collecting local knowledge could precede a more advanced digital strategy, including different members of the community regardless of their digital literacy or access to connectivity, software, and hardware.

6. **Seeding the communities and encouraging digital social innovation**

   The public sector must actively create incentives for all sectors and points of intersections. We envision the model as one that gives back the power of technology in the city to the communities that form it. This process cannot happen without enablers and incentives, from making hardware and software available to local innovators, to creating incentives for researchers and small companies to start both sharing and using city data to improve processes and services, to strategic tax incentives and subsidies across sectors to cultivate the data needed, to plug it into knowledge systems and drive local change.

7. **Federated data, federated city platforms**

   The ambition of Citynetics is to transform the fabric and modes of urban life by federating efforts and connecting the global with the hyperlocal in a new form of diplomacy that places cities and citizens centrally, circumventing national bureaucracies to accelerate the change humanity needs to prosper.

Musiani and Dulong de Rosnay discuss alternative ways to prevalent models: "For these alternatives to digital capitalism to have a chance, at least three things are needed: a legal, political, economic, and social environment that preserves the possibility of ethical and responsible innovation and a culture of sharing; a favorable context for research on these themes, where researchers can operate in a multi- and interdisciplinary approach with a variety of actors in 'civil society', including developers, other technologists, projects, policymakers, public authorities, and cooperatives; and finally, a detailed knowledge of the functioning of information systems and the history of technology and infrastructure in order to influence the present and enable alternatives to emerge with sustainability for the future" (Dulong de Rosnay & Musiani, 2020).

We consider that our blueprint provides some initial solid steps, grounded locally, to counter the prevalent Smart City extractive model while leading to the improvement of the digital citizen experience in interactions with local government, reducing frictions and time, with additional collateral benefits for specific sectors that will see increased local opportunities for service and innovation.

6. Conclusion: Towards a Federated City Data Commons Displacing the Smart City

The City Data Commons we proposed with the blueprint offered in the previous section seeks to shield digitizing cities from a cycle of exploitation and data extractivism. It provides the tools to fight back a 'one size fits all' digital future, where only a few tech actors take all the benefits, but recalibrating 'openness', so it serves everyone in the community in a fair manner.

Data in the city finds itself largely privatized and disinhabited from its origins, often unaccounted for, subject to skill and knowledge gaps among the relevant municipal personnel, and providing real, lasting benefit to very few or often no local stakeholders. This is a situation that can and should be redeemed. Data is necessary infrastructure that can readily be collected, curated, maintained, and cultivated by the city and all its stakeholders.

While we have not found a viable City Data Commons model active and running, there is progress in public policy and theory, and even notable pilots. In the North, an emphasis on privacy and data protection prevails, driven by the GDPR. In the South, efforts around sharing data and other digital infrastructure in a commons-based model transcend the individual and are more connected with communities, collectives and policies implemented by some municipalities on open data and Free Software.

The most advanced theoretical conception of common data governance is present in the work of indigenous groups at the intersection of data, ancestral values, and collective consensus-building. Different models described in this paper offer clues to propose a blueprint towards starting City Data Commons projects.

The City Data Commons acquires a broader meaning by being federated and focused on current challenges, as described in Section 4. Its governance models need not be identical, but must be interoperable to expand the power of city data beyond the city and benefit from comparisons, machine learning and pattern recognition, among other opportunities.

After describing a possible governance model for the City Data Commons in the previous section, we conclude that another digital city is possible, divorced from the current corporatized Smart City paradigm of privatization, gentrification, greenwashing, precarization, and surveillance. It is also urgently needed to tackle the most pressing challenges, from extreme inequalities to climate disasters and pandemics. It is important to give a name to this counter model to the Smart City, and we have proposed Citynetics, a federated commons for city data that emphasizes the relationship between the citizen and technology, in effect recognizing the citizens' humanity first, and only then their position and value as an information-generating unit. Citynetics leverages the new and powerful technologies we have with a new democratic form that has evolved to match it.

"The City Data Commons, the blueprint we propose in this paper, governs and experiments with data generated by and for a city in its interactions with its citizens, from the personal data derived from a form, a parking payment, a driving lesson, or a survey, to the sophisticated, real-time data collected by Internet of Things (IoT) sensors, CCTV cameras, and any other technology deployed by the municipality as infrastructure, including data on air quality, electricity consumption, or mobility."

While the scope of Citynetics goes beyond the research and ideas presented in the previous section, we consider the City Data Commons a foundational element of this new form of digital cities governance and federated data power, combined with agile experimentation, democratic participation, and intermunicipal collaborations, i.e., city diplomacy.

Citynetics acknowledges an opportunity in the complexities that cities exhibit today, and the richness in maintaining them not as isolated but live, federated, interconnected systems, learning from each other constantly. The City Data Commons described and proposed in this paper will be the spark to ignite the process.

We want to carefully rebalance power without falling into past traps as described by Keller and Tarkowski (2021): "Opening up informational resources means exposing them to the power structures governing the networked information ecosystem. As that ecosystem has become dominated by monopolistic intermediaries, it is necessary to re-examine the assumption that opening up resources predominantly results in emancipatory and empowering consequences."

Keller and Tarkowski, in their essay, 'The Paradox of Open', also highlight the importance of funding and developing interoperable alternatives, especially platforms. Citynetics is precisely this: a federated, community-driven, decentralized platform that seeks to empower local collectives and abandon a fixation with privacy isolated from other important values such as innovation and knowledge. Citynetics does not trade away privacy or democracy but expands autonomy, as explained by Wong and Henderson (2020): "Co-created data commons can protect individual autonomy over personal data through collective curation and rebalance power between data subjects and controllers."

The Citynetics approach is possible in any city, as raised by Webber (2017), who indicates that local governments have within existing policy toolboxes the powers to enact new rules enabling creation of non-personal data commons, including but not limited to data localization regulations, mandatory sharing, and piloting. Our idea of Citynetics is precisely the point where the power of public policy meets the efficiency of a publicly coded, maintained, and federated platform of platforms for agile intelligence and systemic local and regional transformations focused on ownership and control of data.

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