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Smart city innovations for sustainable cities? An analysis based on data challenges

Mathieu Saujot, Timothée Erard (IDDRI)

QUESTIONING THE POTENTIAL OF SMART CITIES

The profusion of optimistic views, success stories and marketing operations singing the praises of smart cities call for clarification of the challenges of this project and the conditions for its success. The aim of this study is to lift this veil using data, the building blocks of smart cities, in order to better understand the key questions that condition (or will condition) the contribution of digital technologies to urban sustainability.

SMART CITIES AND SUSTAINABLE CITIES: COMMON CHALLENGES

In many cases, the obstacles to be overcome by these smart city initiatives have already been experienced by sustainable city projects and stakeholders: articulating technological innovation and changes in usage and lifestyles; breaking down data silos and fostering cross-cutting, intersectoral approaches; organising citizen participation; and developing a framework to enable upstream innovation between private and public partners.

DIGITAL TECHNOLOGIES ARE TRANSFORMING THE URBAN FABRIC

Digital technology is a fundamental trend and the changes it will bring to the urban fabric can already be identified: public service concessions, governance, planning and urban development methods, cross-cutting city management, etc. However, there are many challenges and conditions for this change, concerning both the reconfiguration of the roles played by urban fabric operators (planners, producers, users) and implementation (legal framework, economic model, political will).

DEBATES FOCUS ON PERSONAL DATA AND CITIZEN PARTICIPATION

The issue of privacy and personal data is critical, and citizens/users play a central role. Hence the importance of gaining a better understanding not only of what is required in terms of regulation, but also of the impacts of future legal frameworks on smart city projects.

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LIST OF BOXES, FIGURES AND TABLES

ABSTRACT

For the last few years, "smart cities", understood as cities that use digital technologies to improve their quality and performances, have been central to the latest attitudes towards cities, with the dreams, hopes and concerns that go with them. The aim of this analysis is to get behind the headlines in order to judge their contributions and limitations in terms of sustainability. The approach we adopt in this analysis is based on data, from production to flow and use, since data provides the building blocks for smart cities. We characterise urban data as follows: it is produced in different ways (sensors, citizens/users, legacy data, operational data, surveys, etc.) and by numerous stakeholders (municipalities, public service concessions, other private companies, citizens, etc.). It serves as a basis for improving or developing municipal services. These goals can be divided into four categories according to their contribution to sustainable urban development:

i) optimising traditional municipal services: data can produce substantial gains, but the assumptions underlying these gains must be identified and analysed, in particular the role of users;

ii) intersectoral city governance: although views on centralised city governance have largely arisen from a misguided, simplistic view of city operations, potential gains exist in terms of sectoral data comparison, especially in urban crisis management;

iii) urban planning: data improves traditional planning while potentially modifying its very nature, especially in terms of the timescales involved;

iv) citizen participation: data and digital technologies can potentially put citizens at the heart of the urban fabric, but this entails a more general shift in the way in which cities are managed.

These potential contributions, which are a reality even though they may appear more limited than the initial goals, mean digital technologies and data are increasingly becoming a pivotal dimension for cities.

We consider four issues to be of importance:

- The complex reconfiguration of operators' roles and of existing city governance through the emergence of digital technologies: public operators are by no means powerless against private operators, and new entrants to the digital scene lack the job skills of traditional operators. It is essential to analyse the governance and management methods taking shape at the local level in order to better identify the changes needed to public-private frameworks and governance models, particularly for data.
- The legal issues raised by this data in terms of both privacy and ownership: there are currently a number of grey areas that need to be clarified. French and European debates on personal data need to be more closely connected with those on smart cities.
- Shifts in economic models caused by digital technologies: data plays a complex role, enabling the arrival of new entrants in cities, while reinforcing dominant positions. The economic model for smart cities is still under construction.
- The role and place of citizens in the smart cities under construction: digital technologies are an opportunity to give citizens a more central role through new participatory tools, but they could also easily fall into the old trap of technological reductionism in their approach to users.

The intelligence provided by digital tools and greater control of data are unquestionably key to guaranteeing urban sustainability. Efforts must therefore be made to design the organisational models required, striving to consider all policies rather than just the most visible ones, and to put changes in practices and methods (in both the public and private sectors) at the heart of this digital revolution, which is the only means of taking full advantage of the opportunities presented by this technology.

INTRODUCTION

The concept of sustainable cities has been repeatedly criticised because of the difficulty of making it fully effective in cities. Reference frameworks and other guidelines have certainly been developed, planning has steadily matured—integrating an increasing number of environmental issues, for example—and sectoral solutions (building, transport, development, etc.) have helped to achieve certain objectives. But the fact remains that sustainable cities—understood as a balance between environmental performance, social equity and economic efficiency—are an elusive goal. It is therefore easy to see the recurrent temptation to abandon inclusive ambitions in favour of approaches that are either more sectoral or more partial (resilient cities, low-carbon cities, sensitive cities, etc.). Our aim is to determine whether the approach in question here, that of smart cities, can support the ambition of more sustainable cities, and if so, under what conditions. Are digital cities a stop-gap measure or, on the contrary, a valuable tool for progressing towards sustainable cities, as many stakeholders believe?

In order to answer this question, certain clarifications are required. What do we mean by smart cities? What lies behind the plethora of different views and examples? Going against those who address these issues by conceptualising cities (resilient, living, reflexive, optimised, etc.) and striving to describe their potential, we opt instead to focus on the trigger for this movement: data and the new means available for its production, organisation and utilisation to support cities. The approach based on data, the building blocks of smart cities, is thus particularly effective in looking beyond conventional positive thinking, as it raises specific questions: which urban functions are targeted? What technical, political, legal or economic conditions must be met in order to manage this data and to achieve the potential gains associated with these new services? What kind of model is required for the management and exchange of data between different stakeholders? And what role do citizens play in both data production and data use?

1. WHICH DATA? FOR WHICH APPLICATIONS?

1.1. Which data are we talking about?

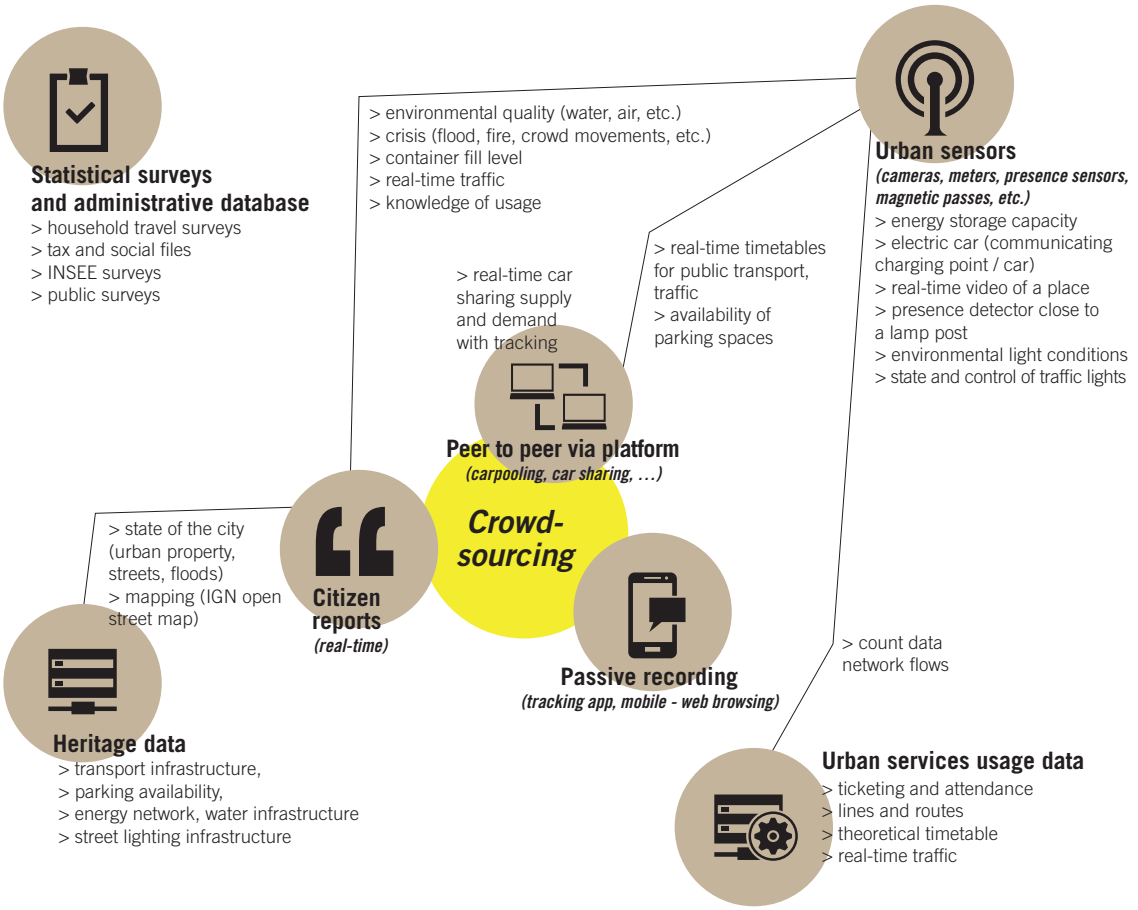
To begin this analysis, it seems important to demystify the term data by illustrating what exactly is meant by the concept of urban data. This can be defined as data[1]—in other words descriptions of reality—situated in a specific territory and of interest to city management. This very broad definition avoids artificially restricting the field of analysis to a single type of data. Based on this definition, Figure 1 thus presents different examples of urban data, characterising them according to their method of production: statistical surveys, city sensors, and crowdsourcing (understood here as data produced by citizens).

Several remarks can be made:

➡ Often, **the same data can be produced by different processes;** for example, real-time traffic information can be generated by infrastructure measurement sensors (such as underground electromagnetic detection loops), in-vehicle sensors (such as the Inrix “Smart Driver Network” or the

1. Note that data is always built; it must be produced (sensors, citizens, etc.) then transmitted (telephone network, Internet, etc.) and structured (translation, aggregation, comparison with other data, etc.).

Figure 1. Urban data production methods



services developed by Tom-Tom), or community-based user feedback (such as Waze). Although the subject of this data is the same, its characteristics in terms of format, timescale, reliability or access will differ. Depending on the purpose of the data, one solution will thus be preferable to another. Of course, this choice of production method is not just technical;[2] cost and data access issues are equally important. Moreover, it may reveal different attitudes towards urban management. Optimising waste collection using either an electronic sensor indicating the fill-level of containers or a portal for residents to provide this information themselves indicate different approaches to participation in city life. Another example is that of knowledge of mobility practices. Traditionally, municipalities conduct household travel surveys among a representative sample of local households. Given the shortcomings of these surveys (high cost, low frequency, lack of detail about the routes taken, etc.), new initiatives have emerged[3] based on citizen involvement and mobile phone tracking (the Mobi-Lise project financed by ADEME, Flux Vision by Orange), which enable the production of new useful data, although they pose other problems concerning representativeness or data processing, for example. Over and above changes in practices and philosophy, these different production methods should be considered in terms of their complementarity and in view of the end use of the data.

➡ **Infrastructure sensors produce a considerable share of urban data.** This production method raises some specific questions. Different data formats exist, depending on the producers and the technology adopted in terms of information

2. This nevertheless reflects two approaches to robustness, the reliability of a measurement, between the ex ante scientific evaluation of sensor performance, and Big Data or crowdsourcing, where the relevance of the measurement produced is verified ex post by the use made of it.

3. For more information, http://www.datact.fr/articles/comprendre-le-territoire-par-les-donnees

capture and transmission.[4] Hence the challenge of standardising data formats, especially in order to minimise the cost of comparing data from different sensors and to ensure municipalities do not get "locked in" to a particular software solution. Another challenge is linked to the transmission of data in the urban environment. Different options exist: Gazpar meters will communicate via NFC and GPRS smart cards, Linky meters by powerline communications and GPRS, and Cisco is calling for an "Internet of Everything". This raises the question of the opportunities for pooling these different information collection and transmission systems, for reasons of cost and efficiency. The resilience of the technical system thus developed is also a factor to take into consideration, since a centralised solution may be more vulnerable to technical failure or hacking. Although it is not often addressed, this issue of the structure of the network and of the associated economic model outlines different types of smart cities: a "bottom-up sectoral" vision (where innovation and the equipment of an urban sector guide the broader digitisation of the city), compared to a "top-down technological" vision, through the development of a meta-network by an operator of operators.

➡ **Big data** often comes up in discussions on smart cities. It should be remembered that big data is primarily a data processing method rather than a type of data, resulting from the conjunction between mechanisms that generate large amounts of data (Internet use, mobile phones, in situ meters) and the IT tools used to process this data (greater processing power, new management methods) (Commissariat Général à la Stratégie et la Prospective, 2013). "New data" can thus be showcased, characterised by its mass (quantity), by the variety of data formats in relation to traditional sources (Google searches, images) and by the speed at which data is updated and analysed (sometimes in real time). But it is important to note that the emergence of digital technologies in cities is not limited to big data alone, even if frequent examples of American cities use this method.[5]

➡ **This categorisation according to the production method must be associated with a distinction between the different producers of data.** The municipality is one of the main producers of data through city management and its activities as a public service provider (local government control) or as a concessioning authority (outsourcing). Public service concessions (public transport, water and sanitation, energy, waste, etc.) produce and manage data on traditional urban sectors. Private companies active in the area other than public service concessions (peer-to-peer platform managers; vehicle-sharing fleets; network operators such as Orange; operators such as Google; Uber and taxis; shopping centre managers, etc.) also produce data that can be described as urban. The majority of the data belonging to these operators comes from users themselves or from sensors utilised within the framework of this industrial or commercial activity. Finally, citizens play a hybrid role, as both subjects of measurement (attendance, mobile tracking, usage, etc.) and data producers, which raises serious issues in terms of citizen involvement, consent and privacy protection. A distinction must be made between data produced voluntarily for a specific purpose (such as the "FixMyStreet" application, which enables citizens to report information about the state of their city) and data recorded passively as part of a secondary service (tracking through consultation of a mapping tool or a web browser, for example). In the latter case, data currently belongs to the digital operator that acquires it (Internet operator, telephone operator, search engine, etc.). We will return to this issue of urban data ownership later on.

Urban data is therefore highly diverse in terms of its subject matter, production method and data producer. But what is the purpose of this varied data that "reveals" cities? Which urban functions are modified and/or invented by the massification of digital technologies in cities? And what real gains can be expected in terms of sustainability?

Box 1. Methodology

This study is largely based on:

- the literature, including grey literature, on smart cities and the influence of digital technologies on cities;
- a study (Erard, Saujot and Chancel, "La précarité énergétique face au défi des données", IDDRI, 2015) focusing on policies to combat fuel poverty and data issues. This study demonstrates in particular that this data is an excellent indicator of broader challenges, especially in terms of governance and economic models;
- interviews with different smart city operators (Cisco, IBM, Schneider, ERDF, GrDF, Chaire Vinci Eco-conception, Fabrique de la Cité, Canal TP, Rennes Métropole, Grand Lyon, CDC Numérique, Montpellier Agglomération, Montpellier, Nice Métropole, Mulhouse, Fing, OpenDataFrance, CNUM/Orange Labs, etc.).

4. Road traffic measurement is a good example of this: (http://www.transport-intelligent.net/technologies/capteurs-77/)

5. The PredPol software in Los Angeles, for example, compares data in order to direct police action. In New York, an algorithm helps to better identify high-risk buildings in order to direct inspections by municipal services and fire officers.

1.2. Using this data to improve cities

Digital technology is often championed by "revolutionary" discourse promising to reinvent cities through the centralised governance of all urban functions. But this governance—whose potential remains to be determined—is only one of the many goals of the emergence of digital technologies in cities. These goals can be divided into four major categories (Figure 2) according to their contribution to sustainable urban development:

i) optimising traditional urban functions (such as transport, energy or waste management)

ii) governing and managing cities in real time, in an intersectoral manner (*operational governance*)

iii) analysing and planning cities

iv) fostering the emergence or consolidation of participatory processes

Box 2. The environmental cost of data

Before attempting to determine whether the digital "revolution" helps to reduce the environmental impact of our cities, one thing is already certain: beyond the environmental impacts generated by IT equipment manufacturing, data and its management require energy in quantities far greater than people might expect at first glance. For example, worldwide electricity consumption for data centres in 2011 was equivalent to half of all electricity generated in France (WWF, 2011).[6] The main factors of this consumption are the exponential growth in communications, the multiplication of memory-based applications—resulting in a race for storage associated with fears of system failure due to user demand—and energy wasted in data centre management (NYT, 2012).[7] Over time, the energy and environmental footprint of this industry will steadily increase: any analysis of sustainability gains produced by digital technologies in cities must therefore take into account this factor, which is not currently a concern for the majority of operators.

i) Optimising existing urban functions

The first gains to be expected from ICT in terms of increasing urban sustainability can be found within traditional urban management sectors, as shown in Table 1. It is useful to differentiate between regular city operations, in other words the baseline (mean annual air pollution or energy consumption for a municipality, annual cost of waste collection, etc.), and peaks, with known frequency (rush hour traffic, energy consumption in the early evening, water consumption in summer, regular closure of a road for a sporting event), or crises, which are unpredictable one-off events (road accidents, water network leakages, downed power lines, etc.).

Figure 2. What are the goals of urban data?

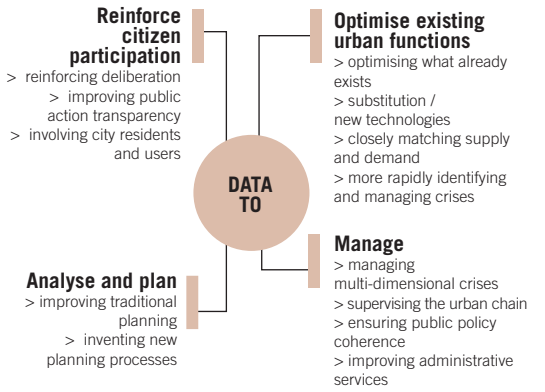
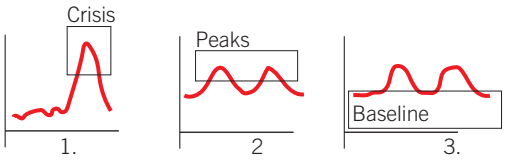


Figure 3. Crises, peaks and baseline



It should be noted that the functions mentioned in Table 1 do not all share the same degree of technological maturity or the same level of deployment.

As shown in Table 1, digital technologies provide a wide range of innovations capable of optimising the different urban sectors. However, it is essential to identify the assumptions underlying these potential gains and to avoid any technological positivism. It should thus first be pointed out that, in general, the approach based on data and the very concept of smart cities tend to present any problem as a measurement and information problem, whereas other obstacles exist: lifestyles, the rigidity of technical infrastructure, economic capacity, etc.

➡ **Optimisation based on usage is by no means automatic.** Many optimisation gains seem to require adjustments or changes in household usage (a modal shift, a different departure time, working from home, load management, etc.). Optimisation in this case is by no means automatic and depends on behavioural change, which is rarely reflected in attitudes towards smart cities. This echoes the problems already experienced within the framework of eco-district development (the complexity of lifestyle changes, the limitations of education, and the challenge of the

6. WWF (2011). Guide pour un système d'information éco-responsable.

7. http://www.nytimes.com/2012/09/23/technology/data-centers-waste-vast-amounts-of-energy-belying-industry-image.html?_r=0

Table 1. What are the goals in terms of optimisation?

	Baseline	Regular peaks	Crises
Traffic	Easing traffic flow (proposing real-time routes, developing dynamic carsharing services, managing traffic lights) Developing interoperability (real-time MIS) Developing green transport (MIS incentives, adapting infrastructure and services to usage through more precise knowledge of demand and usage) Encouraging substitution (working from home, online ordering) Improving the quality of travel time (online services, traveller information)	Avoiding predicted/actual traffic jams (electronic road pricing, traffic forecasting on MIS, adaptation of speed limits) Relieving congested roads (traffic light management, real-time feedback on MIS)	Identifying alternative solutions to avoid traffic jams (real-time feedback on MIS, traffic light management) in case of traffic disruption
Energy	Optimising network size and power levels proposed (through more precise knowledge of demand and usage) Encouraging sustainable energy use through a Green Button Facilitating the development of heating networks with waste water recovery Enabling the injection of decentralised energy into the network (smart grids) Developing energy storage capacities (dynamic management of electric vehicle charging) Billing real rather than estimated consumption Identifying heat loss in buildings	Implementing load management (through coercion or incentives) Decarbonising energy production back-up systems by predicting peaks	Ensuring more rapid and effective grid intervention in case of incidents
Waste	Optimising waste collections routes (collection only when containers are full, managing vehicle fleet, etc.)	///	///
Street lighting	Adapting light output according to light conditions and busy periods	///	///
Water and sanitation	Optimising supply according to usage and demand (volume for a sewage treatment plant or a water purification plant, etc.) Encouraging sustainable use (knowledge of real-time consumption) Billing real consumption	Managing peak demand (precise knowledge of water reserves)	Ensuring more rapid and effective network intervention in case of leakage Managing periods of drought

socio-technical approach).[8] It is therefore clear that smart cities come up against obstacles already experienced in the context of sustainable cities.

Moreover, to understand the potential for optimising energy consumption in housing, for example, it is necessary to conduct a prospective analysis of the nature of requirements (heating, lighting, appliances, high-tech products, ventilation, hot water, vehicle charging), some of which will fall sharply (thereby reducing the potential for optimisation) while others will increase. It is also important to identify the existence of technical-economic margins (optimising load demand, adjusting to increasingly complex billing methods to effectively manage the load curve) or behavioural margins (usage changes through economic or environmental incentives). The same applies to traffic, taking into account the different travel requirements that exist and margins for change for each of these. Consequently, although smart systems are able to take advantage of the capacity of end consumers to change their consumption patterns, the actual flexibility of our usage remains to be determined. For example, smart meters are sometimes presented as a solution to fuel poverty. But this overlooks the fact that far from being caused by energy-intensive behaviours, fuel poverty is above all a situation in which limited budgets require choices between fixed expenses, as shown by the large number of restrictive situations. Similarly, according to Miroux and Lefèvre (2012),[9] the gains in terms of CO_2 emissions for ICT-driven mobility are far from clear, especially due to this uncertainty about user behaviour.

➡ **What cost-efficiency?** It should be remembered that the assumption behind "big data" is obtaining low or marginal gains on very high volumes, and this clearly pays in different sectors, especially where data is already available.[10] Demonstrating this profitability is less evident for cities, where deployment costs (financing digital

8. See Saujot (2015). La transition énergétique au défi des usages et de la participation : l'expérience des écoquartiers, IDDRI *Working Paper* N°10/15.

9. Miroux, F. Lefèvre, B. (2012). Mobilité urbaine et technologies de l'information et de la communication (TIC); enjeux et perspectives pour le climat, IDDRI, *Study* n°5/12.

10. For example, UPS already has data on delivery routes, and can use them on a very large scale to optimise its journeys. See *The Economist* (2014). Little things that mean a lot. http://www.economist.com/news/business/21607816-businesses-should-aim-lots-small-wins-big-data-add-up-something-big-little

infrastructure) and transaction costs (data is divided between a multitude of stakeholders) are higher. For example, a large number of smart grid experiments and demonstrations are underway (the CRE recorded around 100 in 2014)[11], but to our knowledge it is still too early for a robust evaluation of the results achieved, even if certain elements already exist. The Infini Drive project thus tested optimisation systems for the management of electric vehicle charging, and demonstrated that significant economic gains could be achieved, without however proving the viability of the economic model (there is no estimation of costs for implementing optimisation tools, which are currently in the R&D phase).

➡ **Conclusion:** a necessary but insufficient condition? It is clearly well worth gaining several percentage points for efficiency here and there, if this can be done at limited cost and for large volumes. This is especially true for traffic, for example, where congestion is not linear, and this minimal gain can therefore make a significant difference. It should also be noted that optimising a new solution (for example electric vehicle charging) sometimes makes its deployment possible, with the added benefit of substantial environmental gains. And reducing peak consumption also implies a sharp fall in grid investment requirements. This process is therefore worthwhile, but it should not be forgotten that it ignores whole segments of the city (housing, for example), and that major obstacles stand in the way of the goal of optimisation (for example, reducing RER train congestion at peak times requires a set of ambitious measures, not just digital optimisation). Ultimately, digital technologies provide opportunities for making cities more sustainable, but are just one technological building block for "transformational" optimisation (the decentralised massification of renewable energy production, the deployment of electric vehicles, etc.). They also constitute a premium for size and concentration, as this is a condition for effective optimisation.

ii) Governing and managing cities (operational governance)

"Breaking down silos" is one of the key promises of smart cities, through real-time multisectoral decision-making and management centres (like the IBM "Smarter Data Centres" or other urban dashboards): city management would depend on interconnected networks and the aggregation of data currently "stuck" in silos. Although some demonstrations have been made in new cities such as Songdo and Masdar, it is now clear that a far more nuanced approach to the idea of real-time city governance through data centralisation is required. First, as seen in point 1.2.1., many optimisation processes remain intra-sectoral, from data production to the implementation of a service. In addition, even in cases where data comparison proves useful, the goal often remains sectoral and the challenge therefore primarily concerns ad hoc data access.

This inter-sectoral city management is nevertheless appropriate in certain cases:

➡ **Real-time multidimensional crisis management** can be improved using decision-making tools based on different city data. For example, as part of its partnership with IBM, the city of Montpellier is setting up a flood crisis management tool based especially on forecasting the development of disasters in order to manage sluice gates. This type of centralised management may also be appropriate when fires or road accidents occur; information is immediately passed on to the relevant services and intervention is facilitated by traffic light management, while traffic is diverted through the MIS, in particular. Finally, where the environment is concerned, urban environmental monitoring, as tested by the city of Nice, could help to provide more rapid and accurate information about the measures to be taken in case of pollution peaks, for example.

➡ **Transforming urban services** within the municipality: this can imply the creation of a centre for diverse data, whose comparison may result in improvements in specific services. One example of this is the identification of fire risks by New York City services, which combines data comparison and big data: an algorithm compares highly diverse data (poverty, age of building, presence of a caretaker and fire extinguishers, etc.) in order to prioritise the highest fire risk buildings during inspections by fire officers. Similarly, highway maintenance efforts can be shared by using a common information system for all services concerned. Finally, some public policies lie at the junction between different challenges, such as fuel poverty (social, energy, housing, health, environment). To manage these cross-cutting policies, stakeholders need to have access to different kinds of data from areas other than their field of origin. Data – for example in the form of an urban table comparing different sectors – is thus both a goal (this aggregation of data makes the policy in question

11. CRE (2014). Délibération de la Commission de régulation de l'énergie du 12 juin 2014 portant recommandations sur le développement des réseaux électriques intelligents en basse tension.

more efficient) and a means of creating collective, cross-cutting action.

➡ **Management of public service concessions by the municipalities:** access to a multitude of sectoral data can enable a municipality to alter the balance of power with its public service concessions by resolving any asymmetries of information between stakeholders. The municipality thereby increases its power of negotiation when renegotiating contracts. Although the potential gains from such action have not yet been proven, experiments exist, such as the partnership between IBM and the city of Madrid. The key challenge here lies in the possibility for the municipality to access the necessary data and to obtain the skills needed—whether internally or externally—to analyse this data.

Ultimately, the principal gain of the cross-cutting management of urban sectors is not to be found in operational management alone, but also in terms of changes in methods, organisation and culture. It throws new light on traditional urban fabric issues, such as the fragmentation of public action (both between and within organisations), the distribution of roles between operators (who manages which service?) and the accompanying power relations. These are not new questions, but digital technologies show them in a new light: who owns data? Who has access to it? Who manages it? A new political will arising from digital technologies could thus provide fresh answers to these questions.

iii) Analysing and planning cities

New information and communication technologies and access to new data can enable the municipalities to better understand their territory through a more comprehensive, detailed and up-to-date analysis. Here, data access and processing issues take on their full meaning. This improved analysis can first enable the municipalities to refine and consolidate their territorial planning by defining both the key issues and the measures to be taken, especially using modelling and foresight tools. New indicators that are more detailed and precise can also be implemented. For example, research consultancies are currently developing powerful mapping and environmental and energy assessment tools for the local authorities (Energie Demain, Burgeap, etc.). These tools have the potential to considerably improve the efficiency of this process.[12] Beyond improvements in traditional planning, the possibility of accessing new data also raises questions about urban planning and development methods. According to the geographer Mike Batty,[13] this new availability radically alters the approach to planning and its theories, by making it possible to go beyond long-term approaches to explore cities on much shorter time horizons, and to observe movements rather than locations. According to Gabriel Dupuy,[14] operational planning methods will also change, moving towards short-term city governance based on feedback provided by the new tools. He adds that digital technologies and data can also give rise to a renewal of urban planning methods, with an increase in their legitimacy to impact on cities through more "scientific" and more bottom-up approaches. However, the challenges differ from one sector to another: for traffic, based on existing processes (surveys, network measurement), the challenge is to integrate new sources of additional data in order to better understand and organise the system. Where energy is concerned, local level planning is a field that is still developing; we are in a phase of exploration and construction were the primary goal is to ensure the availability of basic data.

This area of planning is relatively clear and consensual: the availability of new data and better tools is obviously beneficial and the planning process encourages the municipalities to examine the issue of data, which can potentially be useful in other circumstances. But analysis and planning can only have a real impact on urban sustainability if they also have an impact on decision-making, which is not at all certain, as shown by past urban planning or the example of local energy governance.[15] The existence of different levels of planning, and uncertainty about its legal force and its political weight, can considerably limit its effectiveness.

iv) Increasing citizen participation

As we have seen, a good deal of data is produced—whether actively or passively—by citizens themselves, and many optimisation processes (multimodal information systems, load management, etc.) are based on the assumption of usage changes brought about by incentives, whether economic or environmental. The risk is therefore that the role played by citizens could be reduced to just another

12. These tools are currently based on traditional national statistics. One challenge will involve integrating other forms of data into them.

13. Batty, M. (2013). Big data, smart cities and city planning, *Dialogues in human geography* 3(3) 274-279.

14. Dupuy, G. (2014). L'avenir de la smart city, *La Revue Urbanisme* n°394

15. See Saujot, M., Rüdinger, A., Guerry, A. (2014). Gouvernance locale de l'énergie, IDDRI *Working Paper* N°08/14.

sensor and to the adoption of "adequate" behaviour to optimise cities. Current discussions on smart cities, as in the past on sustainable cities (with the example of eco-districts developed for residents but without residents), generally stumble because of their technological reductionism. Digital technologies can contribute to a functional, instrumental approach to cities, led by their experts and based on the neutrality of technology and data. This "technological risk" could lead to the depoliticisation of issues that are nevertheless political and democratic (what kind of cities do we want to build? How should decision-making and city management powers be distributed?).

However, although digital technologies carry certain risks, they can also contribute to a more participatory vision of cities, in which citizens are central to the urban fabric. This implies taking advantage of digital technologies, especially as an interface, to foster citizen participation in city management and development: participatory processes based on more comprehensive analyses and measurements, project coproduction facilitated by greater collective intelligence, data coproduction (citizens report on the state of their city through applications such as FixMyStreet or the "Green Watch" project led by FING), and the transparency and control of public action (through open data, in particular). Although the flow of information has always been central to cities, new methods are currently being deployed to renew practices and increase citizen participation in city development.

Once again, there is no automatic connection between digital technologies and citizen participation. Reconciling real-time optimisation of a city and its reappropriation by its users is not self-evident, particularly because participatory management potentially requires lengthy deliberation processes. The creation of these new forms of participation, with interaction as in the case of the FixMyStreet application, where citizens can communicate with city authorities to report urban problems and find out about repairs, is equally likely to reduce the municipality to a service provider as to contribute to the construction of a more political connection between citizens and the management of their city. Moreover, involving citizens in both data production and decision-making processes calls into question city management within the municipal services concerned. This can be seen as a loss of control over the urban chain, with all the concerns raised by this citizen involvement: unreliable data, misuse of the system, etc. Here, we once again observe the obstacles experienced for open data several years ago: although there is consensus about citizen participation in discussions, cultural and/or organisational obstacles can delay or block its implementation. Moreover, how can a participatory approach, which requires transparency of information, be reconciled with the economic model of urban operators, in which data acquisition and confidentiality are of strategic importance?

2. KEY CHALLENGES FOR DATA AND SMART CITIES

Our study focuses on four major challenges, seeking both to draw conclusions on current trends and to adopt a more forward-looking approach by identifying key factors that will determine the development of this smart city movement.

2.1. Data governance

➡ **How can public and private roles be reconfigured?** Contrary to what one might think, the situation is by no means one of municipalities or traditional urban operators being powerless against certain private operators possessing superior knowledge of this emerging field. The reality is far more balanced; the municipalities are progressively equipping themselves—and all the more so when it comes to large cities—and are in a position to take advantage of this new situation. For example, when it renegotiated its contract in 2015, the city of Lyon succeeded in obtaining a 24% reduction in water tariffs, particularly due to the deployment of smart water management by Veolia (which joined forces with IBM in this market). In another area, Paris has implemented a systematic open data clause in its public procurement contracts. In the private sector, which is far from homogeneous on this issue, processes are also more nuanced than an urban invasion by digital operators. Although these operators are increasingly establishing themselves as city stakeholders based on their leadership in terms of digital tools and model flexibility, they lack the knowledge of traditional urban service operators. We are seeing a dual movement in human resources: digital operators are seeking to obtain urban management skills, whereas traditional operators are creating more and more positions for data scientists.

The reconfiguration underway is more clearly seen in models for the co-development of innovation between public and private operators. How can experimentation and innovation be incorporated into restricted public procurement frameworks? At present, operators generally adopt evasive strategies, especially through R&D contracts or "partnership" experiments. It is also necessary to foster the implementation and management of

a promising local digital ecosystem. The creation of TUBA[16] in Lyon as a collaborative public-private structure is a good example of this. Finally, the recent introduction of innovation partnerships is attracting interest.[17]

A key issue lies in the identification of individual roles: for example, is it the municipalities' responsibility to produce a traveller information system application, or can they delegate to start-ups? How far should they go to process data themselves? In a legal context still under construction, we are now seeing different stances among the municipalities: some favour the internal development of data processing skills, while others prefer to join forces and rely on innovation by other operators. It should be noted that challenges do not concern only data ownership, but also data hosting and associated expertise. A municipality can also play the role of a trusted third party, serving primarily to organise collaboration between different city operators for data collection and provision. Indeed, a leader is needed to structure both access to and use of data in the context of implementing coherent public policies, and the municipalities seem to be the most suited to this role. Likewise, when a company requires data for a given project, the municipality can act as an intermediary in order to guarantee the usage made of this data and to ensure it is acceptable to citizens.[18]

For all of these challenges, the first question concerns the means and the will to use data to benefit the city. Difficulties existing for "traditional" policies and data (housing, energy, etc., see Box 3) clearly reveal the administrative and organisational obstacles. The reality is simply that the teams involved often fail to make the effort to efficiently organise and share their data owing to a lack of time or money, or because of power struggles between divisions or organisations. The basic prerequisite for a public data service is therefore the will, and the means associated with it, to promote this raw material, in other words to develop working methods (data-driven policies) and to approach data differently. In the case of the French state, this is the mission of Etalab, a structure tasked since 2011 with managing open government data.

As regards data management, due to technical difficulties, economic models and the stakeholder interactions specific to each sector, a sectoral approach appears to be the most appropriate, at least initially.

- The field of mobility today seems to be the most mature, driven by open data dynamics and the deployment of multimodal information systems. We are seeing the implementation of the different elements of what could make up a public data service. The challenge is to orchestrate the shift from a closed mobility model (by mode, by operator) to an open mobility ecosystem (Miroux and Lefèvre, 2012). This is reflected in the evolution of the legal framework (the Macron bill includes a clause on open data for mobility)[19], the inclusion of data issues in certain public service concession contracts or negotiations with other private operators (such as Uber, which plans to share its data with Boston).
- Where energy is concerned, we are witnessing a progressive movement in which the concessioning authorities, the municipalities, are securing greater powers for energy issues. In order to plan and implement their policies, they need to make use of different types of data, which is new to them. It is therefore important to clearly define the data needed and to develop processing skills: the local authorities are progressively doing just that, but overall they lack maturity on these subjects. At the same time, in the context of opening up energy markets to competition, GrDF and ERDF are evolving their strategy and culture from a national focus towards closer relationships with the local authorities. In this context, data has been or remains a source of misunderstanding, frustration and even conflict where discussions on the organisation of distribution are concerned, but it can also be a positive element in negotiations and collaboration (joint efforts in the context of planning, for example). It should be noted that the energy transition bill seeks to reduce grey areas existing in the transmission of data between distributors and municipalities and to avoid tailor-made situations by ensuring a better definition of the framework and responsibilities (quality, confidentiality, etc.). Further rationalisation efforts are still needed. This emerging local interest in energy data could be the source of a whole ecosystem ranging from real-time grid optimisation

16. The "*Tube à expérimentations urbaines*" is a physical location open to the public, where urban data projects can be tested in an ecosystem that connects the Lyon city authorities, their private partners, start-ups and citizens (http://www.tuba-lyon.com).

17. http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000029504714&dateTexte=&categorieLien=id

18. In the context of the management of a district, for example, a participatory project could be led by the municipality, facilitating citizen involvement and the availability of detailed data enabling private operators to optimise a specific service.

19. "*The key data produced by regular public transport services shall be available online to the public, in an open, freely reusable format*" (Article 1.4 of the Macron bill)

to long-term planning: research consultancies or major IT groups (IBM, etc.) assisting the municipalities in using their data or developing management tools (electric vehicle charging); start-ups using open data or data from smart meters to develop applications; and a public data service organising transfers and usage. Where energy is concerned, at the local level data is therefore central to stakeholder interaction, to a policy under (re)construction and to new technical solutions.

Box 3. Traditional policies in need of data

The new dynamics surrounding data should not ignore "traditional" public policies that are in need of quality data, such as housing and land policies. Recent events provide us with the best illustration of this: on average, 50 000 houses per year have been "forgotten", or "missed" by public statistics over the last five years,[20] even though housing figures are at the heart of political debates.

More generally, a threefold problem has been identified (Vorms report, 2012)[21] for the implementation of housing policies: insufficient national and local data; inefficient circulation (arbitrary exchange processes) and poor processing of existing data (a sub-product in which no investment is made); and uncertainty about the robustness of public and private data.

For example, knowledge of land and property markets is often fragmented, as shown by the attempt at rent regulation: price monitoring was insufficient to implement this process. For land, the work of the tax administration is based on administrative conventions rather than on market values, and the data available is limited, which tends to obscure the market (Levasseur, 2013).[22] Finally, in a recent study (Erard *et al.*, 2015) we demonstrated the numerous data difficulties facing policies to address fuel poverty.

These examples highlight a key point: possessing the technical capacity to generate and process data is by no means a sufficient condition for improving public policies (this capacity already exists for many of these policies). Above all, methods needs to be changed and data access procedures clarified.

➡ **A new city sector?** But how can this issue be addressed in the long term? Will data management become just another skill for the municipalities, subject to pooling and sharing between different municipality levels and potentially between public service concessions themselves? Or will it be a cross-cutting dimension incorporated into each sector? Will the municipalities be capable of declaring data to be of public interest and of using the right of first refusal, as with land or housing?

These questions currently remain unanswered within a shifting ecosystem of operators in which stakeholders continue to seek their position. We can however now see the emergence of divisions or departments in the organisation charts of companies and local authorities geared towards more effectively leveraging this data trend. Beyond the technical system for data analysis, organisational frameworks must therefore be developed to ensure data can be used to benefit cities. A good example can be found in Montpellier: in order to manage waste with greater user participation, more than 200 different types of requests need to be processed. One real challenge thus involves organising protocols and procedures to enable waste disposal services to access and utilise this feedback.

The push towards cross-cutting policies, which was already a challenge for sustainable development, is central to smart cities. It appears that both public and private operators are equipping themselves for the task. The impetus provided by digital technologies could deliver these changes on a broader scale than sustainable development, where implementing cross-cutting processes has been a permanent challenge.

Where companies are concerned, the digital revolution questions and disrupts their internal models and their organisational methods (hierarchy versus community) (Pezziardi *et al.*, 2013).[23] Will companies that operate within silos and adopt local optimisation approaches be suited to the production of a more integrated city? Are organisational methods with strict boundaries with the outside world coherent with urban policies that result in ever more porous boundaries for innovation and management? Of course, the answers to these questions differ considerably depending on whether the companies in question are traditional or internet companies. Solutions to these new challenges require traditional urban operators to make cultural and organisational changes to evolve a new way of thinking: services rather than infrastructure should be the starting point for

20. See in particular: http://www.latribune.fr/entreprises-finance/industrie/biens-d-equipement-btp-immobilier/20150227trib410f178f2/ces-dizaines-de-milliers-de-logements-fantomes-oublies-des-statistiques-officielles.html

21. Baietto-Beysson, S, Vorms, B, Vorms (2012). « Les observatoires des loyers », Agence nationale d'information sur le logement.

22. Levasseur, S. (2013). Éléments de réflexion sur le foncier et sa contribution au prix de l'immobilier, OFCE review (128).

23. Pezziardi, P., Soudoplatoff, S., Quérat-Hément, X. (2013). Pour la croissance, la débureaucratisation par la confiance, Fondapol.

developing interesting ways of using data in order to optimise a range of different situations rather than an average. These changes are underway.

Box 4. Open data is coming of age

After the initial enthusiasm for open data and a period of disillusionment faced with the barriers existing and the lack of long-term results in terms of economic development, it seems that we have entered a new phase: the municipalities are now benefiting from feedback and are better equipped to embrace open data with more specific strategies. Several key challenges exist today:

- Open data is a building block for the emergence of new economic services or activities, but does not guarantee this emergence. Support (in the form of labelling, as in Lyon, and/or through incubators, for example) is needed to ensure projects become economically viable. Today, the economic model cannot be based on a hypothetical return on investment linked to open data.
- Raw data is often operational data, whose production was not intended for purposes of sharing. Yet the "neatness" and readability of data will be a key condition for its reuse. Open data does not therefore amount to "data liberation", but rather to the construction of this data.[24] This has a cost and requires expertise that may be lacking today.
- Organisational obstacles exist, but open data is also a possibility for overcoming these through the cross-cutting nature of the approach.
- To ensure an open data strategy is coherent, it must combine public and private data. The issue of data recovery is therefore crucial. Given that this recovery is currently a subject of negotiations between municipalities and companies, it is in the interest of the municipalities to join forces in order to influence power relations and to benefit from feedback on the matter. An initiative such as OpenDataFrance,[25] which involves around 20 municipalities, thus seeks to standardise data sharing procedures.
- The issue of the licence associated with open data use reveals different types of models, whether more liberal (the Etalab licence) or more collaborative (the ODbL licence). The Etalab licence is aimed at enabling commercial use of data while the ODbL licence is less "permissive", targeting the production of common goods.
- Some data falls outside of the urban field as such (for example data pertaining to health). For this data, the connection must be made with Etalab, whose efforts focus primarily on state services and the major public administrations.
- Care should be taken to ensure open data differentiates between essential and non-essential content. In other words, it must not be restricted to the least conflictual data, while the most necessary data, facing the largest number of obstacles, remains unavailable.

In view of these challenges, the most advanced cities when it comes to "data liberation" have opted for different strategies. This difference echoes the specificities of each territory with regard to operator networks and data produced, but also the different political and economic choices made. The city of Lyon, for example, has set up a system involving different types of licenses depending on the data in question: 98% of data is covered by open licenses (Etalab), where the only obligation in case of re-use is to mention the source and the date of the last update. But the use of some more sensitive data must be accompanied by an authentication and a statement on the use of the data. This is essentially to guarantee public policy coherence and, for example, to prevent multimodal information systems from guiding people towards unsuitable routes (such as driving past a school). Finally, a fee must sometimes be paid to access data in order to prevent open data from reinforcing dominant positions (the first company targeted is Google). The level of the fee depends on the market share and/or the market penetration rate of the company wishing to access the data, with no charge for new entrants and very high fees for companies in a strong position. This support for SMEs is reinforced by a labelling system enabling emerging applications to use the "Grand Lyon" label. Although the city of Rennes is considering similar solutions to protect itself from "data vacuums", the municipality has nevertheless opted for a "free" license (ODbL), reflecting an approach focussing not on the economic development of this data but rather on a more collaborative process. This is linked in particular to the presence of a dense network of local associations. Rennes is thus attempting to embody its digital strategy in physical locations and to use open data to consolidate the participatory dimension of the city. One of the challenges facing this municipality is ensuring the sustainability of applications developed using open data, once the initial enthusiasm of the hackathon has worn off.

24. Denis, J, Goëta, S (2014), « La fabrique des données brutes. Le travail en coulisses de l'open data », in *Penser l'écosystème des données. Les enjeux politiques et scientifiques des données numériques,* dir. Mabi Plantin Monnoyer-Smith, Editions FMSH, Paris, 2014.
25. For more information, see: http://www.opendata france.net.

2.2. Which economic model for smart cities?

The issue of economic models has become a recurrent feature of smart city analysis. Companies thus attempt to calculate the potential returns on investment associated with data processing. For the municipalities, the issues are rather different, since they are not tied to profitability alone. The challenges here are rather to find viable financing models and to succeed in developing public services, potentially with the support of more profitable services. Likewise, for operators such as energy distributors, the goal is to distinguish between their traditional distribution activities (the cost is then passed on to electricity or gas bills) and what may be considered to be complementary services (for example, their expertise in the use of energy data), and which could therefore have their own financing system.

Different approaches exist to this issue of economic models: an operator such as Google uses data to attempt to move up the urban chain to reach users. Its investments in home automation (its purchase of Nest) and collaborative transportation (its contribution to Uber's capital) illustrate this kind of strategy. Other operators are currently positioning themselves as providers of technological building blocks, like IBM or Cisco. Traditional operators, on the other hand, are using digital technologies to develop competitive advantages and to meet the requirements of municipalities that make innovation one of the factors in their public procurement. In contrast, by opening up new fields (energy management services, collaborative transportation through digital platforms), digital technologies can remodel the value chain and enable the emergence of new entrants. The most striking example today is unquestionably that of Uber, which is establishing itself as a fully fledged local transportation operator. Data could therefore become a key issue through the development of economic models based on its possession. Hence a serious legal challenge regarding data ownership, for example when renegotiating public contracts.

Today, private and public stakeholders are investing in R&D processes, but the economic model has not stabilised and returns on investment are difficult to evaluate. There is competition to cover the largest part of the value chain: traditional operators are arming themselves with data scientists, while digital operators are equipping themselves to better understand urban service activities. Another issue is that of the replicability of solutions developed for a given city in view of the wide range of contexts: to be effective, a "data platform" must adapt to the needs of the territory (especially in terms of the availability of data and skills for the city). This challenge is even greater for start-ups originating in a specific area, which are often assisted by the public authorities: their development inevitably depends on their deployment in other areas.

2.3. Legal issues to be clarified

Numerous legal issues exist for urban data and relate to different areas of law: personal data, public data, intellectual property, public procurement and contracts, and sectoral law (environmental, urban planning, energy and transport codes, etc.).

➡ **The issue of personal data.** Posing serious challenges for the internet giants, this issue is central to debates on digital technologies, with the forthcoming French bill (2015) and the European draft regulation (expected in 2016). The French Council of State and the CNIL recently made proposals for changes to French legislation. Based on the observation that digital technologies "provide new scope for freedom while posing risks to this freedom" (Conseil d'État, 2014),[26] the goal is to develop an approach that makes it possible to capitalise on digital technologies while limiting risks to citizens. The regulation of personal data has been remarkably stable since the French data protection act of 1978, which gave rise to the CNIL, and the European directive of 1995 on the protection of personal data. Based on the major principles (loyalty, purpose, proportionality, consent, limited conservation, etc.)[27] that are still largely effective, the main challenge today is to transform the instruments used to ensure compliance with these principles. The rights of citizens to their data must be given effect in a world that has changed, as the risks are very real: personal data disclosure without citizens' agreement (raising the issue of consent), receipt of personalised advertisements, unfair business practices (differentiation of supply according to the customer), reputational risks (insurance, employment), misuse or criminal use of

26. Conseil d'État (2014). Étude annuelle 2014 - Le numérique et les droits fondamentaux.

27. The principles of purpose limitation and proportionality: data shall be collected with restraint and for a particular purpose. Data is therefore not a commodity like any other, since the rights of the acquiring party remain limited by the rights of individuals to their data. Consent embodies personal freedom in relation to data, and should be neither overestimated (neither necessary nor sufficient for the collection and processing of data) nor ignored (Conseil d'État, 2014).

data, or abuse of state power in the name of public order, etc. (Conseil d'État, 2014). The central debate in fact focuses on the connection between citizens and their data, from strengthening personal property laws within a liberal approach (capital that individuals can sell), to a rationale of strict regulation by the public authorities.[28] Between these two extremes, hybrid regimes of a more participatory nature can be envisaged, based for example on the principle of self-determination, which strengthens the right of access to and information on personal data (CNIL, 2014), or the right to be forgotten and to delisting (possibly in the future European regulation).

It should be remembered that personal data does not block everything. For example, big data is possible because the principle of purpose limitation does not rule out statistical reuse. For many applications, anonymised data is sufficient, and this is often the case in cities. Moreover, many operators are seeking to reassure: the safety of anonymisation is guaranteed by well-defined knowledge and processes. However, this does not conclude the debate. Smart meters, the use of participatory platforms or applications (route requests), cameras, mobile tracking and web browsing; all of these practices are based on personal data, with the risk of growing control over individuals (Peugeot, 2014), and of "becoming trapped in a personalisation process over which we have no control" with the growing importance of algorithms (Conseil d'État, 2014). This is set against a backdrop of events (such as the Sony Pictures Entertainment hack or that of Uber's accounts, which recently made headlines) that have clearly demonstrated the limitations of information security, and in which data is circulating far more than in the past (data brokering, the sale of large amounts of data between operators).

Behind this legal issue, there are therefore different forms of data regulation and organisation. Some are based on personal accountability, others on regulation by the public authorities, while others still envisage the idea of more participatory management. A key challenge is to better understand the intersections between the possible systems for managing personal data at the global level (national and European) and city-level data management methods, an area that receives very little attention at present, with the exception of Peugeot (2014).[29] The common thread is the level of empowerment and participation of citizens, as both internet users and city users. The challenge here consists in bringing the community of digital technology operators closer to that of city operators around these common issues.

➡ **Ownership of urban data.** The second key legal issue concerns data ownership. Several different cases exist.

In the case of administrative data internal to the authority, the question of ownership does not arise. However, this does not mean that access to data within an organisation—and this also applies to private companies—is always simple, in view of organisational obstacles: the absence of a data culture, no communication between sectors, and concern about the future of data, etc. Statistical and administrative data comes directly from citizens through surveys or administrative files. The obstacle here concerns the cost of surveys, the non-use of assistance and the acceptability of surveys to households.[30]

Regarding data from public service concessions (water and sanitation, waste, public transport, energy, car parks, etc.), for a long time contracts did not include data issues such as ownership or transmission methods (form, frequency, etc.). But the basic trend is one of growing awareness among municipalities that they are the legitimate owners of a certain amount of data. Access to this data is now strongly conditioned by the contract between the municipality and the public service concession. Situations vary considerably from one territory to another: first, proactive municipalities on this issue, which have taken advantage of a favourable balance of power to systematically integrate data access clauses into the renewal of their contracts; and second, municipalities that lack awareness or technical skills and now find themselves deprived of this data. Nevertheless, there does not seem to be a common position for public service concessions, but very different challenges depending on both the sector in question and the business strategies. Where energy is concerned, the latest legal developments tend to clarify the practical modalities of this exchange of data between grid managers and municipalities; the latter will thus be able to recover commercially sensitive information and with it the obligation to manage this information accordingly.

28. See for example the interview with G.Babinet and P.Bellanger in *Les Échos*, 12/02/2014.

29. Peugeot, V. (2014). Collaborative ou intelligente, la ville entre deux imaginaires, Vecam ; Peugeot, V. (2014). Données personnelles, sortons des injonctions contradictoires, Vecam.

30. For example, non-use of CMU (*couverture maladie universelle*, French universal health care coverage) results in an incomplete statistical database that is subsequently used by the public authorities for fuel poverty.

The final case is that of private data that the collectivity deems to be of public interest. At present, the recovery of this data depends on mutual accord and, as a last resort, on the agreement of the company producing the data. It should be noted that the bill on digital technologies to be discussed in 2015 highlights the concept of "data of public interest"[31] whose boundaries remain unclear, but which could give the municipalities the right to expropriate certain data. For the subfield of private data generated directly by citizens, one alternative would be to give these citizens the possibility of providing their data to the municipality (under suitable anonymisation conditions), within the framework of a participatory project.

➡ **Latest developments and future commitments.** The issue of urban data is evolving in a changing legal context, through different approaches: sectoral (the energy transition bill legislates on data transfers between distributors and municipalities, the CNIL issues an opinion on Linky/Gazpar data, European pre-positioning towards the widespread opening of public and private transport data, the Macron bill requires the opening of certain transport data); organisational (the third bill on new territorial organisation in France requires the local authorities to provide open data for certain administrative information); or via digital technologies (particularly through the digital bill, expected in 2015, which will propose developments for open data, personal data and the implementation of interoperability standards). Today, a number of grey areas remain to be clarified: which law applies to which situation? What is the status regarding the re-use of intermediate data (for example, to whom do MIS user requests belong)? And does intellectual property law apply to certain databases?

These issues can clearly only be addressed if they are returned to their political and economic context. Consequently, questions to be decided by law are primarily a matter of public and citizen debate, such as the boundaries of public services or the management of personal data. This raises the question of suitable frameworks for discussion and decision-making on these subjects, and highlights the connections to be made with participatory democracy.

31. http://www.nextinpact.com/news/93124-open-data-axelle-lemaire-veut-donner-statut-aux-donnees-dinteret-general.htm

2.4. What is the role of citizens and decision-makers?

➡ **A smart citizen?** In attitudes towards smart cities, there are numerous, often implicit assumptions about citizens and users, as summarised by Miroux and Lefèvre (2012) for the case of traffic. Ultra-mobile users, capable of optimisation based on their control of new technologies, *homo economicus* reacting to incentives, etc.: this image is clearly only a partial reflection of reality, where households are not all equally capable of using ICT, requirements are very constrained, and decisions are not just the result of cool-headed optimisation.

➡ **The role of participation?** At present, a top-down approach (data and digital technologies used to better control processes, and to more effectively govern decision-making, etc.) coexists with a more bottom-up, participatory and community-based approach. It is important to accept the socio-technical dimension of smart cities and to avoid any technological positivism, whether 1.0 or 2.0. Many authors thus advocate urbanising and humanising the technologies used in cities, and making new information infrastructure visible to citizens (Saskia Sassen or Serge Wachter, for example). This does not imply that citizens/users must be involved at every level of technical processes; it is logical that at certain moments and for certain tasks technical subjects must be invisible. What is required is that local democracy can identify the right level for participation, in other words whether the issue raised pertains to lifestyles or to policies on city organisation or personal data management. It is also important to create the right conditions for this participation: preparing the issues and overcoming the technicality of questions, relying on specialist support operators, and moving away from a purely top-down way of thinking for the public authorities. Over and above what applications can do, to what extent will citizens use them effectively? Will it be possible to go beyond early adopters and to change scale? It is clear that digital training and education will have an important role to play.

A participatory city also implies risks, however. One such risk is that cities could be reduced to their political dimension, with the intrusion of debates into an increasing number of areas, including technical arenas: this could give rise to instability in public management and the emergence of new conflicts with the advent of open data, whose reliability is not always guaranteed. Tension could occur between long-term urban

deliberation and planning and the increasingly short-term optimisation of flows and infrastructure in the context of feedback provided by users (Dupuy, 2014). In addition, there is the danger of a digital divide between citizens driven by problems of exclusion due to the skills required to become an accomplished e-citizen. Self-sufficiency could also develop (communities organise their own district based on technologies developed for them), which could constitute another form of exclusion.

➡ **The role of policy debate.** We are still in the early stages of this smart city movement and more generally of digital technologies in cities. Consequently, legal frameworks are not necessarily keeping pace with innovation. To a certain extent, discussions therefore take place within existing frameworks for data rights and obligations, with considerable differences between sectors (access to private data for energy or mobile phone services, for example). These frameworks need to be renewed and developed, with the challenge of making a distinction between issues belonging to technical discussions (how to guarantee anonymisation), problems inherent to the sector (competition, institutional architecture, relationships between operators) and, finally, issues belonging to the political and social debate (the limitations of privacy or of commercially sensitive information, participation, etc) that need to be discussed in greater depth.

More generally, issues are addressed within a framework inherited from the past, for example making a clear distinction between raw data and anonymised data, even though technological progress is questioning the effectiveness of anonymisation and the debate concerns far more than just privacy alone, including in particular the quality of data use (or misuse) for the common good.

Ultimately, are we more generally faced with a new social contract due not only to the new role played by citizens but also to this new intrusive dimension? A new social contract capable of reconciling the technical and participatory dimensions of smart cities? The novelty is that citizens are needed to produce data. They therefore play a key role. Could reinforcing citizens' ownership rights to this data strengthen their means of participation? Will the creation of these new forms of participation, with feedback according to needs and sectors, reduce the city to a service provider, or will it contribute to the construction of a more political connection/exchange between citizens and cities?

CONCLUSION

Smart cities held the promise of overcoming the tension inherent to the concept of sustainable development that makes it so difficult to implement, based on the assumption of high potential for improving and optimising cities through a win-win process (environmental, economic and even social with the participatory dimension). But analysing the conditions for smarter cities shows that tension does exist and that compromises must be found. This tension has shifted from public policy goals (social, environmental, economic) to personal data management, with the shadow of Big Brother, whether private or public.

We are currently in the second phase of smart city development, after an initial phase of intense communication, or even "evangelism". Technologies are now largely mature and the obstacles are no longer truly technical, but rather political, economic and legal. The first discussions on smart cities have been confronted with reality, particularly through experiments and demonstrations; operators have clarified their positions, and risks and obstacles have emerged. The municipalities have taken up the subject: this is not a monolithic movement in which new private operators are taking the lion's share to the detriment of traditional and/or public operators. The reconfiguration of roles is more complex and varies from one territory to another.

In terms of urban sustainability, digital technologies help to optimise existing processes (water management), to make innovation possible (smart grids) and to do more to harness the alternatives (multimodal information systems). But these gains cannot be taken for granted, and it is currently impossible to provide a generic response given the wide range of situations and the importance of user behaviour. Nothing is yet certain, and there are many obstacles to implementation (economic and legal feasibility, political will, etc.).

Moreover, although optimisation helps to improve efficiency by a few percentage points here or there, which is by no means insignificant, steering cities towards greater sustainability requires more radical changes. These include renewing an energy-intensive fleet, and dramatically reducing congestion and pollution. In other words, we must not limit ourselves to this digital dimension, but rather seek to identify transformative ways to optimise urban models while considering the contributions of data to achieving better urban planning, reinforcing participation and managing it in a cross-cutting manner, even if the economic model for the latter dimensions is perhaps less apparent.

Smart city innovations for sustainable cities? An analysis based on data challenges

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- Erard, T., Chancel, L., Saujot, M. (2015). La précarité énergétique face au défi des données, IDDRI, *Studies* n°01/15.
- Chancel, L., Erard, T., Saujot, M. (2015). Quelle stratégie de lutte contre la précarité énergétique ? Propositions pour une politique de transition écologique et sociale, IDDRI, *Policy Briefs* n°02/15.
- Saujot, M., Peiffer-Smadja, O., Renard, V. (2014). Ville et énergie : quels enjeux communs ? IDDRI, *Working Papers* n°09/14.
- Chancel, L., Saujot, M. (2013). Inégalités, vulnérabilités et transition énergétique, IDDRI, *Policy Briefs* n°02/13.

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