DATA, AI AND GOVERNANCE

# Artificial Intelligence in Cities

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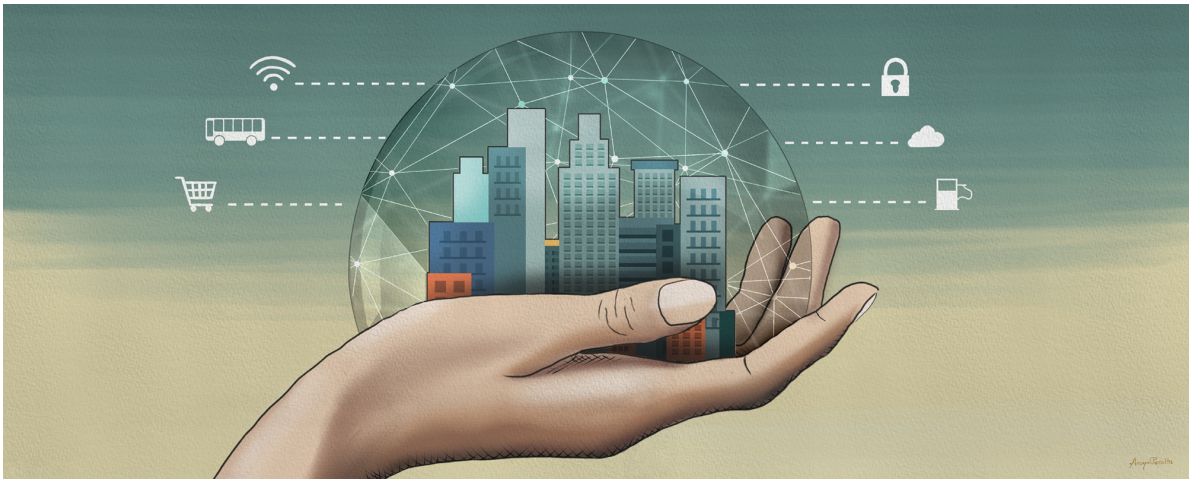

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At a worldwide level, there is growing awareness around AI. The United States and Canada have been leading in the AI field for a long time whilst China has developed a mega initiative to take the lead [1]. Recently, things are starting to move in Europe. A number of European countries do recognize the importance of AI, and are catching up and developing AI-strategies. The European Commission announced a plan to invest 1,500 Millions of euros up to 2020 to promote AI research and exceed the 20,000 million euros invested in the next 10 years.

Notwithstanding the capacity AI has to transform the way we are living, working, moving and consuming, it is mystifying. The term AI was qualified as the 2018 marketing buzzword [2] raising expectations which promise El Dorado for businessesljust like the Smart City phenomenon ten years ago. However, looking in detail reveals important differences. Firstly AI is an umbrella term for various technologies [3]. The Gartner Group Hype Cycle for Emerging Technologies [4] lists an important number of AI technologies and applications. Secondly, AI, as a catalyst, gives meaning to emerging technologies such as IoT, 5G, or Big Data, unlocking the potential for transformation they have together. Finally, although Artificial General Intelligence (AGI) is at the beginning of the innovation cycle, and the majority of the Artificial Narrow Intelligence (ANI) related technologies and applications are at the peak of inflated expectations, it can be found only in two technologies i.e. deep neural networks and virtual assistants, that are close (2 to 5 years) to reaching broad market applicability.

The first applications are demonstrating the highly transformative potential of AI. However,

they are raising a significant number of challenges related to ethics, citizens rights, accountability, etc. that must be addressed urgently before deploying it more widely in cities.

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AI is set to deliver significant benefits to cities administration, public policies and public services provision. But, is it ready to deliver real value for citizens? How will this affect cities and citizens? In which areas can AI deliver more value?

This contribution will deliver a realistic overview of expectations for AI, asking local administrations and citizens to participate in defining where and how AI should be applied, and how they can help to pave the way to adopt these emerging technologies in city administration. The article explains how cities are introducing AI in city government and administration, focuses on the challenges society has to face regarding AI application in cities and provides a list of recommendations for city practitioners.

## City areas of impact

AI comes with impressive credentials. When focussing on city governments, it promises to make citizen-centric government a reality, unlocking trapped value by increasing efficiency and reducing costs for public administrations. A progressive automation of public sector menial tasks would provide not only higher productivity and cost savings but also higher employee satisfaction. This can trickle down to citizens leading to greater satisfaction with governments and the services they provide. It can also deliver new services to groups who are currently underserved.

According to McKinsey [5], AI can create added value by transforming the way companies are projecting or predicting demand, producing, promoting and providing their goods or services. This can be directly translated into city administration processes for defining public policies, including predicting service demand, anticipating urban problems and obtaining more accurate diagnosis of people’s problems; decision making; planning, organizing and producing public services; communicating with citizens and companies; and finally delivering public services.

AI will allow politicians and city managers to have a better grasp of city needs, to have a more refined diagnosis of city problems and gather evidence to evaluate the impact of public policies, moving towards better and radically innovative public services. The way urban environments are governed will be radically transformed.

Meanwhile, as AI technology has become more mature, cheaper and more accessible, AI-driven applications pop up in the city [6]. Early adopter cities are paving the way to apply AI by building data lakes and developing pathfinder projects or envisioning the application of AI in areas like transport, health care, education, safety, culture and assistance for disadvantaged groups, where citizens will feel AI impact most strongly [7]. Although there are still few AI based applications, we can provide some examples.

## Transport and mobility

People's mobility will be an area of impact with the introduction of intelligent cars, autonomous vehicles and intelligent transport systems to improve traffic management in cities. This includes public transport as well. The Metropolitan Transport Authority of Barcelona (ATM) is leading a project where millions of Call Data Records (CDRs) have been analysed jointly with data coming from the national institute of statistics, major transport operators and road management authorities, in order to obtain more accurate origin-destination matrix.

Logistics and transport of goods can also benefit from empowered planning systems for logistics, autonomous shipping and drones to make deliveries over a short distance. The further introduction of AI in transport could lead to less pollution and fewer accidents, car park reduction and less traffic jams.

## Education

AI will help to provide better feedback and more personalized online learning systems. The large amounts of data about the learning patterns of students, could be used to improve the courses [8].

Combining data from both the job market and educational domains AI can help Vocational Education and Training (VET) to fit better with labour market demand. The AI system can assist policymakers to design active policies that help on building the bridge between VET system and the labour demand.

## Public safety and security

Face recognition, automatic translation, pattern recognition and Machine Learning (ML) will improve analysis of data from cameras, social media and other sources to make predictions where problems may arise. AI is also considered a potentially powerful weapon in unmasking fake news.

This area of application raises important challenges. Edinburgh is focusing on security and ethics both strategically (Baillie Gifford has pledged £5m to support research into the ethical challenges posed by the growing use of data and AI) and through new start-ups such as Ethical Intelligence, and the development of a healthcare data safe haven within

University of Edinburgh.

## Environment

Environment is an area where AI can contribute by leveraging IoT to understand patterns and trends. This knowledge will further be applied to new public policies or services. Edinburgh has used the 'Noiseability project' to demonstrate the impact of IoT data to inform mobility planning. Air quality simulation based on statistical models facilitates predictions for pollution levels which are the foundation of the new service in Barcelona to restrict private cars when air pollution reaches the threshold established by the World Health Organization.

## Culture

AI will bring new formats of culture content and new life to old content. Using Natural Language Processing technology (NLP), Ghent University Library has turned a million scanned cards into valuable records that could be added to the main library database, which made lost books available to the public again. Art restorers working in Ghent cathedral are benefiting from deep neural network algorithms applied to X-ray images of the ancient altarpiece.

AI can help to manage tourism. Barcelona analysed CDRs in order to obtain a closer picture about the origin and behaviour of tourists along Catalan most visited regions. The results will be used to plan better tourist experience while minimizing the downside. To ensure the quality of touristic apartments Barcelona tested an AI solution to automatically identify non licensed touristic rentals.

Bordeaux's big data and tourism project brings private and public actors together to monitor tourists' behaviour and provide the city and regional governments with information on tourism trends. By analysing social media data, the areas of most interest are revealed, the development of cultural and nightlife activities is tailored to tourists' interests and needs, and the impact of public policies and investments in culture, tourism and internationalisation is evaluated.

## Social Care and disadvantaged groups

AI creates new opportunities to better fight urban poverty and deliver social care. In UK, the Department for Work and Pensions is using AI to more efficiently process incoming correspondence. The Barcelona Social Rights Assistant applies ML to social services records including transcripts of citizen's interviews, specific demands, identified problems, diagnosis, prescriptions and grants awarded and proposes a diagnosis with the most appropriated solutions for citizen needs and reduces response time, improves diagnosis accuracy and homogenizes responses.

The Barcelona (social) Aid Simulator is an online public service designed to reduce the “non take up” of social aid. It uses algorithms to analyse a citizen’s economic and social situation and recommends social aids of benefit, as well as their economic impact and information to apply for. The service uses a core of 16 municipal and regional aids and collects user information and recommendations to allow improving social welfare policies.

Finally, the creation of a data lake on urban poverty will allow the identification of poverty cases in Barcelona and help to fight them. It includes information from municipal records, exchanges with other public administration, 3rd sector actuations; and offers a 360 degree view of citizens at risk of social exclusion. Future developments based on mainly ML and Deep Learning (DL) will provide valuable insights to refine policies and define specific actuations.

## Citizen attention and participation

AI has a clear role in city contact centres. In Singapore, the government is using AI to answer citizen’s queries and in UK’s London Borough of Enfield they are running a chatbot for conversation with citizens. Within the ParkLife project Edinburgh has installed a chatbot as part of a physical/digital notice board where people can engage with the project, find out what data is being collected and see real-time reports about parks. In the city of Ghent, CityNet is allowing rapid search through documents and regulations by applying natural language understanding to city council data and regulations. Via an intelligent e-desk or fully automated chatbot citizens can request information in many languages. Citynet improves the efficiency of service provision to citizens while complying with open data policies.

Moreover, AI can be a tool to enhance citizen participation and enable a more direct democracy: groups that otherwise have no voice in society can unite and organize. AI programs can help determine the agenda by showing the consequences of decisions, e.g. when deploying sensors on smartphones to monitor environmental issues.

The US Department of Health and Human Services successfully tested AI to process thousands of public comments on regulatory proposals. The NoiseTube project is a participatory research project that carried out sound measurements through smartphones and mapped the noise pollution in Antwerp (Belgium) [9]. Zaragoza launched the Periscope project to make citizen data containing the traces and patterns that define urban life – how people move around, interact with, use services and enjoy the city – more understandable and useful for citizens. The outcomes are providing powerful leverage for new mobility policies as well as valuable tools to communicate directly both with citizens and with local stakeholders.

## Challenges for cities to apply AI

The adoption of AI represents many new opportunities for governments. It can aid in putting people at the centre of e-Government services, can increase the speed and quality

of services, and can help optimize processes freeing up personnel from repetitive tasks. AI is the key to unlocking the trapped value in Smart City development in general and will be interesting in the context of developing a cognitive government.

The adoption of AI by the private sector shows various solutions some of them reaching astonishingly good results. Nevertheless solutions are not yet developed with cities and government in mind, the complexity of urban needs demand more than solely a focus on financial gain. In addition to the societal dimension, the personal one is also of importance. Systems based on AI in the public and private fields must be trusted and designed in a respectful way with privacy and ethics based on transparent verifiability criteria.

Despite the potential of AI, there are many concerns. What are the limits, the risks, limitations and problems with premature or incorrect use? What actions must be taken to ensure that AI is used in safe and reliable ways? Which usage of AI by the public sector as a whole can provide for a sustainable and desired outcome for all? These challenges are an opportunity for citizens and governments to participate in the definition of how AI should be applied, and in the development of new solutions and services.

## Jobs reinvention, skill set

The current enthusiasm for AI sometimes gives the impression that human intelligence is no longer needed [10]. However, human expertise remains more powerful than AI in many domains such as creativity, interpersonal relationships, caring, strategic thinking, leading employees, emotional skills and complexity.

Technology takes over tasks but does not have to replace people. McKinsey [11] believes that half of all professional activities can be automated. Nevertheless, AI will mainly be used to improve human work in automatizing some tasks while creating new tasks requiring another skill set and generating new job opportunities in data analysis, customer experience, online supervisors and new types of vehicle operators.

Governments must anticipate in the area of education and training to prepare citizens and employees for new roles and skills related to AI and useful for the new jobs. In addition, AI opens an opportunity to redefine and increase public services offered that governments must take advantage of.

## Improper and unauthorized use

Algorithms and all-knowing decision systems are not neutral [12]. What happens if algorithms, assign a score to an individual on the basis of all kinds of data and formulas, and thus determines a person’s value in society, access to services and employability, like the national social score for citizens China wants to introduce by 2020? Following every digital movement can lead to a society with major social pressures, a powerful and subtle form of control. This may bring about a culture of self-censorship where people (voluntarily) adjust their behaviour to conform, for fear that their monitored behaviour may influence

their reputation or their chances of finding work, goods or services. In extreme cases, this may lead to the extinction of creativity and to a society where the freedom of expression is endangered.

## Reliability, safety, homologation and quality

AI systems should undergo rigorous testing to check their reliability and safety. There are significant differences between an AI-test data set and the deployment in the real world. AI applications can enhance or hide intrinsic or data-based bias. They have no consciousness, reflect human prejudices and opinions and repeat and perpetuate incorrect data, which lead to misinterpretations and errors. Predictive policing leads to stigmatization, discrimination, distrust of the police and has a self-reinforcing effect [13]. Government authorities use various internal and external data sources. A decision by one government affects the decision of another. If something goes wrong, it is difficult for the citizen to correct the errors that expand from this [14].

Cities should develop verification and validation procedures for data-based AI and AI human-in-the-loop systems. Security methods against threats such as hacker attacks or antagonistic learning must be integrated. In addition, a network of agencies (or a central European agency) is needed that validates applications. The European Parliament has approved a plan for a Robotics and AI agency that could take on this task.

## Interpretability

Governments use AI-technology to support or take decisions (e.g. automated decisions when calculating the income tax assessment). Automated decisions have advantages: the data is collected carefully; citizens often get to see in advance what information the government already has, which benefits transparency, and the computer treats all cases equally. But there are drawbacks. Citizens have no insight into the decision rules and algorithms. There is no independent authority that checks the accuracy of the instructions. When contesting (decisions), a judge cannot check whether the government interpreted the law correctly. The assumptions made by programmers remain invisible [15].

Citizens have the right to information. City governments must be open and transparent. Since AI systems are making more decisions, anyone who wants to understand must be able to interpret and understand why the decision was made to challenge the decision [16]. Many of the current data-based AI systems are unable to do this. We need accessible AI that clarifies their behaviour [17]. In addition, a supervising authority is required for citizens who have problems with computer decisions and the instructions on the computer to be public and accessible in a way that is understandable for judges and for people without programming knowledge.

## Transparency

There are concerns about AI chatbots intended to manipulate political opinion, delivering disinformation, extortion, or other forms of behaviour that are dangerous to the individual and can destabilize society. These chatbots mislead users, pretend to be human and do not expose their identity [18]. Algorithms already determine our lives to a large extent. How does Apple compile your news? How does Amazon know what you want to buy? Who designs the rules and how do they work? The black box should be opened, so citizens can see inside. Cities must make clear when an interaction comes from a human or an AI system, and if it is an artificial system, ensure that those who are responsible can be traced and identified.

## The clash of different cultures and ethic values

AI systems have in their algorithms a translation of a human point of view. AI solutions development should not be solely trusted to tech experts and should be based on ethical principles and societal values. The European Commission understands that this is the right approach. However it is not a top down exercise but a social exercise. Citizens and governments should discuss the relationship we want to have with AI. What role do we want AI solutions to play?

## Accountability

AI in physical systems such as a self-driving car has the potential to make decisions and to convert them into actions in the real world. This raises questions about safety and who is responsible and liable [19]. To what extent can these systems become dangerous and surpass people? Clear autonomy rules are needed so that developers can integrate into their systems right from the design phase. This way, the responsible person can be determined if there is a failure.

## Data enthusiasm

Machine learning is mostly based on statistics, which are a simplification of the real world. How do these systems deal with ambiguity and nuances? The use of AI systems must take into account the social, cultural and economic diversity and ensure that the algorithms do not have illegal or non-ethical biases.

Data can be the new soil, where its analysis and decision making can empower citizens and improve lives. Therefore, data quantity and quality are of paramount importance. Without data governments cannot manage public good, cannot serve citizens. As the new gold, data is gathered and owned by private companies that are using it for their competitive advantage. This is a privatisation of a public good. Many think this reality is the only possible one, but there are alternatives.

Finally the privacy of personal data must be guaranteed throughout the entire cycle of the use of AI based systems.

## Citizen’s rights, the rule of law and moral issues

Many AI applications have a low risk because the user can easily spot and correct errors e.g. personal assistants such as Siri and Alexa. Other AI applications contain high risks. Errors in perception, reasoning and execution can put human lives at risk such as robotics in surgical techniques. Market instability caused by automated trading has been observed [20]. What about disruptions in infrastructure caused by failing AI systems? Do we allow autonomous AI systems to conduct war operations? What is right, what is wrong?

The Moral Machine experiment investigated social expectations about the ethical principles that guide autonomous vehicles among people in 233 countries. There appears to be no universal morally superior option: preferences changed depending on their countries and cultures [21]. There is no “correct” ethical choice. How should society and cities deal with the (errors of) such machines, the ethical questions and difficult choices? Can we accept that human lives are influenced by the result of an abstract mathematical function?

AI systems also entail risks for fundamental human rights. The right to life (through AI weapons), the right to privacy and data protection (e.g. through profiling through AI), freedom of expression, equal opportunities, the prohibition of discrimination and life-friendly working conditions are covered. Professional codes of computer sciences and AI require respect for human rights, realizing that these rights can also conflict in-between [22].

Smart technology is becoming imperative and penetrates many facets of public space and citizenship. What is the long-term effect on society if a government has more confidence in its big data analyses and algorithms than in its own citizens?

## Regulatory frameworks and codes of conduct

Regulatory frameworks and codes of conduct are being developed. With the General Data Protection Regulation (GDPR) (May 2018), Europe took a step to provide legal guidance for the use of AI systems. The GDPR limits and regulates data use, wants the user to regain control of his personal data and give citizens rights in automated individual decision-making [23]. It also explicitly addresses requests for explanation. A mandate for the right to an explanation is still a matter for debate [24].

To ensure an ethical approach for AI, the EU created the “High Level Experts Group on Artificial Intelligence” (AI HLEG) and published guidelines for companies and governments in developing AI applications in an ethical manner, to ensure the ethical and democratic principles that must guarantee the individual rights and freedoms of EU citizens are applied [25]. These guidelines are meant for AI to be developed as a human-centric and trustworthy tool. They are not compulsory but can shape future EU legislation for ethical AI.

The EU also established the European AI Alliance, a think tank and consultative body where experts in AI from a variety of disciplines meet for discussion [26]. From the discipline itself there are codes of conduct such as the Barcelona Declaration for Proper Development and Usage or Artificial Intelligence [27].

## Recommendations: how can cities be well prepared?

The EC is working towards ‘open platforms’ and ‘common data space’ for AI to be made available across the EU in digital innovation hubs, providing testing facilities and knowledge to small businesses and local innovators. The EC programme foresee action lines directed to strengthen the EU’s high-performance computing and data-processing capacities and ensure their wide use; increase opportunities for students and technology experts to train in advanced digital technologies; help develop high capacity digital networks; support workforce upskilling; and ensure member states can rely on more secure infrastructure.

Cities must increase pace in the area of AI. They must recognize that AI can fundamentally change the city and demonstrate their commitment to address this challenge. What can cities do to reap the benefits of AI technologies for citizens as well a city government?

## Drivers: it’s about people, not about technology

Cities can use two important drivers for starting AI: the increasing growth potential of AI (AI-driven innovation as a new source of productivity and a better way of achieving the public good) and the potential to save costs.

In addition, there is a rather philosophical question: do cities want to use AI to “command and control” their citizens? Or do they want to deploy AI to increase the care, convenience and comfort of their citizens and the quality of life in the city? We propose that cities focus on the latter.

Citizens associate the smart city with technology, efficiency and an improvement in their quality of life by focusing on current problems: a humane city with citizen-centered technology [28]. The city thus acts as a true partner of the citizen, willing to strengthen the urban quality of life and the living environment in dialogue and co-creation, so every citizen and visitor can grow up in a pleasant and people-oriented environment. The themes of safety, environment and mobility are possibilities which include locations of road works, real-time traffic information, positions of public transport, smart traffic lights, crowds in shops (streets), noise levels, number of cyclists in the city or air quality [29].

## Data as an engine for AI

Qualitative data is the engine of AI and a fundamental success factor for AI adoption. However, few cities have succeeded in mapping and analysing their data flows as yet.

Cities must develop their digital maturity, adopt an analytical data-driven mindset and become proficient in data excellence. They have to divide the data (flows) into small components (e.g. through business process management) and map them in a robust underlying data architecture. In addition, their data processes must scale and they must think about which (additional) data are useful for smartly automating and optimizing their services.

Information security, penetration testing and interchangeability of the format are issues that cities must address. In many cases, the lack of an overarching data architecture that makes data accessible at different (government) levels is a large organisational issue that must first be addressed.

## Get on the roller coaster, it has already left

City representatives, you need to tackle this challenge. Get to know and understand AI, experiment with AI. Invite AI pioneers to help, visit other urban AI projects or projects from players who are at the forefront of the new AI wave: sectors such as high tech, telecom and financial companies.

Cities are ideally suited to set up experiments and pilot projects. They can work with living labs in a space that allows learning about the new AI models, gains experience and develops AI knowledge. For this, cities would be best to collaborate with innovative players and partners. We recommend working with a portfolio approach: a combination of moon shots that could transform the organisation and small AI projects that achieve results quickly. In choosing an AI project the city must have reasonable data quality, the project must add value in the real world, the pilot must be feasible and the project must be scaleable.

## A well-considered project approach

When setting up an AI project, cities must think carefully about the project approach. Henke, Levine & McInerney [30] provides a step-by-step plan for implementing AI:

1. Identifying and prioritizing business cases.
2. Collecting and preparing the data needed as input.
3. Building the analytical engine.
4. Validating the AI validation and deriving the implications for the business.
5. Implementing the application.

Davenport & Davenport and Morse [31] recommend a four-step framework based on:

1. Understanding the technology.
2. Identifying a project portfolio.
3. Launching pilot projects and creating a Cognitive Centre of Excellence.
4. Scaling up and integrating AI into existing processes and systems.

Everything starts with a good business case that aligns with urban strategy. Business cases should start with the needs of the citizen or the business. Van Belleghem [32] recommends starting with the daily irritations and frustrations of the citizens about the city. There seems to be support from citizens for tackling mobility, climate or environmental issues, health care and projects that minimize citizen effort for maximum user convenience; so there is potential for AI projects.

In addition, a multidisciplinary and “agile” team is needed, where the technologists work closely with the business. Translators, data scientists, information architects, data engineers, data visualization experts and experts in change should be part of it.

The challenge is to create a hybrid intelligence: to use both the power of the machine and the experience of man as a leverage to successfully deploy AI. The learning ability of a machine is different from that of a person, and in addition, a machine has no empathy. Any project should be aware of this and take an approach that brings both together. Decision-making also requires assessment: determining the meaning of a specific action in a specific environment. For this, AI and human evaluation should be complementary.

## Partnerships and ecosystems

We recommend that cities join forces and form partnerships to successfully deploy AI and enter into a broader AI ecosystem such as a Cognitive Centre of Excellence.

For partnership, a city can choose from various options: collaborating with AI start-ups or leading AI companies, universities, potential competitors (in this case other cities), existing suppliers and collaborating at the intersection of various industries. Co-creation or a sounding board group with local entrepreneurs, committed and specialized citizens is also a possibility. See the example of the Scottish Industrial Centre for Artificial Intelligence Research in Digital Diagnostics (iCAIRD) that is creating hubs in Glasgow, Aberdeen, St Andrews, Edinburgh and Dundee. It’s a collaboration among industrial, academic and health and social care delivery partners to overcome barriers to commercialisation and adoption of AI in health and social care.

## Guarding citizens’ rights and freedoms

Citizens expect the government and municipalities to play an active role in the smart city debate. A city must play a pioneering role, facilitate and guard the rights and freedoms of its citizens [33].

Citizens want a positive impact within an inclusive story, with respect for privacy. They want to share actual data (location, means of transport, etc.) with the city to develop smart services. There is less support for sharing personal data and emotions, and cameras that capture personal data or applications that have features such as facial recognition [34].

But there are issues. Who owns the data collected on the public domain, e.g. through

cameras? Do we allow private companies to use this data, if yes, for what purpose? What can AI mean for a city: what do we allow, where do we draw the line? What about the ethical and social issues when using AI by the government? With regard to the latter, the principles of legality, efficiency, proportionality, honesty and care are highly relevant to protect citizens. Value-based design seems interesting for designing AI-applications [35].

AI is not an agnostic subject; it throws down a gauntlet to fundamental human rights and principles of democracy. There are many challenges ahead. The citizen deserves a voice in the communal debate and transparency – about what happens in his city, in his immediate environment, with data that he, whether or not he wants to, has already been shared.

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Joan Batlle-Montserrat holds a PhD in Information Sciences (Universitat de Barcelona) and a diplome on ICT Audit (Universitat Politècnica de Catalunya). Since 1984, he has worked in many areas in the City Council of Barcelona, as head of Cooperation and International Innovation and as head of European Projects at the Municipal Informatics Institute. He participated in the creation of the website *bcn.cat* in 1995 and in the development of a Content Management System in 2002. His specialisation areas are authentication, authorisation and role management, digital certification and e-Democracy. He has worked for the implementation of Open Source Solutions, in the coordination of the HOPS Project on semantic websites, natural language processing and voice technology. He is currently involved in projects related to Smart Cities and advanced Internet services, and he is an expert on the Internet of Things at the European Commission.

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