Artifical Intelligence in Smart Cities and Connected Communities:

A Roadmap for Developing Best Practices

by Nick Graham and Monika Sobiecki

The trend of rapid growth of urbanisation[1] is expected to continue as a result of rising populations in major cities, coupled with expansions of regional cities.[2] This will lead to pressure for: (1) sustainable environment initiatives, with demands for more and better infrastructure in the diminishing space available; and (2) improved quality of life for city dwellers at a more affordable cost. The interconnection and interworking of "Smart City" technologies can help to meet these challenges and improve quality of life in a variety of ways, including reducing crime, lowering health burdens, shortening commutes and lowering carbon emissions.[3] Devices producing data and connecting to high-speed communication networks, computers processing the data, and people interacting with the technologies all occur simultaneously to create the Artificial Intelligence (AI) that can generate predictions and provide workable solutions for specific problems.[4]

1 https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html

2 https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html

3 https://www.mckinsey.com/~/media/mckinsey/industries/capital%20projects%20and%20infrastructure/our%20insights/smart%20cities%20digital%20solutions%20for%20a%20more%20livable%20future/mgi-smart-cities-full-report.ashx

4 https://www.mckinsey.com/~/media/mckinsey/industries/capital%20projects%20and%20infrastructure/our%20insights/smart%20cities%20digital%20solutions%20for%20a%20more%20livable%20future/mgi-smart-cities-full-report.ashx

HOW CAN ARTIFICIAL INTELLIGENCE FACILITATE THE DEVELOPMENT OF SMART CITIES?

To function, Smart City technologies require the processing of enormous quantities of data, or "Big Data". Big Data has been described in terms of the three "Vs" as "high-volume, high-velocity and/or high-variety information assets"[5] which means massive datasets, processed very quickly (through the use of algorithms) and the use of different data sources, including combining different datasets.

Big Data and artificial intelligence (AI) are interlinked. AI refers to various methods "for using a non-human system to learn from experience and imitate human intelligent behaviour".[6] AI can efficiently sift through large quantities of Big Data to generate data predictions and cost-effective solutions to fuel Smart City technologies.

The way this works depends on whether the AI is supervised or unsupervised. In supervised learning, datasets and target values are created to train AI networks to find specific solutions in the collected raw data. The AI will then carry out programmed tasks and actions, whilst exploring new opportunities and possibilities that may provide better outcomes than current solutions. In unsupervised learning, non-labelled and non-classified datasets are used to train and ask questions of AI networks, which will then find latent characteristics and hidden patterns in the data.[7]

While there are innumerable possibilities for AI in smart cities, some of the immediate use cases include:

- **Public transit.** Cities with vast transit infrastructure and systems can benefit from applications that harmonise the experience of its riders. Passengers of trains, buses and cars can provide real-time information through their mobile apps to communicate delays, breakdowns and less congested routes. This may, in turn, encourage other commuters to alter their choice of travel routes, and free up future congestions. Collecting and analysing public transit usage data can also help cities make more informed decisions when modifying public transport routes and timings, and allocate more accurate infrastructure budgets.[8] For example, Dubai has completed a number of Smart City projects, one of which monitored the condition of bus drivers. This monitoring contributed to a 65% reduction in accidents caused by exhaustion and fatigue.[9]
- **Public safety.** The same networks of sensors and cameras can be used to save lives and lower crime. Traffic lights and congestion data can be used by emergency services to get to their destinations quicker and more safely. Cities can gather data on accidents or choose other factors to measure in order to develop predictive and preventative measures for the future.[10]
- **Building automation systems.**[11] Sensors can be placed in strategic building locations that will help to gather information on energy usage and predict consumer behaviour. For example, store owners and retailers can use sensors to track the peak times that individuals enter and use the stores, as well as towards which areas the public gravitates. Through the use of AI, the data generated can help to produce consistent predictions and track daily, weekly and seasonal differences.
- **Power grids.** AI and Smart Cities have the potential to enhance the safety of power grids and improve performance management. Smart grids (power networks, such as generation plants, that are embedded with computer technology) can make

5 https://www.gartner.com/en/information-technology/glossary/big-data
6 Pg 6, Information Commissioner's Office Draft Guidance on the AI Auditing Framework https://ico.org.uk/media/about-the-ico/consultations/2617219/guidance-on-the-ai-auditing-framework-draft-for-consultation.pdf
7 https://reader.elsevier.com/reader/sd/pii/S0140366419320821?token=F2AE20F02C1B4B0AC9B42D70819F6A8C5B79EED130DD8545A37E3413256CF58BE0E561437241CFF922E80FF163F2FA38
8 This is from the McKinsey paper coupled with some general web research and footnote from No.5; but phrased in my own language.
9 https://www.intelligenttransport.com/transport-news/79089/dubai-public-transit-ai/
10 https://emerj.com/ai-sector-overviews/smart-city-artificial-intelligence-applications-trends/
11 https://emerj.com/ai-sector-overviews/machine-learning-in-real-estate-trends-and-applications/

smart meter readings of large quantities of data to assess and predict demand response and load clustering. Prediction models can be set up on these grids to forecast the price and demand for energy for specific periodic intervals. Research conducted has found that these models can surpass existing methods in terms of accuracy of price and load forecasting.[12]

LEGAL AND REGULATORY FRAMEWORKS FOR IMPLEMENTING AI

Vendors developing future Smart City technologies leveraging AI systems (and national and local governmental organisations procuring those technologies for their cities) will have to consider how to navigate the current legal and regulatory frameworks which govern the development and deployment of AI systems. These frameworks, to the extent there are any, will vary from one jurisdiction to another. For example, just a few months ago the European Union released a white paper on "Artificial Intelligence – A European Approach to Excellence and Trust" exploring both the opportunities presented by AI and the possible requirement for a future regulatory framework.[13] In 2019, recognising the potential for AI and for public-private partnerships, the UK government tested a new set of AI procurement guidelines[14] which were developed by the World Economic Forum. It will become increasingly necessary for all governments to have robust frameworks in place in order to ensure that the products they are procuring are beneficial for their citizens.

The use of AI raises a number of data privacy and other risks. The data collected and processed by systems may include personal data, such as facial recognition and biometric systems for monitoring and security purposes. How and whether this data may be used will vary significantly from one jurisdiction to another. There may also be risk associated with developing and deploying an AI system. In Europe, the High Level Expert Group (HLEG) on Artificial Intelligence, set up by the European Commission, is working on non-binding "Ethics Guidelines for Trustworthy AI,"[15] calling for AI systems to be lawful, ethical and robust, and to meet certain criteria in order to be deemed "trustworthy".

AI industry experts and academics are also working on developing best practices. They have produced a white paper that provides recommendations on how to improve the auditing of claims about products developed by the AI industry.[16]

OTHER RISKS IN IMPLEMENTING AI

In addition to general cybersecurity best practices associated with sensors and devices connected to the open internet, and the risks inherent in processing personal data, AI may pose challenges regarding the fairness and reliability of the algorithms used. For example, with facial recognition technologies deployed for policing and public safety, the dataset for "training" the technology should have access to a sufficiently broad range of demographics so that it can correctly and reliably identify people of different racial and ethnic origins. Purchasers of these technologies should be asking the developers what steps were taken to ensure that the AI avoided either creating or reinforcing unfair bias in the design of the system (for example, whether the algorithm was designed with the dataset it would typically be processing (such as the citizens of a diverse metropolis) in mind and whether processes were in place to test for potential bias). On deployment, there should be governance mechanisms developed to ensure that any potential unfairness can be flagged by citizens, including bias, discrimination or poor performance of the system.

Transparency in AI is a major challenge in Smart Cities. For example, municipal leaders must consider whether and how to inform citizens moving around a Smart City *when* they are interacting with AI systems. In some cases, there may be onerous requirements that may be

12 https://www.mdpi.com/2071-1050/11/4/987
13 https://ec.europa.eu/info/sites/info/files/commission-white-paper-artificial-intelligence-feb2020_en.pdf
14 https://www.gov.uk/government/publications/draft-guidelines-for-ai-procurement/draft-guidelines-for-ai-procurement
15 The Ethics Guidelines for Trustworthy AI are accessible here: https://ec.europa.eu/futurium/en/ai-alliance-consultation/guidelines#Top
16 Toward Trustworthy AI Development: Mechanisms for Supporting Verifiable Claims, accessible here: https://arxiv.org/pdf/2004.07213.pdf

impractical in an urban environment. In other instances, there may be no written prescriptions, however it may be necessary to obtain informed consent, or a social license, from the public in order to implement a project. It will be advisable to develop signage that may include the use of commonly recognised signs and symbols, along with interactive signs and QR codes which can allow the individuals to access fuller information (i.e. a layered approach to fuller privacy information available on the internet).

Finally, there is the challenge of establishing appropriate human oversight mechanisms. For those involved in the procurement of AI systems, what is the appropriate level of human control for the particular "Smart City" infrastructure? There are a number of different models that could be considered, but the volume and velocity of data moving through these Big Data systems make it challenging to identify where meaningful human supervision can realistically be introduced. In any event, there will need to be a mechanism in place to facilitate the system's auditability.

HOW DO ORGANISATIONS OVERCOME PRIVACY AND OTHER AI HURDLES?

There are a number of evolving best practices to aid organisations in addressing privacy and other AI risks. The following are based on experience with these issues in Europe in light of the EU General Data Protection Regulation (GDPR), but offer best practice suggestions that will be applicable across other jurisdictions globally:

- **Data Protection Impact Assessments (DPIAs)**: The use of novel technologies and the processing of integrated data sets using AI may trigger the requirement to conduct a DPIA in some jurisdictions, but even where not required, it is advisable, particularly where the data in question has a personal nature (e.g., where is might lead to profiling data subjects on a large scale, or where biometric or genetic data is involved). A robust impact assessment will include criteria that considers characteristics of AI systems such as transparency, robustness, bias reduction, accountability. In larger-scale projects, municipal leaders may also want to assess the impact of AI on fundamental rights and equity considerations of relevant stakeholders.
- **Enhanced transparency**: In order to ensure lawful, fair and transparent collection and processing of data, organisations seeking to use AI in Smart City technologies may wish to develop a "layered" approach. This could range from posting signs and symbols around the urban landscape, to reviewing current privacy notices and embracing an enhanced transparency standard.
- **Internal policies**: Organisations should be prepared to demonstrate accountability by adopting and implementing rigorous internal policies that set out rules and responsibilities concerning the explanation of AI-enabled decisions to individuals.
- **Privacy by design and by default**: Embedding privacy by design and default in the deployment of the AI should help to ensure that the organisation is moving towards good data governance. The implementation of techniques such as:
    - *data minimisation measures*, to ensure that only data which is strictly necessary for the purposes is being collected, processed and retained by the system;
    - *purpose limitation measures*, such as segregating datasets to ensure that they are used for the purpose they were collected for; and
    - *security measures*, such as the anonymisation or pseudonymisation of data where possible and the implementation of access controls, audit logs and encryption.
- **Solely automated decision-making**: Finally, it is important to recognize that AI that processes personal data and is deployed for use in solely automated decision-making (including profiling) with no meaningful human involvement in the decision-making process may still have a significant effect on individuals. One example is the prioritisation of emergency services calls in a city based on data relating to the citizens making emergency calls. Organisations will have to ensure that they have

an appropriate legal basis and social license to carry out the solely automated decision-making. In many cases, the data subject's explicit consent may be required, and there will need to be suitable safeguards, in particular a right of appeal against the decision to a human decision-maker.

In summary, while the use cases of Smart City technologies promise to revolutionise the way we live in our urban areas, both organisations in the public sector procuring these systems and in the private sector developing them will need to take account of the unique implications of this new technology and navigate the data privacy and AI risks with good governance measures.

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Nick Graham, a Partner in Dentons UK, is the Global Co-Chair of Dentons' Privacy and Cybersecurity Group. He is an expert on all aspects of data protection, including international data governance, data risk reporting and audits, as well as cyber incident response, CRM strategy, customer data exploitation and freedom of information. He is on the Panel of Experts for Data Guidance and sits on the Editorial Board of Privacy and Data Protection. He is a Co-Chair of the IAPP London KnowledgeNet Chapter and was appointed to the IAPP Training Advisory Board in 2016.

Monika Sobiecki is a Senior Associate (Barrister) in Dentons UK. She holds CIPP/E and CIPM certification from the International Association of Privacy Professionals (IAPP). Monika advises government bodies, technology and biotech companies, financial institutions, charities, research institutions and universities on a wide range of privacy matters including international transfers of data, GDPR readiness audits, data protection (privacy) impact assessments and freedom of information issues. She has particular experience in data breach response and contentious data protection issues.