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# Artificial Intelligence and Robotics in Smart City Strategies and Planned Smart Development

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**Abstract:** Smart city strategies developed by cities around the world provide a useful resource for insights into the future of smart development. This study examines such strategies to identify plans for the explicit deployment of artificial intelligence (AI) and robotics. A total of 12 case studies emerged from an online keyword search representing cities of various sizes globally. The search was based on the keywords of "artificial intelligence" (or "AI"), and "robot," representing robotics and associated terminology. Based on the findings, it is evident that the more concentrated deployment of AI and robotics in smart city development is currently in the Global North, although countries in the Global South are also increasingly represented. Multiple cities in Australia and Canada actively seek to develop AI and robotics, and Moscow has one of the most in-depth elaborations for this deployment. The ramifications of these plans are discussed as part of cyber–physical systems alongside consideration given to the social and ethical implications.

**Keywords:** case studies; smart city strategies; artificial intelligence (AI); robotization; cyber–physical systems

## 1. Introduction

The rapid expansion of digital technologies—including digital communication, infrastructure, and other frontier technology—restructures many domains of social life, including production and consumption, how people interact with each other, how they work and behave. Technical innovation and ICTs also offer new opportunities for managing cities more effectively and holistically and transitioning towards "smart cities." Technologies such as high-speed internet, 5G mobile networks, the internet of things and big data play an increasingly important role for cities. Smart cities and automation have also been a trigger for the deployment of artificial intelligence (AI) and robotics in cities.

Big data and the rapidly falling cost of computing and connectivity have enabled the explosion of AI: technology that is able to learn from experience how to complete increasingly complex tasks and automatize decision-making and assist in various aspect of life (e.g., [1]). AI applications are already common in healthcare (diagnosing disease, assisted living for an aging population, transportation (traffic control, advanced driver assistance systems), public safety and surveillance (facial recognition), manufacturing (process control), and online retail. Combined, this makes AI highly relevant in smart city development too.

A scientometric analysis [2] pinpoints the incorporation of AI in smart cities research (as a novel field itself) since 2008. Moreover, it has been linked to sustainable development at the global scale, including by developing nations (e.g., [3]) that are, for example, adopting AI to promote the UN Sustainable Development Goals. Indeed, according to advocates, AI can be deployed to tackle "wicked" urban challenges associated with rapidly growing urban populations, environmental degradation and pollution at various scales (e.g., from industrialization to global warming). Beyond expanding across scales, AI and robotics are expected to penetrate every aspect of human life. For example, they are expected to be a vital part of "social infrastructure," to accommodate social services, to promote the social functionality and well-being of cities [4].

What represents the particular interest of our study is the actual penetration of plans for AI and robotics into near-future city visions (as embodied in city strategies themselves) and how these plans are laid out against cities' existing functions, and what new functions and roles they suggest. Based on a roster of 51 smart city strategies collected from around the world, we have discerned trends emerging from those smart strategies that specifically convey AI and robotics applications. Before presenting the details of this analysis, the next section contextualizes it with a more general discussion of the intersection of smart cities, AI, and robotics.

## 2. Artificial Intelligence, Robotics, and Their Application in (Smart) Cities

Cities have become test beds for automation and experimenting with robots in managing urban services and public spaces. These robotics and autonomous systems (RAS), as they are known in engineering, extend considerably the initial smart city applications. While "smart" technologies embody a computational logic whereby computers are programmed to perform tasks, the RAS technologies employ AI and machine learning to make decisions and adapt processes to circumstances without direct human agency (Table 1) [5]. Although AI is currently designed to mimic human brain structures, in deep learning as part of machine learning [6] or to develop the "city brain" as brain-like tissues interacting with the internet [7] and functioning, the ultimate intent as with emotional intelligence simulations [8] is to outdo human performance (cf. [9]) and efficiency: "With AI, computers can [analyze] and learn from information at higher accuracy and speed than humans can" [1]. The reason for this may be that they are intended for service as service robots ([10]; including, for example, autonomous robots operating in public service [11]), industrial (and service) robots [12], and care providers in the burgeoning caring robot industry [13]. Ultimately, this technology will serve humans, indicating the future importance of AI and the internet of things or IoT-aided robotic applications [14].

In addition to care and assistance applications, research [15] has also identified potential applications in the areas of security, transportation, construction, sustainability and energy management, education, government, as well as manufacturing. In the area of transportation, for example, there are initiatives to promote car-sharing schemes in conjunction with autonomous and connected vehicles that enable machines to take over driving [16]. Further innovations, such as the hyperloop, are expected to contribute towards this transport revolution, where automated self-driving, on-demand shared mobility, and big data analytics are to provide more choice as part of a disruptive mobility "ecosystem" without the need to build much more additional infrastructure ([16]—see his figure 1). The National Science and Technology Council [17] has also noted new opportunities that have opened in association with AI in the areas of health, education, energy, and the environment. In India, investments in robust IT infrastructure are based on a host of smart applications, including smart power generation and distribution, smart traffic management, smart waste management and utilization, smart governance, and so on [18]. GovTech start-ups support the smartification of public services and "chatbots" and "robo-advisors" are expected to provide public engagement and assistance as part of the shift toward automation [19].

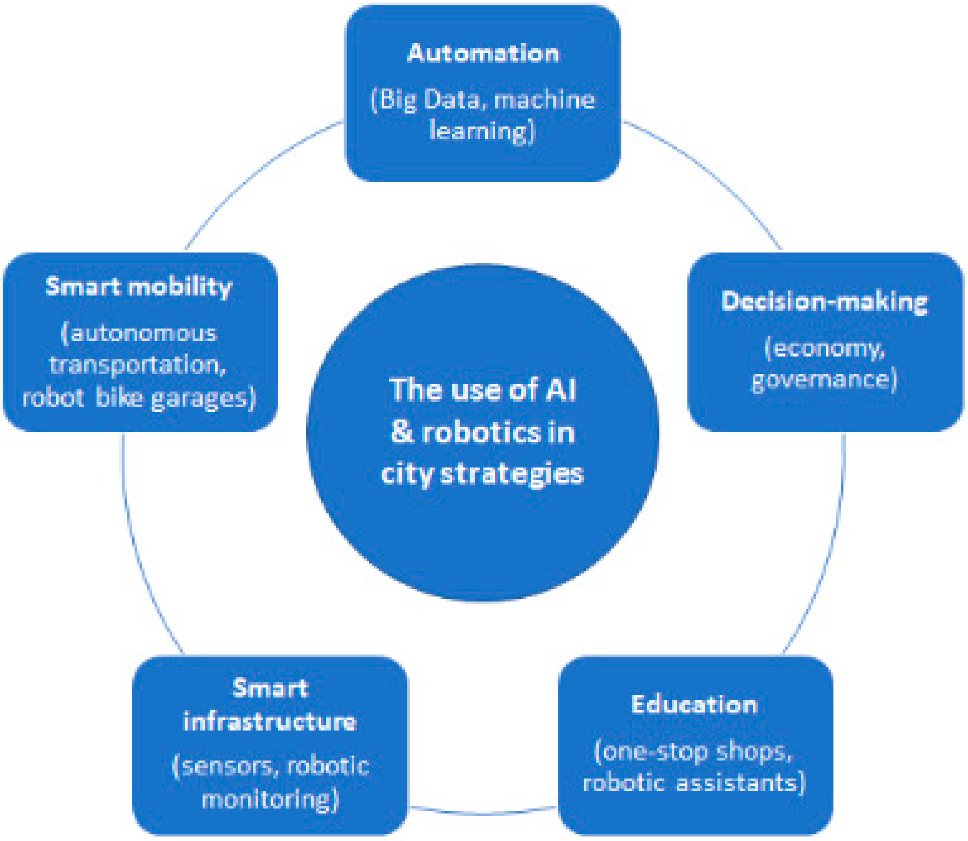


**Figure 1.** Summary of the five main categories derived from the keyword search performed in this study.

The role of the smart home for integration is critical as, according to [18], these data are used to develop innovative smart city services, which is part of "machine learning" (cf. [17]). There is currently already simple home technology that controls indoor climate that has led to energy savings based on smart meters. Another example is the use of Amazon Alexa in the home, which has spanned from the basic function of playing music and has since been extended to monitoring and security through doorbell and camera sensing and controls as well as answering the phone, accessing the internet through voice command, and other functionalities.

However, rather than functioning as merely home appliances do, according to [20], it is anticipated that AI and robotics would entirely replace humans where production and management decisions are concerned, causing a "disappearance of labor" or "end of labor" due to the automation process in production as part of intelligent capitalism [21]. Romania, for instance, plans to boost production using cyber–physical systems in its smart factory vision as part of the fourth industrial revolution involving AI [22]. Essentially, in the "second machine age," the evolution of AI and robotics depends on the IoT as another smart city enabler [23] as well as automatization driven by:

1. production controlled by machines
2. real-time production, where intelligent machines determine the optimal utilization capacity of production
3. decentralization of production, where the machine is self-organized
4. no alterations to machines required by humans.

The progression towards full automation, however, is yet circumscribed; it requires both technology and integration. Camarinha–Matos and Afsarmanesh [24] emphasize collaborative networks, reiterating that integration is key to better system organization (performance) and optimal resource use (efficiency). For the convergence of enabling technologies to be possible, however, there needs to be a network of wireless sensors for detection and "smart environmental monitoring" that effectively links cyber–physical environments (cf. [25]). In their turn, sensors cannot function in isolation. AI is necessary for data integration and processing. Pattern recognition, for example, is involved in machine learning, which depends on inputs from sensory information in the environment that is processed by technology to elicit robotic actions and responses to environmental stimuli. Another key element is organization, as with swarm intelligence that draws from AI and robotics as well as data mining for task optimization, optimal routes where sensors' streams are involved for spatial monitoring [26]. This includes visual sensors for accurate and robust, efficient 3D representation (e.g., necessary for autonomous navigation, [27] and crowd sourcing data reporting for mobile robotic systems [28] and data analysis [29].

While AI is popular, there remain caveats in its application even in smart cities. The shift toward intelligent capitalism is associated with job loss for people as they are replaced in automation [21]. In a provocative article, [30] refer to the "Elysium City," where a congregation of agents, including technologists, technocrats, intelligent machines, and wealthy capitalists is expected, who will embrace AI in cities particularly in physical, intellectual, information, governance, and socioeconomic domains and self-govern them as city-states. In an AI economy as part of "de-tech migration," they will be shedding themselves of the unemployed, who will be (and remain) impoverished.

Other authors present further caveats, such as pointing to the potential of AI trapping people into an easy life, where they become dependent on intelligent machines [31]. Cappelli [32] further asks important questions concerning ethical, legal, and social issues. More of these issues need to be addressed for more than the autonomous smart car since it seems that AI is here to stay. According to [33], there has been a recent demand for a robust ethical strategy that will ensure the safe use of such emerging and advanced technologies (e.g., AI, robotics, and automation technologies). Even though some subdisciplines (e.g., AI ethics, robo-ethics, machine ethics, cyber-ethics, artificial moral agents, robotic privacy, robot rights, etc.) have already appeared, they tend to focus on the anticipated impacts of future technologies. As such, they remain visionary and speculative, only broadly referring to any potential ethical conflicts in " … machine-user relations, accountability, privacy and human/robot rights, technological singularity, and design of ethical machines," which they outline in their report [33]. There are positive elements of AI, nevertheless, as for instance it is thought to be an enabler of a circular economy, where restoration and regeneration are possible through reduced resource use, recycling, and reuse [34]. Thus, both sides need further examination from diverse vantage points.

**Table 1.** Contribution of robotics and autonomous systems (RAS) to solving urban challenges.

| Urban Challenge | The Potential of Robotics and Autonomous Systems |
|---|---|
| **Congested transport infrastructure in growing cities** | Automatic autonomous vehicles (AVs) allow more efficient use of transport infrastructure and can radically reduce the demand for parking in central areas and free up valuable space for housing and recreation;<br>Automated traffic control systems making use of artificial intelligence (AI) and real-life sensor information;<br>Unmanned aerial vehicles (UAVs) exploit underused urban airspace. |
| **Low carbon energy networks and ecological management** | Automation enables buildings and infrastructure to respond to climate change (e.g., regulating energy use and comfort, air quality);<br>Sensors and AI can underpin the development and management of green infrastructure. |
| **Assisted living for an aging population and inclusion** | Automated and robotic health and social care support assisted living. Scope to extend age- friendly urban environments.<br>AVs extend personal mobility. |
| **Infrastructure maintenance and repair** | More efficient monitoring, repair, and control through robotics, especially in contexts where human accessibility is difficult or unpleasant. |
| **Controlled internal environments for leisure and food** | Automation and AI provide the climate control needed to manage advances in controlled internal environments for food growing and leisure. |
| **Urban security and policing** | UAVs and automated robotic policing help extend policing and surveillance. |

Source: adapted from UK-RAS ([35]).

The accumulation of those trends, opportunities, and challenges associated with the intersection of smart cities on the one hand, and AI and robotics on the other, inevitably draws our attention to very important actors that shape much of the evolution of smart cities; that is, to cities themselves. Technological change (and various innovation, entrepreneurs, and interests around this change) notwithstanding, it is cities that, in their diversity of political, social, and material circumstances, circumscribe the adoption of technologies and the actual pathways of urban socio-technical change. Thus, analyzing city-based visions for the deployment of AI and robotics will not only reflect on the state of the development of these technologies in general or their variations geographically, but also on the articulation of these technologies with "actually existing" urban futures.

In what follows we provide our grounded, real-world perspective on this subject using "actually existing" or planned smart cities to demonstrate the "state of affairs" in the contemporary application of AI and robotics in smart city development.

## 3. Methodology

This research is based on the examination of a roster of smart city strategies available online as PDFs available in English, either through government websites or actual smart city websites (see Appendix A). Overall, in our study we managed to identity and analyze 51 smart city strategies, with the following regional representation: Europe (25), North America (12), Asia (8), Australia and Oceania (3), Africa (2), and South America (1). This result is like findings by [36] and [37], who used a larger sample size of 143 smart green city *projects*. They found most such currently ongoing or completed projects to be in Europe (47), Asia (40), North America (35), South America (11), and the Middle East and Africa (10).

The city strategies were accessed online and downloaded to a database of PDF files. These were subsequently searched in a text/narrative analysis for plans relating to "artificial intelligence" or AI and "robot" for robotics and related terms contained in the strategies. They, therefore, project what can be expected in this aspect of the hard or technical domain at some future time as smart cities are realized in practice at various locations around the world. The results reveal 12 cases that actually employ these keywords in their smart city strategies.

Related terms such as "machine learning" as well as "pattern recognition" and "sensors" and "automation" were not deployed to retain a broader focus on the use of AI and robotics in city strategic visions rather than investigate specific steps in the evolution of technology or to capture all words that could have been substituted to represent AI and robotics. Our search from this perspective was not exhaustive. However, it was sufficiently indicative to reveal "core" cases, i.e., with the "active" application of AI and robotics in city strategies and then analyze their key parameters of the use and deployment of AI and robotics.

The keyword search was further limited by the availability of PDFs in English that were used as a basis for collecting information in this topical area. Some had evidently been translated and the vocabulary of the translation could have restricted access to some content. However, the search was not temporally limited, so that all available strategies during the time of the search have been included in the results. Other studies are welcome to adopt the methodology to extend the findings based on this approach, including other languages and more recent time frames.

## 4. Results

The resulting subset of 12 smart city strategies from the search appears in Table 2, which denotes direct quotes from the relevant text containing these terms from each strategy. Evidently, these "actually existing" or planned smart cities are mainly based in Europe and North America.

**Table 2.** Smart city strategies that address "artificial intelligence" or AI and robotics.

| City (Country) | Term Frequency |
|---|---|
| Dubai (UAE) | Artificial intelligence (1) = 1 |
| Eindhoven (The Netherlands) | Robot (1) = 1 |
| Helsinki (Finland | Artificial intelligence (3), robot (1) = 4 |
| Hong Kong (China) | Artificial intelligence (2), robot (1) = 3 |
| London (UK) | Artificial intelligence (5), AI (1), robot (1) = 7 |
| Lyon (France) | Robot (4) = 4 |
| Melbourne (Australia) | Robot (1) = 1 |
| Moscow (Russia) | Artificial intelligence (5), AI (6), robot (7) = 18 |
| New York (USA) | Robot (1) = 1 |
| Ottawa (Canada) | Artificial intelligence (5) = 5 |
| Sydney (Australia) | Robot (2) = 2 |
| Toronto (Canada) | Robot (1) = 1 |
| Total: | Artificial intelligence (21), AI (7), robot (20) = 48 |

There are 48 instances where artificial intelligence (=21) or AI (=7) or some form of robot (e.g., robotics, robotization) (=20) are mentioned. The use of these two basic terms in the keyword search appeared in different associations or contexts. These can be exhaustively summarized according to the five categories of automation, decision-making, education, smart infrastructure, and smart mobility (Figure 1). More specifically, the five main categories of AI and robotics application in these 12 cases are part of:

1. Automation, but also using computer programs for open data and to enable big data for analytics (e.g., as part of London's industrial strategy; Hong Kong's plan for big data analytics; evident in Lyon; as part of Moscow's Industry 4.0; and Ottawa's predictive analytics and machine learning for enhanced operations).
2. Decision-making (e.g., acting towards preventing managerial errors and facilitate making optimal decisions in Moscow—applied to the economy and governance).
3. Education (e.g., Eindhoven's high-tech campus to foster high-tech hardware innovations); access via training and e-services via "one-stop shops" (e.g., Helsinki; Hong Kong—to nurture young talent; also evident in Cape Town; Lyon's robots to teach mathematics and in junior high; robotic assistants and professional retraining in Moscow; and in Sydney as part of National Centre of Indigenous Excellence after school program and experiential learning in the City of Sydney Libraries).
4. Smart infrastructure (e.g., for e-services in Hong Kong; London, including sensors for improved energy managed as part of Digital Greenwich; sensors used in Moscow for automation/automatic processing; and New York's Robotic Monitoring Network for water quality, etc.).
5. Smart mobility (e.g., Dubai Autonomous Transportation Strategy; Melbourne's robot bike garages; and Toronto's Quayside to reduce congestion through last mile delivery).

## 5. Discussion

Automation is one of the main driving forces behind the use of AI and robotics, enabled by sensors and web-based platforms for integration and management. In fact, automation was one of the five main categories discovered in this study. The other categories affected the economy and governance through decision-making and touched upon education as well as smart infrastructure and mobility.

The sample in Table 2 represents different city sizes including those that have small central business districts (CBDs), such as Ottawa, but the majority of cases actually represent a larger metropolis.

Australia and Canada are particularly well-represented by multiple cities (including Melbourne and Sydney as well as Ottawa and Toronto). The discussion extends to some emerging national strategies in the context of the fourth industrial revolution (Industry 4.0) that is part of cyber–physical systems and includes a temporal component, where future directions are scrutinized based on emergent and some critical questions.

Moscow (Russia) is one of the cities that uses artificial intelligence/AI and robotics most ambitiously and has a detailed smart city development plan where the role of AI is to enable transparent city governance based on big data for monitoring and e-government. Here, AI is the basis for Concept 3: artificial intelligence for fulfilling a city's tasks. AI drives the digital socioeconomic transformation, with routine operations performed by robotic devices and decisions by the city administration and corporate management informed by AI technologies, including AI and big data analytics. To that end, it is anticipated that AI will assist in the prevention of managerial errors as well as facilitate optimal decision-making in areas of economics and government. Moscow anticipates becoming a data-driven city by 2030, using sensors to enable automatic processing and analysis. Monitoring systems will automatically convey information regarding power, heat, gas, water supply, weather, and ecological aspects of the city through a multitude of sensors, with the aim to automate and robotize city infrastructure processes.

This is envisioned as part of its fourth industrial revolution (Industry 4.0) that is part of cyber–physical systems in manufacturing achieved by a combination of real and virtual environments, through " ... innovative technologies as robotics, AI, 3D simulation, scanning and print, the internet of things, augmented and virtual reality, and blockchain" (Moscow "Smart City—2030"). Suggested future professions do not include medicine because AI will be in place to diagnose diseases and administer medical treatment, monitor patients' condition, transplant organs, implant medical devices, and so on. By combining human capacities and technologies, it is possible to have neuro-interfaces and digital assistants (e.g., smart meters, smart device control, digital teachers, etc.) so that technology becomes an enabler of the day-to-day experience. Residents will be given the opportunity for professional retraining in cases where professions have become automated or robotized. Moscow is the only smart city strategy in our analysis to address viable future careers through professional retraining.

This research addresses only city-level strategies, but there are some instances of emerging national strategies (as for Portugal) that involve technological fixes embracing AI and robotics. For example, part of the Neurocity, the city of Évora, located east of Lisbon in the Alentejo region, is deploying an LED module for its street lighting system based on smart technology and network communication (founded on the Arqulgest system) that is a simple retrofit that does not require the lamp to be replaced. To this end, 45 lanterns were replaced in Évora using an AI system with sensors and PLC communication as part of the control system involved in management and monitoring (see: https://www.arquiled.com/projeto/iluminacao-publica-led-evora-inovcity/). This endeavor has been extended to other locations in Portugal, including the Praça do Município de Lisboa (Lisbon), and is an effort towards energy efficiency as part of smart city development.

While these strategies outline their envisaged futures, all these critical transformations raise new questions, including whether cities are becoming too technocratic. One important dimension remains a search for new ethical principles for ICT-based smart cities. Problems that are associated with cybersecurity and big data, including personal privacy—and ultimately democracy—need to be addressed [38]. Smart and digital systems penetrate increasingly deeper into the intimate spheres of personal life, which allows technology giants to aggregate, analyze, and trade personal data, so that an individual's right to privacy becomes increasingly elusive [39].

More attention is needed to address at this early stage where exactly people will fit into a world with increased automation and robotics. On the one hand, services will become more easily accessible and fluid in an environment that is sensed and digital. On the other hand, however, will people be replaced by machines? How will they earn their living and be able to participate in daily life? The use of AI and robotics is justified as the deployment of technology to improve the human experience and to serve society. However, it is questionable to what end. Researchers, practitioners, and decision-makers need to rigorously consider the impact that automation will have on jobs in the service sector, but also in manufacturing and elsewhere in the economy and governance.

If machines are doing the work for humanity, what is there left for people to do in order to engage with society and to earn a living? How will people, especially those in the lower socioeconomic tiers, be able to afford to live without jobs that have become automated and delivered to machines? This can escalate the "degrowth" that is known to have already occurred in many places in the West when manufacturing shifted to Asia. In the middle of this fourth industrial revolution, perhaps civil revolt will also ensue. How can this be avoided or dealt with? Advances in robotics could eventually lead to intelligent machines (such as Sophia—the AI robot launched in 2016 by Hanson Robotics, Hong Kong, China) and with it raise more socio-ethical questions and concerns.

There are calls to introduce "responsible urban robotics" [40], while the ethical artificial intelligence movement demands technology companies develop and commercialize AI that prevents harm and advances humanity, increases societal and environmental well-being, and respects human rights. This includes, but is not limited to, voluntary ethical codes, ethics-by-design principles in software development, new governance structures, and employee training programs [41].

## 6. Conclusions

The smart city concept is non-static, evolves over time, and involves human capital, social capital, hard infrastructure, and ICT technologies in the provision of a sustainable environment. In this paper, we have presented our analysis of 51 existing smart city strategies across the world with regard to their operation with AI and robotics (or RAS). The variety in the results, both geographical and thematic, represents much interest. While the existence of explicit smart city strategies is uneven across the world, the use of discourses around AI and robotics in these strategies is further limited to just a few cities (we were able to identify 12 cases based on a simple, broad keyword search). As the deployment of these technologies nevertheless becomes more and more widespread, these pioneering cities serve as antecedents of the growing and future tendencies. We identified five main categories in association with which these cities articulate AI and robotics: automation, decision-making, education, smart infrastructure, and smart mobility. However, more research is needed from the integrated socio-technical approach to analyze various social challenges emerging alongside the promotion of such technologies and practices in city contexts.

**Author Contributions:** O.G. formulated the original research project and acquired funding. M.T. collected city strategies as part of the database appearing in Appendix A, performed formal analysis, and prepared the first drafts. O.G. directed the methodology and analysis and revised the drafts. O.G. and M.T. prepared the final draft. All authors have read and agreed to the published version of the manuscript.

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**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A

**Table A1.** City Strategies Roster.

| City Strategy | Online Resource | Search Results |
|---|---|---|
| Amsterdam (The Netherlands): Amsterdam smart city program, 2007 | https://www.napier.ac.uk/~/media/worktribe/output-950256/how-to-become-a-smart-city-learning-from-amsterdam.pdf | Nil |
| Barcelona (Spain): DC4CITIES, 2013–2016 | http://www.dc4cities.eu/ | Nil |
| Berlin (Germany): Smart city strategy Berlin, 2015 | https://www.berlin-partner.de/fileadmin/user_upload/01_chefredaktion/02_pdf/02_navi/21/Strategie_Smart_City_Berlin_en.pdf | Nil |
| Bologna (Italy): SMARTiP, 2010–2014 | http://www.smart-ip.eu/ | Nil |
| Brussels (Belgium): smartcity.brussels: Livre blanc, 2014–2019 | https://cirb.brussels/fr/quoi-de-neuf/publications/livres-blancs/livre-blanc-2014-2019 | Nil |
| Canberra (Australia): ACT government digital strategy, 2016 | https://www.cmtedd.act.gov.au/__data/assets/pdf_file/0007/981952/ACT-Government-Digital-Strategy-2016-full.pdf | Nil |
| Cape Town (South Africa): Cape Town's "Smart City" strategy in South Africa, 2001–2005 | http://unpan1.un.org/intradoc/groups/public/documents/cpsi/unpan033820.pdf | Nil |
| Chicago (USA): City of Chicago Technology Plan, 2013 | https://techplan.cityofchicago.org/wp-content/uploads/2013/09/cityofchicago-techplan.pdf | Nil |
| Columbus (USA): Smart city: Columbus, Ohio, 2016 | https://www.eenews.net/assets/2016/03/31/document_pm_02.pdf | Nil |
| Dallas (USA): Smart Dallas Roadmap, 2015–2017 | https://dallascityhall.com/departments/ciservices/smart-cities/DCH%20Documents/Smart-Dallas-Roadmap.pdf | Nil |
| *Dubai (UAE): Dubai plan 2021, 2017 | http://www.itssa.org/wp-content/uploads/2017/05/DUBAI-Smart-City-.pdf | "artificial intelligence" = 1 |
| Dublin (Ireland): Smart Dublin: Open, connected and engaged, 2016 | http://smartdublin.ie/wp-content/uploads/2016/06/Smart-Dublin-Brochure.pdf | Nil |
| Edmonton (Canada): Smart city strategy, 2017 | https://www.edmonton.ca/city_government/documents/PDF/Smart_City_Strategy.pdf | Nil |
| *Eindhoven (The Netherlands): Triangulum: Demonstrate, disseminate, replicate, 2018 | https://www.triangulum-project.eu/wp-content/uploads/2018/10/2018-01_D6.2-Smart-City-Framework.pdf | "robotics" = 1 |
| Flanders (Belgium): Smart Flanders, 2017–2019 | https://www.vlaanderen-circulair.be/src/Frontend/Files/userfiles/files/20180220%20Smart%20Flanders%20Open%20Data.pdf | Nil |
| Gothenburg (Sweden): EU-GUGLE, 2013–2018 | eu-gugle.eu/project | Nil |
| *Helsinki (Finland): The Most FunctionalCity in the World: Helsinki City Strategy,2017–2021 | https://www.hel.fi/static/helsinki/kaupunkistrategia/helsinki_city_strategy_leaflet.pdf | "artificial intelligence" (×3), "robotization" = 4 |
| Heraklion (Greece): Heraklion smart city, 2009 | https://smartcity.heraklion.gr/en/our-vision/ | Nil |
| *Hong Kong (Hong Kong, China): Smart city blueprint, 2017 | https://www.smartcity.gov.hk/doc/HongKongSmartCityBlueprint(EN).pdf | "artificial intelligence" (×2), "robotics" = 3 |
| Las Vegas (USA): Innovate Vegas, 2018–2025 | https://www.transportation.gov/sites/dot.gov/files/docs/NV%20Las%20Vegas.pdf | Nil |

**Table A1.** *Cont.*

| | | |
|---|---|---|
| Leipzig (Germany): Smart infrastructure hub Leipzig, 2017 | https://english.leipzig.de/fileadmin/mediendatenbank/leipzig-de/Stadt/02.7_Dez7_Wirtschaft_und_Arbeit/80_Amt_fuer_Wirtschaftsfoerderung/1_Unternehmensservice/Smart_Infrastructure_Hub_Leipzig_englisch.pdf | Nil |
| Lisbon (Portugal): POR Lisboa 2020, 2014–2020 | http://lisboa.portugal2020.pt/np4/%7B$clientServletPath%7D/?newsId=78&fileName=ENEI_Vers_o_final.pdf | Nil |
| *London (UK): Smarter London Together, 2018 | https://www.london.gov.uk/sites/default/files/smarter_london_together_v1.66_-_published.pdf | "artificial intelligence" or "AI" (×6), "robots" = 7 |
| *Lyon (France): Let's invest a co-smart city together, 2016 | http://www.business.greaterlyon.com/fileadmin/user_upload/fichiers/site_eco/20161118_gl_lyon_smart_city_metropole_intelligente_plaquette_en.pdf | "robot" (×2), "Robotimes," "robotics" = 4 |
| Manchester (UK): Triangulum: Demonstrate, disseminate, replicate, 2018 | https://www.triangulum-project.eu/wp-content/uploads/2018/10/2018-01_D6.2-Smart-City-Framework.pdf | Nil |
| *Melbourne (Australia): A knowledge city strategy: Strengthening Melbourne's knowledge sector through collaboration, 2014–2018 | https://www.melbourne.vic.gov.au/SiteCollectionDocuments/knowledge-city-strategy-2014-18.pdf | "robot" = 1 |
| Milano (Italy): Milano smart city, 2014 | http://www.milanosmartcity.org/joomla/images/sampledata/programma/SmartCity/milano%20smart%20city%20-%20guidelines.pdf | Nil |
| Milton Keynes (UK): MK digital strategy 2018–2025, 2018 | https://www.milton-keynes.gov.uk/assets/attach/51579/Milton%20Keynes%20Digital%20Strategy%202018-2025.pdf | Nil |
| Montreal (Canada): Montréal: Smart and digital city, 2014–2017 | http://villeintelligente.montreal.ca/sites/villeintelligente.montreal.ca/files/montreal-strategy-smart-and-digital-city-an.pdf | Nil |
| *Moscow (Russia): Moscow "Smart city – 2030," 2018–2030 | https://2030.mos.ru/netcat_files/userfiles/documents_2030/strategy_tezis_en.pdf | "artificial intelligence" or "Artificial intelligence" (×5), "AI" (×6), "robotic" or "robotics" (×4), "robots," "robotized" (×2) = 18 |
| *New York (UK): PlaNYC: A greener, greater New York, 2007 | http://www.nyc.gov/html/planyc/downloads/pdf/publications/full_report_2007.pdf | "Robotic" = 1 |
| Oslo (Norway): Smart Oslo, 2017 | http://www.osloregionen.no/wp-content/uploads/Profileringsstrategi_del12_Engelsk.pdf | Nil |
| *Ottawa (Canada): Smart city 2.0, 2017 | https://documents.ottawa.ca/sites/default/files/smart_city_strategy_en.pdf | "artificial intelligence" or "Artificial Intelligence" (×5) = 5 |
| Pune (India): Reimagining Pune: Mission smart city, 2015–2030 | https://punesmartcity.in/?smd_process_download=1&download_id=6293 | Nil |
| Rijeka (Croatia): mySMARTLife project, 2018 | 2018_10_22_mySMARTLife_press-release-studytour_final_web.pdf | Nil |
| Rio de Janeiro (Brazil): Big data to smart city: Recommendations to COR, 2017 | https://priceschool.usc.edu/files/2010/06/Brazil-Report-for-COR-2017.pdf | Nil |
| Seattle (USA): Seattle IT, 2017–2018 | https://www.seattle.gov/Documents/Departments/InformationTechnology/SeattleIT2017-18StrategicAgendaWEB.pdf | Nil |
| Seoul (South Korea): Social Seoul City, 2015–2020 | https://seoulsolution.kr/sites/default/files/gettoknowus/Seoul%20Solution%20for%20Urban%20Development_Part1.pdf | Nil |

**Table A1.** *Cont.*

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|---|---|---|
| Shanghai (China): The smart city in 2030, 2018 | https://www.itu.int/en/ITU-T/Workshops-and-Seminars/201810/Documents/Ottein_Herzog_Presentation.pdf | Nil |
| Singapore (Singapore): Smart city nation, 2014 | https://www.smartnation.sg/ | Nil |
| Songdo (South Korea): Songdo International Business District, 2001–2015 | https://www.citylab.com/life/2018/06/sleepy-in-songdo-koreas-smartest-city/561374/ | Nil |
| Stockholm (Sweden): GrowSmarter, 2015–2019 | http://www.grow-smarter.eu/inform/reports/ | Nil |
| *Sydney (Australia): Digital strategy, 2009–2030 | https://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0005/288167/Digital-Strategy.pdf | "robotics" (×2) = 2 |
| Taipei (Taiwan): Taipei smart city project, 2017 | https://www.lct.tp.edu.tw/ezfiles/1/1001/img/207/110629308.pdf | Nil |
| Tampere (Finland): Tampere, working together for a bright future, 2025 | https://www.tampere.fi/tiedostot/k/P1IFwM6Al/Tampere_City_Strategy.pdf | Nil |
| Tel Aviv (Israel): Tel Aviv smart city, 2016 | https://www.tel-aviv.gov.il/en/WorkAndStudy/Documents/SMART%20CITY%20TEL%20AVIV.pdf | Nil |
| *Toronto (Canada): Sidewalk site plan, 2018 | https://sidewalktoronto.ca/wp-content/uploads/2018/11/18.11.29_Quayside_Draft_Site-Plan.pdf | "robot" = 1 |
| Tshwane (formerly Pretoria, South Africa): Tshwane vision 2055: Remaking South Africa's capital city, 2013 | http://www.gis.tshwane.gov.za/Documents/Online%20version-%20CoT%202055%20vision%5Bsmallpdf.com%5D.pdf | Nil |
| Vancouver (Canada): Digital strategy, 2013 | https://vancouver.ca/files/cov/City_of_Vancouver_Digital_Strategy.pdf | Nil |
| Vienna (Austria): Smart city Wien: Framework strategy, 2013–2015 | https://www.wien.gv.at/stadtentwicklung/studien/pdf/b008384b.pdf | Nil |
| Washington, DC (USA): Smarter DC, 2016 | https://ddot.dc.gov/sites/default/files/dc/sites/ddot/page_content/attachments/District%20of%20Columbia%20Smart%20City%20Application%20Part%201.pdf | Nil |

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