Policy Brief: Smart City Technology & The Digital Opportunity in Medellín



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SMART CITY TECHNOLOGY & THE DIGITAL OPPORTUNITY IN MEDELLÍN

Background

The Agency for Cooperation and Investment of Medellín and the Metropolitan Area (ACI Medellín) promotes cooperative and collaborative alliances to strengthen the development of Medellín and its surrounding areas. ACI Medellín is particularly active in the knowledge sharing and innovation spaces and ACI Medellín believes that it is critical to engage with actors across the ecosystem to cultivate innovation. Smart city policy and the digital opportunity are key factors for "Medellín Futuro", the city's local development plan. In order to maintain its position as an attractive city for business and global cooperation, ACI Medellín seeks to strengthen its knowledge sharing and innovation apparatus.

ACI Medellín is proud to present the following brief in collaboration with Mohammad Zia, a Sinclair-Kennedy Fellow at Harvard University and an International Fellow at the Institute for Technology and Society in Rio de Janeiro, Brazil (ITS Rio). Mohammad is researching the role of emerging technologies in promoting economic development and inclusion in Latin America.

Mohammad is a former Fulbright Scholar, speaks both Spanish and Portuguese, and completed his JD from Harvard Law School. While at Harvard, Mohammad was a member of the Cyberlaw Clinical Program and Co-President of the Harvard Law & International Development Society. Mohammad also completed an MPP from University of Oxford and a BA (summa cum laude) from the University of Maryland.

The ensuing discussion seeks to contribute not only to the local conversation but also the national and international debate around the digital opportunity for city governments.

Introduction

Medellín is one of Latin America's most advanced smart cities. In 2019,

- 2 <u>terminal.io</u>
- 3 <u>gcn.com</u>

Newsweek named Medellín as the world's top smart city namely for its ascent, in less than a few decades, from one of the world's most dangerous cities to one of the most innovative.¹ Medellín is also widely known as Colombia's most attractive city for science, engineering, and technology talent.² Medellín's deployment of digital innovation has increased rapidly in light of the COVID19 pandemic. With greater need for data driven healthcare decisions, efficient traffic and mobility, and remote and hybrid workforce arrangements, cities will need more smart city policy expertise.³ In light of these rapid developments, Medellín has already taken bold steps becoming a CTi + hub. The city built an Innovation District and in 2021 was declared a Special District for CTI by the National Congress. This ecosystem operates as a hub for the local community, the private sector, academia, and international actors to develop Medellín as a software valley, a mechanism for technology driven post-pandemic economic recovery. Medellín is also leading Colombian cities by investing 1.26% of its GDP in research and development, more than four times the national average.4

Medellín plans to continue its ascent by deploying technologies for smart city solutions and welcoming global collaborators from the public and private sector. Medellín is also seeking to develop best practices with similarly situated cities across the world, such as Rio de Janeiro,

^{1.} teaminternational.com

^{4 &}lt;u>caracol.com.co</u>

Mexico City, Madrid, and Buenos Aires. This following brief will outline the definition of smart cities, discuss Medellín's deployment of smart city technology, and highlight the digital opportunity in Medellín.

What is a smart city?

"Smart City" is a term used to describe cities that are actively working to bring the benefits of the fourth industrial revolution to city planning and development. Some define a city as "smart" if it uses specific emerging technologies to increase operational efficiency and effectiveness in city services.⁵ This definition identifies the "smart" in smart cities by calling attention to the increasing use of technology as a tool. According to this

5. Cohen, Natasha, and Brian Nussbaum.



definition, smart cities are defined by their ability to use emerging technologies for urban service delivery.

The second conventional definition of a smart city focuses more squarely on human dimensions and impacts as the central characteristic of a smart city. According to this second definition, a smart city is one that maximizes inclusive and equality while improving service delivery. The second definition doesn't explicitly mention technology as a defining characteristic of a smart city.

Instead, technology is viewed as one of many tools that cities have at their disposal to advance equality, safety, and sustainability. The "smart" in smart cities is defined by a city's ability to improve socio-economic out-



comes for its residents regardless of their social class.⁶ There is growing acceptance of the second conventional definition of a smart city and greater calls for city planner to think beyond technology and focus on underlying challenges that are institutional and socio-economic.

How do we measure the "smart" in "smart cities"?

How are cities evaluated for their ability to improve the outcomes described above? The IMD Smart City Index, a partnership between the Singapore University of Tech-

nology and Design and the IMD Business School, is a popular tool to measure the performance of smart cities. The IMD Index reflects the second definition of a smart city because it seeks "a holistic attempt to capture the various dimensions of how citizens could consider that

their respective cities are becoming better cities by becoming smarter ones. Part of its uniqueness is to rely first and foremost on the perceptions of those who live and work in the cities covered by the index, while providing a realistic recognition that not all cities start from the same level of development, not with the same set of endowments and advantages."7

The IMD index ranks cities by assessing resident perception. The index solicits perceptions based on five key areas: health and safety. mobility, activities, opportunities, and governance. Cities are placed into an overall ranking and then evaluated based on their performance on each pillar.

The IMD Smart City Index & Medellín Smarty City Vision 2030

In 2019, Medellín ranked 91st overall with high scores in cultural activities, green spaces, lifelong learning opportunities, employment opportunties,

and recycling services. Medellín had the lowest scores in air pollution, public safety, traffic congestion, and corruption of public officials. The ranking also includes a survey on the five areas that residents deem the most urgent. The top five areas, in descending order of urgency, are air pollution, security, corruption, fulfilling employment,

and road congestion.8

Medellín's city government developed its 2030 Smart City Vision with similar metrics and approaches from the IMD Index. The 2030 Smart City Vision includes ambitious plans for Medellín to improve, within less than a decade, from its current ranking as 91st to among the top 50 in the IMD Index. The 2030 Smart City Vision outlines a set of policy

- 6. <u>oecd.org/</u>
- 7. Id. 8. imd.org

and legal levers that Medellín is pursuing to reach these goals. The municipal government identified Big Data, Blockchain, Cloud Services, Digital/Open Government, Artificial Intelligence, Internet of Things (IoT), and 5G/fiber as technologies that could improve Medellín's global standing as a smart city.

Internet of Things (IoT)

The Internet of Things, or IoT, has further accelerated the ability of city planners to collect and process data from multiple data points. IoT refers to millions of devices around the world that are connected to the internet and share data that is exchanged an analyzed. IoT devices include mobile phones, cars, watches, refrigerators, street lights, and airplane engines. IoT specifically refers to digital connection and data processing that enables devices to be smarter than if they were used without interconnectivity. ⁹

Once these devices are connected, their data can be sent to a cloud services platform for processing. Experts at Indian Health Service-IHS estimate that, by 2030, approximately 125 billion IoT devices will be in use around the world.¹⁰ According to experts at Navigant Research, the global market for smart city solutions was worth US\$ 36.8 billion in 2016 and is expected to reach US\$ 88.7 billion by 2025.¹¹ Smart cities can use IoT in various ways ranging from parking and street light sensors to monitors in buildings and homes for energy efficiency.

Big Data/Artificial Intelligence

Once IoT devices collect data such as photos, pedestrian and vehicle traffic patterns, or energy usage, big data/artificial intelligence can be used as tools to analyze this information for insights. Big data involves analysis and visualization of large data sets and it introduces efficiency into complex data sets. For example, residents often use smart public transit cards when navigating public transportation in a city. This data is then analyzed using big data tools to identify trends and then notify travelers about traffic, road conditions, and arrival/ departure times. Cities can also use big data analytics to reduce energy consumption after collecting data from smart meters.¹²

Artificial intelligence introduces algorithms that analyze large amounts of data to make decisions. Unlike traditional machines that can only produce predetermined responses, artificial intelligence algorithms use sensors, for example on IoT devices, to combine various data inputs for instant analysis.¹³ This analysis can provide decisions that reduce a city's electricity bills, help residents find a parking spot, or prevent crime using surveillance technologies. For example, a city

- 9. <u>zdnet.com</u>
- 10. <u>news.ihsmarkit.com</u>
- 11. <u>techrepublic.com</u>
- 12. dataversity.net
- 13. brookings.edu

can send data from artificial intelligence supported sensors to collect real-time data on vehicle flow and send it to a traffic control center that optimizes traffic lights for efficient traffic flow.¹⁴

IoT & Big Data/Artificial Intelligence Applications in Medellín

Medellín has already taken the lead in using IoT devices to improve access to high quality water. The cities public utility, EPM (Empresas Públicas de Medellín), implemented Colombia's first smart aqueduct with IoT technology. The project, in the department of Sucre, consists of an aqueduct that uses over thirty devices and data-driven instruments to measure water flow, pressure, chlorine, turbidity, and PH levels. These devices relay this information to a software program that analyzes 17 variables and visualizes them in real time. This IoT water project allows for data-driven decisions that increase the efficiency, health, and safety of public water services. The project also allows the city to quickly predict and react to emergency situations. This pilot project was carried out in partnership with the company Telemetrik and its subsidiary Aguas Regionales. A second stage of the project is now underway. The initiative received an honorable mention in the Portfolio 2020 Awards in the Innovation category.

Medellín has also deployed several artificial intelligence driven smart city technologies to tackle mobility issues. Medellín's Integrated Traffic and Transportation Information Center (CITRA Medellín) is an artificial intelligence driven system that applies helps plan and manage mobility across the metropolitan area of Medellín. The project is also unique because it involves a collaboration with the Government of South Korea. South Korea's Ministry of Land, Infrastructure and Transport has a cooperation agreement with the Mayor's Office of Medellin with an investment of more than US\$ 12 million.



CITRA Medellín uses intelligent data systems to generate, store, and process real-time information on mobility and the interaction be-

tween mobility and city events. The system integrates data from the Medellín Metro, the Metropolitan Area of Aburrá Valley, the Medellín Intelligent Mobility System (SIMM), the Traffic Light Center (CIOS), the Regulated Parking Zones (ZER), the Mobility Secretariat, the Security Secretariat, and from Terminals Medellín. This data serves as the operational brain for advancing metropolitan mobility. This smart city innovation enables Medellín to provide real-time traffic information to citizens and enable smarter travel. thus avoiding traffic accidents and ensuring a more comfortable travel experience.

Emerging Technologies: Blockchain

Blockchain is a transformative technology because it allows for validating transactions without a third-party intermediary. Blockchain consists of a distributed database where responsibility for clearing/authenticating transactions is shared among database participants.¹⁵ Blockchain technology prevents an entity from having unilateral power to control or manipulate a database. Every time a user generates a transaction, such as sending money or recording a land ownership contract, members of the distributed database verify the transaction. The transaction is subsequently recorded using hash functions and blockchain allows for secure encryption. These measures prevent manipulation and enable

- 16. iberdrola.com
- 17. <u>lexology.com</u>
- 18. govtech.com
- 19. <u>cointelegraph.com</u>

greater trust over the information that is being recorded.¹⁶

Blockchain technology can speed up processes such as settlements since there is no intermediary in a blockchain transactions.¹⁷ Blockchain also provides a vehicle for more transparent and immutable public records. More direct, secure, and transparent communication among government departments and with the broader public can lead to more trust and prevent corruption.

Estonia has introduced blockchain based online voting for their parliamentary elections and, according to the Estonian government, about 30% of the population used the online system in 2020.¹⁸ Other potential applications include vaccination tracking, public land registries, and public procurement. Malta, for example, requires all new rentals to be recorded using blockchain technology.¹⁹

Medellín is currently working with Institute for Technology and Society-ITS in Rio de Janeiro on benchmarking best practices for city use of blockchain technologies.

Emerging Technologies: AR/VR

In addition to the efforts above, Medellín is also exploring emerging technologies in the tourism sector. Still in its early stages, AR/VR technology can serve as a conduit for developing city tourism.

^{15. &}lt;u>pwc.com</u>



Medellín has also deployed several artificial intelligence driven smart city technologies to tackle mobility issues.



Virtual reality (VR) involves a computer-generated simulation of 3D images. Special hardware, such as a headset or gloves, help a user interact with the 3D environment. VR use in smart city planning is still in its early stages. Potential applications include digital "pre-visit" experiences with headsets that provide insights to guide an eventual in-person city experience.

Augmented reality (AR) works by overlaying digital information in real world environments. AR provides an enhanced version of the physical world by applying digital imaging, sounds, or other enhancements. Hovering your phone's camera on a famous street sign to learn about the street's history is one example of how AR can advance meaningful tourism.

AR doesn't require expensive hardware and cities are already using it to encourage tourism. For example, AR can provide real-time translation of street names and other city infrastructure. AR also provides city government with an enhanced feedback loop of real-time data and observations.

Medellín is exploring smart tourism through innovations such an AR based city mobile app and real-time data processing to help tourism businesses tailor their services. These efforts are part of Medellín's Smart Destination initiative.

Medellín's initiatives reflect a similar trajectory in other leading smart cities. Valencia has been a pioneer in smart tourism sector and was named the European Capital of Smart Tourism for 2022. Valencia's innovations included tourist chatbots, smart tourist information kiosks that operate 24/7, and a geocaching experience to help tourists discover city attractions.²⁰ Farther East in Singapore, the national tourism board is creating 1,000 pieces of AR content that represent the city's tourist destinations, heritage, and culture. Singapore plans to make these digital assets free to access in an effort to increase post-pandemic tourism.²¹

The Digital Opportunity in Medellin

The smart city market is set to double from a total value of US\$ 410 billion in 2020 to US\$ 820.7 billion by 2025.²² Some academics predict the market to expand even faster with a compound annual growth rate of 29.3% from 2021 to 2028.23 This exponential growth is being fueled by innovations in IoT, big data/artificial intelligence, and emerging technologies such as blockchain and AR/ VR. The public and private sector can pursue effective partnerships for cities to competitively cultivate the future economic and social benefits that smart city technology can cultivate. Medellín is particularly well situated to be a hub for public-private collaborations in the smart city sector.

Medellín's Strengths in Digital Innovation & Smart City Investments

Specifically, five key areas help Medellín stand out as an investment hub in the information and technology sector:

- 20. travelagentcentral.com
- 21. <u>ttgasia.com</u>
- 22. researchandmarkets.com
- 23. grandviewresearch.com

- 1. Technology is at the core of the city's economy. There are more than 2,500 technology companies related to the information and technology (IT) sector in the city and, in 2021, the IT sector generated 26,669 new jobs.
- 2. Medellín is ideally located. The city has agreements with 97% of countries in the Americas. Medellín also is strategically located for remote/hybrid work that bridges the United States with Latin America. Medellín is in the same time zone as EST and +3 hours from PST. During daylight savings time, the difference changes to -1 and +2, respectively.

3. The local talent pool is strong.

The World Talent Ranking, a metric for the world's most qualified workforce, placed Colombia at third in Latin America. 6,000 students enroll in systems engineering annually and, between 2001 and 2020, 37,778 students graduated from IT/engineering related programs. The region has 52 technology communities with more than 51.000 members specialized in the most demanded programming languages. Technological communities refer to groups where best practices, knowledge, and experiences are shared to help improve skills related to software and application development.

4. Medellín is investing in an innovation ecosystem. The city is home to Colombia's only Science, Technology, and Innovation District and more than 48,000 people are being trained in skillsets related to the 4th Industrial Revolution. By 2023, Medellín will have 21 centers dedicated to innovation and software expertise. Medellín invests more than 1% of its GDP in research and development efforts. Nationally this statistic is only at .28% of GDP.

5. Medellín is already home to digitally innovative companies and company associations such as Intersoftware, Fedesoft, Fenalco, ANDI, and Colombia's largest bank, Bancolombia.

Next Steps and Recommendations

For cities like Medellín to promote inclusive development arising from the digital opportunities described above, city leaders should pursue the following three guiding policy principles.

First, digital infrastructure up-

grades. Cities need to ensure that the core infrastructure is in place for innovations like IoT, blockchain, AR/VR, and artificial intelligence to reach their full potential. For example, electric public buses are only viable insofar as the city provides charging stations and optimizes the electric grid for rapid charging. The electrical system also needs to be compatible with advanced telecommunication and IoT sensors. Every piece of the city development puzzle needs to be incorporated into an advanced electrical system. In addition to charging stations, city buildings need to be retrofitted with smart power systems so that these

systems can be overlaid with big data driven innovations like smart grids.

It is critical to focus on the infrastructure that will host IoT sensors and big data technologies. If there are limited hosts and limited locations for data collection, there will be gaps in the data and limits to the impact of innovations like smart grids. Upgrading digital infrastructure in a piecemeal fashion will lead to piecemeal efficiency and thereby fail to enable cities to reach sustainability goals. A smart grid integrated with clean electric transport in only one or a handful of neighborhoods will do little to help a large city tackle pollution and climate change.

Second, cities need to pursue **com**prehensive planning/benchmarking. Medellín has already pursued effective planning strategies that are evident in its Smart City 2030 Vision. Such plans need to address budgeting for technology-driven solutions, consolidate regulatory authority, and encourage public-private funding to implement plans. Regulatory frameworks are critical to encourage clarity for investors. They also serve as preventive measures for legal concerns or surveillance issues arising from collection and storage of citizen data.

Funding allocation and public private partnerships also facilitate smart city development because they create incentives for competitively sourcing solutions and identifying priority areas for city government. Comprehensive planning also improves benchmarking across smart city applications and govern-



ment departments. It enables stakeholders to survey their experiences to leverage strengths and address weaknesses. Planning at five or tenyear timespans allows time for progress evaluation and an opportunity to decipher best practices.

Third, cities need to pursue a **bottom-up approach** with the third sector, namely academia and NGOs. Cities need to leverage their relationships with research labs, universities, and NGOs. These partnerships offer testing grounds that can be more representative of the broader population and they enable the government to extend outreach. NGOs often have access to vulnerable populations that must be engaged for technology to reach marginalized groups. This is critical in cities like Medellín that have a large urban sprawl and areas that can be a long commute from innovation hubs in the city.

NGOs and universities can also serve as testing grounds for creative regulatory approaches to data privacy and prototyping of new technologies, especially those that implicate surveillance concerns. The third sector can also assist with comprehensive planning and benchmarking. NGOs should be consulted to help the city government develop KPIs (key performance indicators). These KPIs will consequently be more reflective of citizen concerns for each of the city's improvement targets identified in broader smart city planning documents. A bottom-up approach also creates a feedback loop for the city government to assess if emerging technologies are improving quality of life.

Developing a smart city vision requires extensive consultation and is a time-intensive process. A focus on digital infrastructure, comprehensive planning/benchmarking, and a bottom-up approach can serve as a set of guiding principles as cities seek to take advantage of the digital opportunity and smart city technologies. ACI Medellín can help investors from the public and private sectors establish strategic alliances with local companies for the development of new smart city solutions. ACI Medellín can also help with efforts to outsource software development and services given Medellín's abundance of qualified professionals at an efficient cost. ACI Medellín is also interested in greenfield investments to serve the Latin American market.

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