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Trends in
Computer Science and Information Technology
OPEN ACCESS JOURNAL

ISSN: 2641-3086 Journal DOI: https://dx.doi.org/10.17352/tcsit

Review Article

Open Data and Smart Cities as Opportunities for the Development of Ecuadorian Cities

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Submitted : 25 March, 2026
Accepted : 02 April, 2026
Published : 03 April, 2026

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Keywords: Smart cities; Open data; Open data portals; Citizen initiatives; Classification

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Abstract

This research examines the intersection of Open Data and Smart Cities as strategic drivers for urban development in Ecuador. Unlike previous descriptive updates, this study provides an evolutionary analysis of the national ecosystem, identifying a critical gap between a robust regulatory framework—highlighted by the 2022 National Open Data Policy—and its uneven technical implementation at the municipal level. Through a systematic review of 221 local governments (GADs) and international indices updated to March 2025, the findings reveal a significant 14-fold expansion in national data volume (surpassing 1,535 datasets) contrastingly met by a steady decline in global smart city rankings for major cities like Quito and Guayaquil in the IESE Cities in Motion Index (CIMI). The study introduces the concept of 'regulatory vs. operational maturity' and highlights emerging leadership in cities like Cuenca through its 'Cuenca en Datos' initiative. The results underscore that while open data availability has increased, institutional capacity, financial limitations, and a lack of technical standardization remain primary barriers to transforming raw data into efficient urban management tools.

Introduction

The widespread use of Information and Communication Technologies (ICT) within the challenges set by the central Ecuadorian government to modernize and streamline processes aimed at improving citizen services has had a positive impact on the population. These challenges have been progressively transmitted to Sectional Governments or Decentralized Autonomous Governments (GADs), formerly known as Municipalities. As a result of the implementation and exploitation of technological solutions, millions of data records in digital format are generated whose ownership is shared between the state and the citizen.

Open Data today constitutes a trend that, among its objectives, seeks to make public and accessible all information collected from internal processes of public and private organizations [1]. In Ecuador, the Organic Law on Transparency and Access to Public Information (LOTAIP) exists, along with the Open Data Public Policy Guide, which aims to "Promote the free use, reuse and redistribution of Open Data to generate value through products, processes and services directed at citizens from the public sector" [2]. The Ministry of Telecommunications and Information Society of Ecuador provides Decentralized Autonomous Governments (GADs) with the White Paper on Digital Territories in Ecuador, to support them in proposing new city management models mandatorily based on ICTs, encompassing not only the urban sector but also the rural sector, as the rural environment is also essential for the development of smart cities [3].

Unlike previous studies that focus solely on the existence of portals, this research provides an evolutionary view of the open data ecosystem in Ecuador. It identifies the implementation gap between the robust national regulatory framework (such as the 2022 National Open Data Policy) and the uneven technical execution at the municipal level. The study introduces the concept of 'regulatory maturity vs. operational

Citation: Labanda-Jaramillo M. Open Data and Smart Cities as Opportunities for the Development of Ecuadorian Cities. Trends Comput Sci Inf Technol. 2026;11(1):035-040. Available from: https://dx.doi.org/10.17352/tcsit.000107

maturity,' demonstrating that the increase in data volume (a 14-fold increase in the national portal) does not automatically translate into improved smart city rankings, suggesting a disconnect between open data and its impact on efficient urban management.

From this analysis, the following research question is posed: What is the current state of open data in Ecuadorian cities in the context of their transformation into smart cities?

Background

Smart cities

For the Inter-American Development Bank (IDB), the notion of a Smart City goes beyond the use of ICTs in municipal management, referring instead to those cities that place the human being at the center of development and planning [4]. For the same IDB, a Smart and sustainable city is an innovative city that uses ICTs and other means to improve decision-making, operational efficiency, the delivery of urban services and its competitiveness [4].

As noted by [4], the American researcher Boyd Cohen describes the generations of Smart Cities, starting with the technological initiatives acquired by municipal managers (Smart Cities 1.0), progressing through municipalities that were already thinking of their cities as intelligent and oriented toward improving the quality of life of their citizens (Smart Cities 2.0), and arriving at Smart Cities 3.0, where citizens as a differentiating element take a very active role in municipal processes and initiatives.

Among the four focal areas in which a smart city must concentrate according to [4] is being inclusive and transparent, making direct communication channels with citizens available, operating with open data, and allowing the tracking of its finances. Our cities need to improve the quality of life of our citizens, as highlighted by [5], which also emphasizes the benefits of open government and open data that underpin transparency, collaboration, innovation and citizen participation, elements that are becoming very active components of smart cities.

Open data

The growth of open data portals, primarily from national governments and municipalities, is demonstrating that data has become the new "black gold" [6], driving cities around the planet toward new ways of living. According to a study conducted across 308 municipalities using the local open data census platform of the Open Knowledge International Foundation [6], Open Data is simply defined as data that can be used, edited, and shared by anyone and in any form. A more complete definition summarizes the key aspects: availability and access, reuse or redistribution, and universal participation.

Open data must meet certain characteristics that denote its level of impact and utility: integrity, availability, usability, non-proprietary nature, non-discrimination, variety, timely processing, and regular updating [7].

Open data and smart cities

Open Data has demonstrated its value as evidence for resolving public-interest problems [8]. Hundreds of open data applications [9] arise in various cities around the world, thanks to the vast amount of information collected through wireless networks, mobile devices, and sensors that qualify these cities as smart cities. The relevance that open data achieves within Smart Cities standards is such that within the main requirements of the ICT Reference Architecture for Smart Cities, requirement number 6 states: "Put Open Data at the heart of the proposed ICT Reference Architecture" [10].

Opening city data is more than necessary to drive innovation and create new societal values. At the global level, the two leading and pioneering countries in Open Data are: the United States in the West with its portal data.gov, and the United Kingdom in Europe with data.gov.uk. The ECLAC 2030 Agenda for Sustainable Development states regarding open data that a true revolution in public information access has begun, denominated Open Data, which consists of making data of common civic interest available to society so that, in any form, a new idea or application can be developed that delivers new data, knowledge or other services that the government is unable to provide [11].

Within the urban intelligence of cities, open data strategies enable cities to achieve:

- **Transparency:** enabling citizens to understand, examine, and question municipal actions and decisions requires information. The more open data that becomes public, the more participation is encouraged, and services are improved.
- **Participation:** increasing citizen participation in city development, service provision, decision-making processes, and participatory debate requires that citizens understand the context in which the municipality operates.
- **Service improvement and efficiency:** Providing open data will support and accelerate data exchange between municipalities and other entities, yielding expected results in service improvement and efficiency.
- **Economic development:** The release of data is today considered a "trigger" for the promotion of economic and community activity. Cities worldwide have already discovered that the massive availability of open data enables local businesses and developers to create new applications, products, and services, opening space for the emergence of new markets [6].

Furthermore, [12] establishes that to achieve smart cities, one must work hard on open and linked data, as these are considered necessary prerequisites for developing systems that integrate the services that configure a smart city. For the IDB, the open data policy contributes to transparency and increased trust in managers, eliminates information silos, and replaces misinformation and duplication with team integration and

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intelligent sharing of data, human resources, technological resources, and financial resources, thereby improving public management results and reducing costs [4].

Notable initiatives

Global initiatives

Dong, et al. [7] detail a set of initiatives and tools implemented by seven Canadian cities. In Calgary, a sports and athletic parks application was developed. In Surrey, a tool was created to collaborate with the poverty reduction plan, allowing citizens to find low-cost products and services, such as health services, work, and food. In Waterloo, the "Ping Street App" was developed to enable daily interactions between citizens, for example, to access events, waste collection, and recycling. In Ottawa, "Save the Rain" was invented as an application allowing users to calculate how much rainwater they can collect on their roofs annually. In Vancouver, the "Pay by Phone" application allows users to pay for on-street parking via phone. Finally, the "Wellbeing" application in Toronto provides residents with a thorough understanding of the areas and communities where they live and work.

Latin american initiatives

In 2016, [13] published the state and projection of open data in Latin American and Caribbean countries, highlighting outstanding applications already implemented. In [14], cities that have been able to link data processing technologies with existing infrastructure to efficiently manage their resources and improve the quality of life of their citizens are described. Buenos Aires stands out for the modernization of the police and integration of emergency systems; Medellin, Colombia, for the integration of security and emergency actions; Rio de Janeiro for its integrated risk management system and the use of applications to interact with the population using 15,000 files with 400 terabytes of information, including GPS-based bus localization and traffic light synchronization; and Medellin, Colombia, for the Intelligent Mobility System (SIMM).

A case study of three South American cities — Montevideo, Buenos Aires, and Lima — [15] details multiple applications generated thanks to the existence of open data from the public sector in Montevideo, such as Gxbus (navigation of the public transport system), GiTour (a city tourist guide), and ¿Dónde reciclo? (providing citizens with the nearest recycling point). In Buenos Aires, hackathons and application development contests have produced applications such as "Bicicleta Buenos Aires" and "Parkeando" In Lima, "Proyectos de inversión pública de la municipalidad de Lima" combines financial and public investment data to display a complete record of each project.

Methodology

This research employs a qualitative-descriptive approach with a systematic review of official sources and global indexing platforms. Targeted searches were conducted on Google and institutional repositories using combined keywords such as: "Open Data," "Open Data," "Ecuador," "GAD," "Smart City," and "Data Portal". Data sources were consulted at three levels of information: (1) Official portals of 221 GADs and national organizations, (2) Prestigious international indices (IESE Cities in Motion Index 2024/2025), and (3) Public policy documentation (Open Government Action Plans). To review the state and score of initiatives related to Open Data in Ecuador, a research group of students first conducted Google searches for open data portals of Ecuadorian cities (municipalities), whose results can be found in the public repository: https://github.com/miltonlab/researchlab-opendata.smartcities.

Inclusion criteria included portals active as of March 2025 that allow data downloads in reusable formats (CSV, JSON, GeoJSON). Websites that only publish static transparency PDFs were excluded while the validation was based on the veracity of the data categorized with the National Portal datosabiertos.gob.ec and the reports of the Datalat Foundation.

Search for Ecuadorian cities in recognized rankings and indices

Subsequently, Ecuadorian cities were searched in the different rankings or classifications related to open data and smart cities at the global level. First, the Local Open Data Census was reviewed — a platform where any user or citizen can freely input information across a broad set of indicators. Another index analyzed was the Global Open Data Index, to provide a reference for Ecuador's current global state regarding data openness. Finally, the most up-to-date index at the time of writing, and the one where specific data were found, was the Cities in Motion Index (CIMI) [16].

Open city and open data standards

The proliferation of Smart Cities, which essentially pursue being better and more livable, has constituted an urban innovation [17] that needs Open Data as one of the factors or elements that make a city intelligent. Regarding how to measure how open and intelligent a city is at a given moment, ISO standards and related national standards have been created, including the ISO 37120 standard, according to which smart cities are based on integrated and interconnected strategies and systems to provide better services efficiently and increase quality of life, ensuring equal opportunities for all and environmental protection [18]. More specifically, the provisional recommendation "Open Data Indicator in Smart Cities" [19], issued by the International Telecommunication Union (ITU), establishes a collection of metrics to be considered by Open Data initiatives. At the national level, the UNE 178301:2015 Smart Cities – Open Data standard [20], created by the Spanish Standards Association (AENOR), was designed to measure the degree of maturity of data openness in Spanish cities through a set of metrics and indicators.

Results

An updated survey of open data portals in Ecuador was conducted in March 2025, covering municipal governments (GADs), national government institutions, and universities. The landscape has changed substantially since the original 2018 survey. The national portal datosabiertos.gob.ec, managed

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by the Secretaría Técnica Planifica Ecuador, now hosts more than 1,535 datasets from 98 public institutions, organized into 17 thematic categories. This represents a significant expansion from the 108 datasets recorded in 2018.

At the municipal level, the most notable development is the emergence of "Cuenca en Datos" (cuencaendatos.cuenca.gob.ec), launched by the GAD Municipal of Cuenca following a formal Open Data resolution signed by the Mayor in February 2023, developed in collaboration with Fundación Datalat and GIZ Germany under the "GAD 4.0" project. The portal now hosts over 30 datasets across 12 thematic categories. The Municipality of Quito continues to operate its Gobierno Abierto portal (gobiernoabierto.quito.gob.ec) with approximately 79 statistical datasets, while the GAD of Guayaquil has developed a geographic open data infrastructure through an ArcGIS Hub geoportal (geoportal-guayaquil.opendata.arcgis.com) focused on urban cartographic data, with a cutoff date of November 2024. Additionally, the national public procurement agency SERCOP launched a dedicated open data portal (datosabiertos.compraspublicas.gob.ec) providing real-time access to all public contracting processes, representing an important transparency milestone. After conducting searches for open data portals related to Ecuadorian cities and institutions, the following updated results were compiled (Table 1).

The analysis of Table 1 reveals three critical patterns of disparity in the Ecuadorian ecosystem: Data Macrocephaly, there is an extreme concentration of resources at the national level (SERCOP and Planifica Ecuador concentrate the majority of datasets), while most of the 221 municipalities lack their own infrastructure. Technological Divergence, a lack of standardization is observed; while Cuenca uses portals aligned with the International Open Data Charter, Guayaquil is limited to geographic layers (ArcGIS Hub), which restricts interoperability for Smart Cities 3.0 applications. Academic vs. Municipal Leadership, institutions such as UTPL surpass almost all municipalities in dataset volume (555), except Quito, which indicates that academia is generating more inputs for the smart city than the urban managers themselves.

Regarding global smart city rankings, the IESE Cities in Motion Index (CIMI) 2024 edition — covering 183 cities in 92 countries — confirms that Quito and Guayaquil remain the only Ecuadorian cities ranked globally. In the 2024 edition, Quito occupies position 157 (score: 27.02) and Guayaquil occupies position 169 (score: 22.61), both rated in the category B (relatively low performance). These positions represent a continued decline from the 2018 positions of 140 and 150 respectively, continuing the downward trend observed since 2016. The 2025 edition of CIMI (the 10th edition), which introduces updated metrics on renewable energy use, women's safety, and urban green spaces, places London, New York, and Paris at the top, with Latin American cities — led by Santiago de Chile — continuing to lag considerably behind global leaders.

The initiative "Municipios Abiertos Ecuador," part of the Second Open Government Action Plan (2022–2024), identified Cuenca, Quito, and Riobamba as the Ecuadorian municipalities with the greatest advances in open government and open data. This initiative, supported by USAID, Counterpart International, and the Fundación Datalat, has contributed workshops and methodological tools to build open data capacity at the municipal level. A Third Open Government Action Plan (2025–2027) is now in development, signaling continued national-level commitment to expanding open data [21-28].

Discussion

Comparing the 2018 data with the 2025 survey, Ecuador has made measurable but still insufficient progress in open data. The most notable advancement is the national portal datosabiertos.gob.ec, which grew from 108 datasets across 15 groups in 2018 to over 1,535 datasets from 98 institutions in 2025 — an approximately 14-fold increase. The emergence of "Cuenca en Datos," a purpose-built municipal open data portal backed by a formal resolution, an international cooperation project (GIZ/BMZ), and adherence to the International Open Data Charter, represents a qualitative step forward in the maturity of Ecuador's open data ecosystem.

Nevertheless, significant structural gaps persist. Guayaquil, Ecuador's most populous city, still lacks a dedicated open data portal; its ArcGIS-based geoportal provides geographic layers but does not constitute a full open data platform in the CKAN or equivalent sense. The 221 GADs that make up Ecuador's municipal structure remain overwhelmingly absent from the open data landscape. The declining CIMI rankings of both Quito (from position 140 in 2018 to 157 in 2024) and Guayaquil (from 150 to 169 in the same period) suggest that progress in the open data dimension has been outpaced by other cities globally, even as local initiatives expand.

Table 1: Open Data Portals in Ecuador (Updated: March 2025).

Organization	URL	Type	Datasets	Scope
Secretaría Técnica Planifica Ecuador	datosabiertos.gob.ec	National	1,535+	National
Municipality of Quito	gobiernoabierto.quito.gob.ec	Municipal	~79	Local
GAD Guayaquil (Geoportal)	geoportal-guayaquil.opendata.arcgis.com	Municipal/Geo	n/a*	Local
GAD Cuenca – Cuenca en Datos	cuencaendatos.cuenca.gob.ec	Municipal	30+	Local
Prefecture of Carchi	datosabiertos.carchi.gob.ec	Provincial	56	Provincial
SERCOP (Public Procurement)	datosabiertos.compraspublicas.gob.ec	National	Real-time	National
Central University of Ecuador	datosabiertos.uce.edu.ec	Academic	24	Institutional
UTPL (data.utpl.edu.ec)	data.utpl.edu.ec	Academic	1	Institutional
UTPL (ambar.utpl.edu.ec)	ambar.utpl.edu.ec	Academic	555	Institutional

*Geoportal provides geographic layers (shapefiles, GeoJSON) via ArcGIS Hub; dataset count not directly comparable to CKAN-based portals.

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The alignment with the International Open Data Charter by Cuenca (April 2022), the National Open Data Policy (Ministerial Agreement MINTEL-2022-0021), and the inclusion of open data commitments across three consecutive Open Government Action Plans (2019–2022, 2022–2024, and 2025–2027) indicate that Ecuador is building a more robust normative framework. However, implementation at the municipal level remains limited to a small number of cities. International standards such as ISO 37120, the ITU recommendation on Open Data Indicators, and the UNE 178301:2015 standard provide concrete measurement frameworks that could accelerate broader adoption if applied systematically across Ecuador's GADs.

The assertion that progress is 'insufficient' is supported by the systematic decline in the CIMI index: Quito fell from 140th to 157th place and Guayaquil from 150th to 169th between 2018 and 2024. This phenomenon is due to several critical factors:

- **Institutional capacity:** Most local governments lack specialized technical personnel, limiting data openness to legal compliance (LOTAIP) rather than an innovation strategy.
- **Financial gap:** The implementation of portals like 'Cuenca en Datos' has depended on international cooperation (GIZ Germany), suggesting that without external funding, Ecuadorian municipalities prioritize other areas over data infrastructure.
- **Governance:** Although a National Policy has existed since 2022, there are no mechanisms for technically mandating that municipalities adopt international standards such as ISO 37120, which creates disconnected 'information islands.

Conclusion

This updated study, revisiting the 2018 research question on the state of open data in Ecuadorian cities, finds a mixed picture of progress and persistent gaps. On the positive side, the national portal datosabiertos.gob.ec has grown from 108 to over 1,535 datasets; Cuenca has launched a dedicated, standards-aligned municipal open data portal; and three consecutive Open Government Action Plans have kept open data on Ecuador's policy agenda. On the negative side, the CIMI ranking positions of Quito (157th) and Guayaquil (169th) in 2024 confirm a continued decline relative to global peers, and the vast majority of Ecuador's 221 municipalities remain without open data portals.

The gap between the normative framework (LOTAIP, the National Open Data Policy, the International Open Data Charter) and actual municipal implementation remains the central challenge. Future work should focus on: (1) developing a systematic open data maturity assessment of Ecuadorian GADs using international standards (ISO 37120, UNE 178301:2015); (2) studying the Cuenca model as a replicable blueprint for other mid-sized municipalities; (3) evaluating the impact of the "Municipios Abiertos Ecuador" program on municipal-level open data adoption; and (4) exploring the intersection of open data with emerging technologies (artificial intelligence, linked data) as enablers of Smart Cities 3.0 environments across Ecuador.

As future work, it is proposed to carry out new evaluations based on the creation of a Municipal Open Data Maturity Index (IMDAM) based on four axes observed in this study: Legal Basis with respect to the existence of local resolution or policy (e.g., Basin), Volume and Diversity with respect to the number of datasets in more than 10 thematic categories, Technical Accessibility with respect to the use of standard platforms (CKAN/Dedicated Portal vs. Geoportal) and Impact on Ranking referring to the correlation with CIMI quality of life metrics.

Acknowledgment

This work is part of the activities of the research network between Universidad Nacional de Loja and Universidad Internacional del Ecuador (Loja campus). The authors thank the students of the Programming course, third cycle 2018, Systems Engineering Program, Faculty of Energy, Universidad Nacional de Loja, for their collaboration in this work.

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