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AI CITIES STRATEGY CONCEPTUAL MODEL

APPLICATION TO FOUR CITIES: NEW YORK, BUENOS AIRES, BARCELONA AND MADRID

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ABSTRACT

This paper develops and applies a systemic conceptual model to analyze how cities integrate artificial intelligence (AI) into urban governance through AI strategies. The conceptual model interrelates three core components—stakeholders, urban systems (spatial, technological, and service-based), and strategic objectives—to interpret AI strategies in New York, Buenos Aires, Madrid, and Barcelona. The model enables comparative analysis and supports the design of adaptable, inclusive, and sustainable AI strategies. By synthesizing diverse urban experiences, the study proposes a flexible framework for guiding future AI-driven urban transformation initiatives in an integrated way, opening paths to understand relations other aspects of the city.

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1. Introduction

Technological innovations and their effects are among the foundations of urbanization processes in the 19th century, from the Industrial Revolution and the urbanization processes that led to the birth of urban planning, and they maintain a significant influence to the present day. This has significant economic, but also social and environmental, repercussions. Urban systems benefit from economies of scale and agglomeration, tending to maximize their efficiency and generating positive externalities (quality of life, knowledge, and innovation). However, cities consume 75% of the world's energy and generate 80% of CO2 emissions (Lazaroiu & Roscia, 2012). Technology poses new challenges but can be an instrument to face urban problems at the same time, as proposed by concepts like Smart City.

This research uses a methodology based on the systems approach as a tool to address urban complexity. Systems science emerged during the 1950s from conceptualizations in physics, mathematics, and computer science, blending with biology and expanding into fields such as sociology and mathematics. From a mathematical perspective, with the theory of self-reproducing automata, Von Neumman, (1966) became one of the precursors of artificial intelligence, He was one of the first proponents of this systemic vision, which has evolved in its transdisciplinary application. General Systems Theory (Von Bertalanffy, 1969) constitutes a milestone and a synthesis that illustrates the potential for its transdisciplinary application. The systems approach has been applied to a variety of fields, with significant work in sociology, describing complex social systems (Luhman, 1984), economics, with Simon's hierarchical structure of complexity, and philosophy, with complexity thinking (Morin, 2005). Regarding its application to the city, Wolman (1965) defined the city as open urban ecosystems, and in the late 1970s, the systems approach was extended to the field of urban planning based on the work of McLoughlin (1969) and Forrester (1969). In recent years, this complexity has been addressed with a global vision of urban dynamics within the context of complexity theory (Batty, 2005), also using cellular automata. In parallel, scientific advances in artificial intelligence have been maximizing its application possibilities, bringing them to the present moment, where it is permeating and transforming different aspects of our lives, including, of course, the way we approach and live in our cities. Current literature on the field focuses on the opportunities of AI for urban studies (Caprotti et al., 2024) or smart cities (Herath & Mittal, 2022), and focuses on the development of new technologies alongside more humanized approaches to cities such as the 15 minutes city (Allam et al., 2022), to even reach more specific aspects such as mixed of uses within the city (Drici & Carpio-Pinedo, 2025). Furthermore, the topic of urban governance related to Artificial Intelligence becomes the focus of research of different authors regarding generative AI (Cugurullo & Xu, 2025), social governance and energy in cities (Ji & Huang, 2022) and even generating comprehensive literature reviews (Lartey & Law, 2025). Artificial intelligence, from the perspective of the systemic vision to which it has been linked since its origins, can become a powerful tool for managing urban complexity with a transdisciplinary approach.

To illustrate the diversity of approaches to artificial intelligence (AI) integration in urban governance, this research analyzes the strategic frameworks of four cities: New York, Buenos Aires, Barcelona, and Madrid. These cities were selected for their pioneering roles in developing municipal AI strategies and for representing distinct regional contexts—North America, Latin America, and Europe—with Barcelona and Madrid, both belonging to Spain (Europe). New York launched its initial AI strategy in 2021 (NYC Mayor's Office of the Chief Technology Officer, 2021), followed by a detailed implementation plan in 2023 (OTI, 2023). Buenos Aires introduced its "Ciudad Futuro" strategy in 2021(Gobierno de la Ciudad Autónoma de Buenos Aires, n.d.), positioning itself as a regional leader in Latin America. Barcelona's ethical AI governance framework was published in April 2021, emphasizing transparency and human rights (Ajuntament de Barcelona, 2021). Madrid, the most recent among the selected cases, unveiled its Artificial Intelligence Strategy (MAIA) in 2024, aligning with the European Union's AI Act and national digital transformation agendas (Ayuntamiento de Madrid, 2024b) and developing an Artificial Intelligence Roadmap (Ayuntamiento de Madrid, 2024a). This temporal and

geographical variation enables a comparative analysis of how cities with different institutional cultures and governance structures conceptualize and operationalize AI within urban systems. The reason of adding the recent strategy of Madrid to the group is the possibilities of interaction of this strategy to a current process of development of an Urban planning strategy for the city of Madrid that includes a strong focus on technology through the process "Sueña Madrid" (Ayuntamiento de Madrid, n.d.).

This research adopts a systemic approach to analyze the artificial intelligence strategies of various cities, with the aim of proposing a comprehensive model that can serve as a foundational framework for other urban areas seeking to initiate their own strategic development processes. Following an introductory section, the second part outlines the research objectives and the methodology employed. The third section presents the systemic model used as the analytical basis. In the fourth section, this model is applied to examine the AI strategies of four cities: New York, Buenos Aires, Barcelona, and Madrid. The fifth section compares and discusses urban models, leading to the proposal of a new comprehensive framework for municipal AI strategies. Finally, the study concludes with key findings and suggests future steps for continued research and implementation.

2. Objectives and methodology

This section describes the primary and secondary objectives of this research. The different steps of the methodology followed are outlined below, leading to the explanation of the conceptual model in the next section.

2.1. Objectives

The main objective of this research is to analyze the applicability of a conceptual city model for describing and comparing artificial intelligence strategies, resulting in an integrated model, and draw conclusions that can be used to design new urban models using AI as a tool.

From this central objective, several sub-objectives emerge:

- First, a review of some conceptual models used by other research projects is undertaken to propose a model that can be applied to different concepts of cities.
- The application of this conceptual model to synthesize different municipal strategies for integration.
- The drawing of cross-cutting conclusions about the strategies analyzed and the relationships between their various components.
- The establishment of the bases for generating a new synthesis model that integrates the main common points of the analyzed tools.
- The identification of gaps and the opening of new lines of future research.

2.2. Methodology

The methodology followed for this research consists of several stages (Figure 1).

First, a review of the scientific literature was conducted using specialized scientific literature search engines and physical libraries to consult the main reference volumes. From this bibliography, the model elements and case studies necessary to define a base model for the Artificial Intelligence city were selected.

Second, the relevance of the conceptual models was reviewed, and an adaptation of an existing model was proposed for the evaluation of the different concepts. New layers of analysis were added, and existing ones were modified to obtain a generic model that could be used for the analysis of various concepts.

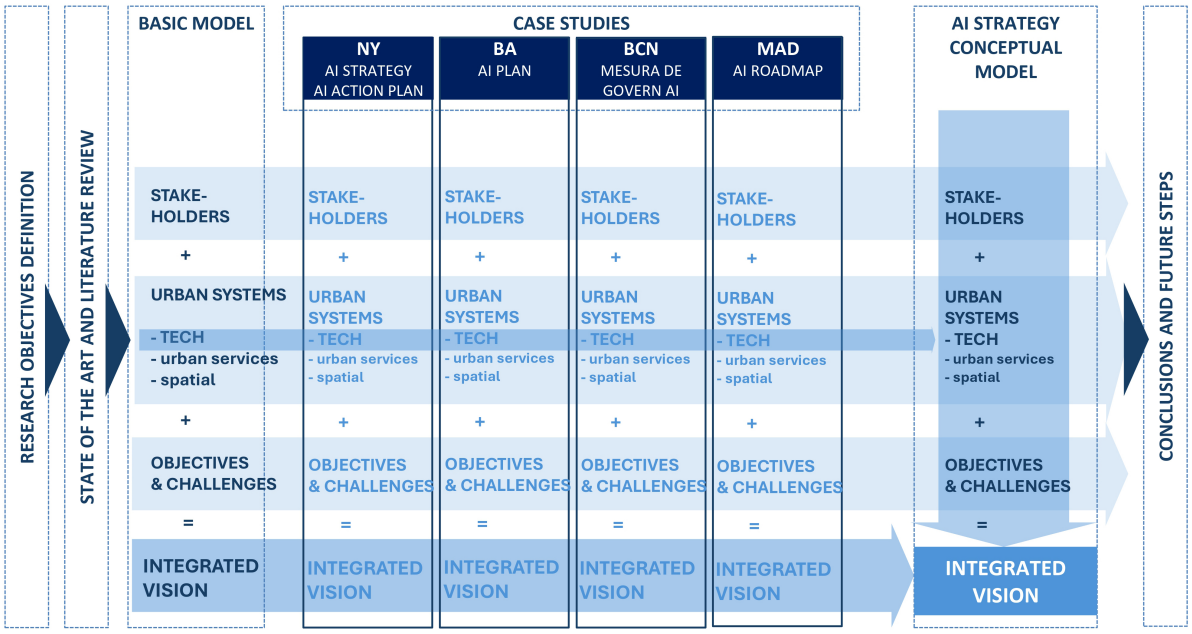
The third step consists of applying the proposed model to describe the strategies developed by the selected cities: New York, Buenos Aires, Barcelona and Madrid. Content analysis of their strategies was used to identify the elements that comprise these strategies in each of the defined subsystems, including the implementation of conversational artificial intelligence assistants developing a specific agent trained for the analysis of the strategies. The agent is based on a Large

Language Model (LLM) architecture, specifically a customized implementation of a Generative Pre-trained Transformer (GPT). It operates as a domain-specialized assistant, optimized for tasks involving urban planning and emerging technologies in city systems. The analysis took as main sources mainly the official webpage and official documents of the strategies and action plans, considering them the most accurate description of the strategy of the municipality.

In the fourth stage of this research, the strategies are analyzed and compared for extracting common elements and differences. The comparison was multilayered according to the different elements of the proposed model using the trained conversational AI assistant.

In the fifth stage, a synthetic model for AI Municipal strategies is proposed as a departure point for the development of multi-stakeholder processes of elaboration of complex strategies for cities. Finally, conclusions are extracted and new research pathways identified.

Figure 1. Proposed methodology



Source: Own elaboration, 2025.

3. Conceptual model

To conduct this research, we review the conceptual model used to describe the Smart City in various articles (Fernandez Añez, 2019; Fernandez-Anez et al., 2017) a holistic and innovative perspective. The development of conceptual models for the definition of the Smart City is a key subject in scientific literature, focusing on the relation of stakeholders with technology (Chourabi et al., 2012; Dameri, 2013; Nam & Pardo, 2011) and governance of technology (Castelnovo et al., 2015). The proposed model was then faced to different concepts of the city for validation, such as the Creative cities (Florida, 2005) or the 15-minutes city (Moreno et al., 2021) for refining. This model was used as a starting point for developing the proposal that serves as the basis for this research, which combines three system scales: participating agents, city implementation systems, and urban challenges. The objective is to provide a holistic and integrated view of the city by interrelating these elements and allowing for comparisons between approaches from the perspective of innovation and creativity.

Based on these guidelines, an integrated conceptual model is developed. First, a series of basic subsystems are defined at the confluence of which the proposed model arises: the Spatial Subsystem (streets and urban infrastructure, open spaces, etc.) and the Technological Subsystem (technological tools in the city, primarily ICT). Key actors are located at the center of the city system and rely on two main urban functional subsystems—spatial and technological—where the city is understood as the confluence of these two spaces (Castells, 2004).

3.1. Stakeholders

First, the key agents are extracted from the different proposed systems (economic, social, governance, and environmental) (Fernández Güell, 2022) to integrate them as part of urban demand and improve their characterization. This approach is refined by incorporating the Smart City stakeholders identified by different authors as a triple helix (Deakin, 2014) and quadruple helix (Lombardi et al., 2012) system. The different concepts analyzed propose different central subsystems and different groups of key agents to be included in this section.

3.2. Urban systems

For the analysis of the city, we are selecting three different systems (Figure 2):

a) Urban services system: From a perspective much closer to urban governance, the proposed vision of urban services focuses on the services provided by a municipality, which are much more closely related to the areas in which these governments are organized than to the infrastructure or urban facilities that would constitute their translation into the physical level. This approach is taken by different authors in their proposals for the Smart City concept (Chourabi et al., 2012; Giffinger et al., 2007).

b) Spatial System: The elements of the built urban environment make up the urban spatial system: streets and urban infrastructure, residential areas, productive spaces, urban facilities (cultural, health, education, security, sports, etc.), and of course the system of open and green spaces. The organization of the spatial system will be characterized by various parameters depending on the different concepts to which the model is applied or may even play a non-essential role.

c) Technological System: The technological system is made up of the various technological tools developed in the city and—in the smart city literature—is primarily based on ICTs and information transfer (Batty, 2005). It articulates and connects the elements of the spatial system and the urban services system.

Figure 2. Proposed model that articulates agents, urban systems (services, technological and spatial) and urban challenges.

Source: Own elaboration, 2025.

3.3. Urban challenges and objectives

Clear strategical objectives are essential for defining a conceptual model, as the aim of the strategy is to address the urban challenges cities are facing. Either formulated as a challenge or already transformed into an objective and integrated into a strategy, the conceptual model should incorporate the goals the city should meet and show how stakeholders and the different systems (spatial, technological and urban services) can focus into getting them.

4. Artificial Intelligence City: case studies

Artificial intelligence is permeating every aspect of people's lives, and it's inevitable that cities will be any different. At the strategic level, it is being addressed primarily at national and even international levels through strategic artificial intelligence plans with different geographical scopes of application (AI Strategy 2024 (Spain), the Aragonese AI Strategy, and the AI Plan for the city of Buenos Aires, to name a few). These plans primarily focus on the resources, means, and steps to be taken to advance in the field of artificial intelligence. The development of conceptual models needs the analysis of comprehensive content regarding the specific topic they are focused at. This paper focuses on the use of conceptual models for the interpretation of urban strategies and implementation plans for the development of artificial intelligence. For this purpose, three case studies in different regions are selected: New York, Buenos Aires, Barcelona and Madrid. The three first were pioneering the development of Artificial Intelligence within cities launching their strategies in 2021. New York is implanting this strategy through is implementation plan launched in 2023, while Buenos Aires has diluted or integrated the efforts on Artificial Intelligence, and Barcelona is about to launch the next stages of their plan. The last one, the city of Madrid, launched its itinerary for artificial intelligence in December 2024, being of special relevance the parallelism with the process of launching the Urban Strategic Plan through "Sueña Madrid"(Ayuntamiento de Madrid, n.d.).

4.1. New York AI Strategy

In October 2023, New York City released the Artificial Intelligence Action Plan (OTI, 2023), a strategic roadmap focused on the responsible implementation of AI technologies within municipal governance. This document builds upon the foundational insights of the earlier NYC AI Strategy (NYC Mayor's Office of the Chief Technology Officer, 2021), which mapped the city's AI ecosystem and outlined key stakeholder groups across government, academia, industry, and civil society. Together, these documents represent a sequential and complementary effort to guide AI adoption in urban governance, transitioning from vision-setting to structured execution. The two documents are studied, and the model is applied, generating a result that combines both analysis' results.

The NYC AI Strategy organizes stakeholders into sectoral groups, establishing a broad vision for AI governance, while the Action Plan identifies stakeholders by their operational roles in implementing specific initiatives. The AI Action Plan further institutionalizes stakeholder engagement through mechanisms like the AI Steering Committee and External Advisory Network. Together, these documents illustrate a shift from ecosystem mapping to actionable governance, reflecting the evolution of stakeholder involvement in urban AI policy.

Regarding the urban systems, the strategy focuses on the technological systems, briefly including in the examples for the spatial system and urban services. New York City's AI policy evolved from conceptual frameworks and strategic mapping to operational execution, as seen in the transition from the NYC AI Strategy to the AI Action Plan. The strategy outlined broad goals and five thematic areas (data infrastructure, city applications, governance, external partnerships, and workforce development), while the action plan established concrete initiatives for governance, stakeholder engagement, capacity-building, and responsible AI adoption across city agencies. Together, these documents demonstrate a progressive model for urban AI integration that balances technological advancement with adaptability, accountability, and democratic values.

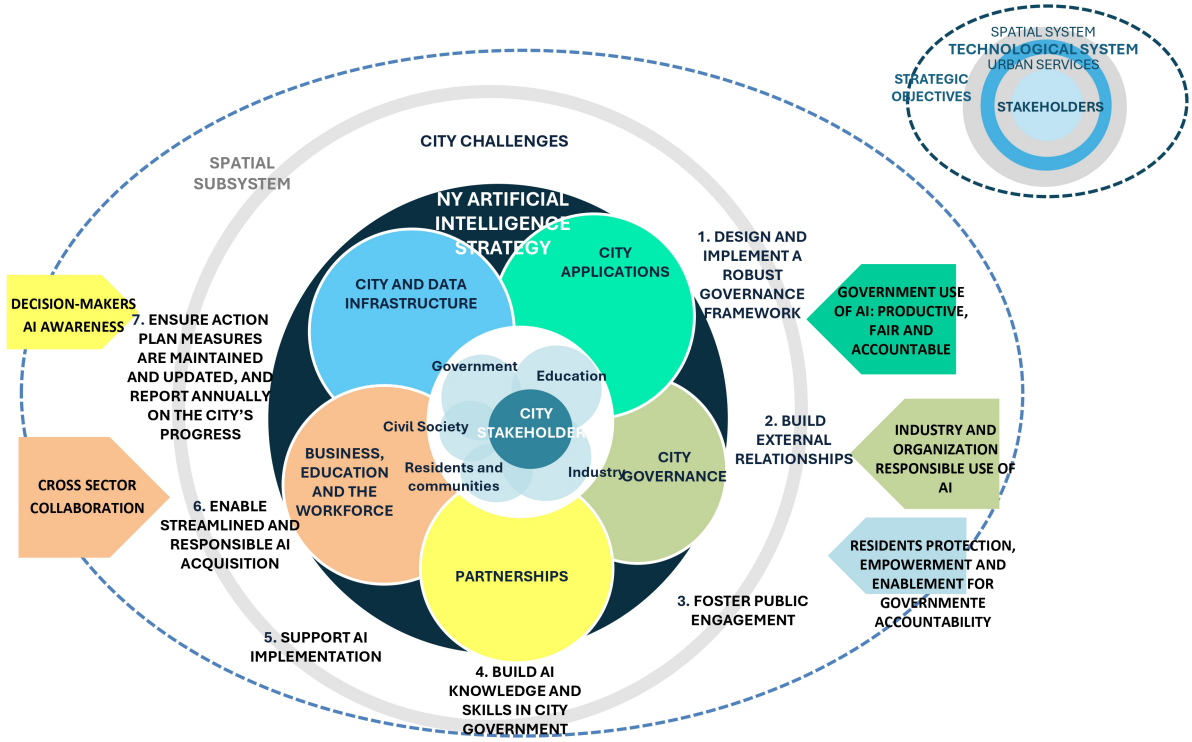
The NYC AI Strategy articulates a clear set of objectives aimed at establishing a foundational framework for the responsible use of artificial intelligence in New York City. These objectives include mapping the local AI ecosystem, identifying opportunities and risks, and proposing strategic directions across the five thematic areas. The strategy serves as a diagnostic and vision-setting document, emphasizing transparency, equity, and innovation in urban AI deployment. In contrast, the NYC Artificial Intelligence Action Plan does not present a standalone section labeled

"objectives." Instead, its purpose is embedded within the introduction and the structure of its seven initiatives. While the action plan lacks explicit objective statements, its design implies a continuation and execution of the strategic intent defined in the earlier document.

New York City's AI Strategy sets out the foundational goals and guiding principles for responsible urban AI, while the subsequent Action Plan operationalizes these aims through targeted governance, engagement, and implementation initiatives. The strategy provides the vision and objectives into 5 analyzed thematic areas; the action plan details how these objectives are put into practice across city agencies organizing them into 7 initiatives.

The different elements described are visualized by the application of the conceptual model described in the previous sections and its adaptation to the characteristics of New York AI strategy (Figure 3).

Figure 3. Conceptual model for New York AI strategy.



Source: Own elaboration, 2025.

The coordinated deployment of artificial intelligence (AI) in urban governance requires the alignment of three interdependent systems: stakeholder engagement, urban systems (mainly technological infrastructure), and strategic objectives. The documents NYC AI Strategy and NYC Artificial Intelligence Action Plan offer a sequential framework that illustrates how these systems evolve and interact within New York City's AI policy. Together, these systems form a dynamic model of urban AI governance, where stakeholder roles, technological capabilities, and strategic goals are mutually reinforcing and progressively institutionalized.

Stakeholders are both users and developers of AI technologies. In the strategy document, stakeholders are categorized by sector—government, academia, industry, civil society, and residents—highlighting their roles in shaping the AI ecosystem. The action plan reconfigures this into operational roles, assigning specific responsibilities to agencies such as the Department of Health and Mental Hygiene and Office of Technology and Innovation. These actors are directly linked to technological systems through initiatives that support AI implementation, procurement, and governance. For example, the creation of typologies and risk assessment frameworks depends on stakeholder input and agency-specific data infrastructures.

The technological system serves as the medium through which strategic objectives are realized. The strategy's goals—such as transparency, equity, and innovation—are embedded in the action plan's initiatives, which operationalize them through tools like public reporting, lifecycle support, and adaptive policy mechanisms. The emphasis on data infrastructure and AI applications in the strategy is translated into concrete actions for tool development, acquisition, and monitoring in the plan.

Stakeholders are also central to defining and achieving objectives. While the strategy outlines the "why" of AI governance, the action plan details the "how," assigning roles and creating feedback loops through advisory networks and public engagement sessions. This ensures that objectives remain responsive to community needs and institutional capacities.

4.2. Buenos Aires AI Strategy

Another important case to mention is Buenos Aires, one of the first cities in Latin America to have an artificial intelligence strategy called "Ciudad Futuro" (- Government of the Autonomous City of Buenos Aires, n.d.). Buenos Aires is focusing its Artificial Intelligence strategy on several key sectors to drive development and improve the quality of life of its residents.

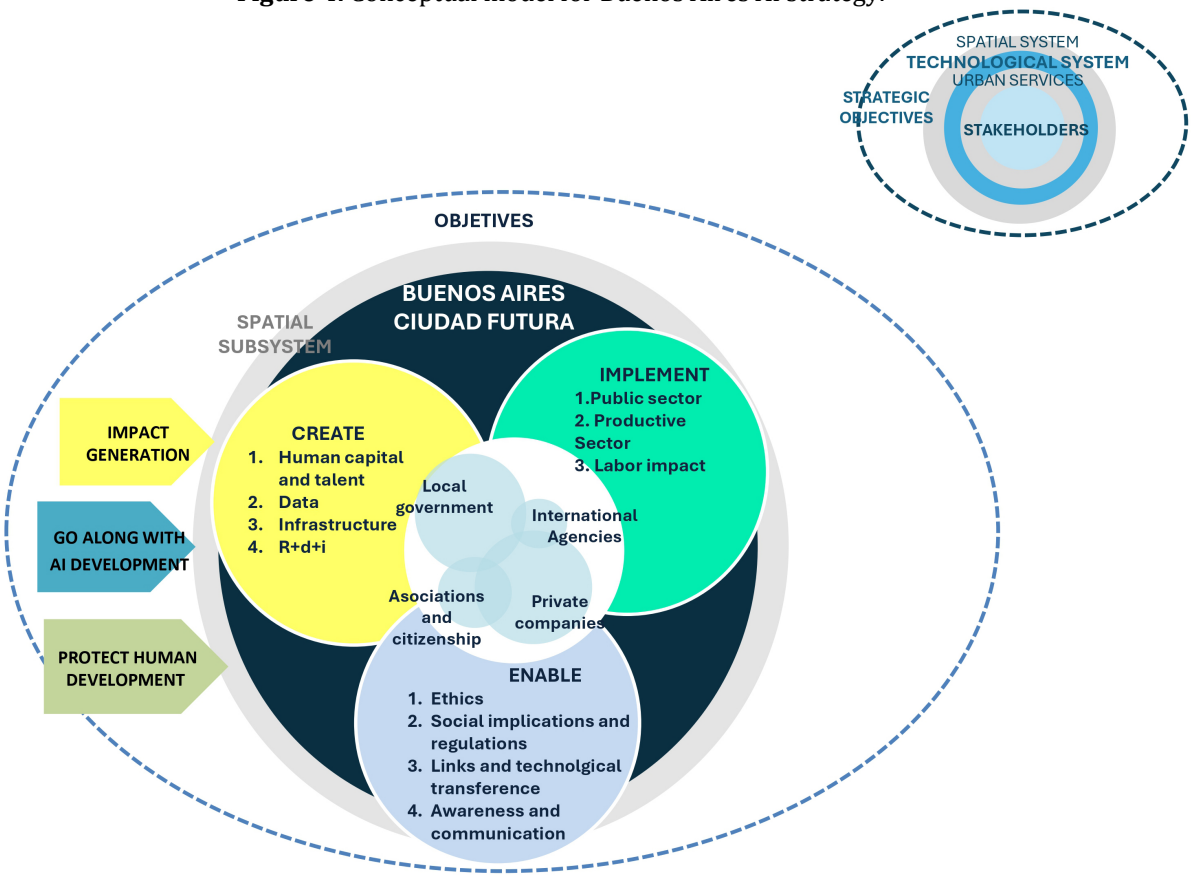
Buenos Aires' Artificial Intelligence Plan involves a multi-stakeholder framework that integrates city agencies, academic institutions, private sector partners, civil society, and international organizations to advance ethical, transparent, and innovative urban AI governance. This inclusive model emphasizes participatory citizen engagement and positions the city as a regional leader in smart, sustainable urban transformation. For the development of the strategy 22 working groups were created for each of the strategic axes for interdisciplinary and multisectoral ideation of the strategy. A total of 147 professionals and experts participated in these groups, along with teams from 16 government areas.

Regarding the urban systems, as in the case of New York, Buenos Aires AI strategy is mainly focused on the technological system. The strategy is structured into three branches: "Create", "Implement", and "Enable". "Create" focuses on generating the conditions for the development of AI in the City, focusing on four areas: human capital and talent, Data, Infrastructure, and R&D. "Implement" focuses on promoting the use of AI for the benefit of citizens and for the development of the City, and is targeted at key stakeholder groups: the Public Sector, the Productive Sector, and its impact on work. Finally, the "Enable" strategic line aims to enable cross-cutting tools to ensure the sustainability of the Plan in the City, such as Ethics, Social Implications and Regulation, Technology Connection and Transfer, International Connection, and Awareness and Communication.

Buenos Aires' Artificial Intelligence Implementation Plan focuses on three main objectives aligned with urban innovation and ethical governance: generating impact, supporting technological evolution, and protecting human development.

The application of the proposed conceptual model allows the visualization of the characteristics of Buenos Aires AI strategy (Figure 4).

Figure 4. Conceptual model for Buenos Aires AI strategy.



Source: Own elaboration, 2025.

The Artificial Intelligence Strategy of Buenos Aires analysis and model application is structured around three interdependent systems: stakeholders, technological architecture, and strategic objectives. A comparative analysis between each pair reveals how these systems reinforce one another to enable coherent urban transformation.

Stakeholders provide the institutional, technical, and social capacities necessary for the development and deployment of AI technologies. Their roles—ranging from governance and research to implementation and oversight—are embedded within the technological system's three strategic branches: Create, Implement, and Enable. The Create axis depends on stakeholder investment in infrastructure, data governance, and talent development. The Implement axis reflects stakeholder engagement in applying AI to public services and productive sectors. The Enable axis, which includes ethics, regulation, and international collaboration, is shaped by stakeholder values and institutional frameworks. Thus, the technological system is both a product of stakeholder input and a platform for stakeholder action.

Strategic objectives—impact generation, technological evolution, and human development—are defined and pursued through stakeholder collaboration. Stakeholders interpret these goals within their domains, aligning their actions with broader urban priorities. For example, the objective of maximizing impact is operationalized through citizen-focused initiatives, while the protection of human development is advanced through ethical oversight and inclusive governance. Stakeholders serve as mediators between abstract objectives and concrete implementation, ensuring that strategic aims are contextually grounded and socially responsive.

The technological system functions as the operational mechanism through which strategic objectives are realized. Each axis corresponds to a specific objective: "Create" supports technological evolution, "Implement" drives impact generation, and "Enable" safeguards human

development. This alignment ensures that technological investments and innovations are not isolated efforts but are purposefully directed toward achieving the city's long-term vision for equitable and sustainable AI integration.

4.2. Barcelona AI Strategy

Launched in April 2021 by the Ajuntament de Barcelona, the document titled "Mesura de Govern de l'estratègia municipal d'algoritmes i dades per a l'impuls ètic de la intel·ligència artificial" (Ajuntament de Barcelona, 2021) outlines a pioneering municipal strategy for the ethical governance of artificial intelligence (AI) and data systems. Developed in response to the accelerating digital transformation and its societal implications, the strategy aims to establish a normative and operational framework that ensures AI deployment aligns with human rights, democratic values, and social equity. It positions Barcelona among leading global cities—such as Amsterdam and New York—in promoting responsible urban innovation through transparent, inclusive, and accountable technological systems.

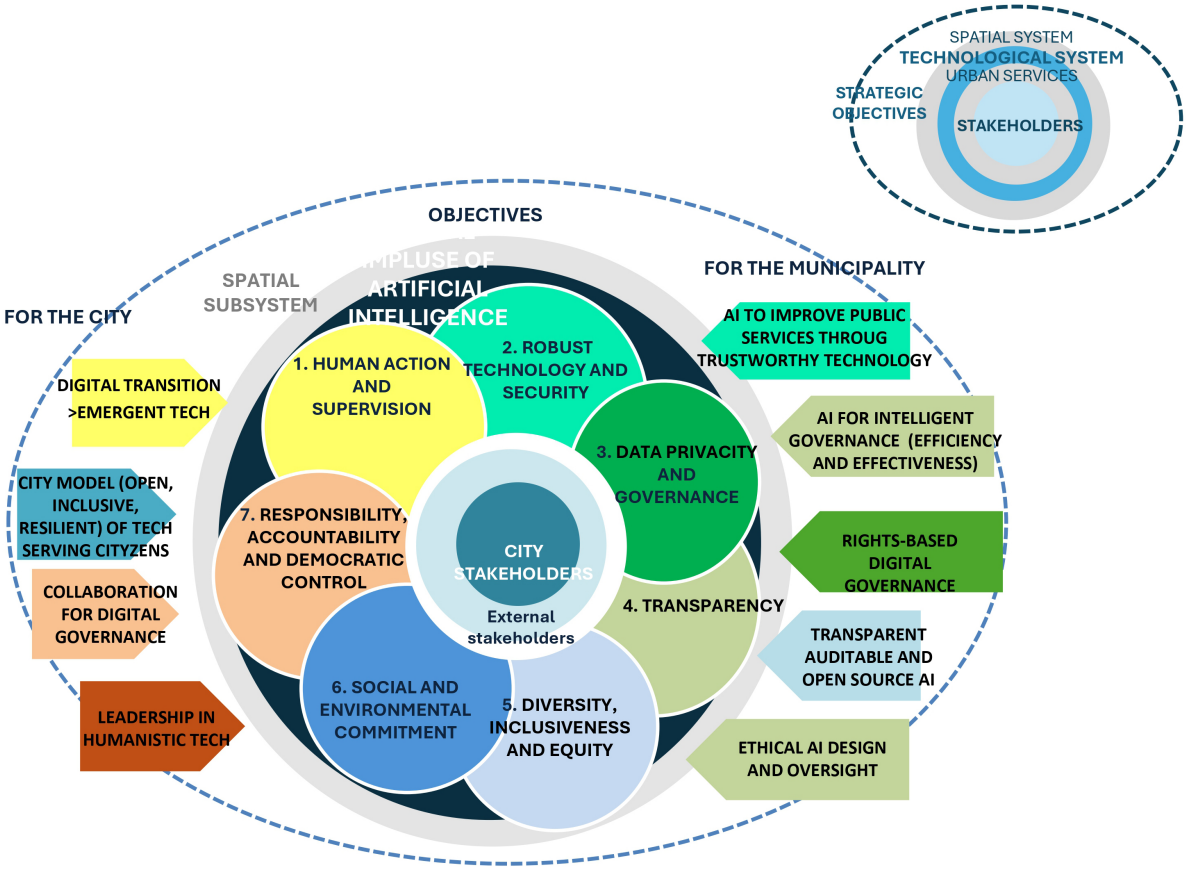
The governance proposal outlined in the strategy identifies a comprehensive set of stakeholders essential to the ethical deployment of artificial intelligence (AI) within the municipal framework of Barcelona. This multi-stakeholder approach reflects a commitment to participatory governance and aligns with international standards for responsible AI, ensuring that technological innovation remains anchored in human rights and democratic values, while involving diverse municipal areas underscoring the transversal nature of AI's impact on urban management.

The ethical framework for AI governance outlined in Barcelona's strategy is built on seven guiding principles, including human oversight, technical robustness, privacy, transparency, equity, social and environmental commitment, and accountability. These principles ensure AI systems remain secure, inclusive, and under democratic control, with a strong focus on transparency, data protection, and public participation. Mechanisms such as audits and public consultations guarantee that AI deployment aligns with human rights and fosters community involvement at every stage. The document do not articulate the application to the spatial and urban services systems, however some of the proposed examples relate to these fields.

Barcelona's AI strategy is designed to establish the city as a leader in ethical digital transformation, emphasizing social good, inclusivity, and alignment with the Sustainable Development Goals. The city council prioritizes trustworthy AI in public services, robust internal governance, and citizen participation through transparent and accountable processes. Overall, the approach focuses on innovation, open-source technology, and the protection of fundamental rights, ensuring AI serves both the public interest and democratic control.

Fostering understanding of the different elements of the strategy, the proposed conceptual model is applied (Figure 5).

Figure 5. Conceptual model for Barcelona AI strategy.



Source: Own elaboration, 2025.

The governance strategy outlined in "Mesura de Govern de l'estratègia municipal d'algoritmes i dades per a l'impuls ètic de la intel·ligència artificial" (Ajuntament de Barcelona, 2021) reveals a dynamic interplay between stakeholders, technological systems, and strategic objectives, forming a triadic structure essential for the ethical and effective deployment of artificial intelligence (AI) in urban governance. The relationship between stakeholders and technological systems is characterized by mutual reinforcement: municipal departments such as the Gerència de Recursos and Oficina Municipal de Dades provide domain-specific expertise that informs the design and implementation of AI systems, while the technological principles—such as human oversight, transparency, and data governance—guide institutional behavior and decision-making. This reciprocal influence ensures that AI applications are not only technically robust but also socially responsive. Similarly, the connection between stakeholders and strategic objectives reflects a governance model rooted in participatory and interdisciplinary collaboration. This connection is clearly reflected in the dual approach to both objectives (for the municipality and for the city) and the stakeholders (internal and external), integrated by the humanistic approach to the technological system. The involvement of external experts and civic actors aligns with the city's ambition to lead globally in ethical digital transformation, reinforcing objectives such as inclusivity, resilience, and democratic control.

The relationship between technological systems and strategic objectives is equally foundational. The seven guiding principles—ranging from privacy and equity to accountability—serve as operational criteria for achieving the city's broader goals of digital justice and institutional innovation. For instance, the emphasis on transparency and auditability directly supports objectives related to citizen trust and participatory governance. Moreover, the challenges posed by algorithmic bias, data misuse, and automation risks aim to be addressed

through technical safeguards embedded in the AI systems, thereby operationalizing the city's commitment to human rights and sustainability. In sum, the strategy's coherence lies in its systemic integration: stakeholders shape and are shaped by technological norms; technologies embody and enable strategic goals; and objectives provide the normative direction for both governance and innovation.

4.4. Madrid AI Strategy

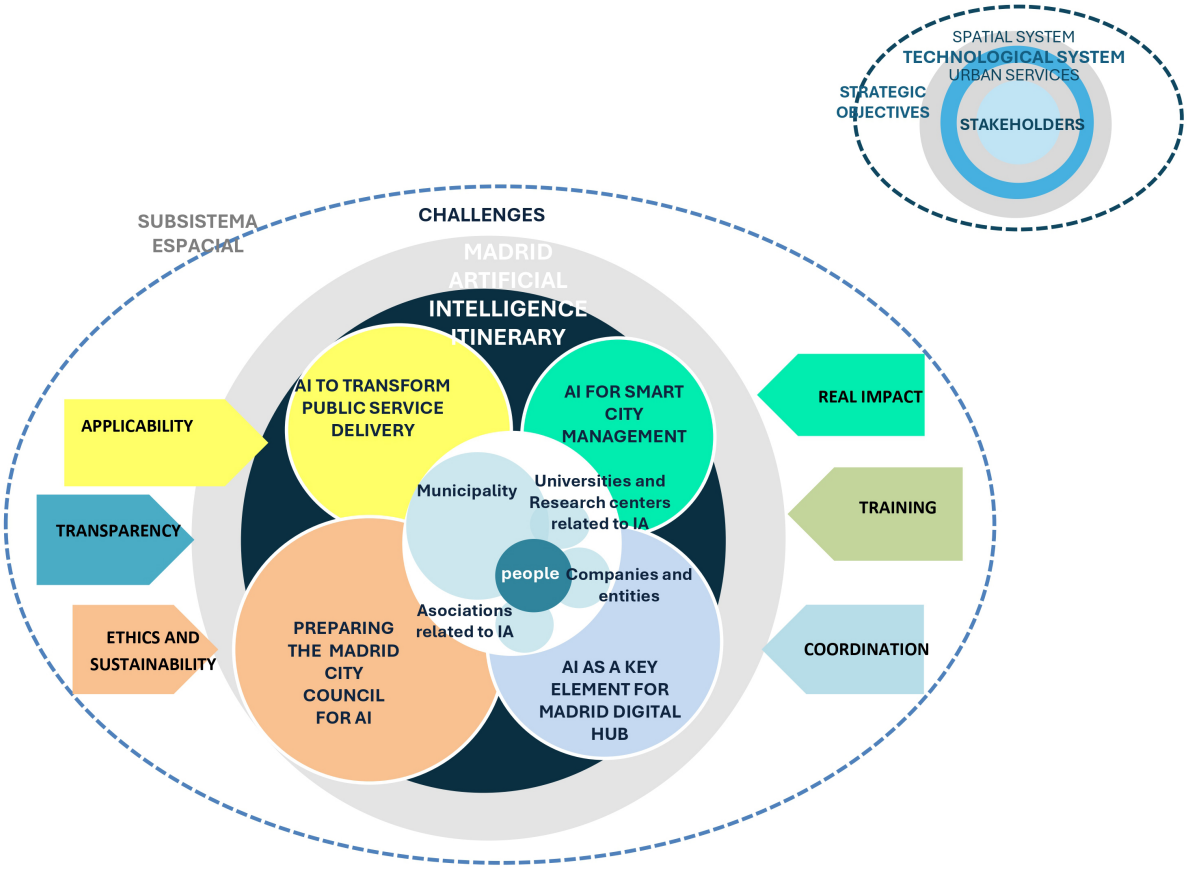
The Madrid Artificial Intelligence Strategy (MAIA) is a pioneering initiative to integrate ethical, robust, and citizen-centric AI into urban governance. Developed under the coordination of the Oficina Digital and the IAM (Informática del Ayuntamiento de Madrid) unit, MAIA aligns with the European Union's AI Act (European Data Protection Supervisor, 2025) and Madrid's broader Digital Transformation Strategy 2023–2027. The strategy is structured around principles of ethics, legality, and technical-social robustness, aiming to enhance public service delivery through data-driven decision-making and advanced AI technologies such as LLMs, RAG architectures, and multimodal systems(Ayuntamiento de Madrid, 2024b).

Madrid's Artificial Intelligence Roadmap (Ayuntamiento de Madrid, 2024a) offers a structured strategy for deploying AI in urban governance, organized around four main "objectives" and thirteen lines of action. These objectives are mainly operational, as the challenges faced are identified in other part of the document, and they would conceptually correspond to the "initiatives" described in the NY AI Action Plan (OTI, 2023). They focus on transforming public service delivery through personalized and predictive AI tools, establishing smart city management for efficient and sustainable operations, developing Madrid as a digital innovation hub, and preparing city council staff for AI integration with dedicated training and ethical standards. Together, these initiatives aim to embed AI across city systems such as mobility, urban planning, and public infrastructure, balancing technological advancement with public value, ethical oversight, and sustainable urban development. Its implementation includes diverse use cases: predictive analytics in citizen participation platforms, urban climate mapping, social care interventions like the PALOMA project, and digital twins for urban planning. Therefore, even if the focus is mainly technological, urban services play a key role throughout the Smart City objective and lines of action, and there is a transversal vision of the spatial system through specific actions.

The Artificial Intelligence Roadmap of Madrid identifies six principal challenges that must be addressed to ensure the effective integration of artificial intelligence within the governance and operational framework of the Madrid City Council. These challenges are not technical in nature but rather institutional and societal, reflecting a strategic orientation toward responsible innovation. Collectively, these challenges underscore a governance model that prioritizes human-centered, ethical, and sustainable AI adoption in urban administration. As a main difference to the other analyzed strategies, these challenges were identified after deployment of AI initiatives within the municipality, as lessons learned.

The conceptual model is applied to the case study of Madrid Artificial Intelligence Strategy and its AI Itinerary (Figure 6).

Figure 6. Conceptual model for Madrid AI strategy.



Source: Own elaboration, 2025.

The integration of artificial intelligence (AI) into urban governance frameworks is reshaping the operational, ethical, and strategic paradigms of city management. In the case of Madrid, the development of a comprehensive roadmap for AI deployment reflects a multidimensional approach that encompasses institutional coordination, technological application, and strategic planning. This analysis compares three core dimensions—stakeholder engagement, technological systems, and implementation challenges and objectives—highlighting their interdependencies and divergences as outlined in the Madrid AI Itinerary

Stakeholder engagement and technological systems represent two foundational pillars of Madrid's AI strategy. While stakeholder dynamics focus on the creation of collaborative environments across municipal departments and external actors, technological systems are oriented toward the operational deployment of AI in urban services. The roadmap emphasizes the importance of building a community of practice around AI, fostering shared standards and ethical frameworks. In parallel, the technological dimension is manifested through application cases such as traffic management, housing demand prediction, and infrastructure mapping. Notably, these applications are not embedded in the structural design of the roadmap but serve as illustrative examples of AI's transformative potential in urban systems.

The strategic objectives of the roadmap are designed to guide the institutionalization of AI across city functions, while stakeholder engagement ensures the legitimacy and adaptability of these objectives. The four main goals—transforming public service delivery, managing smart city systems, positioning Madrid as a digital hub, and preparing the municipal workforce—are supported by thirteen lines of action. These objectives rely on stakeholder collaboration to ensure relevance, scalability, and ethical compliance. The participatory nature of the initiative reinforces

the roadmap's capacity to align technological innovation with public value and institutional readiness.

The relationship between technological systems and implementation challenges reveals the tension between innovation and governance. While AI applications demonstrate high potential for improving urban services, their deployment is constrained by non-technical challenges such as staff training, interdepartmental coordination, ethical oversight, and transparency. These challenges underscore the need for robust governance mechanisms that can support the responsible use of AI. Moreover, the roadmap's emphasis on real impact and explainability reflects a commitment to ensuring that technological systems are not only efficient but also socially accountable.

The strategic objectives and implementation challenges are inherently interlinked, forming the backbone of Madrid's AI governance model. Each objective is operationalized through specific actions that must navigate the identified challenges. For instance, the goal of transforming public service delivery requires overcoming barriers related to staff capacity and citizen trust. Similarly, the ambition to establish Madrid as a digital hub depends on addressing infrastructural and cultural constraints. The roadmap's six challenges—training, coordination, applicability, ethics and sustainability, real impact, and transparency—serve as critical filters through which the feasibility and effectiveness of each strategic objective must be assessed.

5. Discussion

As the methodological proposal followed the sequence proposed by the model, this section will follow the same structure to discuss the results of the research in four stages: stakeholders, urban systems, challenges and objectives and integrated approach.

5.1. Stakeholders

The AI strategies of New York City, Buenos Aires, Barcelona, and Madrid reflect a shared commitment to pluralistic stakeholder engagement, yet each city follows a distinct institutional trajectory shaped by its governance culture and strategic priorities. Despite structural similarities in stakeholder typologies—government, academia, industry, civil society, and international actors—their integration pathways diverge.

New York City's approach evolved from a broad ecosystem model in the NYC AI Strategy (NYC Mayor's Office of the Chief Technology Officer, 2021), which mapped sectoral stakeholders to establish a vision for long-term governance, toward a more municipality-centered operational framework in the Artificial Intelligence (OTI, 2023). This shift illustrates a transition from conceptual inclusivity to functional implementation, where city agencies and advisory networks assume central roles. Buenos Aires began with strong municipal leadership, but embedded stakeholder pluralism early on through 22 interdisciplinary working groups involving 147 experts across 16 government areas. This model emphasizes co-creation and participatory governance from the outset (Gobierno de la Ciudad Autónoma de Buenos Aires, n.d.). Barcelona's "Mesura de Govern de l'estratègia municipal d'algoritmes i dades per a l'impuls ètic de la intel·ligència artificial" (Ajuntament de Barcelona, 2021) underscores the centrality of municipal departments in AI governance, while also integrating external experts and aligning with international standards, through a dual vision of internal and external stakeholders. The involvement of entities such as the Comissionat d'Innovació Digital and consultations with digital rights specialists reflects a dual emphasis on institutional leadership and global ethical frameworks. Finally, Madrid's Artificial Intelligence Roadmap (Ayuntamiento de Madrid, 2024a) followed the opposite trajectory. Initially conceived as an internal municipal initiative, it expanded outward to incorporate universities, companies, civil society, and international

networks such as UCCI and Eurocities, forming a collaborative AI community and reinforcing its position within global urban innovation ecosystems.

Therefore, all four cities demonstrate stakeholder pluralism, yet their strategies diverge in sequencing: New York moves from integrative mapping to municipal execution; Buenos Aires embeds participation within municipal leadership; Barcelona balances municipal authority with international ethical alignment; and Madrid expands from municipal control to collaborative engagement. These trajectories highlight the flexibility of urban AI governance in adapting pluralistic models to local institutional contexts.

5.2. Urban systems

The AI strategies of New York City, Buenos Aires, Barcelona, and Madrid reflect a shared commitment to integrating artificial intelligence into urban governance, with a strong emphasis on the technological subsystem. Each city adopts a distinct structural approach, yet all aim to enhance public service delivery, infrastructure management, and spatial planning through data-driven innovation.

New York City's strategy evolves from conceptual mapping to operational deployment. The NYC AI Strategy (NYC Mayor's Office of the Chief Technology Officer, 2021) outlines five thematic pillars (data infrastructure, applications, governance, partnerships, and workforce development), later translated into seven initiatives in the NYC Artificial Intelligence Action Plan. This progression illustrates a shift from ecosystem visioning to municipal implementation. Buenos Aires structures its strategy into three branches—"Create," "Implement," and "Enable"(Gobierno de la Ciudad Autónoma de Buenos Aires, n.d.)—focusing on enabling conditions (e.g., data, infrastructure), sectoral deployment, and ethical sustainability. Barcelona's "Mesura de Govern de l'estratègia municipal d'algoritmes i dades per a l'impuls ètic de la intel·ligència artificial" (Ajuntament de Barcelona, 2021) centers on ethical governance, guided by seven principles that ensure transparency, human oversight, and democratic accountability. Urban systems are addressed through a transversal lens, with AI applications subject to rigorous ethical standards. Madrid's Artificial Intelligence Roadmap (Ayuntamiento de Madrid, 2024a) presents four strategic objectives (similar to what in the NY AI Action Plan are called "initiatives") and thirteen lines of action, integrating AI into mobility, housing, and urban infrastructure through pilot projects. The roadmap emphasizes institutional readiness and smart city management.

In all cases, spatial and service systems—such as mobility, housing, and environmental services—are present but secondary to the technological subsystem. Their inclusion demonstrates AI's transformative potential in urban management, though they are not structurally central to the strategic frameworks.

5.3. Objectives and challenges

The AI strategies of New York City, Buenos Aires, Barcelona, and Madrid reveal a shared commitment to responsible innovation, yet each city articulates its challenges and objectives through distinct governance logics and institutional priorities.

New York City's NYC AI Strategy (NYC Mayor's Office of the Chief Technology Officer, 2021) establishes a foundational framework for AI governance, with objectives centered on mapping the local ecosystem, identifying risks and opportunities, and guiding strategic development across the defined five pillars. The subsequent NYC Artificial Intelligence Action Plan (OTI, 2023) operationalizes these goals through seven initiatives, focusing on implementation mechanisms such as procurement reform, public engagement, and adaptive policy design. The absence of new objectives in the action plan reflects its tactical role in executing the strategic vision. Buenos Aires AI strategy (Gobierno de la Ciudad Autónoma de Buenos Aires, n.d.) frames its challenges as objectives within a tripartite structure: maximizing AI's impact on public services, supporting

technological evolution across sectors, and safeguarding human development through ethical regulation. These goals are embedded in a broader narrative of innovation, competitiveness, and institutional modernization, positioning AI as a transformative tool for urban governance. Barcelona's "Mesura de Govern de l'estratègia municipal d'algoritmes i dades per a l'impuls ètic de la intel·ligència artificial" (Ajuntament de Barcelona, 2021) articulates objectives grounded in technological humanism, aiming to enhance municipal services while safeguarding rights and promoting democratic oversight. The strategy emphasizes ethical deployment, participatory governance, and alignment with the UN's Agenda 2030, positioning the city as a leader in rights-based digital transformation. Madrid's Artificial Intelligence Roadmap (Ayuntamiento de Madrid, 2024a) identifies six institutional and societal challenges, including staff training, interdepartmental coordination, ethical compliance, and transparency, that are operationalized into the mentioned four strategic objectives emphasizing applicability, measurable impact, and citizen trust in AI systems.

In conclusion, while all four cities pursue inclusive and ethical AI integration, their strategies diverge in structure: New York transitions from vision to execution; Buenos Aires embeds objectives within innovation and regulation; Barcelona centers its strategy on democratic and ethical imperatives; and Madrid frames challenges as institutional prerequisites.

5.4. Integrated vision

The deployment of artificial intelligence (AI) in urban governance increasingly demands a systemic approach that interrelates stakeholder engagement, urban systems (focusing on technological infrastructure), and city objectives and challenges. The AI strategies of New York City, Buenos Aires, Barcelona, and Madrid exemplify this integrated model, albeit through distinct trajectories shaped by institutional contexts and governance cultures.

In New York City, the NYC AI Strategy (NYC Mayor's Office of the Chief Technology Officer, 2021) and NYC Artificial Intelligence Action Plan (OTI, 2023) positions the city as a leader in the responsible governance and strategic deployment of AI technologies, and it illustrates a sequential framework where stakeholder typologies evolve from ecosystem mapping to operational roles. Government agencies, academic institutions, and civil society actors are progressively embedded into the technological system through initiatives such as risk assessment frameworks and lifecycle management tools. Strategic objectives —transparency, equity, and innovation—are realized through these mechanisms, with stakeholders serving both as contributors and beneficiaries, concentrating efforts in municipal stakeholders. Buenos Aires strategy (Gobierno de la Ciudad Autónoma de Buenos Aires, n.d.) adopts a tripartite structure—"Create," "Implement," and "Enable"—that aligns stakeholders with specific technological functions. Public agencies, academia, and private actors co-develop infrastructure, apply AI in service delivery, and shape ethical and regulatory frameworks. Strategic goals such as impact generation and human development are pursued through stakeholder-mediated actions, ensuring contextual relevance and institutional coherence. Barcelona's "Mesura de Govern de l'estratègia municipal d'algoritmes i dades per a l'impuls ètic de la intel·ligència artificial" (Ajuntament de Barcelona, 2021) emphasizes ethical governance, embedding stakeholders in the co-creation of AI systems guided by principles such as human oversight and democratic control. Technological systems are designed to embody strategic goals like inclusivity and sustainability, with audit mechanisms and participatory processes reinforcing accountability. Madrid's Artificial Intelligence Roadmap (Ayuntamiento de Madrid, 2024a) integrates stakeholders into a community of practice, linking them to technological applications in mobility, housing, and infrastructure. Strategic objectives—transforming services, managing smart systems, and fostering innovation—are operationalized through thirteen lines of action that navigate institutional challenges like staff training and

transparency. The roadmap's participatory design ensures that technological deployment remains aligned with public value.

In conclusion, all four cities demonstrate a pluralistic and interdependent approach to AI governance. New York transitions from systemic, value-driven integrative visioning to municipal execution; Buenos Aires embeds stakeholder participation within strategic branches; Barcelona anchors its strategy in ethical and democratic imperatives; and Madrid expands from municipal leadership to collaborative innovation. These models reflect the adaptability of urban AI strategies in aligning technological systems with stakeholder capacities and strategic ambitions to face urban challenges.

6. AI City strategy: comprehensive model proposal

Getting the common aspects of the analyzed strategies, a generic model for Artificial Intelligence Strategies for cities is proposed. It is aimed to serve as a basis for the development of collaborative and participatory processes and discussions in the elaboration of Artificial Intelligence Strategies able to answer to the needs of different municipalities. Therefore, it is not a fixed model, but a model to be questioned, modified and adapted to the real needs detected in the process of elaboration of different strategies, aimed at ease the departure point producing different results in its application.

6.1. Stakeholders in the Artificial Intelligence City Strategy

The proposal for a stakeholder architecture for AI intelligence strategies aligns with the pluralistic models observed in the analyzed strategies and provides a scalable foundation for ethical and effective AI integration in urban contexts.

- Municipal Government: City councils, innovation offices, and technical departments responsible for policy design, implementation, and oversight.
- Academic Institutions: Universities and research centers contributing to ethical standards, technical expertise, and evaluation frameworks.
- Private Sector: Startups, tech firms, and business alliances driving innovation, infrastructure, and public-private partnerships.
- Civil Society: NGOs, advocacy groups, and community organizations promoting transparency, digital rights, and citizen-centric development.
- International Organizations: Multilateral bodies offering policy guidance, benchmarking, and funding support.
- Citizens: Residents (or even visitors) engaged through participatory platforms, open data initiatives, and public consultations.

6.2. Urban systems

Drawing from the structural and operational frameworks of the AI strategies of New York City, Buenos Aires, Barcelona and Madrid, the following proposal outlines five integrated lines of action for urban AI governance. These lines synthesize the strategic pillars, ethical principles, and application domains emphasized across the four cities, offering a coherent structure for cities aiming to align technological innovation with spatial governance and public value. This structure offers a multidimensional and scalable framework for cities seeking to integrate AI into urban governance. It balances technological innovation with ethical imperatives and institutional resilience, reflecting the evolving nature of Artificial Intelligence strategies in the global urban landscape.

1. Institutional Capacity and Ethical Governance: This line ensures that municipal institutions are equipped to manage AI responsibly. It includes, among others: Training programs for public employees on AI literacy and ethical use; Establishment of steering committees and advisory

networks; Implementation of ethical principles: transparency, human oversight, accountability, and inclusion.

2. Data Infrastructure and Technological Foundations: This line supports the development of robust data ecosystems and technological enablers. It includes: Creation and maintenance of interoperable city data platforms; Lifecycle management of AI systems and procurement reforms; or support for R&D and innovation in AI technologies.

3. Stakeholder Engagement and Ecosystem Development: This line promotes inclusive governance through multi-sectoral collaboration. It includes Public-private partnerships and innovation clusters; Engagement with academia, civil society, and international organizations; and Participatory platforms for citizen input and co-creation.

4. Strategic Policy Adaptation and Sustainability: This line ensures that AI strategies remain responsive and aligned with broader urban goals. It includes: Integration of Municipal strategies, Iterative policy updates and adaptive governance mechanisms; Alignment with sustainability agendas (e.g., UN Agenda 2030); Monitoring and evaluation frameworks for impact assessment, among others.

5. Urban Intelligence for Spatial System and Urban Services: This line focuses on the deployment of AI in core urban systems—mobility, housing, infrastructure, and environmental services. It can include: Predictive mobility management systems; Public space management systems; AI-driven housing analytics and demand forecasting; Environmental monitoring (e.g., noise, water, air quality) using sensor networks and machine learning; Integration of spatial data (e.g., LiDAR, satellite imagery) for urban planning and infrastructure optimization.

6.3. Challenges and objectives

Based on a comparative analysis of the AI strategies of New York City, Buenos Aires, Barcelona, and Madrid, a unified set of five strategic objectives can be proposed to guide urban artificial intelligence (AI) governance. These objectives synthesize the institutional priorities, ethical imperatives, and operational challenges articulated across the four cities, offering a coherent framework for responsible and inclusive AI integration in urban contexts.

1. Strengthen Institutional Capacity for AI Integration: Cities must develop internal capabilities to manage AI systems effectively. This includes training municipal staff, fostering interdepartmental coordination, and establishing governance structures that support innovation and accountability. The objective reflects the emphasis on workforce development in NYC AI Strategy, institutional readiness in Madrid Artificial Intelligence Roadmap, and internal governance mechanisms in "Mesura de Govern de l'estratègia municipal d'algoritmes i dades per a l'impuls ètic de la intel·ligència artificial".

2. Promote Ethical, Transparent, and Rights-Based AI Deployment: AI systems should be designed and implemented in accordance with democratic values, human rights, and ethical standards. This involves ensuring algorithmic transparency, preventing bias, protecting privacy, and enabling public oversight. Barcelona's ethical principles, New York's governance pillars, and Buenos Aires' regulatory safeguards converge on this objective.

3. Foster Inclusive Ecosystems and Stakeholder Engagement: Urban AI strategies should cultivate multi-sectoral collaboration among government agencies, academia, industry, civil society, and residents. Mechanisms for participatory governance, public-private partnerships, and international cooperation are essential to ensure legitimacy and innovation. This objective is reflected in the stakeholder frameworks of all four cities.

4. Ensure Strategic Adaptability and Sustainable Innovation: Cities must adopt flexible policy instruments that allow for iterative updates, continuous evaluation, and alignment with global agendas such as the UN's Sustainable Development Goals. This includes supporting research and development, promoting open-source technologies, and embedding sustainability into AI

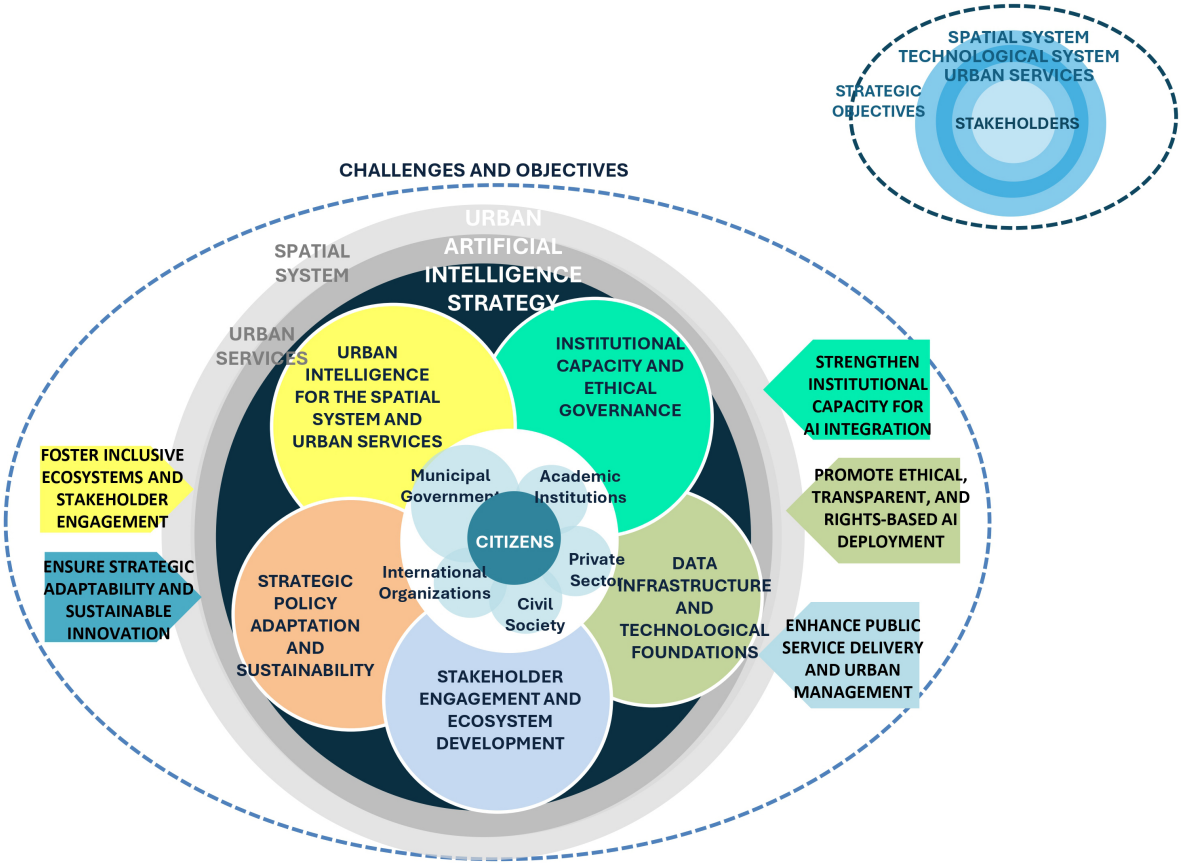
governance. The strategic adaptability seen in New York's action plan and Barcelona's alignment with Agenda 2030 exemplify this goal.

5. Enhance Public Service Delivery and Urban Management: AI must be leveraged to improve the efficiency, responsiveness, and personalization of urban services—such as mobility, housing, sanitation, and environmental monitoring. This objective aligns with the application-focused initiatives in New York the impact-driven goals of Buenos Aires, and Madrid's emphasis on measurable outcomes.

6.4. Integrated approach

Finally, the proposed model is applied to offer a comprehensive vision of the different elements of the AI general strategy (Figure 7).

Figure 7. Comprehensive conceptual model for AI strategies.



Source: Own elaboration, 2025.

The integration of artificial intelligence into urban governance necessitates a systemic alignment between stakeholders, urban systems (mainly technological infrastructures), and strategic objectives, as reflected in the analyzed documents. These three components form a triadic model wherein each element reinforces and constrains the others. Stakeholders—ranging from the core role of municipal governments to civil society and international organizations—serve as both initiators and beneficiaries of AI strategies. Their engagement determines the legitimacy, inclusivity, and ethical orientation of technological deployments. In contrast, the technological system encompasses the operational backbone of urban AI, including data platforms, sensor networks, and algorithmic applications. It translates stakeholder intentions into actionable systems, while also shaping the scope of possible interventions.

When comparing stakeholders and technological systems, a reciprocal dependency emerges: stakeholders define ethical and governance parameters, while technological systems enable or limit their realization. The relationship between technological systems and challenges/objectives is characterized by a tension between innovation and regulation. While AI technologies offer transformative potential for urban management, they also introduce risks—such as bias, opacity, and infrastructural fragility—that must be addressed through strategic objectives like transparency and adaptability.

Finally, the interaction between stakeholders and challenges/objectives reveals the normative dimension of urban AI governance. Stakeholders articulate societal values and institutional priorities, which are then codified into objectives such as ethical deployment, inclusive engagement, and sustainable innovation. This pairing underscores the importance of participatory governance and iterative policy design.

In summary, the integrated model for urban AI strategies is not merely a technical framework but a socio-political construct. Its effectiveness depends on the dynamic interplay between actors, infrastructures, and goals. Cities that successfully harmonize these elements—drawing from the experiences of New York, Buenos Aires, Barcelona and Madrid—are better positioned to leverage AI for public value, institutional resilience, and democratic accountability.

7. Conclusions

This research has examined the conceptualization and implementation of artificial intelligence (AI) strategies in urban governance through a comparative analysis of four cities—New York, Buenos Aires, Barcelona, and Madrid. Using a systemic model that integrates stakeholders, urban systems, and strategic objectives, the study provides a comprehensive framework for understanding how cities are navigating the complexities of AI integration in the context of urban transformation.

A central insight emerging from the analysis is the convergence of stakeholder pluralism across diverse urban contexts. Each city demonstrates a commitment to inclusive governance, engaging actors from municipal administrations, academia, industry, civil society, and international organizations. New York transitions from ecosystem mapping to operational execution; Buenos Aires embeds participatory governance within municipal leadership; Barcelona anchors its strategy in ethical oversight and international alignment; and Madrid evolves from internal coordination to collaborative innovation. These trajectories underscore the adaptability of urban AI strategies to local governance cultures and institutional capacities.

The technological subsystem remains the structural core of all four strategies, reflecting the centrality of data infrastructure, algorithmic tools, and digital platforms in contemporary urban governance. While spatial and service systems—such as mobility, housing, and environmental services—are referenced in each strategy, they are often treated as domains of application rather than foundational pillars. This suggests a need for more integrated approaches that elevate spatial governance and urban infrastructure within AI frameworks, ensuring that technological innovation is grounded in the lived realities of urban environments.

Ethical considerations and institutional resilience emerge as cross-cutting themes. The cities analyzed articulate a shared concern for transparency, accountability, and human-centered design in AI deployment. Barcelona's emphasis on democratic control and rights-based governance, New York's adaptive policy mechanisms, Buenos Aires' regulatory safeguards, and Madrid's focus on institutional readiness collectively reflect a normative shift toward responsible innovation. These strategies recognize that AI is not merely a technical tool but a socio-political construct that must be aligned with public values and democratic principles.

The proposed integrated model synthesizes these findings into a triadic structure comprising stakeholders, technological systems, and strategic objectives. This model reveals the reciprocal

dependencies among its components: stakeholders define governance parameters and ethical standards; technological systems operationalize these parameters while shaping the scope of intervention; and strategic objectives codify societal values and institutional priorities. The effectiveness of urban AI strategies thus depends on the dynamic alignment of these elements, reinforcing the importance of participatory governance, iterative policy design, and ethical oversight.

Ultimately, the integration of AI into urban governance demands a systemic and adaptive approach. Cities must move beyond isolated pilot projects and fragmented initiatives toward comprehensive strategies that interlink institutional capacity, technological infrastructure, and societal engagement. The experiences of New York, Buenos Aires, Barcelona, and Madrid demonstrate that while there is no singular path to AI integration, common principles—such as inclusivity, transparency, and sustainability—can guide cities in leveraging AI for public value and democratic accountability.

This research contributes to the growing body of literature on urban AI by offering a conceptual model that is both descriptive and generative. It serves as a foundation for future studies and policy development, enabling cities to critically assess their AI strategies and adapt them to evolving technological, social, and environmental conditions. As urban systems become increasingly complex and data-driven, the capacity to design and implement ethical, inclusive, and resilient AI strategies will be essential for shaping the cities of the future.

This study acknowledges limitations in different fields that open the path for further research. First, the geographical scope of the analysis remains constrained, and future research should extend the empirical application of the proposed framework to a broader range of cities, particularly in Asia, emerging urban centers in Africa, and selected cases in Oceania. Second, while the synthetic model introduced herein offers a conceptual foundation, its robustness could be significantly strengthened through empirical validation involving key stakeholders and its application to the development of real strategies. Given the dynamic evolution of AI as both a technological and governance domain, continuous refinement of the model is essential to ensure its alignment with emerging technological innovations, evolving stakeholder priorities, and shifting regulatory and legislative landscapes. Finally, the integration of sustainability frameworks into AI strategies, as in the case of Barcelona, represents a critical dimension for future inquiry, particularly in light of the growing emphasis on sustainable urban development and ethical AI deployment.

Therefore, this paper opens the path for future development of research and proposals in the field of AI city strategies and their integration into more holistic and global strategies for the city, combining the technological approaches with the urban spatial systems and the coordination of urban services. As explained in the introduction of this research, a development process is ongoing in Madrid through the initiative" Sueña Madrid" (Ayuntamiento de Madrid, n.d.), a strategic initiative launched by the Ayuntamiento de Madrid to collectively envision the future of the city through a participatory and inclusive process. Currently, the Strategic Plan development is ongoing, generating new opportunities. Authors such as Castells (2004) or Angelidou (2014) explored the interaction of the technological and the spatial dimensions of the city. This paper and the selection of Madrid case study aim at opening the path for the generation of new models integrating spatial and technological aspects exploring the possibilities of Artificial Intelligence to enable this interaction based.

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