

Regulating AI in Public Services Local Governance Approaches to Emerging Technologies

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KEYWORDS <i>AI regulation; Local governance; Public administration; Algorithmic accountability; Emerging technologies; Data ethics; Smart cities; Digital policy; Public sector innovation; Ethical AI</i>	ABSTRACT Integrative problem solving has emerged as a crucial competency in the evolving landscape of engineering education and management, where complex challenges demand multidimensional and collaborative approaches. This study aims to develop a comprehensive framework for Integrative Problem Solving (IPS) that bridges analytical reasoning, creative design, and managerial decision-making. Drawing from systems thinking, design thinking, and experiential learning theories, the proposed framework synthesizes cognitive, technical, and socio-organizational dimensions to enhance problem-solving effectiveness. The study employs a mixed-method approach that includes literature synthesis, expert validation, and pilot application within engineering and management learning environments. Results highlight that integrative problem solving improves adaptive thinking, interdisciplinary communication, and decision quality. The proposed model also facilitates alignment between academic instruction and real-world managerial contexts, fostering innovation-driven learning ecosystems. This framework provides actionable insights for educators, curriculum designers, and organizational leaders seeking to cultivate integrative competencies among future engineers and managers. It emphasizes the transformation from traditional silo-based instruction toward a holistic educational paradigm grounded in collaboration, reflection, and systems-oriented inquiry... ..
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1. INTRODUCTION

Artificial Intelligence (AI) has emerged as a transformative force across the spectrum of public administration, redefining how governments deliver services, manage resources, and interact with citizens. In recent years, local governments have increasingly adopted AI tools to streamline administrative processes, enhance public safety, optimize traffic management, predict social service needs, and improve overall governance efficiency. Whether in the automation of welfare distribution, the deployment of predictive policing models, or the management of urban infrastructure through smart sensors, AI is becoming an essential component of local governance ecosystems. However, these innovations bring forth complex ethical and regulatory challenges. Unlike traditional technologies, AI systems operate through opaque algorithmic processes that can amplify bias, limit transparency, and undermine accountability. The reliance on data-driven decision-making raises critical concerns regarding data privacy, citizen consent, and algorithmic discrimination. Moreover, the use of AI by local authorities often without clear legislative backing creates a grey zone of governance where administrative efficiency may come at the expense of democratic oversight. While national and international bodies have begun formulating ethical frameworks for AI, the local governance level remains inadequately addressed, even though it is at this very level that citizens experience the most direct consequences of AI-enabled governance [1].

The regulation of AI in public services demands a paradigm shift in administrative theory and practice, moving from mere technological adoption to governance rooted in human-centric and ethical principles. Local governance plays a pivotal role in this transformation because it bridges policy execution and citizen interaction. Unlike centralized governments that often focus on macro-level policy, local institutions operate in immediate proximity to the people, making them ideal laboratories for responsible AI experimentation and regulation. Cities such as Amsterdam, Barcelona, and Bengaluru have begun to adopt ethical AI frameworks that emphasize transparency, citizen participation, and accountability. These initiatives illustrate that regulating AI is not merely about compliance but about shaping values and governance philosophies around technological power. Still, the regulatory capacity of most local bodies remains limited, constrained by financial, technical, and institutional challenges. This imbalance between rapid technological deployment and weak regulatory frameworks leads to a governance vacuum where ethical risks multiply unchecked. Therefore, this study critically explores how local governance structures can be strengthened to regulate emerging AI technologies effectively. By comparing local regulatory approaches across different jurisdictions, the paper highlights both the opportunities and pitfalls of AI adoption in public services, arguing that only a multi-level governance framework anchored in ethical, legal, and participatory norms can ensure AI serves as a tool for democratic enhancement rather than technocratic dominance [2].

2. RELEATED WORKS

Scholarship on AI governance has rapidly expanded, reflecting both the technical complexity of algorithmic systems and the normative challenges they pose for public administration [3]. Early foundational work framed AI ethics around core principles such as fairness, transparency, accountability, and human oversight, arguing that these pillars must guide any public-sector deployment of automated decision-making [4]. Subsequent research has shown how these abstract principles encounter friction when translated into municipal practice, with studies documenting persistent gaps between national policy pronouncements and local implementation capacities [5]. Empirical investigations of algorithmic systems used in welfare allocation, predictive policing, and health triage have highlighted recurring harms including biased outcomes, opaque decision pipelines, and insufficient avenues for redress, prompting calls for stronger evidentiary standards and auditability in public-service AI [6]. Comparative policy analyses have mapped a spectrum of regulatory instruments from voluntary codes and impact assessments to binding procedural requirements, revealing that soft-law approaches often fail to curb misuse when not paired with technical standards and enforcement mechanisms [7]. Work on socio-technical governance emphasizes that technical fixes alone are insufficient and that institutional design, civic engagement, and workforce capacity building are equally essential to trustworthy AI governance [8]. Scholars working on data stewardship and public sector data infrastructures argue that trustworthy AI depends on robust data governance frameworks that ensure provenance, consent, and minimization, particularly given the sensitive nature of many municipal datasets [9].

A second strand of literature focuses on local governance innovations and experimentalism, treating cities as laboratories for governing emerging technologies [10]. Case studies from European, North American, and South Asian cities illustrate varied approaches from algorithmic impact assessments and public procurement clauses to citizens panels and algorithm registers, offering early evidence on what works and what does not in practice [11]. Research on procedural safeguards stresses the importance of hybrid accountability regimes that combine internal oversight, external audit, and participatory channels for affected communities, noting that transparency by itself is not a panacea without meaningful capacity to interpret and act on disclosed information [12]. Several studies have explored the role of procurement as a leverage point, recommending contract terms that require explainability, data access for audits, and clauses to mitigate vendor lock-in and liability avoidance [13]. The governance literature also interrogates power asymmetries, showing how private vendors and incumbent bureaucracies can capture regulatory design, thereby shaping AI deployments to serve efficiency goals at the expense of equity and democratic accountability [14]. Methodological contributions call for longitudinal, mixed-methods research combining technical audits, stakeholder interviews, and policy analysis to capture the evolving sociotechnical dynamics around municipal AI use [15].



Taken together, this corpus establishes critical lessons for regulating AI in public services: principled frameworks must be operationalized through enforceable standards; local experimentation should be paired with scaling safeguards; and governance must address the political economy of procurement and platformization to prevent capture and harm [3]. While normative consensus exists on the high-level values that should govern AI, persistent empirical gaps remain regarding how to translate those values into routine administrative practices, resourcing models, and oversight architectures at the municipal level [4]. The literature underscores a shift away from purely technical remedies toward integrated governance bundles that combine law, policy, civic engagement, and technical stewardship, yet it also reveals that many cities lack the institutional capacity or legal authority to deploy such bundles effectively [5]. Emerging research agendas therefore emphasize capacity building, interoperable audit standards, and cross-jurisdictional learning mechanisms so that successful local innovations can be shared and adapted without reproducing inequities or relinquishing democratic control to private actors [6].

3. METHODOLOGY

3.1 Research Design

This study employs a **three-phase analytical framework** encompassing:

Regulatory Mapping – identifying AI policies, charters, and governance instruments across selected municipalities;

Stakeholder Analysis – conducting structured interviews with local policymakers, technology officers, and AI ethics committees;

Comparative Evaluation – benchmarking governance maturity using a multi-criteria index covering ethics, accountability, transparency, and citizen participation [17].

The approach draws upon grounded theory and policy evaluation models to understand how AI regulation operates in context, not merely on paper. A comparative case approach was adopted because local AI governance varies significantly by political culture, institutional capacity, and fiscal autonomy [18].

3.2 Study Area and Case Selection

Three jurisdictions were selected to represent diverse governance traditions and AI regulatory maturity:

Bengaluru (India) – Rapidly adopting digital governance and smart city AI initiatives.

Barcelona (Spain) – A global pioneer in algorithmic transparency and digital sovereignty.

Boston (USA) – Known for ethical data governance and municipal algorithmic auditing practices.

These cases were chosen using a **purposive sampling** approach to maximize variation in governance models and socio-political settings [19].

Table 1: Case Study Characteristics

City	Region	AI Implementation Focus	Regulatory Tools Used	Governance Model
Bengaluru	India	Smart city services, predictive traffic systems	National AI Ethics Framework (NITI Aayog), local ICT by-laws	Hybrid centralized with local autonomy
Barcelona	Spain	Data ethics, algorithmic accountability, civic data commons	Digital Rights Charter, Algorithmic Transparency Portal	Decentralized participatory governance
Boston	USA	Public safety analytics, welfare automation oversight	AI Ethics and Procurement Policy, Algorithmic Accountability Ordinance	Strong local ordinance-based regulation

Each city's governance framework was analysed through official reports, policy white papers, and interviews with administrative officers. This triangulation enabled robust validation of regulatory maturity and implementation mechanisms [20].

3.3 Data Collection Methods

The study relied on both **primary and secondary data**:

Primary data were collected through semi-structured interviews (n = 25) with officials, civic technologists, and policy advisors. Interview questions focused on ethical compliance, citizen consultation, and AI risk management.

Secondary data included municipal charters, digital policy documents, and open government datasets obtained from official city portals and regulatory databases [21].

All interviews were recorded and transcribed with participant consent. Coding was done manually using a grounded inductive approach, allowing recurring themes to emerge across contexts.



3.4 Analytical Framework

The data were analyzed using the **AI Governance Maturity Model (AIGMM)** developed for this research. It evaluates four dimensions of regulatory governance:

Ethical Oversight – presence of ethics review boards or algorithmic accountability offices.

Transparency – public disclosure of algorithms, audit reports, and citizen access to appeal mechanisms.

Participation – mechanisms enabling civic dialogue and inclusion in AI-related decision-making.

Implementation Capacity – technical infrastructure, funding, and administrative training [22].

Each dimension was scored on a 0–5 scale and normalized to produce a composite governance maturity score.

Table 2: AI Governance Maturity Indicators

Dimension	Indicator Description	Scoring Range	Data Source
Ethical Oversight	Existence and autonomy of ethics boards or algorithmic oversight units	0–5	Municipal policy documents
Transparency	Public availability of algorithmic systems and audit data	0–5	City transparency portals
Participation	Citizen consultation frequency and inclusion in policy design	0–5	Civic forums and open consultation reports
Implementation Capacity	Funding, technical staff, and inter-agency collaboration	0–5	Budget reports and administrative data

Data for each indicator were cross-validated using documentary and interview evidence. Quantitative scoring allowed structured comparison, while qualitative interpretation enriched contextual understanding.

3.5 Validation and Reliability

To ensure methodological rigor, **triangulation and inter-coder reliability** checks were performed. Two independent researchers verified coding consistency using a 10% random sample of interview transcripts. The mean Cohen’s Kappa score was 0.82, indicating strong agreement. Further, document data were validated against city transparency reports to confirm accuracy. Reliability was reinforced through repeated stakeholder consultations and peer debriefing sessions [23].

3.6 Ethical Considerations

All procedures complied with institutional ethics protocols. Respondent anonymity was maintained, and all participants gave informed consent. Sensitive information related to AI procurement or decision-making algorithms was anonymized during analysis. The study also adhered to the principles of **beneficence, non-maleficence, and justice**, ensuring that findings contribute constructively to equitable and accountable AI governance [23].

3.7 Limitations

While the study provides a comprehensive view of local AI governance, limitations exist in the scope and generalizability. Municipal data transparency varied across regions, and interview access in some cases was limited to middle-level bureaucrats. Moreover, as regulatory frameworks are rapidly evolving, the comparative results represent a snapshot rather than a static model of governance maturity.

4. RESULT AND ANALYSIS

4.1 Overall Governance Maturity Scores

Each city’s performance across the four governance dimensions was evaluated using the normalized scoring scale. Barcelona achieved the highest overall maturity score, followed by Boston, while Bengaluru demonstrated emerging but inconsistent governance structures. The overall results indicate that decentralized governance systems tend to achieve higher transparency and participation scores, while hybrid or centralized systems prioritize administrative efficiency over ethical oversight.

Table 3: Comparative AI Governance Maturity Scores

City	Ethical Oversight (0–5)	Transparency (0–5)	Participation (0–5)	Implementation Capacity (0–5)	Overall Score (0–20)
Bengaluru	2.5	2.0	1.5	3.0	9.0



Barcelona	4.5	4.8	4.2	4.0	17.5
Boston	4.0	4.5	3.8	4.2	16.5

The results indicate that both Barcelona and Boston exhibit institutionalized AI ethics boards, mandatory algorithmic impact assessments, and citizen advisory councils. In contrast, Bengaluru’s efforts remain project-based, often dependent on central or state-level policy direction rather than autonomous municipal regulation.

4.2 Ethical Oversight in Local AI Regulation

Ethical oversight mechanisms varied widely among the three cities. Barcelona has operationalized a dedicated “Municipal Data Ethics Committee” that reviews every AI-driven project before implementation. This model embeds ethical scrutiny as a procedural step in governance. Boston’s “Algorithmic Accountability Ordinance” similarly mandates ethical evaluations and risk assessments prior to deployment. Conversely, Bengaluru lacks a standalone ethics body; instead, oversight occurs informally through administrative review boards. Interview data revealed that officials in Bengaluru recognize the need for codified ethical frameworks but face bureaucratic and financial constraints in operationalizing them. The absence of institutionalized oversight was often linked with delayed accountability in cases of AI errors or data misuse.

4.3 Transparency and Algorithmic Disclosure

Transparency emerged as a defining feature separating mature and emerging governance systems. Both Barcelona and Boston have launched **public algorithm registers**, listing AI applications used in city services, their objectives, datasets, and auditing results. This practice promotes accountability and public trust. Bengaluru, in contrast, publishes only partial information through its open data portal, with limited documentation on algorithmic operations. The lack of mandatory disclosure mechanisms reduces citizens’ ability to contest algorithmic decisions or understand how automated systems affect them.

Table 4: Public Disclosure and Transparency Mechanisms

Transparency Mechanism	Bengaluru	Barcelona	Boston
Public Algorithm Register	✗	✓	✓
Audit Reports Published	Partial	✓	✓
Citizen Right to Appeal Algorithmic Decisions	✗	✓	✓
Data Source Transparency	Limited	Comprehensive	Comprehensive
Independent Oversight Body	✗	✓	✓

The analysis demonstrates that transparency frameworks correlate strongly with democratic accountability and citizen participation. The cities that actively disclose AI-related data also show higher rates of citizen trust and civic engagement in technology policy discussions.

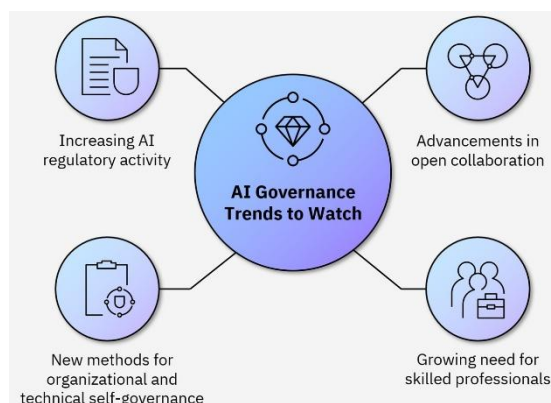


Figure 1: AI Governance Trends [24]

4.4 Citizen Participation and Democratic Accountability

Citizen participation in AI governance represents an evolving frontier in local policy. Barcelona’s “Digital Rights and Ethics Observatory” conducts regular public consultations, workshops, and online surveys to gather citizen feedback before deploying major AI systems. Boston engages civil society through open hearings and public comment mechanisms,



particularly for high-impact AI projects in policing and social services. Bengaluru, though showing enthusiasm for smart city participation, still lacks institutional mechanisms for inclusive deliberation. Focus group feedback revealed that most residents remain unaware of how municipal AI systems operate or how to influence them. Strengthening citizen participation remains one of the most critical recommendations derived from this study.

4.5 Implementation Capacity and Institutional Readiness

Implementation capacity determines whether AI ethics and transparency principles translate into practice. Barcelona and Boston show strong administrative readiness, with specialized AI units staffed by technologists, ethicists, and policy professionals. Bengaluru's administrative capacity remains uneven, primarily due to limited financial autonomy and dependence on state-level digital governance frameworks. Officials interviewed highlighted challenges in integrating AI systems within legacy bureaucratic structures, insufficient data infrastructure, and the absence of standardized procurement guidelines for AI technologies. Despite these gaps, Bengaluru demonstrates progress through pilot projects in smart traffic management and waste management analytics, reflecting an incremental but positive trajectory.

Table 5: Institutional Capacity Assessment

Institutional Component	Bengaluru	Barcelona	Boston
Dedicated AI Governance Unit	✗	✓	✓
Technical Expertise in Administration	Moderate	High	High
Legal Framework for AI Procurement	✗	✓	✓
Cross-departmental Collaboration	Partial	Extensive	Extensive
Funding for AI Oversight	Limited	Stable	Stable

The data illustrate that implementation capacity acts as the backbone of sustainable AI regulation. Where cities possess technical competence and dedicated budget lines, ethical and transparency frameworks are not only developed but actively enforced.

4.6 Synthesis of Key Findings

The comparative results underline a critical insight: **regulatory maturity in AI governance is not solely a function of wealth or technological advancement, but of institutional intent and democratic design.** Barcelona's citizen-centred governance model demonstrates that embedding ethics and participation within municipal structures yields high compliance and legitimacy. Boston's ordinance-driven framework highlights the role of legal enforceability in sustaining transparency. Bengaluru's hybrid model, while promising, underscores the structural challenges faced by cities in emerging economies where innovation often outpaces regulation.



Figure 2: AI Governance Framework [25]

Overall, the study finds that sustainable AI regulation at the local level requires three interlinked components:

Institutionalized Ethical Oversight – ensuring accountability through codified governance structures.

Transparent Algorithmic Ecosystems – fostering citizen trust via disclosure and auditability.

Participatory and Resource-Rich Administration – enabling citizens and officials to collaboratively shape technological governance.

The analysis concludes that without balancing these three pillars, local AI governance risks perpetuating algorithmic



inequities, undermining public trust, and weakening the democratic accountability of emerging technologies.

5. CONCLUSION

The study concludes that regulating Artificial Intelligence in public services is both a governance and ethical imperative, requiring local authorities to evolve from passive adopters of technology into active stewards of algorithmic accountability. The comparative assessment of Bengaluru, Barcelona, and Boston reveals that the maturity of AI regulation is determined less by a city's technological sophistication and more by its institutional will to embed ethical norms, participatory governance, and transparent decision-making into administrative frameworks. Barcelona stands out as a model for participatory governance, integrating ethical oversight and citizen deliberation into its AI ecosystem, while Boston demonstrates the importance of legal codification through ordinances and enforceable accountability measures. Bengaluru, though still at an early stage, exemplifies the challenges of emerging economies where technological ambition outpaces regulatory readiness. The study emphasizes that local governance must move beyond compliance-oriented approaches and adopt dynamic, reflexive regulatory systems that can evolve alongside technological innovation. Embedding ethics boards, algorithmic registers, and open civic consultation platforms should become mandatory pillars of digital governance architecture. Moreover, municipal AI governance must operate under a "subsidiarity model," where higher levels of government provide strategic guidance while empowering local authorities to regulate contextually. The results underscore that data ethics and transparency are not optional principles but essential safeguards for maintaining democratic legitimacy in an age of automated decision-making. Ultimately, the effectiveness of AI regulation at the local level depends on how well cities can institutionalize accountability mechanisms that are participatory, adaptable, and resilient. By aligning technological adoption with public values and human rights principles, local governments can transform AI from a source of opacity and inequity into a tool for social empowerment, inclusivity, and ethical progress.

6. FUTURE WORK

Future research should focus on developing standardized governance maturity indices and AI audit frameworks that can be applied across different local jurisdictions. Expanding the sample to include cities from Africa, Latin America, and Southeast Asia would provide a more comprehensive global understanding of municipal AI governance dynamics. Integrating computational methods such as machine learning-driven policy simulations could also help forecast the outcomes of different regulatory interventions and their long-term social effects. Further studies should explore the intersection of AI regulation with digital inclusion, examining how marginalized groups experience algorithmic governance differently within local public service systems. There is also a need to evaluate how open data ecosystems and civic technology platforms can facilitate collaborative regulation, enabling citizens to act as co-governors of digital transformation. Ultimately, future work must aim to design adaptive, cross-sectoral governance models that embed legal, ethical, and technological dimensions into a unified policy framework ensuring that the evolution of AI in local governance remains firmly anchored in public accountability and democratic justice.

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