

The Social Production of Smart Cities: A Critical Sociology of Technology, Governance, and Citizenship in Digital Urbanism

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Abstract

The concept of smart cities extends beyond the integration of technological systems; it is a social process where technology, governance, and citizenship are mutually constructed. This paper adopts a critical sociology perspective to explore the socio-technical production mechanisms of "smart cities" within digital urbanism. Through comparative case studies of Hangzhou, Singapore, and Barcelona, this research examines how the Internet of Things (IoT), big data platforms, and urban brains reshape governmental governance logic, public service delivery methods, and citizen participation spaces. The study reveals that the deployment of these technologies often becomes embedded in existing power structures, leading to issues such as "data bureaucratization," "superficial participation," and "digital exclusion." True smart cities should transcend instrumental rationality and shift towards citizen-centric "responsive governance," emphasizing transparency, inclusiveness, and techno-democracy.

Keywords

Smart cities, critical sociology, digital urbanism, governance, citizenship.

1. Introduction

The rise of "smart cities" represents a dominant paradigm in contemporary urban development, promising efficient urban management through digital technologies. However, this techno utopian narrative often obscures deeper social and political transformations. This paper argues for understanding smart cities as social productions rather than technological products—dynamic sites where technology, governance models, and citizenship are co-constructed through complex socio-political processes[1,2].

We employ a critical sociology lens to examine three distinctive models: Hangzhou's statecorporate integration, Singapore's corporatist approach, and Barcelona's citizen-centric municipalism. Our analysis reveals how each configuration produces specific forms of urban governance and citizenship, with significant implications for democracy and social justice[3].

2. Theoretical Framework

2.1. Technology as Political Artifact

Langdon Winner's seminal question "Do artifacts have politics?" [4] reminds us that technologies embody specific power relations. Urban sensors and algorithms are not neutral tools but political choices that encode particular visions of social order. Science and Technology Studies further reveal how technologies are "socially constructed" through the values and interests of their designers[5]. In the smart city context, technological systems often reinforce existing power structures while creating new forms of surveillance and control[6].

2.2. Governing through Data

The datafication of urban governance represents a fundamental shift toward what we term "data bureaucratization." This transformation can be understood through the lens of "programmable urbanism" where cities become computational systems. The tension between efficiency gains and democratic deficits can be expressed as:

$$\Delta G = \frac{\partial(Daa)}{\partial(Institution)} \times \alpha - \beta \quad (1)$$

where ΔG represents governance change, $\frac{\partial(Daa)}{\partial(Institution)}$ is data infusion rate, α is efficiency multiplier, and β is democratic deficit. Smart cities become arenas where this equation is constantly negotiated.

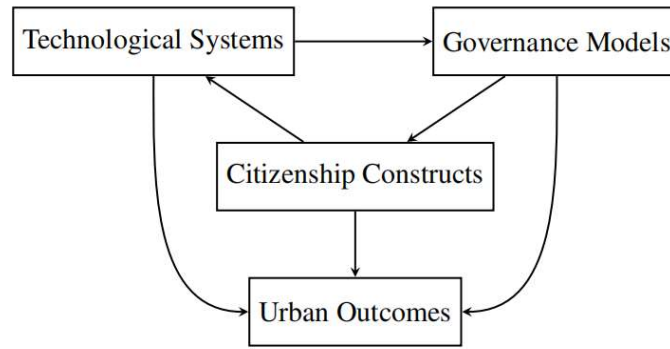


Figure 1. The Socio-technical Production Process

3. Methodology

This research employs qualitative comparative analysis of Hangzhou, Singapore, and Barcelona, selected for their contrasting approaches. Data collection included policy document analysis (2019-2023), 30 semi-structured interviews with urban officials, tech developers, and civil society representatives, and archival research of public consultation records. Thematic analysis followed an abductive approach, connecting empirical findings with theoretical frameworks from critical urban studies.

4. Comparative Analysis

4.1. Hangzhou: The Corporate-State Platform

Hangzhou's "City Brain," developed with Alibaba, represents deep state-corporate integration. The system optimizes traffic flow and public services through real-time data analysis. While achieving operational efficiencies, this model creates "data bureaucratization" where algorithmic decisions supersede human discretion. Citizens become data-subjects rather than political agents, with limited channels for meaningful participation.

4.2. Singapore: Technocratic Corporatism

Singapore's "Smart Nation" initiative exemplifies state-led technocratic governance. The government strategically partners with technology firms to create integrated digital services. However, this efficiency-focused approach often results in "superficial participation"-citizen feedback is channeled through managed platforms that limit fundamental critique. As one interview

we noted, "The conversation is always about 'how' to implement smarter, rarely about 'why' this policy."

Table 1. Comparison of Smart City Models

Dimension	Hangzhou	Singapore	Barcelona
Primary Driver	State-Corporate Symbiosis	State-led Corporatism	Citizen-Centric Municipalism
Governance Logic	Algorithmic Management	Technocratic Pragmatism	Co-Creation
Citizenship Model	Data-Subject	Service User	Political Agent

4.3. Barcelona: Technological Sovereignty

Barcelona's alternative model under Mayor Ada Colau emphasized "technological sovereignty" through open-source platforms and citizen co-creation. Initiatives like the Decidim participation platform and city-owned IoT infrastructure aimed to reclaim digital rights. This approach actively combats digital exclusion but faces challenges in scalability and sustainability beyond political cycles[7].

5. Critical Discussion

5.1. Recurring Pathologies

Our analysis identifies three persistent challenges. First, data bureaucratization creates accountability black boxes when algorithmic logic becomes opaque. Second, superficial participation reduces complex political choices to simplified digital interactions. Third, digital exclusion marginalizes communities lacking technological access or literacy[8].

The legitimacy of smart city projects can be modeled as:

$$L = \int_{t_0}^{t_1} [A(t) \cdot T(t) \cdot I(t)] dt \quad (2)$$

where legitimacy L depends on authentic participation $A(t)$, transparency $T(t)$, and inclusiveness $I(t)$ over time.

Table 2. Stakeholder Perceptions of Smart City Impacts

Impact Area	Positive (%)	Negative (%)
Administrative Efficiency	85	15
Public Accountability	30	70
Social Inclusion	40	60
Civic Engagement	35	65

5.2. Toward Responsive Governance

Moving beyond efficiency-oriented models requires responsive governance based on three principles: radical transparency (open algorithms and data), substantive inclusion (design justice), and empowered participation (co-creation). This approach uses technology not to manage populations but to strengthen democratic communities[9].

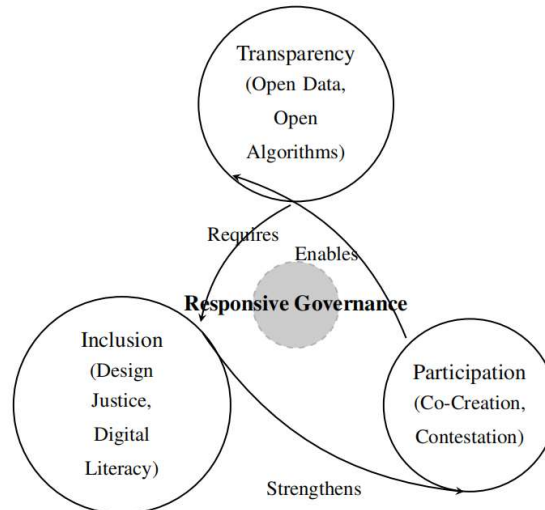


Figure 2. The Virtuous Cycle of Responsive Governance in Smart Cities

6. Conclusion

Smart cities represent contested terrain where technological systems, governance models, and citizenship are mutually constituted. Our comparative analysis demonstrates that without deliberate democratic design, smart urbanism risks reinforcing existing power structures and undermining political agency. The Barcelona case suggests alternatives are possible but require sustained political commitment. Future smart city development must prioritize justice-oriented responsive governance over mere technical efficiency, ensuring that digital urbanization serves democratic ends rather than automating inequality.

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