BUSINESS MODEL ARCHITECTURES FOR SMART URBAN DEVELOPMENT: COMPARATIVE EVIDENCE FROM LONDON, AMSTERDAM, AND BERLIN

Lynne Mitchell
Elizabeth J. Burton

Smart city scholarship has matured well beyond a purely technological discourse, yet the organizational and financial architectures that enable urban transformation remain unevenly synthesized in the literature. This article presents a policy-oriented comparative study of business models used in smart cities, positioned explicitly at the intersection of urban development, digital governance, and sustainable infrastructure delivery. Using a narrative review of Scopus-indexed publications and a comparative analysis of three leading European smart cities—London, Amsterdam, and Berlin—the study identifies the principal institutional arrangements through which smart city initiatives are financed, governed, and operationalized.

The review frame is anchored in a ten-year Scopus search window (2014–2024) and centers the 153 records retrieved for the combined terms "smart cities" and "business models." Across this corpus and the accompanying case analysis, eight recurrent business model families are consistently observed: public–private partnerships, build–operate–transfer arrangements, performance-based contracts, community-centric models, innovation hubs and incubators, revenue-sharing models, outcome-based financing, and asset monetization strategies. The comparative evidence shows that the three benchmark cities do not converge on a single ideal model. Rather, they assemble distinct portfolios of contractual, collaborative, and entrepreneurial mechanisms aligned with their infrastructure priorities, social goals, and governance traditions.

London is characterized by strong large-scale infrastructure partnerships and revenue-linked service operation; Amsterdam demonstrates especially coherent integration of redevelopment, mobility innovation, and participatory urbanism; Berlin stands out for combining infrastructural pragmatism with community-driven housing and innovation ecosystems. The central conclusion is that successful smart urban development depends less on any one contractual instrument than on the strategic orchestration of complementary business models that jointly enhance efficiency, resilience, legitimacy, and long-term urban value creation.

Index Terms — smart cities; urban development; business models; urban governance; public–private partnerships; sustainable infrastructure; innovation ecosystems; comparative urban studies

https://doi.org/10.66033/judsc2024-112

INTRODUCTION

Urban development in the digital era is increasingly shaped by the capacity of cities to combine technological innovation with institutional design. Smart city debates have often focused on information and communication technologies, data platforms, intelligent mobility systems, and digitally mediated public services. Yet the viability of these initiatives depends not only on technological capability, but also on the business models through which cities mobilize capital, allocate risk, coordinate stakeholders, and sustain operations over time.

This article addresses that institutional dimension directly. It develops a clear and policy-relevant synthesis of the business model architectures used in smart cities and examines how those architectures are expressed in three leading European urban contexts: London, Amsterdam, and Berlin. The analytical emphasis is deliberately aligned with the concerns of urban development and smart city strategy: infrastructure delivery, sustainability, livability, participatory governance, and long-term implementation capacity.

The study is guided by three research questions:

RQ1: What business models are most commonly implemented in smart cities?

RQ2: How are these business models operationalized in leading European smart cities?

RQ3: What urban development advantages are associated with the use of particular business model configurations?

Rather than introducing unsupported synthetic scoring, the manuscript remains grounded in the source evidence: a structured narrative review and a comparative case-based interpretation. This produces a more robust and defensible contribution for a journal focused on urban development and smart cities.

CONCEPTUAL FRAMING

Why Business Models Matter in Smart Urban Development

Business models in smart cities are not merely commercial devices. They are institutional arrangements that shape how urban projects are financed, who participates in delivery, how benefits are distributed, and whether initiatives remain viable after initial implementation. In practice, business models mediate the relationship between public objectives and private capabilities. They influence the speed of infrastructure deployment, the degree of citizen inclusion, the ability to scale innovation, and the resilience of service provision.

A business-model perspective is therefore essential for urban development analysis because it links technological ambition to implementation reality. It also addresses a persistent gap in smart city research, where the technological and policy dimensions are often emphasized while the organizational logic of delivery remains less systematically examined.

Core Business Model Families

The literature and case evidence consistently identify eight recurring business model families in smart city practice:

(1) Public–private partnerships (PPP)

(2) Build–operate–transfer (BOT)

(3) Performance-based contracts

(4) Community-centric models

(5) Innovation hubs and incubators

(6) Revenue-sharing models

(7) Outcome-based financing

(8) Asset monetization

Taken together, these models span three broad functions: infrastructure provision, operational accountability, and socially embedded innovation. This functional diversity is what makes them especially relevant to contemporary urban development strategy.

MATERIALS AND METHODS

Research Design

The study uses a narrative review methodology combined with comparative case analysis. The review component synthesizes academic and practice-oriented literature on smart city business models. The case component then examines how the identified models are realized in three leading European smart cities: London, Amsterdam, and Berlin.

The design is intentionally suited to an urban development journal: it combines conceptual synthesis with policy-relevant, place-based interpretation rather than abstract typology alone.

Search Strategy and Review Frame

The literature review is based on Scopus-indexed publications and employs a ten-year search window from 2014 to 2024. The primary analytical corpus is the set of papers retrieved under the combined search terms "smart cities" and "business models." The source study reports 162 total hits for this search string in Scopus, of which 153 publications remained within the filtered 2014–2024 frame.

The search logic also included adjacent segments involving "cities" with "business models" and "sustainable smart cities" with "business models," allowing the authors to situate the focal corpus within a broader field of urban and sustainability-oriented business model research.

Table 1: Scopus search results used to define the review frame

Keyword combination	Scopus total	From 2014
“smart cities”	32,424	31,903
“business models”	19,340	13,656
“smart cities” and “business models”	162	153
“sustainable cities”	2,968	2,594
“sustainable smart cities” and “business models”	9	9
“cities”	185,160	127,469
“cities” + “business models”	247	220

Comparative Case Selection

London, Amsterdam, and Berlin were selected in the source study as leading European smart city cases, with reference to the 2023 ProptechOS smart city ranking. The comparative purpose is not to establish a universal hierarchy, but to examine how similar strategic ambitions are translated into different institutional and business-model choices.

Analytical Procedure

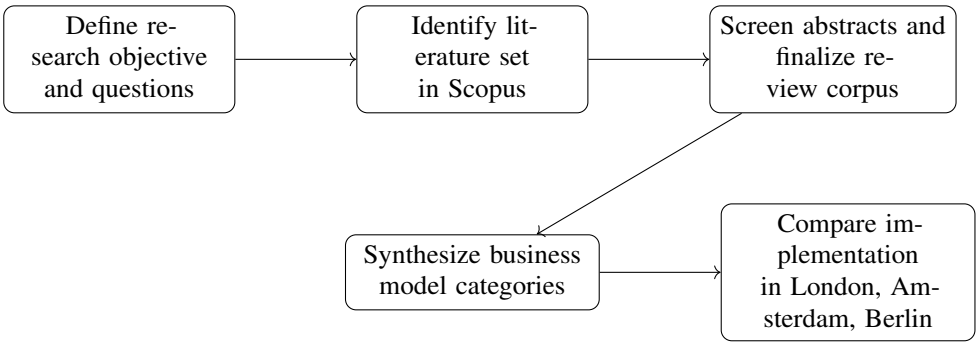

Figure 1: Analytical workflow used in the study.

The analytical sequence comprises five steps:

1. define the research objective and questions;
2. identify the relevant literature set;
3. screen and delimit the working dataset;
4. synthesize the principal business model types;
5. compare how these models are implemented across the three focal cities.

FINDINGS FROM THE LITERATURE REVIEW

The Smart City as an Institutional, Not Only Technological, Project

The literature synthesized in the review makes a consistent point: smart cities should not be reduced to technology stacks. They are socio-technical systems in which ICTs, digital platforms, governance structures, financing instruments, and citizen engagement mechanisms interact. In that setting, business models function as the bridge between urban goals and operational execution.

The review also reinforces four broad propositions:

(a) smart city development depends on combining technological innovation with governance capacity;

(b) long-term viability requires durable revenue and financing arrangements;

(c) social legitimacy improves when residents are involved in design and implementation;

(d) innovation ecosystems are most effective when linked to urban policy objectives rather than treated as stand-alone economic branding.

Business Models Implemented in Smart Cities

Table 2 synthesizes the eight recurrent business model families and their primary urban development function.

Table 2: Business model families and their primary urban development function

Business model	Primary urban development function
Public–private partnerships (PPP)	Mobilize private capital and expertise for major infrastructure and service projects while sharing risk and responsibility with the public sector.
Build–operate–transfer (BOT)	Accelerate infrastructure delivery by allowing private consortia to finance, build, and operate assets before eventual transfer to public ownership.
Performance-based contracts	Improve efficiency and accountability by tying contractor compensation to measurable service outcomes.
Community-centric models	Embed citizen participation, co-creation, and social legitimacy in planning, housing, and neighborhood-scale implementation.
Innovation hubs and incubators	Support entrepreneurship, pilot development, and cross-sector experimentation relevant to urban challenges.
Revenue-sharing models	Create sustainable operating incentives and recurring revenue streams through shared returns between public and private actors.
Outcome-based financing	Link project finance to the achievement of social or operational outcomes rather than mere activity completion.
Asset monetization	Unlock the value of public land, property, or infrastructure to finance further urban development without relying only on taxation.

COMPARATIVE CASE ANALYSIS

London

London's smart city model is characterized by scale, infrastructure intensity, and strong public–private coordination. PPPs are central to large projects, including major transport and utility investments. The source study points to the Thames Tideway Tunnel as an emblematic PPP example. BOT arrangements are also visible in transport-related infrastructure, with Heathrow Terminal 5 cited as a notable case.

Operationally, London uses performance-based contracts in areas such as waste management, especially where recycling and diversion targets can be specified. Its community-oriented dimension is present but less dominant than its infrastructure and innovation profile; examples include community land trusts and cooperative housing in regeneration settings. London also has a highly developed innovation ecosystem, with Tech City (Silicon Roundabout) and accelerator platforms such as Techstars functioning as urban innovation hubs.

Revenue-sharing appears especially clearly in transport operations under arrangements involving Transport for London. Outcome-based financing is present in social policy domains, including homelessness reduction and educational support for disadvantaged youth. Asset monetization remains an important fiscal instrument through the sale or lease of public land and real estate.

Amsterdam

Amsterdam's business model architecture is marked by strong coordination between redevelopment, mobility innovation, and participatory urbanism. PPPs are used in large mixed-use redevelopment projects, with the Zuidas development repeatedly cited as a flagship case of integrated public–private urban transformation.

BOT arrangements are associated with strategic mobility infrastructure, especially the North/South metro line. Performance-based contracts support operational efficiency in service areas such as waste management, where contractors are incentivized to achieve environmental targets. What distinguishes Amsterdam most clearly is the visible integration of community-centric models into broader smart city strategy. Community land trusts and co-housing initiatives, including examples linked to Buiksloterham, reflect a deliberate effort to align smart urban development with social cohesion and affordability.

Amsterdam also hosts a dense innovation ecosystem centered on sites such as Amsterdam Science Park and Startup Village. Revenue-sharing arrangements are used in mobility-related services, including ferries and bicycle rental schemes. Outcome-based financing is applied to social-impact initiatives such as homelessness reduction, where funding is tied to measurable outcomes like housing stability and employment. Asset monetization, through the sale or lease of public properties and land parcels, is used to recycle value back into urban development.

Berlin

Berlin combines infrastructural pragmatism with a particularly strong community and innovation orientation. PPPs are evident in major infrastructure projects such as BER Airport, and also in large-scale regeneration projects such as Berlin TXL—The Urban Tech Republic, which repurposes former airport land for sustainable urban development.

BOT models are used in transportation systems, including long-term arrangements associated with S-Bahn

and U-Bahn operations. Performance-based contracts are visible in waste management and related efficiency-oriented services. Berlin's most distinctive contribution, however, lies in its community-centric housing and neighborhood development logic. Baugruppen initiatives exemplify a model in which groups of residents co-develop housing tailored to local preferences, thereby strengthening civic participation and inclusive urban form.

Innovation hubs such as Factory Berlin and the Berlin Technology Park reinforce the city's entrepreneurial capacity. Revenue-sharing appears in shared mobility systems, including bike-sharing programs. Outcome-based financing is linked to affordable housing and community integration initiatives. Asset monetization, as in the other two cities, involves the sale or lease of public properties to generate capital for further development.

Table 3: Illustrative implementation of business models in London, Amsterdam, and Berlin

Business model	London	Amsterdam	Berlin
PPP	Major infrastructure partnerships; Thames Tideway Tunnel; transport and utility delivery.	Zuidas mixed-use redevelopment integrating infrastructure and public amenities.	BER Airport and Berlin TXL regeneration projects.
BOT	Heathrow Terminal 5 and other transport-linked infrastructure under long-horizon delivery arrangements.	North/South metro line financed, built, and operated by private consortia before transfer.	Long-term transport operations associated with S-Bahn and U-Bahn networks.
Performance-based contracts	Waste management and service contracts tied to recycling and diversion targets.	Waste services tied to environmental performance and resource-efficiency targets.	Waste reduction and recycling performance used to drive operational efficiency.
Community-centric models	Community land trusts and cooperative housing in regeneration contexts.	CLTs and co-housing, including Buiksloterham, embedded in participatory planning.	Baugruppen as community-led housing and neighborhood development.
Innovation hubs and incubators	Tech City and accelerator ecosystems such as Techstars.	Amsterdam Science Park and Startup Village.	Factory Berlin and Berlin Technology Park.
Revenue-sharing models	Transport service contracts with revenue-sharing arrangements involving TfL.	Ferries and bicycle rental schemes with shared returns to the city.	Shared mobility, including bike-sharing, under revenue-linked operating agreements.
Outcome-based financing	Social impact bonds addressing homelessness and educational outcomes.	Homelessness reduction programs linked to measurable housing and employment outcomes.	Affordable housing and community integration projects tied to measurable social outcomes.
Asset monetization	Sale or lease of land and public real estate to fund development and attract investment.	Sale or lease of public land and properties to finance additional smart city initiatives.	Sale or lease of public properties to support regeneration and new investment.

DISCUSSION

No Single "Best" Model

The comparative evidence does not support a one-model interpretation of smart urban success. All three cities use multiple business models simultaneously, and each relies on a distinct mix of infrastructure finance, operational contracting, civic participation, and entrepreneurial support. This suggests that smart city development is fundamentally a portfolio problem rather than a choice of one superior instrument.

Three Distinct Strategic Profiles

The three cases reveal distinct strategic emphases:

(i) London is strongest in large-scale infrastructure delivery, contract-based operational control, and revenue-linked service systems.

(ii) Amsterdam demonstrates the most integrated relationship between redevelopment, social participation, and mobility-oriented innovation.

(iii) Berlin combines pragmatic infrastructure deployment with especially strong community-driven urbanism and entrepreneurial experimentation.

These are not merely administrative differences; they reflect different pathways through which cities align public value, financial logic, and urban transformation.

Implications for Urban Development Theory

From a theoretical standpoint, the findings support a more institutional reading of smart urbanism. Smartness is not just a matter of digital infrastructure; it is also a matter of contractual architecture, financing design, and stakeholder coordination. In other words, urban intelligence depends on the governance logic through which technology is embedded in the city.

IMPLICATIONS FOR URBAN GOVERNANCE AND STRATEGY

For policymakers and urban development practitioners, the analysis supports five practical lessons:

P1: Build infrastructure through blended capacity. Major smart city projects benefit from structured collaboration between municipal authorities and private operators.

P2: Use contracts to govern outcomes, not only inputs. Performance-based and outcome-based models can improve accountability when metrics are well defined.

P3: Embed participation early. Community-centric models increase legitimacy, reduce resistance, and improve fit with local needs.

P4: Treat innovation ecosystems as implementation tools. Hubs and incubators are most valuable when connected to concrete urban challenges.

P5: Monetize assets strategically, not indiscriminately. Asset monetization can support urban development, but only when it remains aligned with long-term public goals.

For the *Journal of Urban Development and Smart Cities*, these implications are especially salient because they connect digital transformation to the core concerns of urban governance, neighborhood development, public value creation, and sustainable infrastructure.

LIMITATIONS

This study has several limitations.

First, it is based on a narrative review and qualitative comparative analysis rather than a standardized quantitative dataset. Second, the case discussion is restricted to three European cities and should not be generalized uncritically to other institutional contexts. Third, because the evidence is synthesized from literature and reported examples, the study is stronger in interpretive breadth than in causal attribution. Fourth,

the comparative analysis identifies strategic patterns, but it does not measure downstream outcomes such as emissions reduction, user satisfaction, or long-term fiscal returns in a statistically comparable way.

These limitations nonetheless do not diminish the study's value; rather, they define a clear agenda for future research based on larger multi-city panels, longitudinal comparison, and more explicit linkage between business model choice and urban performance metrics.

CONCLUSION

Smart city development is often presented as a story of technology adoption. The evidence synthesized here shows that this is only part of the picture. The more consequential question is how cities organize the institutional and financial conditions that allow digital and infrastructural innovations to be delivered, operated, and socially legitimized.

Across London, Amsterdam, and Berlin, eight business model families recur with notable consistency: public–private partnerships, build–operate–transfer arrangements, performance-based contracts, community-centric models, innovation hubs and incubators, revenue-sharing models, outcome-based financing, and asset monetization. Yet the three cities combine these models in distinct ways, reflecting different priorities in infrastructure delivery, social inclusion, innovation policy, and urban regeneration.

The main conclusion is therefore straightforward: high-quality smart urban development is not the product of a single contractual template. It emerges from the strategic assembly of complementary business models that align investment, governance, participation, and long-term urban value. That insight is both analytically important and practically useful for cities seeking to build smarter, more sustainable, and more livable urban futures.

REFERENCES

[1] Wolniak, R.; Gajdzik, B.; Grebski, M.; Danel, R.; Grebski, W.W. Business Models Used in Smart Cities—Theoretical Approach with Examples of Smart Cities. *Smart Cities* 2024, *7*, 1626–1669.

[2] Albino, V.; Berardi, U.; Dangelico, R.M. Smart Cities: Definitions, Dimensions, Performance, and Initiatives. *Journal of Urban Technology* 2015, *22*(1), 3–21.

[3] Batty, M.; Axhausen, K.W.; Giannotti, F.; Pozdnoukhov, A.; Bazzani, A.; Wachowicz, M.; Ouzounis, G.; Portugali, Y. Smart Cities of the Future. *The European Physical Journal Special Topics* 2012, *214*, 481–518.

[4] Caragliu, A.; Del Bo, C.; Nijkamp, P. Smart Cities in Europe. *Journal of Urban Technology* 2011, *18*(2), 65–82.

[5] Hollands, R.G. Will the Real Smart City Please Stand Up? *City* 2008, *12*(3), 303–320.

[6] Komninos, N. Intelligent Cities: Variable Geometries of Spatial Intelligence. *Intelligent Buildings International* 2011, *3*(3), 172–188.

[7] Dameri, R.P. Searching for Smart City Definition: A Comprehensive Proposal. *International Journal of Computers & Technology* 2013, *11*(5), 2544–2551.

[8] Osterwalder, A.; Pigneur, Y. *Business Model Generation*; Wiley: Hoboken, NJ, USA, 2010.

[9] Teece, D.J. Business Models, Business Strategy and Innovation. *Long Range Planning* 2010, *43*(2–3), 172–194.

[10] Giourka, P.; Sanders, M.W.J.L.; Angelakoglou, K.; Tryferidis, A.; Tzovaras, D. The Smart City Business Model Canvas—A Smart City Business Modeling Framework and Practical Tool. *Energies* 2019, *12*, 4798.

[11] Abbate, T.; Cesaroni, F.; Cinici, M.C.; Villari, M. Business Models for Developing Smart Cities: A Fuzzy Set Qualitative Comparative Analysis of an IoT Platform. *Technological Forecasting and Social Change* 2019, *142*, 183–193.

[12] Tanda, A.; De Marco, A. Business Model Framework for Smart City Mobility Projects. *IOP Conference Series: Materials Science and Engineering* 2019, *471*, 092082.

[13] Timeus, K.; Vinaixa, J.; Pardo-Bosch, F. Creating Business Models for Smart Cities: A Practical Framework. *Public Management Review* 2020, *22*(5), 726–745.

[14] Han, J.; Jin, H.-D. Smart City and Business Model with a Focus on Platform and Circular Economy. In *Lecture Notes in Electrical Engineering*; Springer: Singapore, 2019; Vol. 502, pp. 199–203.

Lynne Mitchell, Warwick Medical School, Coventry, United Kingdom

Elizabeth J. Burton, Warwick Medical School, Coventry, United Kingdom

Manuscript Published; 20 December 2024.