Materials Research Proceedings 72 (2026) 570-582 https://doi.org/10.21741/9781644904336-55

Drawing the Smart City: Shifts in Urban Representation from Figure–Ground to Digital Visualization

Massimiliano GOTTI PORCINARI[1,a *], Maroun KASSAB[1,b], Daniele BEACCO[1,c], Francesca DAL CIN[1,d], Chuloh JUNG[1,e]

[1]PMU - Prince Mohammad bin Fahd University Khobar, Saudi Arabia

[a]mporcinari@pmu.edu.sa, [b]mkassab@pmu.edu.sa, [c]dbeacco@pmu.edu.sa, [d]fdalcin@pmu.edu.sa, [e]cchung@pmu.edu.sa

Keywords: Smart Cities, Urban Representation, Architectural Drawing, Diagrammatic Urbanism, Digital Visualization

Abstract. Urban paradigms have historically generated specific modes of representation, shaping not only how cities are drawn but also how they are conceived and understood. This paper presents a preliminary reflection on selected transformations in urban representation, tracing a trajectory from spatial continuity to diagrammatic and relational visualizations based on networks, infrastructures, and layered systems. Beginning with Giambattista Nolli's figure–ground map of Rome, later discussed in figure–ground theories by authors such as Colin Rowe, the city emerges as a continuous spatial field where public and private realms are negotiated through drawing. The discussion then moves to modernist zoning diagrams, in which functional abstraction and color-coded mapping redefine urban space as an organizational system rather than a spatial continuum. The paper subsequently examines projects such as OMA's Melun-Sénart proposal, where layered diagrams and infrastructural logics introduce a more relational understanding of the urban environment, echoing broader debates on mapping and diagrammatic practice. Rather than proposing a definitive narrative, the paper frames these historical examples as exploratory steps toward understanding emerging digital visualizations, including dynamic mapping, digital twins, dashboards, and data-driven interfaces, that increasingly mediate contemporary urban knowledge. These evolving representational practices suggest a gradual shift from static spatial drawings toward more networked, relational visualizations based on infrastructures and data-driven systems.

1. Introduction. Drawing the City in the Age of Smart Urbanism

Contemporary debates on smart cities often emphasize technological infrastructures, data collection, and digital governance. Yet, beyond technical systems, smart urbanism also transforms the ways in which the city is represented, visualized, and conceptually framed. Architectural drawing has historically played a central role in shaping urban knowledge, mediating between spatial imagination and modes of organization. As James Corner notes, mapping is not a neutral reflection of reality but an operative practice that constructs relationships and meanings through representation (Corner, 1999). Within this perspective, the emergence of smart city discourse can be understood not only as a technological shift but also as a transformation in the visual culture through which urban space is conceived.

In contemporary smart urbanism, mapping increasingly shifts from a finished representational artifact to an operational interface: a medium through which urban data are queried, filtered, and acted upon in near real time. This interface condition repositions the map from a descriptive graphic to a socio-technical instrument embedded in standards, platforms, and data governance frameworks. In this context, the key question becomes not only *how cities are drawn*, but *how drawings participate in steering, accountability, and public value claims*.

The paper frames urban representation specifically through the lens of architectural drawing, understood not merely as a tool of depiction, but as an operative medium that constructs, organizes,

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 license. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI. Published under license by Materials Research Forum LLC.

Materials Research Proceedings 72 (2026) 570-582 https://doi.org/10.21741/9781644904336-55

and mediates urban knowledge across different historical paradigms. This approach operates across both architectural and urban scales, positioning drawing as a mediating device between spatial form and broader urban systems.

The paper adopts a historical-comparative and theoretical approach, analyzing selected moments in the evolution of urban representation, from figure–ground drawing to digital visualization, in order to identify shifts in the role and logic of architectural drawing. The selected examples (Nolli, modernist zoning, OMA, and digital interfaces) are not intended as exhaustive, but as representative moments that reveal key shifts in representational logic.

Earlier moments in architectural history reveal how changes in representation correspond to broader shifts in urban thinking. Giambattista Nolli's eighteenth-century plan of Rome, later interpreted within figure–ground theories by Colin Rowe and Fred Koetter, framed the city as a continuous spatial field structured by the interplay of solids and voids (Rowe & Koetter, 1978). In contrast, modernist planning introduced functional zoning diagrams that redefined urban space through abstraction and color-coded organization, as articulated in the discourse of CIAM and the Athens Charter (Le Corbusier, 1943; Mumford, 2000). By the late twentieth century, diagrammatic practices explored by architects such as Rem Koolhaas and theorists like Stan Allen shifted attention toward infrastructures, networks, and layered systems, suggesting a more relational understanding of urban form (Koolhaas, 1995; Allen, 1999).

Today, within the context of smart cities, emerging digital visualizations ranging from dynamic mapping to data-driven interfaces further extend this trajectory, redefining the role of drawing as an active mediator between spatial form and informational processes. As Antoine Picon argues, contemporary urban intelligence increasingly operates through spatialized digital systems that reshape how cities are observed and interpreted (Picon, 2015). Rather than proposing a definitive theory of smart urbanism, this paper offers a preliminary architectural reflection on selected shifts in urban representation, tracing how different modes of drawing ranging from figure–ground plans to layered diagrams anticipate the visual logics that underpin current smart city imaginaries. This paper asks how urban representation has shifted from figure–ground drawings to data-driven digital visualizations, and how architectural drawing continues to operate within this transformation. Across these shifts, representation moves from revealing spatial continuity to enabling systemic governance.

2. The City as Spatial Continuum. Nolli and Figure–Ground

Among the historical examples that reveal how urban representation constructs spatial knowledge, Giambattista Nolli's Nuova Pianta di Roma (1748) remains a foundational reference. More than a cartographic document, Nolli's plan established a graphic language through which the city could be understood as a continuous spatial field. By representing accessible interiors such as churches, courtyards, and public institutions, with the same graphic treatment as exterior urban space, the drawing dissolves rigid distinctions between inside and outside, foregrounding instead the continuity of urban experience. What emerges is a spatial interpretation of the city, where representation operates as a tool for revealing relationships rather than merely describing form.

Later architectural theory would reinterpret this approach through the lens of figure–ground analysis. Colin Rowe and Fred Koetter, in Collage City, highlighted how the alternation between solid and void structures the legibility of urban form, framing the city as a dynamic equilibrium between built mass and open space (Rowe & Koetter, 1978). In this reading, Nolli's drawing becomes a proto-analytical instrument, capable of revealing urban structure through graphic contrast. The black-and-white logic of the plan does not simply distinguish buildings from space; it articulates a continuous urban field in which public life unfolds across thresholds, interiors, and streets. Representation, therefore, operates here as spatial continuity rather than functional abstraction. The Nolli map mirrors how the city is experienced as a sequence of spatial thresholds rather than isolated objects (Diamond, 2022). It preserves ambiguity between inside and outside,

Materials Research Proceedings 72 (2026) 570-582 https://doi.org/10.21741/9781644904336-55

private and public. So, in a sense, Nolli's approach to visualizing the city preserves experiential continuity.



Figure 1. Giambattista Nolli, Nuova Pianta di Roma (1748). Figure–ground representation articulating urban continuity through the graphic equivalence of interior and exterior public space.

The emphasis on relational space resonates with subsequent analytical frameworks such as space syntax. Although developed centuries later, the work of Bill Hillier and Julienne Hanson proposes that spatial configurations shape patterns of movement and social interaction, reinforcing the notion that urban form operates as a continuous field rather than as isolated objects (Hillier & Hanson, 1984). While Nolli's plan was not conceived as an analytical diagram in a contemporary sense, its graphic logic implicitly acknowledges the importance of spatial connectivity and accessibility, qualities that later theoretical models would attempt to quantify.

In contrast to later modernist diagrams, which often abstract the city into functional zones, Nolli's representation maintains a direct relationship with spatial experience. The city is not divided according to programmatic categories but understood through the interplay of built mass and accessible space. This approach reinforces the architectural dimension of urban drawing, where representation operates as a spatial instrument capable of mediating between physical form and lived experience. The plan's enduring influence lies precisely in this capacity to visualize urban continuity without reducing complexity to a single functional or infrastructural logic.

Materials Research Proceedings 72 (2026) 570-582 https://doi.org/10.21741/9781644904336-55

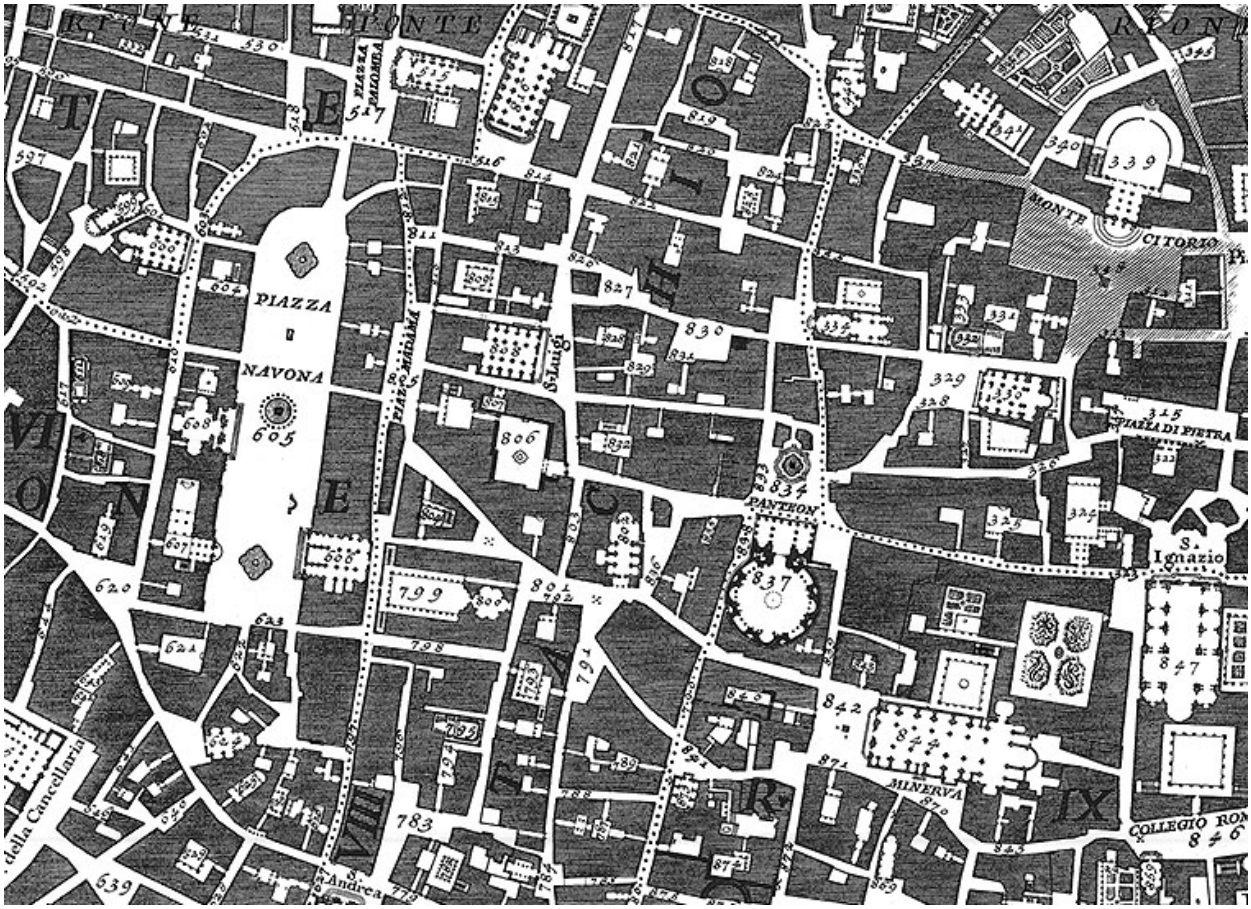


Figure 2. Nolli's Nuova Pianta di Roma (1748), illustrating the collapse between interior and exterior public space through graphic continuity.

Within the broader trajectory outlined in this paper, Nolli's drawing can be understood as an early expression of representation as spatial continuity. Rather than isolating elements, the figure–ground logic constructs a coherent urban field where solids and voids operate as complementary components of a larger system. This mode of representation establishes a foundation against which later transformations, from functional zoning to diagrammatic networks, can be read as shifts in how urban space is conceptualized and visualized. In the context of contemporary discussions on smart cities, revisiting Nolli does not imply nostalgia for historical forms but offers a reminder that urban representation has long been tied to the ways spatial relationships are made visible through drawing.

3. The City as Functional Diagram. Modernist Zoning

If Nolli's figure–ground logic framed the city as a continuous spatial field, modernist planning introduced a radically different representational language. Rather than emphasizing the continuity between built form and public space, early twentieth-century urbanism increasingly relied on diagrammatic abstraction to organize the city according to functional principles. The emergence of zoning diagrams, particularly within the discourse of CIAM and the Athens Charter, marked a decisive shift in how urban space was visualized and conceptualized.

Materials Research Proceedings 72 (2026) 570-582 https://doi.org/10.21741/9781644904336-55



Figure 3. Functional zoning diagram from CIAM discourse, illustrating the separation of dwelling, work, circulation, and leisure as discrete urban territories.

Representation moved away from spatial continuity toward a system of categorization in which urban life was separated into distinct domains such as dwelling, work, circulation, and leisure (Le Corbusier, 1943; Mumford, 2000).

Graphically, this transformation is evident in the transition from the black-and-white figure–ground drawings associated with earlier urban analysis to color-coded maps that foreground functional differentiation. In these diagrams, color replaces spatial depth as the primary organizational device, translating complex urban environments into legible schemes of programmatic order. The city is no longer depicted as a continuous field of accessible spaces but as a structured composition of zones, each assigned a specific role within a broader urban system. Representation, in this context, becomes an instrument of planning rather than an exploration of spatial relationships. Through modernist zoning, the city becomes legible as a system of functions rather than as overlapping spatial conditions. Spatial ambiguity and transitional thresholds are replaced by programmatic clarity, translating urban complexity into clearly differentiated functional territories. Modernism therefore in its approach to visualizing the city loses spatial ambiguity.

This shift reflects broader ambitions within modernist architecture to rationalize the city through abstraction. Figures such as Ludwig Hilberseimer explored planning strategies that reduced urban form to clear, repeatable patterns, reinforcing the idea that representation could operate as a tool for standardization and control. The diagrammatic clarity of zoning plans enabled planners to visualize the city at a metropolitan scale, yet this clarity often came at the expense of the spatial ambiguity and experiential richness evident in earlier drawings such as Nolli's plan. The urban field was reinterpreted not as a continuum but as a composition of discrete functional territories.

Materials Research Proceedings 72 (2026) 570-582 https://doi.org/10.21741/9781644904336-55

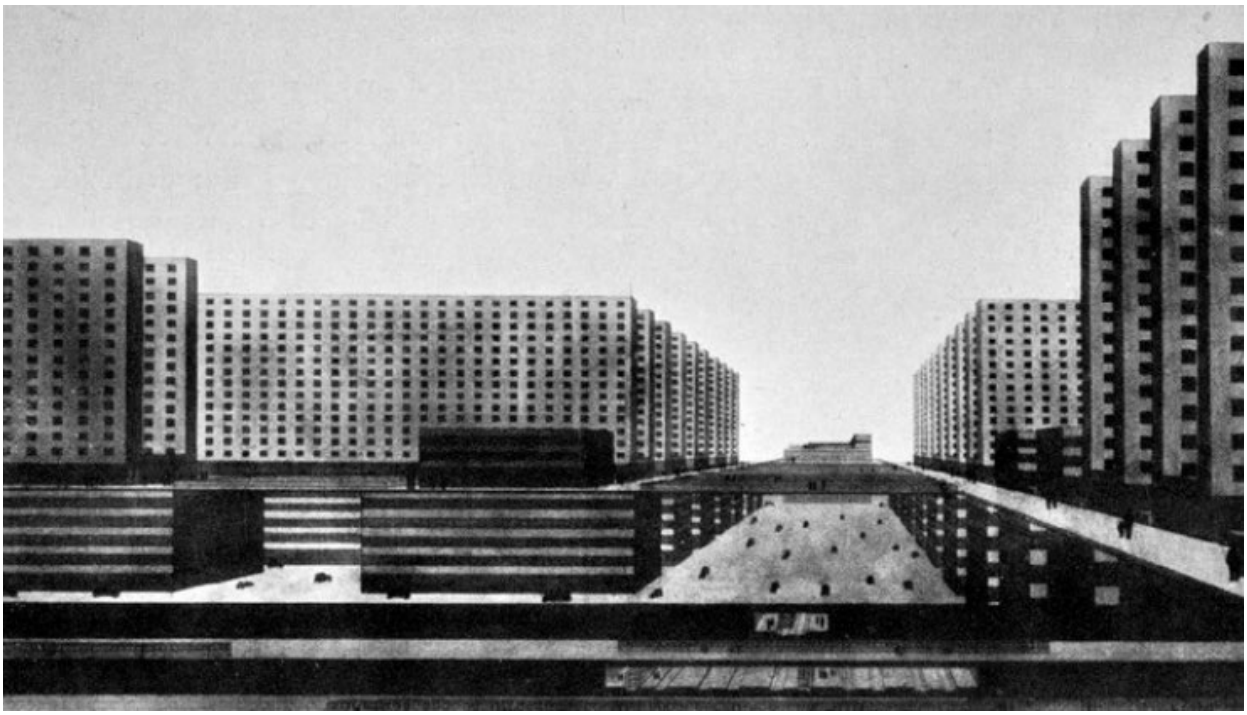


Figure 4. Ludwig Hilberseimer, "The New City" (1944), exemplifying urban abstraction through repetitive and standardized zoning structures

Despite their reductive tendencies, modernist zoning diagrams introduced an important conceptual innovation: the city as an organizational system. By abstracting urban complexity into visual codes, these representations laid the groundwork for later diagrammatic practices that would expand beyond functional separation toward infrastructural and relational logics. As Stan Allen suggests, the diagram in architecture operates less as a representation of form than as a generator of organizational relationships (Allen, 1999). Seen from this perspective, modernist zoning can be understood not simply as a historical rupture but as a transitional moment in which representation shifts from spatial description toward systemic thinking. In the diagrammatic urbanism of OMA, and others, the city becomes a layered field of interactions. However, in privileging systems and organization over material articulation, drawing becomes abstracted from texture, scale, and material presence. The diagram organizes complexity but often suppresses the sensory and tectonic dimension of urban form. The city is understood as logic before it is understood as matter (Lefebvre,1991). So, in a sense, the representation of the city here loses the specific tactile representations that identify the city.

In relation to contemporary smart city discourse, this moment is particularly significant. The reliance on abstraction, coding, and visual categorization anticipates later forms of urban visualization in which information is layered, filtered, and translated into graphic interfaces. While modernist diagrams were primarily concerned with functional efficiency, their graphic logic established a precedent for understanding the city through visual systems rather than purely spatial drawings. The move from figure–ground continuity to functional diagram thus represents a crucial step in the evolving relationship between architecture, representation, and urban knowledge.

4. The City as Layered System. Diagrams, Infrastructure, and Networked Urbanism

If modernist zoning translated the city into a functional diagram, late twentieth-century architectural practice began to question the limits of rigid categorization, exploring instead more open and relational modes of representation. Within this context, the work of Rem Koolhaas and the Office for Metropolitan Architecture, particularly the proposal for Melun-Sénart, offers a

Materials Research Proceedings 72 (2026) 570-582 https://doi.org/10.21741/9781644904336-55

significant shift in how urban space is visualized. Rather than organizing the city through fixed zones, the project deploys layered diagrams that foreground infrastructure, networks, and the coexistence of multiple urban logics within a flexible framework (Koolhaas, 1995).



Figure 5. OMA, Ville Nouvelle Melun-Sénart competition proposal (1987). Layered infrastructural diagram redefining urban space as a relational system.

In contrast to the color-coded clarity of modernist planning, these diagrams operate through superimposition and ambiguity. Infrastructure is no longer merely a background system supporting urban form but becomes the primary structuring device of the project. Lines, bands, and fields replace the discrete blocks of zoning plans, suggesting a city defined less by static territories than by dynamic relationships. Representation here moves away from categorization toward a more relational language, where drawing becomes a means of organizing flows, intensities, and spatial hierarchies across multiple scales.

The diagrammatic turn of this period reflects broader theoretical discussions on mapping and architectural representation. As Stan Allen argues, diagrams function as instruments capable of articulating organizational strategies rather than fixed forms, enabling architects to engage with complexity without reducing it to singular geometries (Allen, 1999). Similarly, James Corner's notion of mapping as an active and projective practice highlights how representation can generate new spatial possibilities rather than merely documenting existing conditions (Corner, 1999). Within this framework, Melun-Sénart can be understood not simply as an urban proposal but as an experiment in representational methodology, where the city is conceived as a layered system open to transformation.

Materials Research Proceedings 72 (2026) 570-582 https://doi.org/10.21741/9781644904336-55

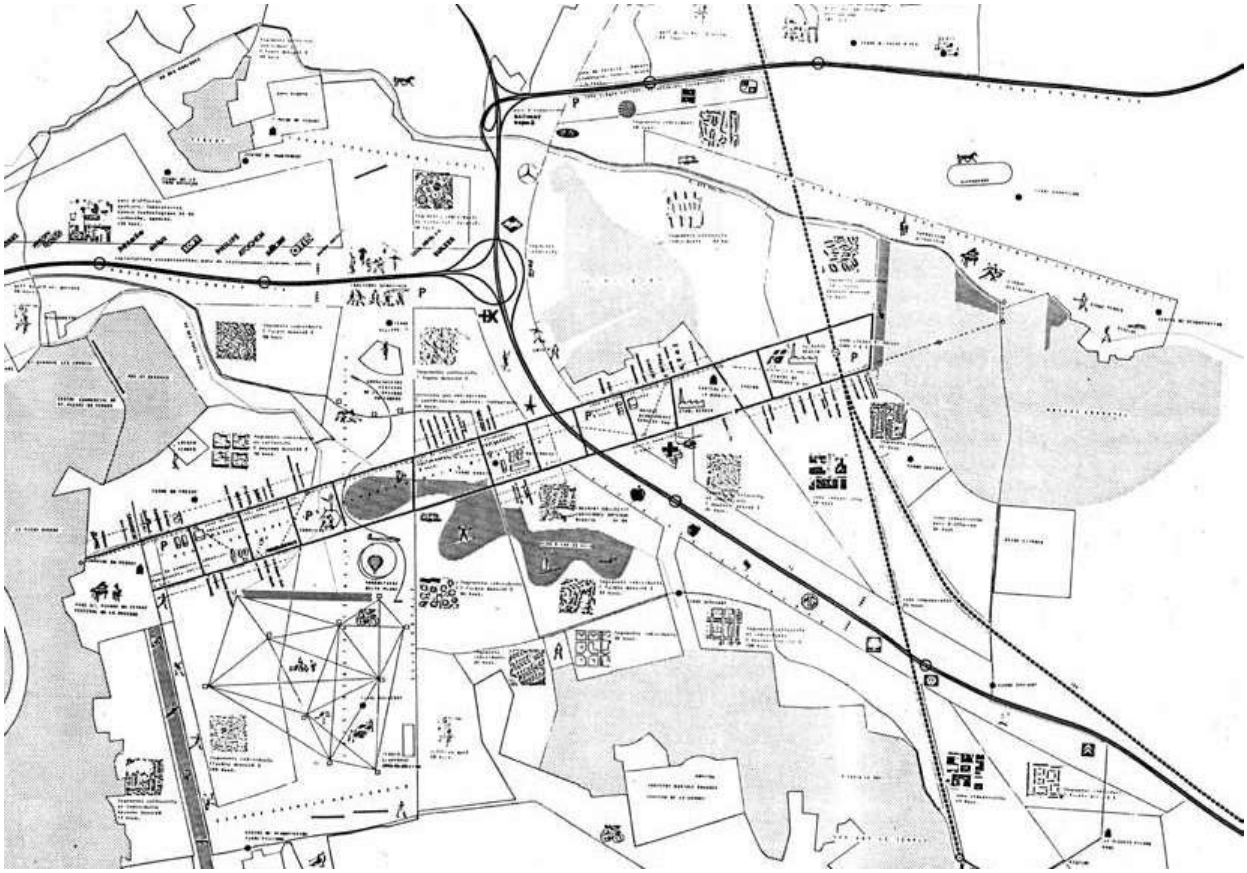


Figure 6. OMA, diagrammatic study for Melun-Sénart, illustrating superimposed networks and infrastructural stratification.

This approach marks a departure from both Nolli's spatial continuity and modernist functional zoning. While figure–ground drawings emphasized the relationship between solids and voids, and zoning diagrams organized the city through programmatic separation, the layered diagrams of late twentieth-century urbanism introduce a more fluid understanding of urban structure. Networks, infrastructures, and spatial fields overlap, suggesting a city that cannot be fully captured through a single representational logic. The urban drawing becomes less about defining boundaries and more about revealing interactions between heterogeneous elements.

Seen in relation to contemporary discussions on smart cities, this diagrammatic shift anticipates a broader transformation in how urban complexity is visualized. By foregrounding networks and relational systems, projects such as Melun-Sénart move representation closer to a condition in which the city is understood through interconnected layers rather than isolated forms. Although still grounded in architectural drawing, these diagrams begin to operate as proto-interfaces, hinting at modes of visualization that extend beyond static plans toward dynamic and adaptive frameworks. Representation, in this sense, evolves from functional ordering toward systemic thinking, a transition that prepares the ground for the emerging digital visualizations explored in the following section.

The evolution of urban representation discussed so far can be synthesized through a comparative framework that highlights shifts in representational logic, drawing techniques, and the conceptualization of the city across different historical phases.

Materials Research Proceedings 72 (2026) 570-582 https://doi.org/10.21741/9781644904336-55

Table 1. Comparative framework of shifts in urban representation

Phase	Representational Logic	Mode of Drawing	Urban Concept	Role of Architectural Drawing
Figure–Ground (Nolli)	Spatial continuity	Plan (solid/void)	City as continuous field	Reveals spatial relationships and public accessibility
Modernist Zoning	Functional abstraction	Diagram (color-coded)	City as organized system	Classifies and separates functions
Diagrammatic Urbanism (OMA)	Relational systems	Layered diagrams	City as networked field	Organizes flows, infrastructures, and interactions
Smart City Visualization	Data-driven processes	Digital interfaces	City as dynamic informational system	Mediates real-time data and supports decision-making

This comparison clarifies how urban representation progressively shifts from spatial continuity to functional abstraction, then toward relational systems, and finally to data-driven visualization. Across these phases, architectural drawing does not disappear but is continuously redefined, moving from a tool of spatial description to a medium that organizes, interprets, and ultimately interfaces urban complexity.

5. Emerging Digital Visualizations. Toward Dynamic Mapping in Smart Cities

The diagrammatic explorations of late twentieth-century urbanism prepared the ground for a further transformation in how cities are represented within contemporary smart city discourse. While earlier architectural drawings relied on plans, diagrams, and layered systems to visualize urban complexity, current digital environments increasingly translate the city into dynamic interfaces composed of data layers, real-time mapping, and interactive visualizations. Rather than replacing architectural drawing altogether, these emerging representational modes extend its logic, shifting attention from static spatial description toward processes, flows, and continuously updated information.

Within the framework of smart cities, visualization plays a crucial role in mediating between urban space and technological infrastructure. As Antoine Picon suggests, digital systems introduce a new form of "spatialized intelligence," in which urban knowledge is constructed through the integration of sensors, networks, and computational platforms (Picon, 2015). Dashboards, digital twins, and heat maps exemplify this transformation, presenting the city not as a fixed composition of buildings and streets but as a dynamic field of intensities and relationships. Representation becomes increasingly performative, enabling planners and designers to monitor, simulate, and anticipate urban processes rather than simply document physical form.

Materials Research Proceedings 72 (2026) 570-582 https://doi.org/10.21741/9781644904336-55



Figure 7. Urban digital twin interface integrating real-time data streams and 3D spatial modeling.

This shift resonates with broader discussions on the digital turn in architecture. Mario Carpo argues that contemporary design culture moves from the mechanical reproduction of standardized forms toward a computational environment characterized by variability and continuous adaptation (Carpo, 2017). In the context of urban visualization, this transformation redefines the role of drawing: plans evolve into interfaces capable of aggregating heterogeneous data streams, while maps operate as platforms for navigating complex informational environments. The city, in this sense, is no longer represented solely through geometry but through layered visualizations that combine spatial, social, and environmental parameters.

Urban digital twins are increasingly understood not simply as detailed 3D city models but as socio-technical systems combining technologies, institutions, and governance frameworks. As Batty and Kitchin note, data-driven urbanism introduces new epistemological questions about how cities are known and governed (Batty, 2013; Kitchin, 2014). While digital simulations promise analytical insight, they also risk reducing spatial experience to quantifiable metrics.

At the same time, systematic reviews suggest that many of these ambitions are still only partly achieved, largely because of persistent hurdles such as limited institutional capacity, uneven participation, and the difficulty of integrating fragmented data sources. Kitchin's idea of "digital twins and deep maps" helps sharpen this point: 3D models can function both as analytical tools and as narrative media that capture place-based perspectives. That dual role challenges the common assumption that more data and more layers automatically lead to better understanding of the city.

Dashboards are now a standard smart-city representation, translating urban complexity into actionable indicators and alerts. Once institutionalized, they do more than inform: they shape what is seen and measured, define "performance," and make issues governable by turning them into metrics. Seen this way, contemporary mapping still has the diagram's talent for simplifying and organizing complexity, but it now depends on databases, interface design, and constant updating. Representation shifts from making a drawing to running an ongoing service.

Materials Research Proceedings 72 (2026) 570-582 https://doi.org/10.21741/9781644904336-55

Seen in continuity with the historical trajectory outlined in this paper, contemporary smart city visualizations can be interpreted as an evolution of representational strategies rather than a complete rupture. Just as modernist zoning diagrams abstracted urban complexity into functional codes, and late twentieth-century diagrams explored networks and layered systems, digital interfaces translate urban space into dynamic fields of data. The emphasis shifts from defining form to visualizing relationships, from static composition to adaptive frameworks. Representation, therefore, becomes a hybrid practice operating at the intersection of architecture, technology, and urban governance. In this approach, the representation of the city is increasingly encountered as information before it is encountered as space risking the loss of embodied experience (de Lange & Ruijer, 2025).

Rather than proposing a definitive theory of smart urbanism, this section suggests that the visual culture of smart cities extends long-standing architectural concerns with mapping, diagramming, and spatial organization. The emergence of dynamic mapping environments points toward a new phase in the evolution of urban representation, where drawing increasingly mediates between physical space and informational processes. This condition does not eliminate the architectural dimension of representation but repositions it within a broader ecosystem of digital visualization, raising questions about how designers might engage with these tools while preserving the spatial intelligence embedded in architectural practice.

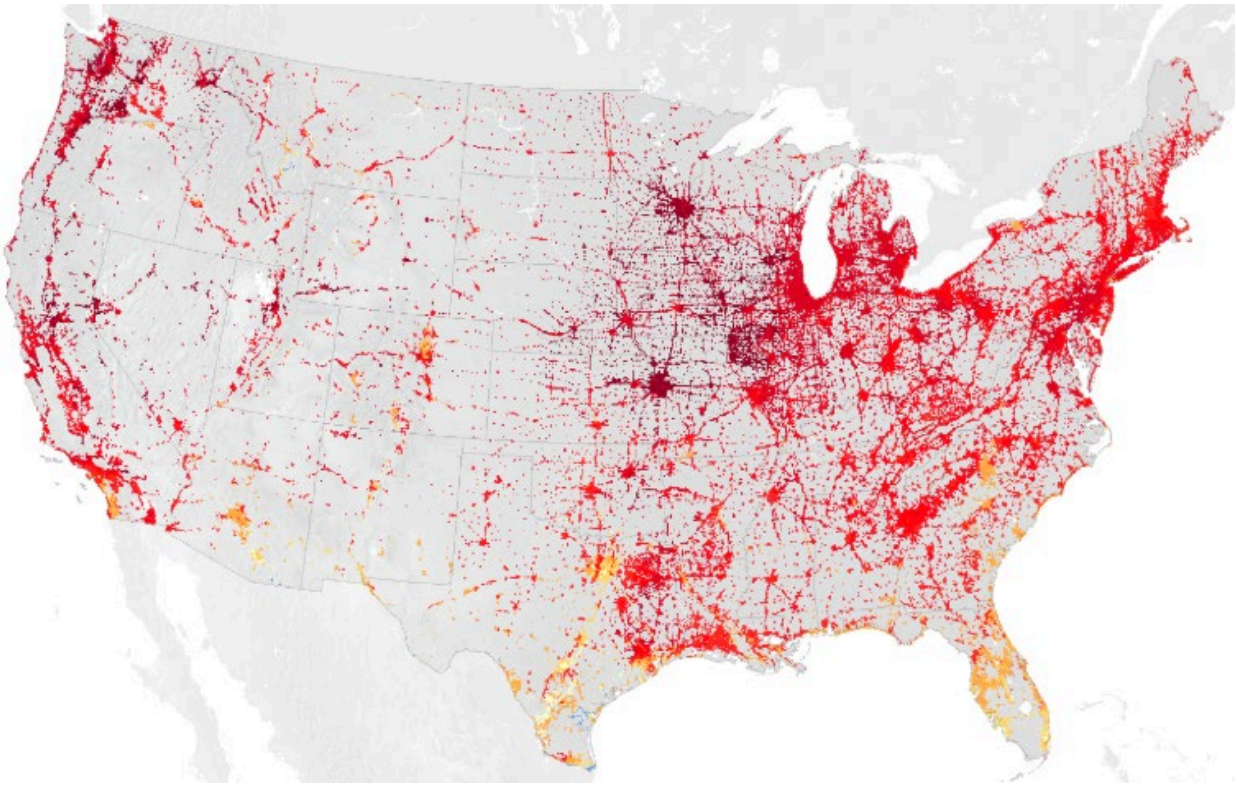


Figure 8. Data-driven urban visualization showing dynamic mapping of mobility flows and environmental intensities.

6. Conclusion. Urban Representation and the Visual Culture of Smart Cities

Tracing the evolution of urban representation from Nolli's figure–ground plan to contemporary digital visualizations reveals how drawing has continuously mediated changing conceptions of the city. Rather than a linear progression, these shifts reflect transformations in how spatial relationships are understood and communicated, from spatial continuity to functional abstraction, to relational systems, and ultimately to data-driven visualization.

Within the context of smart city discourse, emerging digital visualizations extend this trajectory by introducing dynamic interfaces that integrate spatial form with informational processes. Dashboards, digital twins, and real-time mapping environments suggest that urban representation is increasingly oriented toward monitoring, simulation, and adaptive management. Yet, rather than replacing architectural drawing, these tools can be understood as part of a longer continuum of representational practices, where abstraction and visualization operate as instruments for engaging with urban complexity.

Revisiting historical modes of representation highlights the enduring role of architectural thinking within contemporary digital environments. The spatial continuity of Nolli, the organizational logic of modernist diagrams, and the relational layering of late twentieth-century urbanism all resonate, in different ways, with current smart city visualizations. Rather than opposing digital interfaces to traditional forms of drawing, the evolution of urban representation suggests an expanded field in which spatial, diagrammatic, and informational logics coexist.

At the same time, this transformation raises critical questions. As urban representation becomes increasingly data-driven, there is a risk that what can be measured and visualized is privileged over what is experienced but less quantifiable. The city risks being understood as information before it is encountered as space.

Within this evolving landscape, architectural drawing does not disappear but is redefined, shifting from the representation of space toward a hybrid practice that integrates spatial, diagrammatic, and data-driven modes of thinking. This repositioning opens new possibilities for architectural research, suggesting that the future of drawing lies not in resisting digital systems, but in critically engaging with them while preserving the spatial intelligence that remains central to architectural practice.

References

[1] Rowe, Colin, and Fred Koetter. Collage City. MIT Press, 1978.

[2] Le Corbusier. The Athens Charter. 1943.

[3] Mumford, Eric. The CIAM Discourse on Urbanism. MIT Press, 2000.

[4] Hilberseimer, Ludwig. The New City: Principles of Planning. 1944.

[5] Koolhaas, Rem. S,M,L,XL. Monacelli Press, 1995.

[6] Allen, Stan. Points + Lines: Diagrams and Projects for the City. Princeton Architectural Press, 1999.

[7] Corner, James. “The Agency of Mapping: Speculation, Critique and Invention.” In Mappings, edited by Denis Cosgrove, Reaktion Books, 1999.

[8] Batty, Michael. The New Science of Cities. MIT Press, 2013.

[9] Townsend, Anthony. Smart Cities. Norton, 2013.

[10] Kitchin, Rob. The Data Revolution. Sage, 2014.

[11] Picon, Antoine. Smart Cities: A Spatialised Intelligence. Wiley, 2015.

[12] Carpo, Mario. The Second Digital Turn: Design Beyond Intelligence, MIT Press, 2017

[13] Mattern, Shannon. Code and Clay, Data and Dirt: Five Thousand Years of Urban Media. University of Minnesota Press, 2017

[14] Lefebvre, H. The production of space (D. Nicholson-Smith, Trans.). Blackwell. (Original work published 1974), 1991.

[15] Diamond, R. Architecture from drawing: A brief inquiry into three types. In C. Voet, E. Schreurs, & H. Thomas (Eds.), The hybrid practitioner: Building, teaching, researching architecture (pp. xx–xx). Leuven University Press. https://www.jstor.org/stable/j.ctv2vt0209.14, 2022.

[16] Wilson, R. Horizon remix: A 'crisis' in the architectural image – representations of Lacaton & Vassal's 'double space'. In M. Butcher & M. O'Shea (Eds.), Expanding fields of architectural discourse and practice: Curated works from the P.E.A.R. Journal (pp. xx–xx). UCL Press. https://www.jstor.org/stable/j.ctv13xps41.13, 2024.

[17] de Lange, M., Ruijer, E., & Varró, K. Doing inclusion: Negotiation and co-creation for people-centric smart cities. In J. van Dijck, K. van Es, A. Helmond, & F. van der Vlist (Eds.), Governing the digital society: Platforms, artificial intelligence, and public values (pp. xx–xx). Amsterdam University Press. https://www.jstor.org/stable/jj.28874939.17, 2025.

[18] Kitchin, R., *Digital twins and deep maps*. Transactions of the Institute of British Geographers. 2024.

[19] Dawkins, O., & Kitchin, *Urban digital twins: Digital twins for participatory steering*. New Media & Society, 2025.