

Machines and Cities an Evolving Relationship in the Age of Artificial Intelligence

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ABSTRACT

This contribution aims to investigate contemporary conceptualizations of the relationship between city and digital technology, in order to identify useful indications for contemporary cities. Starting from an examination of the most conceptually significant approaches, we aim to shed new light on challenges and opportunities connected with the contemporary urban conditions and particularly with the implementation of Urban Artificial Intelligences (UAI). The issue of UAIs will be investigated through a hybrid approach that connects philosophy of technology and urban planning. An approach that is able to connect the ethical implications of the use of AI in urban contexts and its design consequences. The main objective of the paper is to analyze two of the first and most interesting reflections on the connection between digital technology and urban space (Tomas Maldonado and W.J. Mitchell) to understand how they can be useful for future planning challenges. One of the first systematizations of this issue stressed the tension between a Platonic interpretation of cyberspace, conceived as an escape from reality, and an infrastructural perspective that regards the physical and digital space as deeply connected (Maldonado 1992, 1997). Maldonado's reflection is useful in exploring the dialectic between an immaterial conception of digital space and its interpretation in an infrastructural sense. This ambivalence was also present in the context of urban planning theory (Mitchell 1996), in which digital space is sometimes conceived as a parallel dimension, sometimes as a dimension inherently embedded into the physical one. In Mitchell's urban planning thought and practice, this ambivalence gives rise to decisive differences in the design of hybrid objects and spaces. This historical analysis will be useful in understanding how the concepts of materiality and immateriality also come into play in contemporary discourse on AI Urbanism by defining its planning trajectories, modes of human-machine-environment relationship, and guiding its investments (Barnes 2021, Cugurullo 2021, Batty 2018). Urban Artificial intelligences have the potential to re-shape ontologically and epistemologically (Floridi 2022 Benanti 2018, Carpo 2017) our cities, influencing physical space and the way in which cities are represented. The analysis of these two frameworks will result in a better understanding of the concept of urban space in the age of UAI. The interaction between various forms of agency (human, natural, artificial) in the urban context will be a decisive design theme in the coming years. The geometry of this interaction will also be defined by the ability we have to think concretely and appropriately about digital space, making use also of the insights that can be drawn from the recent history of the relationship between the city and digital technology

Keywords: Urban artificial intelligence, Smart cities, Urban identity, Philosophy of science

INTRODUCTION

The digital revolution has had an enormous impact on urban culture. One of the most significant stages of this journey is the smart city, which during its evolution has moved beyond a merely techno centric approach by highlighting the growing influence of communities and city users in decreeing the success of urban innovation programs (Aurigi and Odentaaal 2021; Komninos et al. 2022). Technological maturation has recently introduced the issue of Urban Artificial Intelligence (Cugurullo 2020; Allam and Dhunny 2019) a potential turning point that introduces extraordinary opportunities for change by reopening the debate on the conceptual and cultural models underlying the relationship between cities and digital technologies. This contribution aims to reread some of the most significant authors - Tomas Maldonado and William J. Mitchell - through an interdisciplinary perspective to detect useful elements to frame current perspectives on UAI and trace possible future developments.

URBAN AI AS A RELATIONAL INFRASTRUCTURE

The term cyberspace made famous by novelist W. Gibson (1984) has certainly been pivotal in the conceptualization of spatiality of digital technology since the 1990s. The idea of investigating the potential of digital technology from the perspective of space production was the cornerstone of a closeness of interests between urban planners, architects and philosophers. In this context, the figure of Tomás Maldonado is particularly interesting. In fact as space theorist and designer with a marked philosophical awareness he devoted two books published in Italian to the relationship between space and the digital in the 1990s: *Reale e Virtuale* (1992) and *Critica della ragione informatica* (1997). In the first book on the cognitive role of virtual reality, a chapter is explicitly dedicated to the concept of cyberspace and to the debate that it had generated especially in the U.S. among architects and philosophers. The fundamental issue concerns the epistemological status of cyberspace, that is, whether we should consider it as a space of otherness and escapism from the real world or as a mode of representation, such as Renaissance perspectivism, which is pivotal for our interpretation of the reality. This essential question leads Maldonado to investigate the cultural matrices of cyberspace and to recognize in Decartes, Pascal, Leibnitz, Babbage, and Von Neumann much more decisive sources of reference than in philosophers more cited and fashionable in the 1990s debate such as Nietzsche and Heidegger.

However, the most interesting and extensive reference is to Plato. This reference appears in a multidisciplinary book edited by architect M. Benedikt (1991). The idea is to interpret the cyberspace as a Platonic space and it is the core of M. Haim's essay *The Erotic Ontology of Cyberspace*. Maldonado interprets this reference to Plato as an immaterial and incorporeal interpretation of digital space. This space would be a space of escapism, of evasion from the troubles and materiality of physical reality, a space to which human beings would tend erotically, in the Platonic sense, to free themselves from the heaviness of physicality. However, by carefully reading Heim's essay, it is possible to realize how his interpretation is more articulated and may even be useful in

Maldonado's own perspective. First, according to Haim, cyberspace is attractive to humans because of the simplicity of the objects that populate it. Digital object and the digital experience would be realities purified of the inconsistencies and residues that characterize physical reality. This essentiality, which Haim compares to that of Platonic ideas, relates to an apparent solidity and almost ethereal perfection of digital objects. However, Haim points to the fundamental difference between cyberspace and Platonic ideal space. Indeed Platonic forms have always existed and only been contemplated, cyberspace objects, on the other hand, are constructed and suitable for various kinds of practical interaction. Platonic forms become in the computer age informed and informational objects. Following Haim «With an electronic infrastructure, the dreams of perfect FORMS becomes the dream of inFORMation [...] Thinkers and mathematicians would no longer stare at the sky of unchanging ideas. By applying mathematics to empirical experiments, science would absorb physical movement in space/time through the calculus. Mathematics transformed the intelligent observer from a contemplator to a calculator» (Heim 1991, pp. 65-67).

Thus according to Haim's Platonic key, cyberspace is on the one hand a reality that attracts us because of its essential simplicity and on the other hand it is manipulable infrastructure capable of affecting our ability to act. This duplicity is particularly interesting of Maldonado's perspective. In fact, already in the 1992 text, the Argentine thinker wonders whether virtual reality and cyberspace could be organs of knowledge, new types of symbolic representation capable of modifying our understanding of reality. Moreover, the very two points highlighted by Heim, namely simplicity and the infrastructural essence of cyberspace, are decisive for Maldonado's interpretation of the relationship between digital technology and urban realm. In *Critica della ragione informatica* (1997) Maldonado notes how cyberspace is proposed as an ideal urban space: «that is, as a new city model that, through widespread digitization of its structure, would be able to overcome all the ills that plague the conventional city» (Ibidem, p. 93). It is straightforward to recognize the Platonic derivation of this interpretation. Indeed, it is Plato himself who, through his theorization of his Kallipolis in the *Republic*, sets a cornerstone of Western urban utopian thought. In Plato's case, the Kallipolis is perfect because its organization responds to the very organization of the soul of its citizens; in the case of Cyberspace, perfection would reside in the seductiveness of an immaterial and essential world such as the one described by Haim. To the Platonic utopia based on philosophical rationalism, the rhetoric on cyberspace replaces a utopia based on the amazing capabilities of digital technology. However, Maldonado's critique is not directed at utopian thinking per se, but at an implication that often is bound up with it. Namely, its tendency to simplify, to reduce the complexity of the object to which it applies, in this case to reduce the complexity of urban reality.

This idea of computational simplification of urban reality intuited by Maldonado in the 1990s has become a decisive theme of contemporary criticism of the smart city paradigm (Söderström, Paasche, Klauser 2014, Kitchin 2014, Greenfield 2013, Mattern 2021). After the economic crisis of 2008, in fact, the smart city paradigm became one of the central topics in urban studies

concentrating at the same time great investment and great criticism (Mora, Bolici 2016; Bria, Morozov 2018). A fundamental critique of this paradigm concerns precisely Maldonado's epistemological insight: digital technology becomes the means through which to have a simplified image of urban reality, a city reduced to a flow of data that can be controlled and analysed algorithmically. «What urban systems theory provides, seen from this perspective, is primarily a powerful metaphor creating a surface of equivalence. It translate very different urban phenomena into data that can be related together according to a classical systemic approach which identifies elements interconnections, purpose, feedback loops etc» (Söderström, Paasche, Klauer 2014). From an epistemological perspective, the urban application of digital technology views reality as perfectly knowable in that it can be enumerated and digitally encoded without distortion (Greenfield 2017). In this rhetorical discourse the city truly becomes that seductive digital Platonic object intuited by Maldonado following Heim' reasoning. An object that attracts by its simplicity and manipulability, by the utopian promise of a total understanding of its dynamics finally made clear by technological development. This sense of immateriality, lightness, and comprehensibility increases in the interpretation that considers artificial intelligence as the brain capable of managing and manipulating this new urban reality (Cugurullo 2020, 2021).

However, at this point another consideration by Haim becomes decisive in understanding this apparent simplification of urban reality produced by digital technology. Indeed, the Platonic digital object according to the philosopher that attracts by its simplicity hides on the informed, constructed essence. Behind the apparent transparency lie techno-social practices that construct the digital object, in our case the digital representation of the city. Maldonado captures this nuance of Haim's discourse. For while he interprets the techno-utopian promise of digital technology at the urban scale, he also highlights its infrastructural essence. The digital will be an urban infrastructure, an infrastructure to be brought into dialogue with others: this is Maldonado's intuition (1997). This dual interpretation – made of simplification and infrastructurality – that constitute the relationship between digital technology and urban reality intuited by Maldonado is decisive for the contemporary interpretation of both the smart city paradigm and AI Urbanism (Picon 2015; Pergn, Maalsen 2019; Picon, Hill 2020). Indeed, a decisive work that criticism must do is to dissolve the apparent and seductive simplicity of the digital city through structural analyses that bring out the material and power relations that constitute the core of the relationship between the city and digital technology. Deconstructing this platonic simplicity and considering the digital as an infrastructure immersed in the context of the material and immaterial relations of urban realities is certainly a promising way out of the path of utopian thinking. Actualizing Maldonado's lesson, we must view with suspicion analyses that by placing AI at the center promise a new golden age for cities or their fall into a technocentric hell. We should privilege analyses on the material impacts of AI at the urban scale, follow analyses on the phenomenology of the relationships between this technology and other urban actors by providing empirical studies on the impact of this technology

on urban assemblages (Tiddi, I., Bastianelli, E., Daga, E. et al. 2020; Kassens-Noor, Hintze 2021; Mintrom et al 2022). In short, following Maldonado, we should not be attracted by the rhetoric of simplicity produced by this digital platonism but investigate the logics of constructing the relationship between digital technology and the city.

URBAN AI AS A LOGICAL PARADIGM

John Tukey was a Bell Labs employee who contributed significantly to many advances in Information Theory. Among them was the use of the term bit, meaning a small piece or quantity of something, as an acronym for “Binary Digit” (Shannon 1948). The twofold meaning of this term, related to the informative or the ontological domain, is well present in the seminal book (Sennett 2023; Carpo 2022) “City of Bits: Space, Place, and the Infobahn” by W.J. Mitchell (1996), then the Dean of the MIT School of Architecture and Planning. Following a well-established tradition of 20th-century architectural criticism, the author starts from phenomena that are already taking place but not yet within the disciplinary debate to innovate the conceptual design framework and set potential operational guidelines on designing in the age of the digital revolution (Hodson, 2018).

From the first example given in the text, fiber-opting cabling, emerges the central role of infrastructure, one of Mitchell’s main points of reflection. Taking up Maldonado’s intuition of the digital reality as an infrastructure in dialogue with other ones, the author explores their operational implications in the design process. Their diagrammatic, computational-like logic enable the relationship to other logical systems such as digital tools and platforms. A perspective later taken up and extended by Graham and Marvin (2001) since “a critical focus on networked infrastructure [...] offers up a powerful and dynamic way of seeing contemporary cities and urban regions” (Graham and Marvin 2001, p. 4). They have analyzed the complexity of these sociotechnical systems, finding how infrastructure design allows us to understand the ideology behind urban development and their role in influencing the city experience. The city of the nineteenth and twentieth centuries, in which continuous and centralized infrastructural development corresponded to a coherent and unified urban space, was being put into crisis by the second half of the twentieth century. A crisis that coincided with a fragmentation of urban space and the growing importance of environmental and social dimensions, which are also often described in infrastructural terms. In an attempt to understand and act in the splintering city, the authors propose a series of theoretical models to analyze infrastructure as a “system of systems” that include social, political, and economic instances. The aim of this “splintering urbanism” is to highlight how the inequalities and fragmentation of the contemporary city affect the entire design process, from analysis to design tools. This is a perspective in many ways opposite to Mitchell’s (Deakin, 2011) which aims to frame urban environment and digital technologies in a unified vision that relates digital technologies and *res extensa* of physical reality from the related infrastructure. The perspective is that of a single environment integrated with the processes of digital transformation, with increasingly

branched and pervasive connections that with their hybrid logic allow for the exploration of new design potentials. The ability to integrate the logic of these systems - anti-spatial, fragmented, asynchronous, connected - into that of the design process (Mitchell 1990) allows us to understand the meaning of the digital and thus plan the 21st century city. Even in its attempt at systematization, this mixture of architectural logic and technological innovation contains within it quite different declinations of the relationship between technology and reality: the Net, “a fundamentally different physical structure” (Mitchell 1996, p. 8) that displaces our notion of community and urban life; and the Bitsphere “a worldwide, electronically mediated environment in which networks are everywhere, and most of the artifacts that function within it have intelligence and telecommunications capabilities” (Mitchell 1996, p. 167). A co-presence typical of the relationship between cities and digital technologies, often oscillating between a dual or immersive view of the urban environment. The alternation of these two perspectives highlights an aspect relevant to AI Urbanism, namely how different use of identical technological tools can lead to a fundamentally different human-technological relationship. On the one hand, a dual vision, in which reality and digital talk to each other through a common logic despite being ontologically different systems. On the other an immersive approach that aims to build a new context that transcends the ontological differences of departure to integrate reality and digital (Dunne et al. 2021).

In addition to this, City of Bits contains a number of elements of considerable interest to UAI. The search for implications of new technologies has two fundamental consequences, namely putting the design of connections back at the center of the creative process, and on the other supporting these reflections with potential scenarios. Despite the criticism regarding the arguments amount in support of his theses (Deakin 2011), it remains in our opinion valid to consider the quality of the design the consequence of the choice of the elements to be connected and the ways in which this connection is realized. From this perspective, the design process starts with the choice of the number and quality of connections to create appropriate interfaces to explore possible design scenarios. Considerations that allow us to frame the evolution of some of UAI's applications, particularly those concerning the digital twin. Within this area of research, one possible development scenario focuses on data, providing multi-physics and multi-scale simulations through installing more urban sensors, increasing the model precision, collecting real time data (Evans et al. 2019); on the other side, other development trends are based on the aggregation of datasets coming from different domains - society, environment, landscape planning - to build up multi-disciplinary models and simulations mainly oriented toward supporting decision making. In line with Mitchell's insights, the main trends in the development of digital twin and UAI models - which, not surprisingly, mainly concern infrastructures - are based on the quantity and quality of connections between the urban and digital environment, declining them from a quantitative or more cross-disciplinary point of view.

Another element of interest, particularly relevant to AI (UNESCO, 2022), is the ethical implication of Mitchell's operative findings. The period of

the author's reflections is that of the mass diffusion of digital technologies, particularly the World Wide Web. Accordingly with the technological development trend, the book's theses weld the conception of urban development with that of technology by opening a perspective that will later be criticized (Morozov 2011) or limited within a broader framework of the possible uses of technological tools. Mitchell emphasizes the urgency of understanding this phenomenon at the dawn of its diffusion, sensing its impact in economic, social, and political terms. Within this context, the author argues that the digital revolution presents an opportunity for urban designers to create more inclusive and democratic spaces that are accessible to all members of society. Nevertheless, the reference point remains that of Western urban culture, as evidenced by the book's historical and cultural references. A privileged perspective that unconsciously results in a look at technological dynamics, aimed at exploring its potential while leaving in the background the potential inequalities in terms of connectivity, accessibility and urban resources. As digital technologies have matured, this aspect has been explored both in the debate around the smart city (Watson 2015) and in AI Urbanism (European Parliament 2021), seizing the positive and negative impact of these innovations by leave behind the cyber-optimistic perspective in favor of a more balanced and critical use of digital technologies. In summary, Mitchell's operational reflection reprises Maldonado's insights by identifying the fundamental categories of connection between real and artificial - diagrammatic logic - and the main modes of relationship - dialectical or integrated - useful to legislate, plan, design the future city.

CONCLUSION

This contribution aims to highlight the persistent relevance of Maldonado and Mitchell's insights in the context of Urban Artificial Intelligence. The previous paragraphs reveal several points of interest, including the central role of infrastructure as the main interpretative model to describe the dialectic between urban environments and digital tools. While Maldonado considers the infrastructure the main interpretative tool to understand the relationship between the digital and physical reality, Mitchell intends it as a series of logical frameworks useful to innovate the design process.

Another key insight is the ambivalent nature of technology, such as AI applications. Maldonado highlights the apparent simplicity of the web, which can allow for the representation of an idealized perfect city or oversimplified trivialization of urban reality. Mitchell, on the other hand, focuses on how different uses of technology could lead to very different operative models.

These findings from Maldonado and Mitchell are particularly relevant in the context of urban AI, where understanding the complex relationship between the digital and physical dimensions of urban environments is crucial. The use of network and connections can aid in the interpretation of this relationship, while acknowledging the ambivalent nature of technology can help in developing more nuanced and context-specific AI applications. Furthermore, this analyses underscores the importance of considering the broader theoretical underpinnings of urban AI, including critical theories of

technology and urbanism. By doing so, we can avoid over-simplifying the relationship between technology and urban environments and develop more responsible and context-specific urban AI applications.

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