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REVIEW

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Making cities smarter for an inclusive green transition towards a long-term sustainable development: A critical literature review

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Abstract

This review critically approaches the literature on smart cities while describing the significance of more value-based rationality and more reflexive practice for constructing smart cities, rethinking how human experiences are approached to improve it to be more balanced and engaging. This transition establishes a sense of place in the city necessary to enhance people's attitudes and overall well-being. As the vision of smart cities promotes them as more liveable cities while focusing on achieving more efficient services, the review clarifies the need to improve the ability of smart cities to produce more engaging experiences to achieve long-term sustainable development, planning and governance as part of their green transition. The authors promote innovative approaches to realising agendas of citizen engagement and sustainability by clarifying the potential of interdisciplinary cooperation among art, place and technology. This will help redefine progress in city development from merely enhancing basic functions to improving the human experience.

KEYWORDS

city design, governance, planning and policy, smart cities, smart cities applications, smart cities standards

1 | INTRODUCTION

Over the last decade, more cities around the world adopted agendas and visions in a general trend towards becoming a smart city by integrating information and communication technologies in urban planning and development processes. The concept of the smart city today originated in the late 1990s and later in 2005 when it was used by several technology companies in integrating complex information systems and urban infrastructure functions. The term refers to the various forms of technology-based city planning and development [1]. Whereas the vision of smart urbanism promises a better experience for people, the focus is primarily aimed at increasing efficiency and improving basic services in the city [2].

The position of this review advocates the view of Degen et al. [3], that the role of the researchers is to reveal the real effects of the designed environments rather than criticising them from a distance [3]. The aim is to emphasise the need to engage in a dialogue with the current design and governance practices of smart cities while exploring the logic implied, celebrating what Guy [4] argued for in terms of creating a more 'fluid' and diverse design that is more 'situated' ([4], p. 143); in the same sense of moving away from the extreme ideologies of either-or, as what described an 'architecture of the in-between' ([4], p. 142).

There is a lack of work that connects upgrading the potential of smart city design practices with its ability to develop sustainable environment that is engaging human experience and provide an atmosphere that fosters a sense of place. This helps to avoid embodied design practices that do not classify humans as consumers or assets of smart city developments, uncritically enrolled in their logics. It is important to have more research works that investigate the logics of developing and making cities sustainably and how these connect, or not, to various experiential needs of the residents to learn, feel, act and interact with their surroundings (for example, physical, sensory, cognitive, psychological, cultural). Finally, the review reveals the need to look for ways to enrich the experience to provide engaging communication and a dialogue between different

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stakeholders in the city while exploring approaches and tools that help on designing and maintaining people's impression, interest and wellbeing. The paper presents connections to innovative human centred approaches for example, in the form of place-based combination among art, place and technology that have not yet made their way into smart city or green transition practice. This assist identifying areas of upgrading the potential of realising sustainable development on the long term during the green transition.

The structure of the paper is as follows: Section 2 covers methods used to perform the literature review followed by discussion on the notion and logic of 'Smart cities' in Section 3. Then a debate around the city as a system of systems and how to intervene is presented in Section 4. Section 5 follows to clarify powers and impacts of place and the relationship between people in the city as humans and their surrounding environment. The following Section 6 presents approaches to human centric strategies and inclusive co-creation. Finally, a conclusion of the literature review is provided summarising knowledge gaps or areas whether further work is needed. Figure 1 presents an illustration of connections made in interdisciplinary cooperation to generate innovative humancentric catalyst methods of engagement and realising change in cities. A further illustration of topics covered including sections and sub-sections of this review with clearer explanation is presented in Table 1 in Section 2.

2 **METHODS**

A mix of systematic and unsystematic method was used in finding, filtering and engaging with the literature. The review was inspired by discussions with expert academics and urban



Section3. The logic of 'Smart cities'

FIGURE 1 Using a combination of art, place and technology to empower cities. [Correction added on 3 Nov 2023, after first online publication. The figure 1 is corrected.]

planners who have long standing experience for example, in smart cities, European cities and architectural design. The suggestions and materials they provided were investigated and filtered by scanning through the abstract, introduction and conclusion sections and where relevant, the resources were integrated to support the position of the study or to engage in a debate to clarify more about the topic and its contribution, Snow balling effect naturally occurred during the systematic process of finding and filtering the resources which helped generate new connections, debates or perspectives amongst different areas of art, architecture, restorative planning and smart cities. This resulted in the insights and clarification on connections or aspects that were found lacking in the existing resources that usually refer to recycle views or criticism from existing literature on smart cities.

The review starts by discussing the associated meaning of various notion such as smart cities and sustainability while expanding more on computer logics of smart cities that are occupied with function while clarifying the problems associated with relying on such logic for the urban. Then the topic changes to unpack the complexity of the urban and the possibility of intervening in its system while presenting the overlooked social aspects in the current trend of 'Smart Cities'. Due to the nature of the built environment and its impact on human beings, the significance of achieving liveability in parallel with sustainability, the role of place and the importance of integrating more value-based logics and innovative engaging methods and interdisciplinary constellation to make cities smarter is explained to move in the next section to rethinking the focus on control and functionality to think about restorative catalyst environments that help achieve the green transition sustainably while focusing on empowering cities to be resilient and healthy. Given the need to consider and utilise pluralism in the research and making of cities, different strategies that are more human-centric and inclusive are presented while stressing the significance of co-creation.

Table 1 below shows the subject areas and matters covered in this review.

3 THE LOGIC OF 'SMART'

Since there is no universal definition of a city or smart city that applies to all cases around the world argued that focusing on what smart urbanism does and what it can achieve instead of the status of becoming a smart city, is far more important; noting that the notion of smart cities is an 'empty signifier' (similar to sustainability). The literature on historic attempts to make cities more scientific like the smart city discourses, which have often failed to achieve the expected success, has been recycled without criticism by supporters of the contemporary smart city [5]. The promoted vision of the smart city promises better sustainability, resilience, and liveability [6]. However, de Jong et al. [7] indicated in their investigation of the actual differences of these terms in 12 city categories; 'sustainable cities', 'green cities', 'digital cities', 'smart cities', intelligent cities', 'information cities', 'knowledge cities', 'resilient cities',

TABLE 1 Topic

Literature
Evans [10], Shelton et al. [5], de Jong et al. [7], Karvonen et al. [6]
Vigar et al. [12], Degen et al. [3], Guy [4], Luque- Ayala and Marvin [11], Menon [2]
Anderson [24], Browning et al. [17], Ellard [20], Kiib and Marling [22], Kelle and Calabrese [18], Heerwagen and Heerwagen [19], Whelan [21], Van and Crosby [25].
Greenfield [9], Ellard [20], Kiib and Marling [22], Marvin and Luque-Ayala [15], Pallasmaa [28], UN-Habitat and WHO [32], Roe and McCay [30], Vanni and Crosby [25]
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'eco cities', 'low ca cities' and 'ubiqui ners and develope more nuanced use of these terms is necessary to understand their implications in urban development and policymaking.

After analysing the academic co-occurrence of these city categories, de Jong et al. [7] found that the 'liveable cities' is a small category of 'sustainable city' with many common interpretations, while the 'resilient city' is linked to the 'sustainable city' and not to other groups highlighting that the consequences resulting in sustainable urban development depend on whether it is 'at least partly about mitigation, in addition to adaptation, in relation to urban development. The effects of policy measures for the benefit of the "resilient city" can only be assessed if unambiguous quantification approaches have been adopted' ([7], p. 35). Conceptually, the 'sustainable city', 'smart city', 'eco city', 'low carbon city', 'resilient city' and 'knowledge city' were the categories proven to be distinct enough to be considered supported by a particular set of theories, noting that each of the 12 categories has a different view of what is meant of the city and how it functions, concerning the citizens' role in the governance of the city, the relationship between the city and nature, and also the role of infrastructure systems and service delivery in the economy and liveability of the city. According to de Jong et al. [7], these distinctions question the assumptions underlying paradigms of sustainable development, ecological modernisation and regenerative development paradigms, that adopt the triple bottom line view, indicating that economic, social and environmental sustainability are closely connected [7] and suggesting that further economic expansion is possible while preserving the ecological environment (sustainable development, ecological modernisation) or even restoration and/or improvement of the natural environment (regenerative development). The social aspect, which is interpreted differently in various categories, is also duly considered in most of the 12 city categories but proves to be the most difficult to define and measure. Therefore, assuming that a win-win situation is always the logical result of modern urban transformation, is not true, as the trade-offs between them and the future city are determined by the chosen

which leads to digitalising the functions and management of the city rather than installing technologies as mere products using the city as a market for technology developers. Major corporations like IBM, Cisco and Siemens support the tendency in the literature to promote the smart city as a global, rational, and nonpoliticised project that uses data to deliver better solutions for city issues [5, 9]. However, this vision has been widely criticised in many ways; particularly around the intertwining of 'mass surveillance' potentials and technocratic logic in city governance ([5, 9], p. 14).

Also, the 'actually existing' [5] smart city has the potential to challenge the dominant neoliberal data frames and narratives, using the examples of alternative competing representations of the vacant real estate problem in Louisville, Kentucky that revealed-based on a neighbourhood survey-how the scale of the problem was larger and longer-lasting than the city might claim. Thus, instead of studying non- representative imaginaries of smart cities as the marketing discourse does not coincide with the reality of sets of actors, ideas, and innovations involved in rolling out the smart city, it is more fruitful to study 'actually existing' smart cities [5]. Also, Evans [10] noted that collective acts on the international level, as well as a deep and comparative analysis of smart urbanism rationalities, is necessary to provide urbanists with a better understanding of the process of creating cities that are truly sustainable and socially inclusive.

Given the complex nature of cities and urban environments, the next section will discuss the focus of Smart, how its integrates or disregards certain aspects and approaches towards the city making as part of the smart cites agenda.

4 **INTERVENING IN THE COMPLEX URBAN**

It is important to understand how smart urbanism is being used to promote certain agendas of governance networks (i.e.

officials, economists, and technology developers), which often focus on the credit and economic benefit more than the other social or daily life aspects. Visions of integrating 'interactive infrastructure, high-tech urban development, the digital economy and e-citizens' [11] are being promoted by technology companies and institutional actors which 'support the drive towards more sanitised, generic, and one-dimensional global cities' ([6], p. 66) and 'undermine modern notions of the city as a unitary and internally integrated space that can be easily identified and separated off from the worlds around it' ([12], p. 1392).

The implications of the speed with which smart cities are being developed is another aspect that needs to be addressed. 'Social injustice and biodiversity loss' for example, are revealed to be caused by the fragmented and 'disorganic nature' of initiatives like smart cities and eco-cities, as Cugurullo ([13], p. 75) confirmed. Institutional actors seem to focus on economic growth as a mechanism to tackle global development, but economic growth is also a contested argument in sustainability discourse that maps market-driven economic growth against resource access, equity and scarcity. According to Meadows [14], solving worldwide issues sometimes requires a slower, negative, or even no growth. It is crucial to clarify the hidden and often contradictory aspects of these visions. Vigar et al. [12] argued that the concept of the multicultural city which is usually associated only with positive impressions of 'cityness' such as 'enjoyment' and 'creativity' through providing multiple identity resources for residents, may also result in anxiety, tensions, and segregation amongst different groups, 'creating deep divides between those with access to "smart" and those without... in more recent work on the early development of the 100 cities smart programme in India Datta shows how the first mover city of Dholera exemplifies a new model of entrepreneurial urbanism with only a weak commitment to enhanced social justice' ([11], p. 2108). A broader understanding of how to intervene in complex systems such as cities is necessary as defining leverage points within is difficult and even if found they are intuitively being pushed in the wrong direction causing further deterioration of problems in the rush for more growth [14].

Smart urbanisation often assumes that technological innovations will lead to a more liveable city and a better experience, however, it rarely discusses the scope, dimensions, or how to achieve these intended effects [7]. The focus on the human experience is often replaced using urban design as a means by which developers and local municipalities promote investment or tourism in modern cities in the international market [3]. Menon [2] asserted that achieving true liveability in the Smart city requires more than just installing hardware and software, as there is an urgent need to understand how a unique city is created so that it makes people belong to it and want to stay and live in it, instead of allowing it to become impersonal and seamless. Technological advancements should not only increase efficiency but also help enrich the life in the city; for example, by promoting more 'citizen engagement and a respect for resources, the environment and the nuances of a city's cultural identity-the

stuff that makes it different from other cities' [2]. Therefore, there is a need to investigate the normative nature of smart urbanisation establishing the possibility of generating alternative concepts and understandings of the city. As topdown and bottom-up approaches are proven incapable of revealing the complexity of smart urbanism-which goes beyond binary logic. These approaches need to be critically examined while questioning the rationality that leads to their emergence instead of idealising them, intending to determine the challenges, risks, and potentials of maintaining informal alternatives of smart urbanism [11].

Guy [4] suggested facilitating better communication, networking and understanding of the emerging development paths by questioning the means and reasons by which designers determine methods for achieving environmental goals; for example, by selecting specific aesthetics, materials, technologies, and by creating relationships between users and places. Also, exploring very briefly (and tentatively) what certain design frames might offer and illustrate them with 'snapshot' examples of architectural practice beyond the fold of what is conventionally thought of as sustainable architecture. Such practices 'may not originate in a narrow prescriptive sustainability agenda, for example, carbon reduction, but they may provide the ingredients for a fluid architectural strategy capable of meeting the challenges of a more complex sustainability agenda that engages our environmental futures in the round' ([4], p. 142).

Limiting the participation of certain actors is a characteristic of governing in the sense of political government and has proven to lack sufficient cooperation internationally, resulting in further deterioration of global problems such as climate change in the first place. Evans [10] mentioned that some countries tend to resist collaboration with their counterparts in less developed areas of the world. On the other hand, 'environmental governance' as a collaborative framework engages non-state actors (e.g. NGOs, businesses, and the public) extending the contributions to solve such complex issues beyond the administrative or political parties [10].

Also, a deeper understanding of topics like relational aesthetics and urban atmosphere design, which relate in turn to evolutionary psychology, biophilic design, sensory design ...etc is needed. These approaches better explain how people can fully engage with their surroundings and how this built environment affects their attitude and wellbeing. However, it is challenging for professionals in the design industry to clearly recognise how the user reacts to the aesthetic qualities in addition to the authorities' disregard community consultations in the design process [3].

Therefore, further research is needed to clarify the role of shaping human experience to engage the residents in existing cities, as the current understanding and utilisation of technological innovations in the city focus on enhancing the effectiveness of services provided, assuming that this is enough for a city to be smart as claimed in the notion and vision of 'Smart Cities'. The implications of counting on problematic city diagramming and on only current ways of including people in city development summoned up with surveys and calls for public participation often suggest changing existing structures and situations that sometimes might be expensive or overlooked by the government. Simple divisions such as 'top-down' and 'bottom-up' that contrast with the technological configurations of the city; as the progressive potential of a smart city is likely to emerge only through processes whose digital methods critically question the epistemological foundations of 'computational urbanisms' ([15], p. 101). This also embodies what Meadows [14] pointed out about intervening in complex systems such as cities, noting the little influence of changing the components under the same systems as a lower leverage point, compared to changing the insight and key players.

It is essential to understand that integrating technology in problem-solving is not what makes a city smart nor it is the solution in itself; political, economic, behaviourist and empowerment agendas are also playing an essential role when it comes to realising technological solutions needed to tackle global issues. Limiting the participation of certain actors is a characteristic of governing in the sense of political government and proven to lack sufficient cooperation internationally, resulting in further deterioration of global problems such as climate change in the first place. Evans [10] mentioned that some countries tend to resist collaboration with their counterparts in the less developed areas of the world. On the other hand, 'environmental governance' as a collaborative framework engages non-state actors (e.g. NGOs, businesses, and the public) extending the contributions to solve such complex issues beyond the administrative or political parties [10].

Due to the digital nature of the implemented technologies, which smart cities depend on in their infrastructure, policymaking and in shaping residents experience, as they tend to be intangible and difficult to compare unlike other elements of the built environment. In four thematic chapters, Karvonen et al. [8] presented 'grounding and contextualising, integrating and aligning, contradicting and challenging and experiencing and encountering' ([6], p. 5) as the processes that generate smart urbanism considering the complex and rapidly changing nature of the dynamics of digitalised urbanism that inevitably produces intertwined contradicting results. The processes also presented how creating the needed change in cities is determined by the context, inclusiveness of the diversity and needs of the residents as well as the shared vision and the tension between the 'transparent governance and entrepreneurial urbanism' where access to data and civic engagement come into conflict with local entrepreneurs [6].

Moving to the intangible aspects and powers of architecture and built environment, the next section presents the role such aspects play in impacting people's wellbeing and attitude amongst various effects that cities environments have on their every day life.

5 | THE ROLE OF PLACE IN REALISING CHANGE

As the rising interest in urban design accompanies an increased concern with the 'totally designed environments', criticised for

promoting the consumer lifestyle of modern society [3], the focus on the human experience of the residents is often replaced by the use of urban design as a means by which developers and local municipalities promote investment or tourism in modern cities in the international market [3]. The developments are unified and 'coordinated' through regulating urban design codes in the case of the UK [3] or in other cases through an international design 'formula' in the North as noted [3]. The incapability of professionals in the design industry to recognise how the user actually reacts to the aesthetic qualities in addition to the authorities' disregard of community consultations in the design process [3], contradicts the suggestion by and others that design codes work in favour of the user [3]. Joss et al. [16] also stated that despite its call for a citizencentred smart city strategy and practice, it has not fully succeeded in creating an internally consistent citizenship system, leading to many unresolved problems and contradictions.

Thus, the techno-computational logic used in the creation of smart cities as Marvin and Luque-Ayala [15] illustrated is problematic as it comes from transmuting city diagrams and approaches from business and military worlds in the 1960s and 1970s, which proved unsatisfactory in providing longlasting solutions capable of solving urban problems. The technocratic nature of initiatives focused merely on representing and reorganising the city in a way that facilitates control, decision-making, and job integration-while reducing the role of the human in being a mere user-through standard operating procedures for many organisational functions so that they conform to the propositions and assumptions of software packages such as enterprise resource planning systems (ERP). These 'smart' rationalities have been revealed as ingrained in the corporate world [11, 15] 'transforming contemporary functions of power, space and regulation' ([15], p. 85). Also, the platforms with which they integrate digital and physical spheres of the city referred to as 'Urban OS' by IT companies-prioritise a highly technocratic approach to integrated urban control and approach the city as an objective reality through instrumentalist rationality that is mainly focused on making it easier to control and shape the city as a system of systems which depends on classification modes providing a systematic organisation. Thereby, the city is rendered through a framework of objective reality that involves developing patterns, creating hierarchies and broad mapping of the interrelations between different components and functions that aims namely on making the entire internal relationship system easy to predict and control [15].

The Urban OS sees the city as an enterprise or a set of streamlined processes, analysing and reviewing, and developing responses as such to achieve efficiency while emphasising on the possibility of producing 'an informational diagrammatic of control that is being transmuted from the corporate sector by being revised, developed and tested in different urban contexts through numerous and diverse smart city programmes. Mirroring a business, the city is envisioned as a simplified and integrated space of functionality, capable of constant re-engineering and characterised by modularity and configurability to assess efficiency and achieve optimisation' ([15], p. 100).

Therefore, it is important to analyse how this new system of control can accelerate and condense the present and manifold characteristics of self-control and responsibility of smart citizens as active and enlightened citizens who use technology to be independent, responding to signals and messages and providing data to broader systems [15] and being entrepreneurs with it (e.g. via hackathons). Policymakers need to be 'smart' in many ways such as reducing the delay to respond to signals as they use new data sources and developing collaborative procedures with a constellation of actors including those from the ICT sector. Finally, more work is needed to understand how the new informational diagrammatic of control reconfigures the logic of controlling resource flow. Hence, it is important to examine today's move towards smart urbanisation broadly worldwide, to determine whether the problems and tensions noted in the failed transition to urban cybernetics in the institutional aspects of ERP persist. To find out whether a new Urban OS offers more potential, Marvin and Luque-Ayala [15] assert that we need to move away from simple divisions such as 'top-down' and 'bottom-up' that contrast with the technological configurations of the city; as the progressive potential of a smart city is likely to emerge only through processes whose digital methods critically question the epistemological foundations of 'computational urbanisms' ([15], p. 101).

Many studies conducted by scholars such as Browning et al. [17] and Kellert and Calabrese [18] Heerwagen and Heerwagen [19], confirmed that creating and maintaining a sense of place evokes a better attitude and sense of responsibility towards the built environment fostering public participation which is vital to the development of a more liveable smart city. Kellert and Calabrese ([18], 6) stated 'this attachment to territory and place remains a major reason people assume responsibility and long-term care for sustaining buildings and landscapes. Conversely, lacking a sense of place, humans typically behave with indifference towards the built environment' which directly connects the design of urban space to behaviour and accountability of individuals within it.

According to Ellard [20] the inherent need for discovery and interaction drives people to explore unfamiliar places and think of works of art; out of curiosity, there is an innate drive to gather the information that partly determines what we enjoy doing when we do it. In a similar position, Whelan [21] asserted that words are enough, and visuals work better because they are quicker and more reliable when expressing meanings around the daily experience, confirming they are considered necessary to change nowadays. This is also justified by the significance of capturing 'complex, non-linear and dynamic entities' and analysing the impact on users journeys or experiences of people in general. On choosing the right visual images, Whelan [21] asserts there are many, not one. Therefore, visuals including paintings, videos, clipart and artistic works, were considered tools of a concrete visual language. Conducting more studies that present and utilise the potential and significance of art as a language for research and making of impactful methods and atmospheric environments, turns the question around the difference between art and science to what kind of difference both could achieve if purposefully combined, specifically in the context of multistakeholder communication, behavioural change, impactful engagement, and atmospheres making in cities.

The term catalyst architecture was introduced by Kiib and Marling [22] to describe the ability of architecture to bring about social, economic and cultural change to the place as a physical, social and experienced construction. It promotes focusing on what architecture of place does and achieves to and with people's experiential needs, environment and behaviours; as it is described as mediator between various parties to transit from a state to another by using the chemical term 'catalyst' as it refers to the ability to stimulating development through an interaction of substances that would otherwise remain unreactive to each other [22]. Two analytical types of performance (internalised and external architecture-related) were developed based on 'performative architecture' concept by Leatherbarrow [23] to determine place's capability to be a catalyst and the extent of impact could be caused. Whereas the internalised relates to the different users and their active use and interaction of architectural place, its flexibility to accommodate different users' needs and to change its aesthetic appeal, the external includes the perception of place's narratives, the physical transformation caused by a project to the surrounding environment, daily life, usage, safety and motivation to interact with and learn from others. For catalyst places of change to emerge, confirm that transition and edge areas have higher potential than inner areas to reduce fragmentation and increase bonds and interaction among various communities, practices and neighbourhoods in the same place and time given its 'in-between' platform, this causes them to feel related and connected to each other. Approaches that do not perceive or show interactions visibly with design elements and architecture is understood as static are described as reductive and dishonest [22]. On the other hand, relational architecture focuses on concepts of form and space (i.e. typological and morphological relations) where the construction becomes architecture through human interactions and usage of space, utilising the physical intervention of place to improve urban life and secure a worthy setting to various billions of people passing by and through that interplay between form and life [22]. According to Kiib and Marling [22], architecture and urban spaces as sensed structures are experienced through bodily presence and movement through space forming the 'cityscape' or overall impression through all senses of the body not merely vision, and it needs to be enriched with narratives and diverse practices in its programme. This is a similar understanding to that of Geo semiotics described by confirming that the meaning of physical representations and choices of aim and concept by which cities and streets form a language that impacts our behaviour. By adjusting practices on the ground, the perceptions of the neighbourhood continuously change as a dynamic social structure that allows the possibility of contemporaneous plurality described by Doreen Massy [22, 24, 25]. In order to ensure effective and lasting environment is created for everyone in the city, it is important to use innovative tools and approaches that are human centric. Such techniques are presented in the next chapter as part of illustration on the

importance of cocreation and codesign for truly sustainable cities.

6 | HUMAN CENTRIC STRATEGIES AND INCLUSIVE CO-CREATION

Marvin and Luque-Ayala [15] asserted the need to integrate scrutiny for the current genre of Smart to progress its potential; 'Beyond simple dichotomies that contrast bottom-up and top-down technological configurations of the city, the progressive potential of the smart city is likely to emerge only through processes that subject its modes of calculation to scrutiny and question the very epistemological underpinnings of computational urbanisms.' Art is known to be a catalyst of change in society. Artists are better equipped with tools to translate imaginaries of trying new ways of living. It can address various issues (e.g. social and political), offering people a creative way to express their imaginaries, views and reflections; which can deliver powerful messages and innovative insights that can initiate a social change (e.g. behaviours, values) or trigger a transformation in the system. Art has the potential not only to present people's experiences and expectations, but also to allow visionary thinking and action, bringing communities together for challenging discussions that result in advocacy, act, and transformation [26, 27].

Pallasmaa [28] emphasises the crucial 'existential need to feel rooted in time as much as in space', acknowledging the existential role that quality spatial experience plays as it 'tames the immensity and endlessness of time for the human mind to tolerate'. According to Ellard [20], immersive technology is also capable of intensifying presence, for example, by simulation of sights and sounds in immersive experiences that the real world outside the helmet is lost for our embodiment in the simulation. Participants in virtual reality (VR) experiences do not entirely get detached from their surroundings, as their perception is slightly tricked. These methods encourage the escape from restrictions found in real life and free the imagination which empowers human minds with the potential to wonder, envision and create [29]. Immersive technology has shown powerful to quickly provide real-life analogues and even 'capture attention, affect and reflexive social conditioning' giving a strong opportunity to study and research human interaction ([20], p. 178).

Given its flexibility, space can be bent to provide benefits to space users and researchers who are no longer restricted to the physical and costly nature of the built environment which could be personalised to tastes and needs in the virtual version. For instance, a virtual setting in which all students could have the effect of the front and middle area of the classroom made it possible to provide better eye contact and closer engagement with the tutor which has proven to produce better learning and performance. Similarly, these capabilities make it easier to understand more deeply people's responses to space, and their effects on their minds and track and measure their behaviour (e.g. higher blink rates gauged higher mental effort or difficulty of a task). Additionally, geocoded indicators of effect could be

extracted from social media on our mobile phones. Through computational linguistics and sentiment analyses, emotional content and measure of attitude can be derived from Twitter feeds that contain certain words, for example. This 'emotional fabric of places' is highly interesting for commercial and institutional interests. Some experiments had a good impact on participants whose attitudes have changed to fit into a better VR version of themselves, others let them feel their presence in other places where they could walk through and interact with their textures and views. This multi-dimensional typology and representations of space are more aligned with the human mind which is found 'vulnerable' to its engaging effect, 'who wouldn't want to avoid a long boring journey by popping through a magic rabbit hole to a new destination'. Nevertheless, these technologies are rapidly spreading outside the lab environment to daily life including education, travel, interaction, and entertainment, making it more possible to share, exchange and access. For instance, enhanced graphics and engaging narratives are being added to improve computer games ([20], p. 189). However, the mind-body connection makes our physicality (such as expressions and movements) important to the development of thoughts and feelings; thus, it plays an essential role in our relationship with the surrounding environment and people.

Ellard [20] advocates a similar position to Greenfield [9] opposing one size fit all system software designed by a logic to collectively control city functions as found in smart cities ignoring the culture and identity that are vital to residents, the impact of design on their behaviours and sensations. This also asserts the need to deeply grasp cities' nature and how they prosper and maintain their adult residents' ability to embrace 'raw contingencies of life' instead of turning them into passive passers through automatic technocratic systems overwhelmed by false assumptions about the nature of the human, the city and their connection. Advanced technology including wearable and mobile gadgets can be used to empower citizens with means to learn about and participate in solving urban problems. Thus, there could be new models in which more benefit is gained by using such tools purposefully while actively realising the value of data streaming from our devices and the ways they are used and choosing ownership of permissions and control rather than abandoning it Ellard [20].

Based on this feature of the plurality of place having multiple forces and processes interrelating, a place-based methodology is recommended for design researchers as this perception of a place can offer a better approach to understanding its multiplicity by allowing interdisciplinary actors to better locate and perform, avoiding homogenisation [25]. Similarly, emphasised the power of securing inclusive narratives of place to negotiate and mediate perceptions conditioned by lifestyle through diverse ways such as local storytelling, events and cultural designs or programmes, as by making them visible we strengthen social cohesion and provide a new more contemporary basis for transforming the area. Kiib and Marling [22] asserted the possibility of opening the city visually and physically creating new narratives through new accessibilities and transparent mediums brought by various architectural projects while observing the resulting cityscape changes and cultural exchange while noting who the users were and how they used the site. However, closed and homogenous spaces were mentioned as demarcation areas that did not allow social change or progress openness of the city in new ways as noticed in connecting transition areas (e.g. parks, bridges, edge areas) that are designed in context to form a flow of people and items while creating a framework for exchanging behaviours, cultures and perspectives on social issues across boundaries [22]. Transition areas or enclaves offer a shared or flow space where the interaction is created through circulation, access to functions that are more specific and the connection between the street and surrounding squares (e.g. neighbourhood's communal space). Enhancing the intermediate areas of the city strengthens its urban life and elucidate the enclaves' daily experience, enabling mutual understanding by providing a framework for crossborder activities. In parallel, abandoned areas that are considered 'cities back side' were turned into the fronts in projects such as the High Line, Superklein and Jane's Carousel where they played recreational role and improved the area's image socially and economically (e.g. for investment). Functionalist thinking has a consequence of division preventing practical and visual contact resulting in 'social gentrification' [22]. Deliberate programmatic diversity and coexistence of uses allows for new activities to arise among the internal interaction areas and a common environment of 'catalytic effects' such as respect and recognition between various user groups. Daily practices can develop through diversely programmed projects that gather various groups and this can be supported by its character, structure, and arrangement. Open and closed democratic urban meeting spaces are necessary for an openminded and lively dynamic city to emerge It is necessary to produce knowledge through more experiments and research on strategically programmed projects in cities [22] in order to enable creating more cities with diverse urban life '12, 7, 24; 12 months a year, 7 days a week and 24 h a day' ([22], p. 275).

Transparency as a visual concept provides a separation between different areas or functions while avoiding social conflict as a visual connection is maintained between different activities while conflicting ones did not mix. Simultaneously, mutual observation of and learning about the other is made possible through transparent materials and can generate a participatory interest. Some projects used architectural aesthetic effects and programmes compositions to provide 'out of the box' architectural typologies and solutions to local areas that connect with their resources sometimes motivated by the need to create a shared identity and ownership among different people. By introducing a new brightly coloured urban intervention that provided recreational structures in an otherwise seamless closed area, Superklien opened it to commuters and tourists. A similar effect was created in Jane's Carousel which added an iconic piece of art that can be viewed through its transparent walls and changed the area's dominantly production image to recreational by soft landscape where natural elements such as trees, grass, and boulders to sit on as well as improved access to the water resulted in new connections to Manhattan, the river, and neighbourhoods of Brooklyn. Such projects

consciously utilised memorable experiences and evocative narratives and aesthetics that broke the site's pattern, scale or colour and focused on bodily interaction, contrast, visual (transparent) interplay and promoting a certain mood or atmosphere which invited a reaction or attention of the viewer and have been done in context of what is needed in the area.

Depending on the context, stories told by projects analysed by Kiib and Marling [22] varied in terms of their focus. The analysis shows the means of architecture used to on history, coexistence, and local communities. For instance, narratives revealed in projects where historic places have been transformed to accommodate potential demands of the future served a cause beyond telling their historical value to show potentials of abandoned places and structures to represent certain meanings, gather diverse groups and interests and communicate the possibility of having futuristic visions that do not abandon the past. While unrestricted access provided a sense of everyone's place, historic elements found on site (e.g. carousel, old train yards and storehouses) have been used as 'anchor points' to ensure the authenticity or (threatened) ancient identity and sense of place and express an improved way of development. However, it should be taken into consideration that the strengthened place image and identity can be used to brand the area economically and cause social gentrification if new projects are brought into the area. Thus, the role of the conversion itself is to provide a chance to pause and rethink the new shared needs and provide a narrative based on historical practices. Other narratives focused on providing an environment for co-existence and a sense of community. By introducing these into areas of segregation the sharp edge in between the separated areas is turned into a softer transition area in which inclusion and reunion exist. For instance, artefacts from around the world were used in Superklien project to provide an experience of social diversity to various senses with the intention of creating a dialogue in which the various groups that do not necessarily adopt the Danish way of thinking are included and not obliged to its standards. Finally, the theme of cultural education was represented in projects that focused on diverse programmes and open places for learning and cultural critique and exchange in their narrative. An example of this is the Bibliotek + Kulturhus which provided opportunities to relax, study and entertainment presenting the neighbourhood as young and growing to improve socially and culturally. In terms of artistic-architectural cooperation, Jane's Carousel present a good example of relational art and architecture which rely on direct participation to perform. The overall intention was to shape a shared experience of aesthetics or medium for communication or dialogue instead of passive observation of art, which in turn provide a 'social free space'. Whereas Jane's Carousel uses art free to be interpreted and narrated by the people, diverse types of installation art are generally described by theorists as 'social turn' including humouristic, imaginative, socially critical and political art [22]. Roe and McCay [30] introduced a framework that explains ways in which urban design can support psychological wellbeing through a 'restorative urbanism' model that focuses on using attributes and contexts of a city to ensure psychological resilience and healthy behaviours. Thus, in this model, place-making,

interactivity and varied experiences on the scale of neighbourhood and the city play a role to provide social connections and maintain mental health. This resonates with WHO (World Health Organisation) recommendation to prioritise health and equity in governance and planning [30] as well as the United Nation's Sustainable Development Goal 11; to provide cities that are safe, inclusive, resilient and sustainable by 2023 [31]. This also stems from its agenda to secure healthy living and wellbeing for everyone through different ages and stages of life for a more sustainable future urban development [31, 32]. A restorative environment is explained to be one that empowers people to recover from stress and mental fatigue. Based on attentions restoration theory by, effortless attention captivated by a complex yet cohort setting such as that of natural scene or element provide a whole different world in which reflection is allowed and enable humans to overcome mental fatigue, opposite to urban streets for example, where noise and various attributes such as visual monotony deplete people's cognition and put them at rest of depression and stress without a room for reflection. Key restorative elements of fascination, affinity and being away such as natural, historical, artistic and cultural settings such as galleries, parks and café's ensure cognitive/affective restoration [30]. On the other hand, stress reduction theory by and Ulrich et al. [30] confirm that a response of immediate like/dislike as well as physiological changes (e.g. heart rate, stress hormones...etc.) is triggered by visual surroundings or attributes such as complexity and availability of a focal point [30]. Additionally, renewed, and peripheral social relations including chance encounters between strangers allow 'collective restoration' that is significant for social wellbeing and overcoming feelings of loneliness and vulnerability among the population. However, the quality of such encounters differs according to the quality of its place. Thus, providing places that are welcoming, safe and equally accessible to different groups helps encourage social cohesion and connection. [30]. The restorative framework combines seven typologies; Inclusive and diversely design for various users beyond the predominant assumed 'baseline' user, Green with a main focus on nature, Blue that expands access to water settings, Sensory that engages all senses, Neighbourly where social connection and cohesion are enabled, Active that promotes wellbeing through mobility and Playable that stimulates creativity and play to all ages in society.

The framework presents a human centred approach that encourages different actors and social imagination to rethink cities growth more creatively to be informed more clearly on which places make people equally healthier. It explains and promotes episodic activities on the micro scale of the city (e.g. life in the square, life in the park) as well as the large scale such as focusing on safety, curiosity and connectivity through regulated equally spread transportation that provides not only quality way finding bur also accessibility to natural scenery, linking various areas of the city and promoting physical activity. The model of restorative urbanisation functions in a wider system where it intersects with regenerative city model (i.e. using resource efficiency, low carbon to secure better health on our planet) and (resilient city model that focus on sustainable inclusive progress to empower cities against future or unforeseen disasters). To achieve resilience in cities, the ability of communities to cope with life's challenges and adapt needs to be improved, relying on healthcare systems alone is not enough. For instance, public or open spaces were key elements in facing challenges during COVID-19 pandemic. Hence, a city can use the framework to make sure it provides restorative environments in its open spaces which can be crucial assets in times of lockdown measures, restrictions, and social distancing not only to ensure the survival of its people but also their prosperity and quality living together. Leveraging urban planning and design is possible through the restorative framework that focuses on securing more lively multi-functional neighbourhoods that provide diverse daily practices, interactions and features that promote and support people's mental health.

Success necessitates diverse co-creation that can communicate people's contribution throughout the different processes of planning and stewardship and leverage cities to maintain social change, justice, and equity. Play and interactive installations encourage people to become more creative and boost their confidence and imagination which also reduces the risk of loneliness and stress, especially if it involves various age groups. Digital tools such as apps and games offer the opportunity to capture elements of the urban such as landmarks and furniture in a fun way to explore the city while engaging in a social competition for instance. Therefore, a synergistic style of thinking is necessary to explore how restorative urbanisation correlate with aspects of sustainability and resilience using creative tools, placement and design of open public spaces or reuse of abandoned infrastructure for example. The restorative role that streets are to play includes providing the opportunity to access and diverse participation in the public domain as they can increase belongingness and neighbourliness. Thus, changing or adding to the otherwise monotonous elements of the urban to make them more interesting or sometimes playful by stimulating interaction, curiosity, self-expression, and fascination while meeting the diverse needs and perspectives of different people is significant to boost the quality of engagement. Providing quality participatory infrastructure and investing is affordable accessible opportunities as such to support and facilitate a range of act a range of activities and increase cultural, economic, and educational aids or opportunities of cities and neighbourhoods not only help boost the level of engagement but also integrate mental health into urban policy, design, and development to be sustainable and restorative. In addition to web-based engagement, surveys and public meetings, a variety of methods have been recommended by the UN and WHO [32] to support participatory approaches to governance and urban health. Examples include exploring the needs and experiences of the participants by providing them with artistic tools or cameras, 3D models construction is suggested to scale and context, street stalls that invite diverse participation as well as open space methods, such as community audit techniques that capture access, quality, and sensory potentials of place [30].

The list shown in Figure 2 explain how a sustainable application of the restorative framework principles necessitate key roles for all parties involved in city development and making by Roe and McCay [30].

7 | CONCLUSION OF THE LITERATURE REVIEW

In conclusion, the literature of smart cities emphasised the importance of focussing on what smart urbanism does and what it can achieve instead of the notion as well as understanding how and from where smart city policies emerge and how these projects rethink urban spaces differently in various places. The problem-solving potentials of 'smart' need to be examined highlighting the specific logics and techniques with which the code functions pointing to the risks of approaching the city as an object, examining how rationalities and mechanisms of smart transform governing the city and the citizens. More insight and evidence are needed regarding the implications of the sociotechnical and political agendas and their workings to find out how and why smart is being used in political and economic agendas across different urban contexts. The promoted positivist visions of smart need to be opposed by investigating 'actually existing' smart city developments on the ground revealing the other side of smart which includes its potential for urban splintering and contradictory outcomes. Whereas the literature concentrates on the technical, engineering, and economic aspects of smart, the social and political aspects also need to be critically illustrated through a broad, interdisciplinary and comparative approach in research to understand how the urban imaginaries and knowledge on smart are produced. Here, the

Policymakers: Implement restorative urbanism as a central part of future city strategies. Recommend, incentivize or require the principles and pillars of restorative urbanism to be integrated into all urban development as a priority.

City planners: Appreciate the impact of planning decisions and developments on people's mental health and wellbeing and afford this impact equivalence with physical health considerations, in line with the city's restorative urbanism guidelines and policies.

Architects, landscape architects and urban designers: Develop an understanding of the restorative factors of design and integrate them systematically and creatively as standard across all projects.

Developers: Recognize the growing expectations and requirements to provide restorative health features within developments. Become expert on restorative urbanism and integrate its principles into developments.

Clients/business: Ascribe value to restorative urban design in commissioned projects, and explicitly require the principles of restorative design to be reflected in all proposals.

Researchers: Recognize the gaps in knowledge and the need for research in the rapidly growing field of restorative urbanism. Seek ways to evaluate the impact of new developments on people's mental health and wellbeing and disseminate this information to all stakeholders to inform new recommendations.

Public health and mental health professionals: Advocate for restorative urban design as a public mental health opportunity. Work with researchers to evidence its benefits.

City residents: Engage in all aspects of planning and design to ensure that the city is designed to meet the full diversity of needs within the population – and, as a bonus, derive mental health and wellbeing benefits just from participating. Leverage the evidence in this book to advocate for restorative urbanism in your neighbourhood.

FIGURE 2 Restorative cities framework principles impact on the key roles of city makers, after Roe and McCay ([30], p. 202).

social aspect of smart cities seems to be the most difficult to define and measure. In response, the research recognises the importance of establishing a new meaning for urban progress by moving beyond improving the basic services of the city to enhance engagement, communication and experience which is essential for the development of authentic smart cities. Also, based on the priories and challenges for future research in smart cities presented by Luque-Ayala and Marvin [11], it recognises the benefit of establishing a dialogue to better inform the making of smart cities, as it advocates an abductive approach that seeks to explore the logic implied in the current smart city practices while communicating with the different parties. This will help reveal the current ways of thinking of the value of innovative approach to bridge different disciplines and stakeholders while examining and reflecting on gathered insights and effects they have instead of merely overlooking, opposing or criticising them. Therefore, the research engages in a debate with the existing rationalities and practices of smart cities exploring a variety of approaches as part of a larger need for theoretical pluralism as well as other critical tools and vocabulary. This in necessary to better inform policymaking and the construction of smart cities by putting more emphasis on the virtual qualities of the city which would better clarify the ontology of the city and the nature of the needed progress advocating a more value-based and reflective practice.

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The authors cited in the article are the only authors of the work. Author contributions relate to all aspects of the work including research, analysis, revision, and final presentation.

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The author declares that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available within the article.

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