Programming Nature as Infrastructure in the Smart Forest City

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Funding

This work was supported by the European Research Council under Grant number 866006.

Biographical note

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Abstract: *Smart cities typically involve the digitalization of transport and buildings, energy and communications. Yet urban natures are also becoming increasingly digitalized, whether through processes of monitoring, automation, mitigation, or augmentation. This text considers what "splintering urbanisms" materialize through programming nature as infrastructure. By focusing specifically on smart urban forests, I suggest that the management logics of smart infrastructures attempt to program and transform vegetation and its ecologies into uniquely efficient and responsive urban organisms. In the process, these programs of efficiency have the potential to exacerbate extractive economies and social inequalities that amplify and materialize through the "internet of nature."*

Keywords: *smart cities; smart forests; smart environments; digital infrastructure; green infrastructure; sustainable cities*

Introduction

Smart green infrastructures increasingly feature as key components of smart cities and urban development. Along with digitalized infrastructures of water and lighting, buildings and roads, more organismal and ecological infrastructures of vegetation and soil, air and water are also undergoing networked monitoring, management, and augmentation. Many smart cities technologies that would ensure automated and optimized flows across communication and transport circuits have been implemented to measure air pollution, detect flooding, monitor soil health, and ensure adequate hydration of urban forests. Smart cities now program green as well as grey infrastructure. But what are the effects of these smart green infrastructures, and how do they potentially exacerbate extractive economies and social inequalities at the same time that they attempt to mitigate environmental impacts?

This commentary discusses the possible consequences of wiring up organismal and ecological contributors to cities. Proposed and emerging digital-organismal urban connections give rise to networked infrastructures that are meant to achieve new levels of efficiency, responsiveness, and coordination. Even more than merely adding the digital to the natural, programmed green infrastructures strive toward an updated "infrastructural ideal" of joined-up systems, that are as likely to result in fragmented and "splintering urbanisms" (Graham and Marvin, 2001). As Star (1999: 379) suggests, the study of infrastructures can surface "essential aspects of distributional justice and planning power" (as cited in Graham and Marvin, 2001: 16). What, then, are the social-political effects of these programmed green infrastructures?

To address these questions, I first consider how digital-natural urbanisms materialize through projects and plans to incorporate digitalized green spaces into the logic of smart cities. I then discuss an architectural proposal for a Smart Forest City in Cancún by Stefano Boeri Architects, which programs nature as infrastructure in a speculative master plan. In working through different approaches to programming nature as infrastructure, I outline how the smart and sustainable city moves beyond energy efficiency and sustainable transport to incorporate digital-natural programs of exchange, coordination, and mitigation.

The programming of these infrastructures in part aligns with natural climate solutions and ecosystem services that would mobilize more-than-human ecologies as key operators in addressing and averting climate crisis while realizing green growth (Sullivan, 2013). Yet it also indicates how these digitalized natures function less as purified ecologies in the outmoded binary sense of "nature" as a world apart, and more as environments and systems that quicken to the logic of circuits, chips, and capital. Here, vegetation becomes technological, operating within digital functions that are co-

extensive with smart urbanism. But such programs of efficiency and responsiveness are as likely to render obsolete and inassimilable any bodies, practices, or organisms that would not contribute to the productive augmentation of smart green economies and ecologies.

Networking Green Infrastructure, Infrastructuring Digital Natures

Transport, utilities, and communications have formed a basic mix of grey infrastructure that informs urban life. The provision of safe drinking water, readily available electricity, and public roadways, are among the infrastructural projects that are meant to undergird the development of "modern" cities (although see Simone, 2004). These infrastructures continue to be updated in the form of smart systems—from smart energy grids to automated transport and surveillance systems—that digitalize urban functions toward greater efficiency. Yet digitalization constitutes distinct modes of power, governance and everyday exchange (Maguire and Winthereik, 2019). As many studies of smart cities and smart infrastructures have demonstrated, the digitalization of urban spaces can reorder social life, variously enable or constrain political engagement, and amplify inequalities by creating new zones of exclusion.

In the context of climate change and environmentally stressed urban environments, infrastructure is increasingly more than the concrete and the cabled. It is also the green and growing. In many smart green city proposals and projects, urban natures are reconstituted to perform particular work that is meant to achieve the infrastructural ideal of sustainable urbanism. Trees become carbon sinks, low-lying vegetation acts as flood defenses, shrubs and vines take up air pollution, and mass planting mitigates urban heat island effects. Ecosystem services, natural capital, and natural climate solutions are just a few of the common concepts that describe how

nature has become infrastructural as it would mitigate and prevent the overheating, flooding, and collapse of cities (cf. Carse, 2012). These increasingly common practices seek to ensure the livability of cities in the context of environmental change (Karvonen, 2015), yet these developments also raise concerns about what infrastructural collectives and exclusions could materialize.

At the same time, green infrastructures are increasingly digitally monitored and managed to ensure optimal contributions to urban processes. Networked green urbanisms do not simply involve planting and preserving what would have otherwise been paved over. Instead, these processes program nature as infrastructure that operates and responds to the demands of ongoing environmental change and climate crisis (Gabrys, 2014; cf. Blok et al., 2016). Digital technologies undertake remote and in situ sensing to assess carbon storage capacity of trees and soil. Mapping technologies geolocate trees and vegetation as "natural assets" that can mitigate environmental stress. Robots plant, climb, and manage trees for improved growth and efficiency. Sensors detect water moisture levels and track chlorophyll levels. Citizen-sensing initiatives track and maintain urban tree planting. And joined up digital systems contribute to real-estate development projects for creating future smart forest cities (Nitoslawski et al., 2019; see also Gabrys, 2020).

Such digitalization of urban ecologies forms what some advocates refer to as an "Internet of Nature" (Galle et al., 2019). As part of the Fourth Industrial Revolution, nature is brought online to perform in "the next frontier of ecosystem management" that is meant to "change our relationship with the natural world in the urban age" (Galle et al., 2019: 279). The Internet of Nature fuses "existing natural ecosystem dynamics and IoT infrastructure," where plants can become biosensors for more resilient ecosystems, wearable technologies can monitor human health for well being nearby green space,

blockchain and crypto-currency can support green initiatives, sensors can monitor urban heat islands, and "ecosystem intelligence" will reside in the cloud (ibid.: 282).

Networked urbanism here involves amplifying communications within ecosystems by constructing urbanism through connections that also are a process of programming, operationalizing, and making functional according to distinct logics for urban environmental governance. The smart green city is one of efficiency and automation, coordination and measurement, contingency and response (Gabrys, 2016). At the same time, the logics of digital operations—including processes for gathering data, apportioning ownership, realizing value and managing property—infuse digital-vegetal operations. Green infrastructure, including smart urban forests, in turn would function as automated systems mitigating, ventilating, and conditioning the effects of environmental change.

As an updated infrastructural ideal that would address planetary environmental change, the seamless functioning of smart green infrastructure relies on a sort of cyborgian organicism that fuses technologies and ecologies. And yet, as Graham and Marvin point out in *Splintering Urbanism*, the emergence of any infrastructure has consequences for politics, social interactions, inequality, and distribution of resources. Infrastructures present distinct ways of making collectives, and of joining up urban environmental life. They can also create specific barriers and exclusions, where infrastructural operations might be available to some but not others. The privatization of infrastructure can cause fragmentation of services. So too do monopolistic formations of infrastructure have the potential to establish technocratic and inflexible exchanges, which constrain social and political life. Moreover, the resources required to create and sustain infrastructures can cause vast disparities across regions, where digital infrastructures in one location could contribute to extractive and unequal economies and

relations in another. Smart green infrastructures must inevitably be considered within this longer trajectory of infrastructural problematics, rather than presented as an easy solution to pressing planetary problems. The next section outlines in more detail one example of how these infrastructural problematics erupt in a smart forest city.

Programming Infrastructure in a Smart Forest City

The Smart Forest City in Cancún, Mexico, is a speculative project and master plan that raises such questions about the consequences of smart green infrastructure developments. Stefano Boeri Architects, a group well known for green city and building projects, developed the Smart Forest City plan in 2019. The architecture group developed the Smart Forest City plan in Cancún for the Honduras-based multinational textile manufacture and real estate developer, Grupo Karim. In addition to manufacturing personal protective equipment (PPE), Grupo Karim has developed a number of smart cities as part of its broader real estate portfolio that includes commercial, residential, and industrial properties. Smart cities developed by Grupo Karim often take the form of business parks in Central America, where call centers cluster together in San Pedro Sula in Honduras; and outsourcing industries integrate with a university, residences, shopping, and a "corporate/diplomatic zone" in the capital city Tegucigalpa.[1]

The Smart Forest City in Cancun fits within this range of developments, as a "unique investment opportunity" within the smart city space.[2] Just south of the Cancún International Airport, and moments from the beach on the Caribbean Sea, the Smart Forest City is designed as a smart green city of networked systems. This "innovation hub" is meant to be regenerative, giving back to nature what would have otherwise been developed into a shopping mall.[3] Flood-proof waterways, drones, glass and steel office

towers, and palm trees garlanding solar panels form a tranquil setting where families with prams, men in speedboats, and leisurely onlookers studying desalination towers populate the scenes of this imagined smart forest city. Electric vehicles provide smarter transport options, and provide a low-carbon way to navigate this zone of high-tech research and sustainable living. Social life unfolds in scenes of seamless integration with the smart forest city, where city-subjects are economically privileged knowledge workers inhabiting a relatively protected enclave.

Here, technology, nature, and society harmoniously commingle in scenes of manicured and digitalized urbanism that might be slotted into the genre of "the eco-fantasy project" that especially focuses on "performance and optimization" (Barber and Putalik, 2018). The work that nature will perform to keep the Smart Forest City operational and balanced includes absorbing and stocking more than 116,000 tons of carbon dioxide. The site includes "400 hectares of green spaces with 7,500,000 plants of 400 different species," selected by a botanist and landscape architect. This mix of vegetation will ensure that there are 2.3 trees to every inhabitant. The project and press literature stresses that the layout will ensure that "public parks, private gardens, green roofs, and green façades will all contribute to achieving a perfect balance between nature and building footprint."[4] Here, natural capital and green growth are meant to work toward a more perfectly organized environment.

However, in many ways extractive logics continue to inform how nature is put to work in support of existing socio-economic systems (cf. Fletcher et al., 2019), despite the extractive and unequal conditions that undergird these. Indeed, these conditions could become even more entrenched through the privatization of smart green infrastructural enclaves situated within contexts of broader socioeconomic depravation. Caribbean spaces and islands have, moreover, served as spaces of ongoing

respatialization in the context of offshore economies, tourism, mobility, and digital infrastructures, which can reinforce colonial forms of territoriality (Sheller, 2009).

Similar to many development schemes, the Smart Forest City is designated as a "forest" less because anything traditionally resembling a forest materializes here, and more because it conveys a seemingly sustainable approach to transforming a greenfield site into a business park. The development is proposed to be self sustaining, producing its own energy and food through adjacent fields and solar panels, desalinating its own water, irrigating its crops, regulating floods, and achieving resilience through carefully orchestrated networked connections watched over by industrious drones. Behind the scenes, digital technologies with a high environmental footprint are meant to ensure the balance and self-sufficiency that this city would achieve.

Yet this organicism of technologies and ecologies is generative of an exclusive enclave that is self-sufficient on its own terms, while still requiring the ongoing extraction of resources from—and fortification against—a wider world. The social milieu that unfolds within this proposed natural-technological harmony includes carefully surveilled spaces where humans operate according to programs as productive and networked as those that would manage vegetation. With these programmed natural infrastructures, there is an absence of weeds and discord. Such balanced systems do not make space for struggle and protest. Order prevails in this master plan, which transforms cities and forests toward urbanisms that resemble a Biosphere experiment caught in an idyllic state of homeostasis. Smart green infrastructures seem to soften the edges of the usual extractive and inequitable digital urbanisms, but reproduce many of the same infrastructural problematics of these developments.

Conclusion

Infrastructures not only sustain forms of urban and environmental organization. They also construct collective worlds (cf. Foucault, 1984: 239; as cited in Graham and Marvin, 2001: xxxi). As Berlant (2016) notes, infrastructures are not mere structures. Rather, they inform the movements of collective social life by generating politics and struggle. Social life is not merely an expression of perpetual balance, but includes disagreement, "brokenness," and crisis (cf. Larkin, 2013; McFarlane and Rutherford, 2008). In other words, while infrastructure informs social and urban life, it also generates moments for extending it in other ways, beyond seamless functioning and toward transformative challenges and connections.

However, such urban unfoldings of process and practice are less evident in plans such as the Smart Forest City and similar smart urban forest initiatives. These projects would program nature as productive and harmonious infrastructure. Climate change in the form of sea-level rise, resource depletion, and overheating are meant to be addressed through adaptive waterways, self-sufficient agriculture and energy, and vegetative air conditioning that together create digital, green, and resilient urbanisms. Such infrastructural imaginings often elide the inequalities, political struggles, environmental crises, and extractive economies that undergird plans such as the Smart Forest City. These smart green infrastructures then run the risk of reproducing and amplifying environmental crisis and injustice, rather than transforming it (cf. Masucci et al., 2020).

In this way, and following LaDuke and Cowen (2020), programmed green infrastructure projects force encounters with the "profoundly practical work of infrastructure" (page 244). Such practical work could even break with the destructive qualities of what these authors refer to as "Wiindigo infrastructure," which requires relentless extraction and inequality to realize its operative ideals. Instead, infrastructure as practice requires developing projects that would work toward "justice,

decolonization, and planetary survival" as joined-up concerns (LaDuke and Cowen, 2020: 245). These are "otherwise infrastructures," that recognize the work that infrastructures do to sustain social life. If urbanisms, more-than-humans, democratic political life, and social justice are to converge in more generative ways, then infrastructures—grey, green, and otherwise—need to be engaged with as key sites and processes of transformation. The practical work of infrastructure could then be wrested from the property developer's portfolio and architect's plan to become an ongoing collective project and political struggle for more livable urban worlds.

Acknowledgements: This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program (Grant agreement No. 866006).

Notes

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[2] Grupo Karim, "About Us," https://www.grupokarims.com/about_us.htm

[3] Stefano Boeri Architetti, "Smart Forest City Cancun," https://www.stefanoboeriarchitetti.net/en/project/smart-forest-city-cancun/

[4] Design Boom, "Stefano Boeri plans Smart Forest City with more than 7 million plants in Cancun, Mexico," https://www.designboom.com/architecture/stefano-boeri-smart-forest-city-cancun-mexico-10-30-2019/

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