

Editorial Introduction

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Cities are changing across the planet. Climate change, rapid urbanisation, pandemics, as well as innovations in technologies such as blockchain, artificial intelligence (AI), and the Internet of Things (IoT) are all impacting urban space. In turn, cities are changing the planet, too. One response to such changes has been to make cities ecologically sustainable and ‘smart’. The ‘eco smart city’ for instance uses networked sensing, cloud, and mobile computing to optimise, control, and regulate urban processes and resources. From real-time bus information, autonomous electric vehicles, smart parking, and smart street lighting, such initiatives are often presented as a social and environmental good.

Critics, however, increasingly argue that technologically driven and efficiency-led approaches are too simplistic to deal with the complexities of the urgent and widespread transformations needed. Sustainability in the smart city predominantly focuses on resource optimisation and efficiencies and is thus performed in limited ways that leave little room for participation and citizen agency despite government efforts to integrate innovative technologies in more equitable ways. More importantly, there is a growing awareness that a human-centred notion of cities, in which urban space is designed for, and inhabited by, humans only, is no longer tenable. Within the age of the Anthropocene¹—a term used to refer to a new geological era in which human activity is transforming Earth systems, accelerating climate change, and causing mass extinctions—scholars and practitioners are working generatively by acknowledging the entanglements between human and non-human others (including plants, animals, and insects, as well as soil, water, and sensors and their data) in urban life.

In *Designing More-than-Human Smart Cities*, renowned researchers and practitioners from urban planning, architecture, environmental humanities, geography, design, and computing systematically and critically consider smart cities beyond a human-centred approach. They respond to the complex interrelations between human and non-human others in urban space. Through theory, policy, and practice (past and present), and thinking speculatively about how smart cities may evolve in the future, the book makes a timely contribution to lively, contemporary scientific and political debates on what counts as genuinely sustainable smart cities. This is of particular relevance now, given how the climate emergency, growing pollution, and species decline, as well as the COVID-19 pandemic and wars, are shifting urban land use and mobility, and bringing issues of environmental and social injustices much more visibly into the public domain.

The aim of this book is to move discourse and practice for the design of sustainable smart cities forward by demonstrating how concepts and theories from the more-than-human paradigm are being brought into a range of emergent design practices, while offering a direction for future work. The book brings together different disciplinary perspectives to explore what it means to co-design with humans and non-humans, embrace our interrelatedness and interdependencies, and co-create more liveable, just, sustainable, and resilient urban environments that contribute to planetary health and wellbeing. The chapters in this book illustrate key concepts using case studies, methods, policies, and frameworks. Our book sits at a timely and unique intersection between smart city and sustainability engineering and conceptual and methodological explorations of more-than-human design.

Our Personal Motivations and Positioning

With a book such as this, which inevitably asks that we acknowledge and limit human-centric approaches, we feel it is important to also represent our interests and concerns in the current research and practice landscape and recognise how taking a more-than-human view requires acceptance of a double bind. The act of writing and editing a book of this kind is, in and of itself, a very human-centric thing to do: we are creating a thing with words and sections designed specifically for other humans to read and design with. We are therefore coming to this work from a particular set of histories, herstories, and perspectives that are grounded in our collective experiences, senses, and knowledges as people, which has its limits. At the same time, we are encouraging our authors and readers to question and decentre human dominance and exceptionalism to empathise, engage, and be compassionate with more-than-human perspectives and not only advocate for other ways of knowing, but other ways of being with.

The more-than-human turn in design signifies a fundamental shift in perspective, acknowledging the intricate web of interactions between not only humans and their surroundings, but also the myriad non-human entities that coexist within our urban landscapes (Clarke et al. 2019; Forlano 2016; Giaccardi & Redström 2020). We connect with and extend long-standing discourse in the environmental humanities on more-than-human ontologies (Abram 1997; Franklin 2017; Galloway 2017; Panelli 2010). As a result of this scholarly history and development across different disciplines, the authors of the chapters in this book employ the term 'more-than-human' in diverse and innovative ways, reflecting a rich tapestry of ideas. Some contributors delve into the realms of ecology and biology, emphasising the symbiotic relationships between urban ecosystems and their human inhabitants. Others explore the infusion of smart-city technology, examining how artificial intelligence (AI), the Internet of Things (IoT), and autonomous systems can foster a deeper integration of human and non-human elements in the city. Additionally, several chapters probe the cultural, epistemological, and ethical dimensions of more-than-human urbanism, offering critical reflections on how this concept can redefine our understanding of

community, belonging, and cohabitation. As we embark on this journey through the pages of this book, readers will encounter a pluriversal discourse that challenges conventional wisdom, inviting us to reimagine our cities as vibrant, harmonious ecosystems where humans, nature, and technology coalesce to create a sustainable and inclusive urban future.

Sara

My interest in the topics of the book developed through long-term participatory design research with urban community food-growers at Spitalfields City Farm, a community farm in inner East London, in the UK. This farm was the site of my PhD work, and subsequent research in a project called Connected Seeds and Sensors that explored how networked sensors, data visualisation, and an interactive seed library could help support more sustainable food production and consumption in the smart city. It was at the farm that I first learned from urban food-growers the importance of plants, insects, birds, and microbes, as well as the role of less-defined entities such as soil, the air, and a changing climate in the urban food web, and this changed how I think about smart cities. I have continued to work with food-growing communities, as well as more recently with different urban nature-based communities such as river activists, and together we have been co-designing digital prototypes for more-than-human smart cities. The aim is not to make urban processes more efficient, but to tell the stories of bio-cultural diversity, share knowledge, distribute benefits of the smart city more evenly, and celebrate practices of care in the web of life, particularly in the context of densely populated, culturally diverse cities (see Nichols & Heitlinger 2022 for a write-up of some of these experiments).

It was at the farm in 2017 that I met Marcus on one of his visits to London, and I remember after showing him the Connected Seeds Library, we hatched the germ of the idea to edit a book on the topic of More-than-Human Smart Cities. Rachel joined us, and the three of us subsequently co-organised two international and interdisciplinary workshops that were important in the development of our book proposal. The first workshop, called *Avoiding Ecocidal Smart Cities: Participatory Design for More-than-Human Futures* took place at the Participatory Design Conference in 2018. It was co-organised together with Ann Light, Carl DiSalvo, and Laura Forlano, and involved seventeen accepted position papers (Heitlinger et al. 2018; Clarke et al, 2019). The second workshop, *Digital Cities #11—Communities and Technologies for More-than-Human Futures*, at the Communities and Technology conference in 2019, was co-organised with Martin Tomitsch and had sixteen position papers accepted (Foth et al. 2019). Together these workshops helped us refine the focus for the book and understand the relevance of the topic for different disciplines and contexts. Many of the participants have contributed chapters here.

Marcus

My scholarly journey from championing human-centred design in urban informatics to co-founding the More-than-Human Futures research group at QUT has been an evolving exploration of the ever-changing relationship between people, place, and technology. Back in 2006, when I established the Urban Informatics Research Lab at QUT, the prevailing industry and governmental approaches to urban computing were distinctly technocratic. I was thus motivated to steer urban computing research and development towards *human-centred* design principles. However, as our group went through the heydays of the smart city, a profound shift in perspective began to take root. This was accompanied by Paul Dourish's (2010) reflections on the limits of 'use' and 'usability' notions in sustainable HCI, Laura Forlano's (2016) article about decentring the human in the design of cities, Mike Monteiro's (2017, 2019) poignant call for ethics in design, and our own early engagement with notions of sustainability in design (Foth et al. 2009; Paulos et al. 2008). All of this contributed to an epiphanic moment of self-reflection that made me recognise design's deep-rooted complicity in the complex, interconnected challenges humanity has wrought upon the planet. This introspection resonated with my colleagues at QUT, leading to the inception of the More-than-Human Futures research group in 2020.² Our collective vision is to strive for socio-ecological justice by co-creating inclusive pathways rooted in Indigenous wisdom, focusing on environmental humanities, ecological justice, and decolonial theory. This self-reflection on my design research practice also fuelled my motivation to co-edit this book alongside Sara and Rachel, exploring the multifaceted dimensions of more-than-human smart cities and their potential to reshape urban futures. With this book, we want to provoke critical discussions and inspire innovative solutions in our pursuit of a more harmonious and sustainable cohabitation between humans and the diverse species and systems of our cities.

Rachel

As a design researcher I have a background in digital live and performance art practice. Prior to joining academia, I worked with environmental organisations and youth groups on mining and quarry restoration projects exploring digital representation of landscape and biodiversity in the United Kingdom and internationally. Now I have a particular interest in how more-than-human sensibilities can be brought into particular design practices in urban environments and the challenges and tensions this creates between organisations. I have had many postgraduate and undergraduate students struggle with the theories and concepts discussed in the works of brilliant authors such as Puig de la Bellacasa (2017) in finding practical routes into design that can take an ethical and speculative stand on more-than-human life. For me the exciting part of working on this edited collection has been reading how designers interpret and work with

these ideas and apply them, build on them or struggle with them. First of all, this is understanding where the generative potential of such work is, but also where the limits of our practice and mindsets might be and what change can happen as a consequence of doing design from these perspectives.

Book Sections

The book is divided into four sections: Cultures, Practices, Justice, and Futures, with a Prologue from Carl DiSalvo and an Epilogue from Laura Forlano, experts we invited to provide overarching critical reflections and personal commentaries for the main chapters to sit with. Taken together, these sections trace the different perspectives and approaches pertinent to the topic of designing more-than-human smart cities, including methods and practices, bringing together different actors and disciplines, and finally reflecting on possible smart cities of the future that are more sustainable and just. In order to compile state of the art knowledge and appeal to a diverse audience, *Designing More-than-Human Smart Cities* draws on academics and practitioners' knowledge, and features studies from established and emerging scholars, as well as aiming to include an internationally diverse array of voices and cases. Each of the four sections—Cultures, Practices, Justice, and Futures—is populated by original chapters that address different aspects of each theme and that together showcase the diversity of thoughts and praxis within each theme.

Cultures

In our first section on cultures, authors provide readers with an overview of frames, theories, and concepts from different cultural epistemologies, highlighting work from indigenous ways of knowing, postcolonial perspectives, and design anthropology. This section provides readers with examples of practices and perspectives that have privileged kinship and alliances over extraction and exploitation of natural resources. Authors introduce pluriversal knowledges across data, organic matter, and indigene-ity, while providing a theoretical and conceptual grounding for the book by drawing on feminist ethics of care. Authors in this section expand on recent thinking from social sciences and humanities to consider the political and practical imperative for attending to the marginalised, for making the invisible visible, and understanding the ways in which to move beyond a human-centred perspective of dominance and privilege to consider feral assemblages and more-than-human alliances. This section helps trace the move from technocratic and efficiency-based approaches to smart cities, towards care and interdependent relationships within urban space.

Donna Houston, Jessica McLean, and Natalie Osborne's chapter considers many of the infrastructural frictions and the necessity of care in the face of ruins in the multispecies smart city. They consider different theoretical critiques of smart cities, and through feminist thinking about care, shadows, and ruins in multispecies worlds, they introduce a series of 'glitch vignettes' to surface the edges of the

smart city to mobilise different forms of interdependence.

Through questions around smart, stupid, and wise cities, Owain Jones's chapter asks how a focus on water can help us move beyond narrow and problematic notions of urban smartness. Drawing on a project called *Hydrocitizenship*, his explorations use water as a lens to rethink technocentric and modernist ideas of smartness in cities and move towards a more ecologically inflected notion of the wise city.

Yoko Akama flips notions of growth and control associated with the smart city on their heads, instead reflecting on the importance of spirits, death, and destruction in relation to Japanese culture and the uncontrollable power of seismic geological forces.

Manuela Tabouda and Jane Turner delve into the realm of decolonial thought to illuminate the intricate relationships between humans and the more-than-human in urban design. Drawing from narratives of Meanjin/Brisbane, Australia, their chapter uncovers the often-unseen 'abyssal lines' in cities that delineate humans from non-human others.

Practices

In our second section, authors consider the different practices that bring some of these theories to life and engage others in the processes of design. The focus here is on strategies and methods aimed at moving beyond a human-centred perspective of design in the urban realm. Here we see how practitioners, including artists, researchers, designers, and policy makers, approached the design of digital infrastructures, monitoring and sensing, data collection, and visualisation aimed at improving more-than-human cities, socially, economically, environmentally, and democratically.

Alexander Holland and Stanislav Roudavski pioneer an innovative approach to addressing the environmental crisis through more-than-human design. By reimagining trees as designers, birds as clients, and humans as assistants, the chapter empowers non-human lifeforms and advocates for their active inclusion in the design process. Through the use of AI, field observations, and computation, the authors provide both a conceptual framework and practical tools to foster cohabitation and sustainability.

In their chapter, Bill Gaver, Andy Boucher, Dean Brown, Naho Matsuda, Liliana Ovalle, Andy Sheen, and Mike Vanis recount their journey as newcomers to the field of smart cities, seeking to incorporate more-than-human perspectives, particularly non-human living beings, into their design practice. Through participatory and design-led engagements with stakeholders, they developed a workbook of design proposals and fictions, challenging conventional notions of smart-city design by opening up new possibilities for cohabitation and reshaping our urban landscapes.

Jonathan Metzger and Jean Hillier explore the unintended consequences of sub-urban development on mosquito populations in Australia. By emphasising the co-becoming of humans and mosquitoes and drawing from the philosophies of thinkers like Bruno Latour and François Jullien, the chapter advocates for an

‘upstream’ investigation approach that challenges traditional ‘downstream’ mosquito-management practices. This thought-provoking perspective suggests that smarter urban planning should prioritise understanding development environments over relying solely on technology and offers a fresh outlook on the coexistence of humans and non-human entities in the smart city context.

Annika Wolff, Anne Paßsila, Allan Owens, and Lasse Kantola tackle the challenge of harnessing environmental data for urban planning and its impact on nature. They introduce the concept of ‘data drama’ as an innovative approach that goes beyond traditional data storytelling and actively involves the audience in embodying and understanding data. This chapter bridges the worlds of drama, education, critical pedagogy, and data science and emphasises the role of emotions and imagination in fostering empathy for the hidden concerns that data can unveil, ultimately facilitating a deeper exploration of the more-than-human dimensions of urban development.

Justice

In the third section, authors discuss different issues associated with achieving justice in smart cities when we consider moving beyond a human-centred perspective. Special attention is given to the tensions around which species we are prepared to live with, and those we are not prepared to tolerate, as well as a consideration of the sacrifices humans may need to make in order to make space for other species. This section also presents a critical analysis of what democracy might mean when non-human stakeholders are brought to the table of urban governance processes.

The chapter by Clara Mancini, Daniel Metcalfe, and Orit Hirsch-Matsioulas advocates for extending the principles of equity and inclusivity to the realm of animal inhabitants within smart cities. Grounded in multispecies justice theory, the authors posit that truly just smart cities should facilitate animals’ pursuit of biologically relevant goals and species-specific capabilities. By providing cases of human–animal cohabitation, the authors highlight the importance of supporting animals’ interaction in cities.

Mennatullah Hendawy, Shaimaa Lazem, and Rachel Clarke explore complex notions of decentring human exceptionalism in the context of urban development and conflict, where communities are spatially marginalised in East Jerusalem. They argue for more-than-human speculations that recognise multiple perspectives, including human inequality when considering designs for cohabitation towards a just smart city.

Alex Taylor and Alison Powell explore the consequences of reimagining our interactions with multispecies neighbours in smart cities. They argue that these encounters can generate new forms of solidarity between humans and non-humans but also bring forth tensions that highlight the political dimensions of ‘partial perspectives’ and asymmetries in recognising others. This chapter encourages reflection on the connections that can be forged through encounters with animal others.

Futures

In our final section, authors present speculations, demonstrators, and futuring approaches to more-than-human smart cities to consider higher levels of impact making. What does it mean to scale up the potential for impact, and at the same time respect the specifics of local communities and practices? How can we reconcile the urgency of the climate crisis and the need to act now with the need to consider long-term even geological—timescales? What might sustainable smart cities of the future look like and what are the drivers of change?

The chapter by Mary Graham, Michelle Maloney, and Marcus Foth offers a longer-term perspective on the future of more-than-human cities. Drawing inspiration from the enduring governance systems of Australian Aboriginal societies, they introduce the concepts of the Relationist Ethos and Custodial Ethic to advocate for regenerative habitats and social justice within cities. The chapter encourages urban governance professionals to embrace thinking across generations and envision cities that act as ‘good ancestors’ for both future generations of humans and non-human others.

At the forefront of engineering and design innovation, Rachel Armstrong explores the practice of working with microbes to build programmable bricks that produce electricity from human waste and AI through biofilms that support a culture of life to inform a new vision of the bio-digital city. Through a series of high-profile international demonstrator projects, Armstrong questions what the future of urban democracy in the smart city might look like when we cohabit with autonomous bio-digital structures inextricably linked to our bodily fluids.

Ann Light, Lara Houston, and Ruth Catlow describe the experiences of developing the *Treaty of Finsbury Park* in London and the significance of intimacy in the process of transforming the urban imagination. They argue intimacy acts as a counter to urban smart-city development that often focuses myopically on efficiency and data abstraction.

In the final chapter, Ron Wakkary provides a unique glimpse into the future of cities by focusing on the lifecycles and endings of designed elements within urban environments. Drawing from the concept of biography in the context of designing-with, Wakkary explores the intertwined narratives of human and non-human agencies and sheds light on the fragility, breakdown, and evolving ontologies of waste that play pivotal roles in shaping and reshaping cities. This chapter ultimately invites readers to perceive cities as intricate interweavings of biographies and multispecies gatherings and offers a thought-provoking perspective on the evolving dynamics of urban spaces and their more-than-human constituents.

What Next?

In editing this book, between its inception in 2019 and throughout the COVID-19 pandemic, we have been constantly reminded of the ever-present challenges

when multispecies relations are focused on human dominance over others. We see repeatedly across the globe that this dominance has resulted in extinction, loss, viruses, and disease. While many of the chapters respond to visible Earth systems and species, when faced with viruses such as COVID-19, monkeypox, and bird flu, the significance of microbes and bacteria is clear (Mitchell 2011; Searle & Turnbull 2020). When a species is under threat for long periods of time, the results can be unpredictable, as species adapt and mutate. From our own gut biome, where stresses can cause certain bacteria to thrive, to the changing land use across the planet due to intensification of animal food production and rapid urbanisation causing habitat loss, these drivers inevitably support the conditions for disease and threaten the wellbeing of much life on Earth. This is yet another reason we should opt for cohabitation and not control. Amidst these challenges, the urgency of our collective and planetary mission becomes clearer than ever. The lessons gleaned from the intricate web of multi-species interactions, including the microbial realms, underscore the necessity of embracing a paradigm shift towards more-than-human smart cities. While the past may be riddled with tales of extinction and pandemics arising from human-centric approaches, our journey forward must be paved with radical and urgent systemic transformations. As we strive towards thriving cohabitation, rather than control, let us develop together new practices and perspectives that recognise the entanglements and interdependencies between humans and other species. At the same time let us remain critically optimistic about the possibilities for harnessing computation to help us advance planetary wellbeing, including in urban space. Let us aim for a future where resilience, adaptability, and a profound respect for the more-than-human world offer a beacon of hope.

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Notes

1. We acknowledge that Capitalocene may be a more fitting term considering that not all human activity is equal across the planet, and it is largely the dominant neoliberal economic-political system from the Global North fuelling consumerism that is at the core of the issues we are facing (Monbiot 2016; Moore 2017).
2. <https://research.qut.edu.au/morethanhuman/>

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