Exploring ‘smart citizenship’ as a socio-technical ecology:

the case of Oxfordshire, UK



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Abstract

Critical social science scholarship on 'smart citizenship' has thus far emphasised 'bottom-up' participation as a democratising antidote to 'top-down' corporate or state-led smart cities. It is implied that contesting these powerful smart actors involves increasing the degree of citizen participation in smart programmes or projects and by enabling greater political agency in grassroots or citizen-centric alternatives. In this thesis, I emphasise the multiple and heterogenous ways 'smart citizenship' is enacted through a diverse set of discourses, practices, and materialities. Approaching these collectives as 'socio-technical ecologies', I seek to move beyond existing dichotomies that frame smart citizenship as either a condition of technologically-mediated authoritarian control (top-down) or of increased democratic participatory processes (bottom-up). My approach, I argue, helps to account for a wider set of interrelated ways in which citizenship is negotiated in actually-existing contexts of the smart city.

The thesis draws on empirical materials generated through a study of how the UK county of Oxfordshire is being made 'smart'. In doing so, I identify four overlapping, interconnected ways in which smart citizenship is constituted through ecologies of discourses, practices and materialities. The first is a type of '*informational*' smart citizenship, which is centred on establishing and mobilising a fairly familiar mix of participatory deliberative engagement practices, procedures, and technologies. The second is the primarily discursive framing of citizens as living lab '*beneficiaries*' who accrue relative advantages from experiments with technological products or services. Beneficiary citizens are enrolled in political-economic discourses of innovation to legitimise imaginaries of anticipated smart futures. The third raises the importance of '*expert*' citizenship, which is deployed by partners to constitute local tech workers as experts engaged in making Oxford smart. I finally consider the '*sim'* citizenships produced from machine learning methods of data analysis generative of road actor behaviour models for digital twin modelling. Sim citizens, calibrated by smart city data, populate the digital twin for iterative validation and verification testing of automated driving systems. The thesis altogether contributes to scholarly understandings of smart city citizenship by identifying emerging sets of relations between humans and technologies in digitally-mediated cities.

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Glossary of Terms

Abbreviation	Term
ADS	Automated Driving System
AVs	Automated Vehicles
BEIS	Department for Business, Energy and Industrial Strategy, UK
C4P	Cities-4-People
CAG	Community Action Group
CAV	Connected and Autonomous Vehicle
CCAV	Centre for Connected and Autonomous Vehicles, UK
DfT	Department for Transport, UK
ERDF	European Regional Development Fund
iHUB	Oxfordshire County Council Innovation Hub
ISfB	Innovation Support for Business programme
LEP	Local Enterprise Partnership
LIS	Local Industrial Strategy
MaaS	Mobility as a Service
MobOx CIC	Mobility Oxford Community Interest Company
NIC	National Infrastructure Commission
OAHSN	Oxford Academic Health Sciences Network
OCC	Oxfordshire County Council
ODI	Open Data Institute
OLEV	Office for Low Emissions Vehicles
OSGB	Ordnance Survey, GB
OSP	Oxford Strategic Partnership
OxLEP	Oxfordshire Local Enterprise Partnership
POTM	People Oriented Transport and Mobility
SMEs	Small and Medium Enterprises
TfL	Transport for London
UKAEA	United Kingdom Atomic Energy Authority
UKRI	United Kingdom Research and Innovation
UTMC	Urban Traffic Management Centre

Chapter 1

An Introduction to Smart Cities and Citizenship

1.0. Introduction

For well over two decades now, the general idea of making a city 'smart' by embedding ICTs in government systems, gathering and analysing large-scale data, augmenting aspects of city design and management with software, or developing digital services or technologies has been influential. The introduction of smart city plans or policies are staged as promising economic growth, stimulating innovation, or furthering the efficiency and sustainability of urban systems (Kitchin, 2014a). Smart city technologies are also about capturing the anticipated flows of people, data, or materials, and then mobilising data as a form of urban intelligence. And establishing a smart city is about providing or enabling the conditions to reconfigure new arrangements of expertise. A broad range of meanings and practices are therefore attributable to the smart city, most of which are rooted in overtly optimistic framings of technological transformation.

Judged by its investment value, the smart city is big business too. According to a UK government report (2016), the global market value of smart was forecast to be worth more than £900 billion by 2020. More recent UK figures highlight an initial return of investment from the Future City demonstrator Glasgow of £117 million from a £24 million public expenditure (2021). Hence, the smart city is an economically valuable

asset for urban stakeholders, one which continues to attract the interests of city and national governments, technology companies, and urban studies scholars alike.

Yet, the definitional imprecision of the 'smart city' term has repeatedly been criticised by practitioners and scholars (Kitchin, 2022a). Some may argue its opacity adds to its conceptual value as an adaptable or malleable placeholder for a number of digitally-mediated experiences in cities (Rose, 2017). For others, this ambiguity has been generative of a number of approaches that address the smart city from multiple angles (Shapiro, 2020). The polysemantic meaning of smart speaks to its various ontological, epistemological, definitional, and practical implications for cities around the world.

One of the earliest approaches to studying the smart city involved researching and analysing the corporate promotional materials of a growing number of technology companies, like IBM, Cisco, Siemens, or Alphabet (Caragliu et al., 2011; Greenfield, 2013; Hollands, 2015; Kitchin, 2014a; Townsend, 2014). This approach understands the combinations of rhetoric, visions, agendas, plans, and videos as articulating and promoting a "corporate imaginary" or a specific vision of what a smart urban future means (Sadowski and Bendor, 2018). For instance, IBM's Smarter Cities campaign has been discussed as a form of "corporate storytelling" which frames the company's software and services as *the* 'solution' to addressing a number of urban challenges (Söderström et al., 2014). Others identify narratives of anticipated urban crises (e.g.,

mass urbanisation, climate change, austerity) that seek to legitimise 'technological solutionist' discourses of for-profits who actively seek to intervene in processes of urban governance (White, 2016). This is a well-researched and well-rehearsed set of arguments developed in the critical smart cities literature. This thesis largely sets aside such questions of corporate storytelling by shifting attention towards other expressions or engagements with the smart city.

The second approach centres on a set of 'purpose-built' smart city developments, such as Songdo in South Korea, PlanIT Valley in Portugal, Masdar City in the United Arab Emirates, or Sidewalk Labs in Toronto. These are neighbourhoods, districts, or cities designed and then constructed as fully realised versions of smart, saturated and embedded with ubiquitous sensing technologies or highly responsive digital infrastructures. In the process of realising these ideal visions of smart, cases like Songdo have begun to function and operate as testbeds (Halpern et al., 2013) to beta-test solutions or attract foreign direct investment. Other cases like Sidewalk Labs have notably attempted (and subsequently failed) to plan, design and build a smart district "from the Internet up" (Goodman and Powles, 2019; O'Kane, 2022). A common thread in these 'from-scratch' cases I have identified are debates about the types of partnerships facilitated between city, state, or national governments with tech corporates who together mediate these experiments. In becoming 'canonical' cases, these have rightly received significant scholarly interest too, much exploring the political-economic implications of such corporate forms of smart governance.

The third approach, which I build on throughout this thesis, is primarily interested in studying the "actually existing" smart city (Shelton et al., 2015). This is a perspective that aims to ground smart city planning or policies by analysing the socio-material effects of its implementation. It is also a response to the early calls of critical scholars for more nuanced, empirically rich, or ethnographic studies to account how smart is retrofitted in existing cities (Kitchin, 2015a). This is argued to be a more 'situated understanding' of ways that smart unfolds. Taking an actually existing approach is thereby sensitive to the empirical diversity of 'real' cities, as well as variegated or piecemeal local practices (Caprotti and Cowley, 2019; Sadowski and Maalsen, 2020). I later detail in Chapter 3, for instance, the contextual specificity and complexity of ways in which smart is being governed and implemented in the UK context.

In parallel, the critical smart city scholarship has begun to debate the implications of these approaches on urban citizenship, which is what I further contribute to in this thesis. First, the literature has noted the corporate and government pivot to discursively framing smart in citizenship terms (Hemment and Townsend, 2013; Joss et al., 2019; Saunders and Baeck, 2015), although a key claim of this work is that smart is actually inherently depoliticising (Cardullo and Kitchin, 2018; Kitchin, 2015a; Vanolo, 2014). Second, is the general idea of 'citizen-centric' smart cities being underpinned by a neoliberal ethos that promotes forms of civic paternalism

(i.e., deciding what is best for citizens) or stewardship (i.e., delivering on behalf of citizens) (Cardullo and Kitchin, 2019). The argument here again is that smart can be depoliticising. Third, the critical literature argues that recasting market-driven notions of smart citizenship involves mediating forms of active 'participation' as an antidote to top-down modes of governance. It is thus argued a democratising model of smart cities is a matter of increasing instances of 'actually existing', participatory forms of citizen engagement . Empirical work has since been committed to identifying and locating the socio-material practices that are constitutive of this kind of smart city citizenship (Gabrys, 2014a; Ghose and Johnson, 2020; Przeybilovicz et al., 2022; Zandbergen and Uitermark, 2019).

My research further builds on this work by developing and then proposing a socio-technical ecology approach to the study of smart citizenship. This is a conceptual framework I use to respond to and problematise dichotomies within the existing literature that reinforces ideas of top-down/bottom-up smart cities or active/passive smart citizens (Burns and Welker, 2022). I argue a current emphasis on participation has led to such binary analyses of smart city politics (Zandbergen and Uitermark, 2019). Instead, I argue for a relational framework that addresses three aspects of smart citizenship: discourses, practices, and materialities. Using this framework, I identify a typology of four citizenships, which is based on a study of the UK county of Oxfordshire. In doing so, I broaden, expand, and multiply current conceptions of

citizenry agency by moving beyond participatory assessments well-rehearsed in critiques of state or corporate power.

1.2. Research Questions

The central question of this thesis therefore asks how the current understandings of smart citizenship can be expanded or multiplied by understanding various ways it is enacted in an 'actually-existing' smart city. I propose the 'socio-technical ecology' framework to describe smart citizenship, as a broad and relational framework that recognises the entwined discourses, practices, and materialities of smart. I answer three main research questions:

RQ1. What different enactments of citizenship emerge from smart city projects in the UK county of Oxfordshire?

RQ2. What forms of discourse, practice, and material devices underpin the way citizenships are being articulated within smart city projects in Oxfordshire?

RQ3. What implications do these enactments and logics have for different forms of democratic citizenship?

1.3. Key Contributions

The main contributions of this research to the smart cities scholarship can be summarised in the following three ways.

First, the thesis makes a substantial empirical contribution to the study of 'actually existing' smart cities and citizenships (Shelton and Lodato, 2019). It responds to the calls of critical scholars for more in-depth empirical studies of smart and the need for critical reflection on its citizenship implications (De Lange and De Waal, 2013; Kitchin, 2015b; Luque-Ayala and Marvin, 2015a). I conducted an original qualitative study of the UK county of Oxfordshire. This builds on previous research by detailing the diverse and complex typology of socio-technical arrangements that unfold in a local context (Caprotti et al., 2016a; Caprotti and Cowley, 2019; Cowley et al., 2018). I analyse interviews with 55 people who represented local government, businesses, and other organisations to explain how they constitute smart citizenship, both discursively and materially. I pair this with methods of ethnographic participant observation to provide a first-hand account of ways citizenship is practiced too. My empirical approach therefore offers a methodological template to systematically map and analyse multiple ways in which both smart cities and smart citizenships emerge in UK cities.

Second, the conceptual framework I develop is useful in revealing how various smart city partnerships or projects discursively deploy similar citizenship terminologies or vocabularies. However, there are also clear and quite distinctive differences between the ways in which terms are then mobilised in practice and materialised. In Chapters 4 to 6, for instance, I show that there were mixed and varied implications of the 'co-creation' term for citizens between two ways of making Oxfordshire smart. Terms

like co-creation are deeply normative terms loaded with meanings that I show have broad implications for citizenship practices enabled in different smart projects or partnerships. This is an empirical insight that is explicated through the 'ecology' term; as a metaphor it provides a way to map dis/connections between discursive deployments of key citizenship terminologies within the socio-technical context of the smart city. I then specifically identify four overlapping and interconnected citizenships, which I analyse in terms of discourses, practices, and materialities. In doing so, I complicate existing accounts in the literature which place significant emphasis on (often unexamined) processes of deliberative 'participation' (Chilvers and Kearnes, 2016a; Kelty, 2019a; Pallett et al., 2019).

Third, Chapters 4 and 7 draw attention to a wide range of ways in which citizen 'engagement' is practised or materialised via an assortment of devices, including bicycles, smartphones, sensors, or post-it notes. I argue that technologies widely understood as creating 'passive' citizens (e.g., CCTV) do enable distinctive articulations of citizenship that do not take 'participatory' forms, as those have usually been understood. The assumption I thereby challenge is that 'top-down' forms of participation mediated by material sensing technologies constrain citizen engagement (Cardullo and Kitchin, 2018; Greenfield, 2013; Vanolo, 2014). Rather, the networks of sensing infrastructure I describe lead to the enrolment of humans (and non-humans) in digital models used to develop other smart technologies.

Thus, the analysis I present challenges existing dichotomies in critical accounts that reductively deploy top-down/bottom-up and active/passive citizenship frames (Burns and Welker, 2022). Such an approach, I argue, assumes that more participation is the only way to create more democratic, more inclusive, or more citizen-centric smart cities. The ecology of smart citizenships I identify in contrast demonstrates a far more diverse, multiple, and entangled set of relations being enabled between humans and technologies in digitally-mediated cities. I thus suggest redefining what constitutes democratic citizenship by engaging with these citizenships.

In sum, the conceptual framework I develop in this thesis of studying smart citizenship as a socio-technical ecology provides a far more capacious way of assessing the political implications of smart cities. I argue my framework indicates a far more complex set of relationships that challenge vertical readings in the critical literature (Zandbergen and Uitermark, 2019). Using my ecology approach is thus a way of evidencing the "interrelations and patterns of diversities" (Chilvers and Kearnes, 2016b, p. 23) of the citizenships that emerge in smart cities.

1.4. Thesis Structure

The remainder of the thesis is comprised of 7 chapters. The following chapter situates the thesis within key ideas, theories, and debates in the literature. The chapter draws together the existing work of urban geographers with scholars in

Science and Technology Studies (STS), urban sociology, and citizenship studies, and then introduces the conceptual framework I use to examine smart citizenship. In Chapter 3, I outline the methodology of the research. I profile four organisational arrangements and institutional forms that are typical of ways cities are being made smart. These relate to the four citizenship case studies I later unpack in the thesis. The empirical findings are then developed in Chapters 4 to 7. This is where I detail the four main ways smart citizenship is constituted through an ecology of discourses, practices, and materialities.

I start in Chapter 4 by identifying how the civic ideals of '***informational***' citizenship were enacted in many of the smart projects with the Oxfordshire County Council Innovation Hub (iHUB). Most iHUB projects I consider follow a deliberative model of participation that is discursively practiced by citizens in organised events, forums, workshops, or consultations. I detail how some smart projects like Cities-4-People frame 'co-creation' as an alternative approach to smart cities practised through a set of participatory engagement methods. In other projects, I highlight the quotidian objects that are used to materialise practices of participatory engagement, like smartphone apps or bicycles. Though I evidence some relative advantages to these participatory forms of citizenship, the chapter is also critical of the norms, expectations, and responsibilities of such roles.

In Chapter 5 I explore a primarily discursive framing of citizens as living laboratory '***beneficiaries***' who are enrolled in the political-economic discourses of innovation of the Oxfordshire Local Enterprise Partnership (OxLEP). In anticipating a 'smarter' future, I argue citizens were being instrumentally framed as users or consumers of prototyped technologies or services in living labs. Citizens emulate the real-world conditions of projected technical services in testbeds, and thus co-produce future smart 'solutions' by demonstrating its commercial or innovatory viability. Hence, the benefits set to be accrued in future visions of Oxfordshire necessitate user engagement in the present, practised by citizens via living lab experiments.

In Chapter 6 I take a slightly different approach by examining the importance of smart city '***expertise***' in constituting smart citizenships. There are two components to this chapter. First, I explain how experts discursively constitute the participatory and beneficiary citizenships I identified in Chapters 4 and 5 in spaces where citizen engagement is discussed or deliberated. Participatory citizenship emerges in smart projects like Cities-4-People as it reflects the knowledge claims of its partners who are focussed on public research methods. Likewise, beneficiary citizenship reflects the stakeholder arrangements configured at OxLEP roundtables and how living lab ideals were subsequently prioritised. Second, I explain the 'expert' citizenships that were valued by the Smart Oxford board and practised at networking or conferencing events. These were purposefully designed to engage local professionals in order to identify further innovation opportunities for Oxfordshire.

In Chapter 7 I explain the '***sim***' citizenships of the generative computational world of a 'digital twin' imagined in a driverless vehicle project called OmniCAV. I show how project partners used machine learning methods of analysing CCTV data to identify, categorise, and profile road 'actor' movements. The form of deep learning I describe is a form of behavioural analysis from which agent models are extracted to develop AI sims in digital twins (or computer model simulations). Sim citizens form part of a virtually-constructed replica of Oxfordshire to test or validate the decisions of automated driving systems (ADS). In effect, I contend the deep learning methods I describe further evidence possible forms of both human and non-human citizenships emerging in smart cities.

In Chapter 8 I conclude the thesis by bringing together the main findings and contributions of the research. The substantive contributions of this thesis relate to the typology of smart city citizenships I identify, the ecology framework I use to understand these citizenships, and the diverse citizenships I describe emerging between humans and technologies in digitally-mediated cities.

Chapter 2

Conceptualising Smart Citizenship: discourses, practices, and materialities

2.1. Introduction

In the following review, I selectively draw on several interconnected literatures that speak to the ways smart city citizenship is currently understood in terms of the discourses, practices, and materialities associated with the accelerated integration of software, data, and digital technologies in cities. Scholarly attention on this comes from disciplines including Urban and Cultural Geography, Science and Technology Studies (STS), Urban Sociology, and Citizenship Studies, where a wide-ranging set of debates have sought to unpack various aspects of everyday life in digitally-mediated cities (Barns, 2020; Isin and Ruppert, 2015; Leszczynski, 2016; Rose, 2017; Willis and Aurigi, 2020). It is authoritatively claimed that the discipline of geography has itself experienced a turn towards 'the digital' within the last decade (Ash et al., 2018), and much of this review is inspired by work in this area.

Since the inception of my research, numerous studies have elaborated on a number of critical smart city debates and addressed some of the early shortcomings of this literature (Kitchin, 2015a). For instance, critical scholarship has expanded from its early focus on rhetoric about or visions of smart cities towards empirical cases that

are grounded in the 'actually existing' ways cities are being made smart (Shelton and Lodato, 2019). Consistently, the smart city literature has been critical of state and corporate-led interventions as delivered in a 'top-down' manner, and thus raises questions of *citizenship* in pursuit of grassroots or 'bottom-up' alternatives (Hollands, 2015; Kitchin et al., 2018; Townsend, 2014). My analysis of this work is critical of its focus on the notion of 'participation' which is treated by many as a democratising ideal towards a more 'citizen-centric' smart city. The argument frequently made in the literatures is that installing deliberative mechanisms or increasing citizen participation will coax into being more democratic smart cities. Smart citizens are largely interpreted here in the form of a 'deliberative' public or an 'affected' public, and this has implications on who, how, and on what terms citizenship is enacted (Chilvers and Kearnes, 2016a).

I am interested in a theorisation of citizenship that allows for a broader range of different kinds of citizenship to be recognised. I do this by approaching citizenship as enacted through relations between discourses, practices, and material things. Inspired by STS accounts of co-production and critical literatures on participation (Chilvers and Kearnes, 2016b; Jasanoff, 2004; Kelty, 2019a; Pallett et al., 2019), I conceptualise these human and non-human ensembles as a 'socio-technical ecology'. Foregrounded by a set of emerging and contextually specific discourses, practices, and materialities, I argue this socio-technical ecology approach better

reflects the ongoing and negotiated relations of citizenship emerging in 'actually existing' smart cities.

The 'socio-technical ecology' approach I develop in this review recognises that there are other forms of citizenship in smart cities beyond dominant discourses, practices and materialities of participation. In other words, the thesis seeks to address a much wider multitude of ways in which smart citizenship is bought into being (or enacted) than practices predetermined or pregiven in 'democratic' spaces. While attention to participatory forms of smart citizenship has raised important questions related to inclusion/exclusion, digital rights, and social justice (Cardullo et al., 2019; Hollands, 2008; Shelton and Lodato, 2019; Tenney et al., 2020), the focus on political voice excludes other spaces and forms of citizenship. To do so requires an examination of existing accounts of political agency in smart cities, which is specifically addressed in the following sections of the review.

I draw on the term 'ecology' here in a distinctively metaphorical sense as a way of emphasising or conveying the connections between "multiple, interacting socio-material collectives" (Chilvers and Kearnes, 2016a, p. 52). I am inspired by others who draw on the term to map the relational interdependencies between citizenship practices, technologies of participation, spaces of negotiation, and the cultural-political settings in which these are established (Chilvers, 2012; Chilvers et al., 2018). An ecological perspective reflects the way that smart citizenship is actively

'in-the-making' through interconnected relations of enablement and agency as opposed to fixed conventions or organised forms of political expression (Chilvers and Kearnes, 2016b). This approach opens ground for other spaces of citizenship to critical analysis other than conventional discursive forums or settings (Pallett et al., 2019). The importance of developing such a framework of smart citizenship is to enable or accommodate a more capacious understanding of citizen agency based on emerging relations between humans and technologies in digitally mediated cities (Rose, 2017).

Furthermore, I mobilise the term 'ecology' in this thesis to map relations between citizenship terminologies and how this is co-produced within the socio-technical context of the smart city and technological transitions (Chilvers and Kearnes, 2016b; Elsdon-Baker, 2015; Jasanoff, 2004). Given smart cities attract or convene people and organisations from multiple competing epistemic communities (Haas, 1992; Kitchin et al., 2017), it is possible there are sets of converging or diverging citizenship discourses enacted in the empirical context I consider similarly to the diverse narratives of smart cities (Joss et al., 2019).

In order to unpack this 'socio-technical ecology' approach, the review is organised in the following way: I start in Section 2.2 with a critical review of existing literatures on smart citizenship. Here, I begin to develop this broad conceptual framework of smart citizenship as a diverse set of discourses, practices, and

materialities and to account its varied, differentiated, and distributed emergence more readily in smart cities. I problematise how existing accounts map 'participation' onto dichotomies of top-down/bottom-up forms of smart city making and evaluate this alongside ideas of passive/active citizenship. I propose the socio-technical ecology framework as a way to expand or multiply conceptions of citizenship beyond existing assessments of participation well-rehearsed within critiques of state or corporate power. I show that there are far more dynamic ways of assessing smart citizenship beyond those fixed on the figure of the 'smart citizen' as a promising democratic alternative for smart.

In Section 2.3 I elaborate the argument by examining how the smart city is deeply rooted in socio-technical *discourses* that rhetorically project normative visions of smart citizenship thus structuring the conditions of its material enactment. Building on Jasanoff and Kim's (2015) concept of 'socio-technical imaginaries' I argue the fashioning and circulation of imaginaries relates directly to questions of power and political agency. I do so by showing how multiple actors are involved in discursively producing 'seductive' and 'powerful' smart city imaginaries, orchestrated by large corporates such as IBM and Cisco (e.g., Hollands, 2015; Luque-Ayala and Marvin, 2015; Sadowski and Bendor, 2018; Söderström et al., 2014; Wiig, 2015) as well as city and local authorities in their role as conduits for articulating context-specific smart city visions (e.g., Alizadeh, 2017; Coletta et al., 2019; Joss et al., 2019). My interest here is in how particular ideals of smart city citizenship are articulated by

and through these imaginaries that anticipate particular expressions of citizenry agency mediated by smart technologies.

In Section 2.4 I consider smart citizenship as a diverse set of *practices* that emerge in relation to the smart city. Here, I explicitly draw upon Isin and Ruppert (2015) and their theorisation of citizenship as practiced through both discursive and material means, in relation to the digital. Such a theorisation I argue requires an expanded understanding of the spaces and practices of smart citizenship that is inclusive of the aforementioned participatory position, but also other embodied practices repeatedly enacted through everyday interactions with the city.

In Section 2.5, I extend Marres (2012) notion of 'material participation' to highlight how smart citizenship is materialised and practiced through objects, devices, and infrastructures. I highlight the mediating role of digital or smart technologies like smartphone apps or environmental sensors in advancing forms of political participation, such as e-government or citizen science. I also argue material devices connect citizens to 'ecosystems of lively participation' (Barns, 2019) that enable far more diverse imaginaries and practices of citizenship to be further articulated.

Altogether, the socio-technical ecology approach I propose encompasses these three dimensions – *discourse*, *practice*, and *materiality* – as the three terms in which I

understand smart citizenship. My empirical chapters demonstrate why this more capacious understanding of smart citizenship is necessary.

2.2. A critical review of current understandings of 'smart citizenship'

Broadly, and with some significant exceptions, the scholarly literature has thus far assessed smart cities as being implemented in either a 'top-down' or 'bottom-up' orientation and smart citizenships as enacted in 'passive' or 'active' ways (Cardullo and Kitchin, 2018; Johnson et al., 2020b; Townsend, 2014). Such a dichotomous set of views are increasingly being challenged by scholars who argue this oversimplifies smart city politics (Burns and Welker, 2022; Zandbergen and Uitermark, 2019). For instance, as Luque-Ayala and Marvin (2015b) argue, "there are also other forms of SU [smart urbanism] being rolled out" and "in practice, community involvement in SU shows that notions of 'top-down' and 'bottom-up' do not adequately reflect the complexity of issues at play" (p.2113). Though some advocate 'alternative' models of smart, precisely what this alternative constitutes is also unclear. Some consider loosely organised, often ad-hoc examples like hackathons or citizen-science as exemplary 'citizen-centric' activities (Hemment and Townsend, 2013; Lange and Waal, 2013; Sassen, 2012). Others consider how *individuals* as citizens engage with, participate in or articulate alternatives to the smart city (Cardullo and Kitchin, 2018; Datta, 2019a; Shelton and Lodato, 2019). Barcelona, for example, is often positioned as an exemplar 'grassroots' version of smartness where residents hold significantly

higher degrees of influence over decision-making (Calzada, 2017a). Both top-down and bottom-up terms, then, lack clarity on what this constitutes precisely in regard to smart cities.

Accounts of democratic smart cities insist on the importance of urban citizens 'actively' *participating* in the design and operations of smart cities (Cardullo and Kitchin, 2018; Granier and Kudo, 2016; Hollands, 2015). This rather restricted focus in the literature on the notion of 'participation' places emphasis on political voice and deliberative processes as a greater form of civic involvement with smart policy or decision-making (Cao and Kang, 2022; Hemment and Townsend, 2013; Levenda et al., 2020; Tenney et al., 2020). It is thus assumed that 'passive' forms of citizen participation through, for instance, sensing technologies create 'transactional' types of political relations between citizens and government (Johnson et al., 2020b). This is considered less valuable compared with 'meaningful' or 'traditional' mechanisms of citizen engagement, like public consultations or workshops. I challenge such an assumption. I argue the overreliance on participation occludes multiple other ways that citizens engage with smart cities. In the remainder of this section, I elaborate this critique by engaging with assessments of 'smart citizenship' to date.

2.2.1. Collapsing the ladder, dismantling the scaffold

Building on Sherry Arnstein's (1969) 'ladder of participation' in urban planning, some consider Cardullo and Kitchin's (2018) revised 'scaffold' to be a useful tool in

evaluating a range of citizen positions emerging from smart cities, such as in Dublin, Ireland (see Table 2.1). From this figure, we can see that greater citizen participation is defined by Cardullo and Kitchin (2018) as empowering and underpinned by a set of rights and entitlements. This argument and the figure also assume that such higher forms of participation are better than those lower down the ladder which mostly involve 'instrumentalising' citizens in market-driven processes. For example, the scaffold reinforces and extends existing critiques by ranking modes of engagement which frame citizens as 'users', 'consumers', or 'recipients' as less democratic and therefore less valuable. Correspondingly, those initiatives that frame citizens as 'participants', 'co-creators' or 'leaders' are ranked highly. Higher levels of the scaffold hereby value '*active*' participation or engagement as a form of citizen decision-making or control, aligned with political discourses of 'democracy' and 'commons' and that enable 'ideas' or 'leadership' to emerge. In contrast, the lower levels of the scaffold show 'non-participatory' or '*passive*' roles as framed through political discourses of 'technocracy', 'civic paternalism' and 'stewardship' that sit below other 'neoliberal' positions. Based on this analytical tool, it appears as if the ideal mode of 'smart citizenship' involves 'bottom-up' or 'active' participation in comparison with other lesser 'passive' forms of engagement.

Table 2.1: The 'Scaffold of Smart City Participation', reproduced from Cardullo and Kitchin (2018).

Form and Level of Participation		Role	Citizen Involvement	Political discourse/framing	Modality	Dublin Examples
Citizen Power	Citizen Control	Leader, Member	Ideas, Vision, Leadership, Ownership, Create	Rights, Social/Political Citizenship, Commons	Inclusive, Bottom-up, Collective, Autonomy, Experimental	Code for Ireland, Tog
	Delegated Power	Decision-maker, Maker				Civic Hacking, Hackathons, Living Labs, Dublin Beta
	Partnership	Co-creator	Negotiate, Produce	Participation, Co-creation		
Tokenism	Placation	Proposer	Suggest		Top-down, Civic Paternalism, Stewardship, Bound-to-succeed	Fix-Your-Street, Smart Dublin Advisory Network
	Consultation	Participant, Tester, Player	Feedback	Civic Engagement		CIVIQ, Smart Stadium
	Information	Recipient	Browse, Consume, Act			Dublinked, Dublin Dashboard, RTPI
Consumerism	Choice	Resident, Consumer		Capitalism, Market		Smart building/Smart district
						Smart meters, Mobile/locative media
Non-participation	Therapy	Patient, Learner, User, Product, Data-point	Steered, Nudged, Controlled	Stewardship, Technocracy, Paternalism		Dublin Bikes, Smart Dublin
	Manipulation					Traffic Control

There are several limitations of the scaffold. In the discussion that follows, I foreground four of particular pertinence to the ways in which smart citizenship is conceptualised and evaluated.

First, the way Cardullo and Kitchin (2018) relate 'lower' and 'upper' levels of the scaffold to ideas of 'top-down' and 'bottom up' imply a vertical reading of smart city politics, which widely assumes that *more* participatory or *more* deliberative initiatives inevitably lead to *more* inclusive or *more* democratic outcomes for

citizens (Chilvers and Kearnes, 2016b). In making this assumption, the scaffold favours a linear reading of participatory citizenship. This privileges activities like 'hackathons' or 'advisory networks' as empowering, despite the ability to 'participate' in such high intensity activities being premised on specific configurations of knowledge, expertise or professional networks held by individuals (Irani, 2015; Perng et al., 2018; Shelton and Lodato, 2019; Zandbergen, 2017). In turn, activities where participation is considered 'passive' are deemed to produce more instrumental positions for citizens as 'manipulated', 'controlled', or 'steered', like in the 'traffic control' or 'smart lighting' examples. These examples are understood as contributing to forms of algorithmically-mediated governmentality, anticipatory governance and city planning underpinned by a 'strong technocratic impulse' (Cardullo and Kitchin, 2017, p. 6). In contradiction with the emphasis of government and corporate discourses on the temporal 'speeding-up' of city operations and optimisation through data (Kitchin, 2019), then, the scaffold values 'slower' modes of smart citizen participation that demand greater levels of resource or labour to facilitate these ideals of political expression.

A second key limitation of the scaffold is that it risks associating technology-led smart city projects with a set of fixed or static citizenship positions with limited space for manoeuvrability or plurality. Given that most smart cities are now considered to be 'in-the-making', hosting multiple kinds of often short-term projects (Cowley and Caprotti, 2018; Torrens and von Wirth, 2021), it is unclear

whether smart citizens can either hold more than one position or move between scaffold levels over the course of a smart city project and its implementation. For instance, is it possible for a smart citizen to start out as a passive consumer to then later move up and become a proposer or co-creator? Is it possible for a smart citizen in a leadership role to envision a smart city optimised through passive interactions with digital infrastructure without being considered a subject 'steered' or 'nudged' by some greater power? Relatedly, the scaffold is based on a set of 'downstream' positions whereby the conditions of participation are fixed or predetermined by factors like stakeholder or funder interests and objectives as opposed to 'upstream' where citizens are involved prior to the formulation of key ideas, policies or decisions (Engelbert et al., 2019). Therefore, I argue the scaffold represents a rather limited framework in which to assess smart citizenship as an ongoing, negotiated, and emergent set of practices.

Thirdly, the assessment of political agency through the notion of 'participation' negates inequalities that exist in the potential to take part in 'active' or practical engagements with the smart city. Some accounts highlight how smart citizen participation can be exclusionary in terms of people's uneven or unequal 'access' to technologies (Greene, 2021; Manchester and Cope, 2019; Sassen, 2012). However, the implication here is that alleviating structural inequalities is simply a matter of acquiring devices in order 'to be counted' rather than locating agency in other forms of political expression. For instance, Dudley *et al*. (2019) describe other significant

forms of participatory engagement through intended (i.e., cycling) and unintended (i.e., vandalism) practices which shape tech-led pilot schemes like in Manchester, UK. Their approach argues quotidian interactions with dockless bikes like vandalism are in fact forms of participation in addition to types of deliberative or consultative engagement practices. Both are forms of political expression that co-produce the outcomes of pilots, such as the perceived failure of introducing an emerging technology. Drawing on feminist, Black and queer perspectives, Elwood (2020) asserts that, "the normative subject of the smart city is by definition one who holds structural advantage – sufficient digital, social and economic resources to do the work of coding the city" (p.7). This is most pertinent in examples like 'hackathons' where there is an overt (and gendered) celebration of programming, engineering and design skills (Irani, 2015). I reflect on this critique later in the thesis where I encounter some of the challenges in fostering participation within a smart city project targeting low or no-income residents in a marginalised area of east Oxford (see Chapters 4 and 6). Here, I highlight how conceptualising smart citizenship as participatory leads to excessive demands or responsibilities placed on individuals to vocalise and express views in democratic spaces, contrary to the very minimisation of labour promised by visions of smart city efficiency.

Fourth, some caution is needed in relation to the claim that non-participatory or 'passive' modes of smart citizenship constrain citizen agency by reducing citizens as 'data points' governed through 'networked' or 'informational' smart city

infrastructure (Cardullo and Kitchin, 2018; Gabrys, 2014b; Johnson et al., 2020a; Luque-Ayala and Marvin, 2020a). Using the example of traffic monitoring systems, Coletta and Kitchin (2017) view this type of smart city infrastructure through the lens of algorithmic governmentality which they claim enacts temporal forms of citizen control in efforts to regulate city flow. In examining smart city design proposals, Gabrys (2014a) notes how the 'sensed' citizen is characterised far less by "advancing democratic engagement through dialogue and debate" and much more with "operationalising the cybernetic functions of the smart city" (p.38) with citizens becoming 'responsive nodes' in feedback systems. Reflecting on Songdo's smart city plans, Halpern *et al.* (2013) extends this even further by arguing that 'sensed' citizens succeed liberal subjectivity by being governed through the "manipulation of synapses" (p.280) in 'totalising' sensory environments. In place of this, Hollands (2008) suggests that a 'real' or 'progressive' smart city is one where IT is used to "enhance democratic debates" (p.316) towards a virtual 'public culture' (Zukin, 1995) centred on a progressive politics of discussion and debate. It prioritises speech and debate as the only means to enact democratic smart city citizenship. Again, this reading of smart citizen agency is reproduced in the scaffold where non-participatory positions reflect a form of 'technocracy' as opposed to the 'commons' framework suggested by other advocates of 'citizen-centricity' in smart (Calzada, 2020b; Cardullo et al., 2019).

While the critique in this section started with Cardullo and Kitchin's (2018) 'scaffold', their approach is symptomatic of a wider trend in citizen science, community engagement and participatory sensing whereby participation is understood as a set of standardised "techniques, instruments, or tool-based procedures" (Chilvers and Kearnes, 2016b, p. 12). This is epitomised by efforts to develop instructive 'toolkits' that explicate models, schematics or frameworks for 'successfully' organising citizen participation, such as citizen air quality or environmental sensing kits (Making Sense, 2018; S. Mattern, 2021; van der Graaf, 2014). Indeed, there are even longer histories in international development, organisational sociology, media theory and public communication of proceduralising participation this way (Kelty, 2019a). Similarly, others highlight the 'material aesthetics' of forms of participation mediated by corporate actors which signify collaborative or democratic processes (Chilvers et al., 2018; Mattern, 2020) . An example is Alphabet's '305 Workshop' in Toronto where post-it notes, mind-maps, index cards and architectural sketches form part of the 'performative ethics' of participation. Mattern (2021) argues these materials signify a type of participatory ethos that is experimental or collaborative by design, whilst actually being a managed and highly structured form of civic engagement.

In sum, I argue the existing literature on 'smart citizenship' is heavily focussed on prioritising *participation* as the fullest expression of 'active' engagement in smart cities, and privileges forms of public voice and deliberation. Despite evidence of its

exclusionary outcomes (Burns and Andrucki, 2020; Elwood, 2020; Shelton and Lodato, 2019), the ideal smart citizen articulated by these accounts is that of *individuals* who vocalise ideas or whose engagement follows a rigid set of participatory engagement methods, techniques or procedures (Kelty, 2019a). I problematise these assumptions. I argue there are many other ways that citizens engage with the smart city beyond participatory spaces or forums. Next, I elucidate a broader understanding of 'smart citizenship' that sets aside the vertical readings of 'top-down' control versus 'bottom-up' participatory democracy I have critiqued by introducing a more capacious conception of what constitutes smart citizenship.

2.2.2. Towards a broader conception of citizenship

In the previous section, I strongly critiqued the assessment of participation as a democratising antidote for smart cities and the subsequent emphasis placed on this specific form of 'democratic' engagement. This focus on political voice has raised some important questions on inclusion/exclusion, digital/civic rights, and forms of social justice (Cardullo and Kitchin, 2019; Lange and Waal, 2013; Shaw and Graham, 2017; Shelton and Lodato, 2019). However, I argue a broader conception of 'smart citizenship' is necessary to reflect diverse ways in which citizens engage with or enact citizenships in smart cities beyond participatory spaces or mechanisms of engagement well-rehearsed in the literature. This section articulates a framework for such an approach.

Existing debates within STS on citizenship and public engagement in science, innovation, and democracy provides fertile conceptual and analytical ground for smart city scholars towards developing a more capacious understanding of smart citizenship. Drawing on a relational and co-productionist idiom (Jasanoff, 2004), STS scholars conceptualise participation as an emergent assemblage of "objects (or issues), subjects (or publics/participants), instrumentalities (or methods and devices), and procedures (or political philosophies)" (Chilvers and Kearnes, 2016b, p. 14). In other words, this framework provides a *systemic* account of participation that asks: "*what* is the engagement about?; *how* are publics participating?; and *who* is participating?" (Pallett et al., 2019, p. 593, original emphasis). For Chilvers (2012), the metaphor of 'ecologies of participation' provides a way to recognise "dynamics of multiple, interacting socio-material collectives" (p.52) beyond conventional sites and forms of participation. I argue this much broader analytical framework could be usefully applied to questions of 'smart citizenship' in recognising multiple sets of emerging agencies enabled in smart cities.

Applying a relation and co-productionist approach in the context of the UK energy system, Pallett *et al*. (2019) evidence how to systematically 'map' the dynamics of 'whole system' energy participation beyond individual instances of procedural or processual engagements (p.593). This study evidences a wider corpus of 'energy participation' from mundane material practices (Marres, 2012) enacted through everyday technologies like washing machines or home energy displays (see Section

2.4) to informal organised engagements via community energy groups (see also: Krzywoszynska et al., 2018). While some might be critical of a broad approach as lacking definitional clarity or specificity, I argue a broad framework of 'smart citizenship' would accommodate its multiple emergent forms in smart cities.

Another example of a different kind of smart citizenship is described in a study of environmental sensing. Zandbergen and Uitermark (2019) discuss an alternative way in which citizens are engaged in smart city projects. While they discuss a fairly conventional case of participatory citizenship centred on informing or empowering citizens through data collection using air quality sensors, they also develop the idea of 'cybernetic' citizenship. They describe "ad hoc, decentralised and individual forms of engagement" (p.12) with an affective informational sensing environment imagined by citizens using these devices. Citizens differently engage or imagine themselves as 'sensorially immersed' in a system of data flows that they are 'attuned' by and through the senses. Some citizens felt empowered through 'creative' or 'flexible' experiences with air quality sensing environments (i.e., the 'cybernetic') while others became 'disenfranchised' by their inability to collect evidential data (i.e., the 'participatory' mode) to advance political claims (see Gabrys et al., 2016). Clearly, this example shows the need for a wider understanding of smart citizenship. Moreover, this paper also demonstrates the utility of a socio-technical ecology approach to analyse citizenships as it articulates overlapping

connections between discourses, practices, and material objects of engagement deployed in a smart city.

Another way of widening accounts of smart citizenship involves moving beyond a strictly human conception of agency. One way this is being addressed is through a turn towards 'more-than-human' smart city relations. In their study of air quality gardens used to draw attention to levels of pollution in central London, Gabrys (2022) describes the more-than-human sensing relations enacted between citizens, plants, and digital sensors that not only provide measurable data but also involve ongoing experiences of pollution in lived environments. Likewise, Powell (2021) discusses a 'seed commons' group in east London where sensing does not only relate to informational data collected from sensing technologies, but also to the "movement of plants, people and animals" (p.149) as more-than-human relations of knowledge making practices. Powell challenges technology-driven conceptions of smart citizenship through 'local ways of knowing' centred on cumulative gardening practices and experiences of growing seeds together. I consider further the implications of more-than-human conceptions of smart citizenship in Chapter 7 in regard to the use of machine learning algorithms.

In the remaining sections of this review, I articulate the 'socio-technical ecology' approach I seek to develop which can engage with the diverse forms that smart citizenship may take. I do this by approaching 'smart citizenship' as *enacted* both

through discourses and practices, and materialised through a set of relations with the smart city. Instead of inheriting a standardised, instrumental participatory approach to studying citizenship, I suggest smart city scholars seek alternative avenues for assessing multiple forms of 'smart citizenship' beyond hierarchical models that seek to schematise the dimensions of participation. I begin in Section 2.2 by arguing smart cities are 'socio-technical' *discourses* that rhetorically imagine specific configurations of citizenship. Then, Section 2.3 discusses smart citizenship as a varied set of practices that emerge from differing modes of smart city activity, such as experiments with new smart technologies. Lastly, Section 2.4. elucidates the importance of technologies as mediating devices in the material enactment of smart citizenship. Together, this is constitutive of the wider approach I take towards unpacking smart citizenship throughout this thesis.

2.3. Discourses of Smart Citizenship: Rhetoric, visions, imaginaries

In this section, I conceptualise the smart city as a 'socio-technical' discourse as a way to direct analytical attention towards the rhetorical constitution of smart citizenships through normative visions or projected futures. I draw on the STS concept of 'socio-technical imaginaries'[1] that I argue can be usefully applied to the smart cities literature too. Socio-technical imaginaries are:

[1] In the last months writing this thesis, I became aware of important discussions amongst the STS community of scholars on the research culture at Harvard's flagship programme, spearheaded by Sheila Jasanoff, and prompted by allegations of sexual harassment and exclusion (Schwarz-Plaschg, 2023). In light of such significant developments, I am increasingly uncomfortable citing Jasanoff or her concept of 'socio-technical imaginaries.' It is important to me that I make conscious decisions

> "collectively held, institutionally stabilised, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology" (Jasanoff and Kim, 2015, p. 4)

The smart city is a socio-technical imaginary as it is grounded in "positive visions of social progress" that "encodes not only visions of what is attainable through science and technology but also of how life ought, or ought not, to be lived" (Jasanoff, 2015, p. 4). Importantly, then, the concept of imaginaries can be used to understand how institutions like corporates, states, and citizens project particular visions of both smart cities and citizenships. Vanolo (2016) describes in his analysis of prevalent smart city imaginaries the "composites of multiple subjectivities" likely to emerge from the number of ways of becoming the 'smart citizen'(p.35). By extension, I deploy the concept of imaginaries to analyse the diverse ways in which smart city citizenships are envisioned. I thereby demonstrate the importance of discourses to the socio-technical ecology framework I propose.

Early interest in corporate imaginaries of the smart city worked through the largely technocentric and instrumental framing of citizenships associated with programmes run by the likes of IBM, Cisco, or Siemens (Hollands, 2008; Kitchin, 2014a; Vanolo, 2014). Here, the concept of imaginaries was used to critically engage with corporate materials, such as promotional marketing, advertisements, websites, financial reports, technical reports, or public speeches, that together construct powerful

about who and how I cite people in my written work. I have begun engaging other STS terms with the ideas I discuss in this section, such as Taylor's (2004) 'social imaginaries.'

discourses of smart and enhance or sustain forms of market influence (Greenfield, 2013; McFarlane and Söderström, 2017; McNeill, 2015; Sadowski and Bendor, 2018; Townsend, 2014; White, 2016). This political-economic lens traced and critiqued forms of corporate power by showing "how individual visions sometimes rise to the status of collectively held objectives" and the "uses of symbolic and cultural resources, such as images, texts, memories, metaphors, and language itself" (Jasanoff, 2015, p. 25) in shaping smartness. This focus on the discursive strategies of large corporations is by now a widely and well-researched aspect of the smart cities literature, one which I largely set aside to engage with other discursive forms of smart citizenships. Others like Luque-Ayala and Marvin (2015b) argue that not all smart discourses are the same as "different rationalities underpinning SU (e.g. IBM vs. Google) are likely to embed different approaches to the interface between 'smartness' and citizenship" (p.2110). Their perspective signals that smart cities involve diverse imaginaries of smart cities that have different implications on discourses of citizenships.

Some studies focus on diverse imaginaries of smart citizenship employed by states. In a UK study, Joss *et al*. (2017) uncover "civic-republican" and "individual-liberal" citizenship imaginaries that emerge from the state through the British Smart City Standard. Both ideals focus on the relationship of smart citizens as *individuals* with the smart city "empowering" citizens to participate in political processes. This does not necessarily sit with the technocentric framing of the smart city in the BSI

standard. Similarly, Datta (2019a) discusses postcolonial articulations of smart citizenship imaginaries in the context of India's '100 Smart Cities Mission'. Her research shows that smart citizens are enrolled as "tech-savvy, entrepreneurial and judicious" (p.137) subjects who participate in the entrepreneurial work of the state as career-oriented, skilled, and ambitious individuals. Postcolonial smart citizens 'collaborate' with smart cities via online tools as "digital acts" as well as through material symbolic engagements enacted 'offline' such as marathons, survey questionnaires, posters, or essays. Both cases evidence this tension in state imaginaries of the relationship between citizens as individuals and the smart city imagined as socio-technical systems.

Critical examinations of the discursive role of IT companies in 'selling' the smart city have also been counterbalanced by studies of cities and the rationales of urban authorities engaged with smart (Alizadeh, 2017; Calzada, 2017a; Coletta et al., 2019; Datta, 2018a; Karvonen et al., 2019a; Odendaal, 2015). This followed early critiques that recognised a need to ground or situate smart discourses in 'actually existing' cities (Kitchin, 2015a; Odendaal, 2021; Shelton et al., 2015). For instance, Wiig (2015) examines Philadelphia's involvement with IBM in developing its 'Digital On-Ramps' app platform and website as part of the 'Smarter Cities Challenge' programme. The ambitions behind IBM's intervention were to address a skills gap between residents and entry-level jobs in IT-focused industries primarily using skills-based training, workforce education and connecting participants to

employers. Despite the implementation of the app differing significantly from IBM's proposals, the scheme was deemed a success by the city's Mayor. Wiig therefore considers this to be a city branding exercise to demonstrate the city's openness to business and enterprise rather than simply being about addressing issues of inequality for underemployed and marginalised residents of the city. As opposed to being passive recipients of corporate visions, this work shows that governments and city authorities also have significant power and resources to shape or construct imaginaries of smartness (Alizadeh, 2017) and its citizenship implications. In a similar vein, Rose *et al.*'s (2020a) study shows a wider set of values implicit in a range of smartphone apps developed in the UK city of Milton Keynes, including heritage, public health, and accessibility. Again, this evidences a much more diverse set of city imaginaries of smartness and citizenship beyond the values identified in corporate studies of smart imaginaries: optimisation, efficiency, and speed.

As well as written accounts of the smart city imaginary, smart city visualisations also play a critical role in communicating socio-technical imaginaries of smart cities in terms of the types of urban infrastructure necessary to construct the smart city as well as anticipating new forms of mediation coordinated through emerging or projected smart technologies (Vanolo, 2016; Wigley and Rose, 2020). Visualisations can be considered a specific form of citizenship discourse that can be deconstructed in a multitude of ways. For instance, Wigley and Rose (2020) analyse promotional videos associated with a major Connected and Autonomous Vehicles project in the

UK city of Milton Keynes. These videos specifically imagine future transport journeys made by a generic modern entrepreneur or businessman in a first-last mile journey from the train station to an office (see Singh, 2020 for more on the gendered dynamics of smart mobility). In such visuals, smart forms of automobility are understood as bringing time, efficiency, and workload solutions to (often) white, professional and able-bodied workers rather than providing a viable public transport alternative. I therefore consider imaginaries useful to analyse the citizenships evident in visuals of smart technologies.

As this section has illustrated, the concept of socio-technical imaginaries provides a useful heuristic to critically analyse the ideas and assumptions about smart citizenships generated by institutions and other smart actors. Much of this work has been interested in socio-technical imaginaries of 'smart citizens' as individuals and the projected political relations of citizens with the smart city. I hereby deploy the term imaginary as part of the socio-technical ecology framework I propose to trace the normative values or ideals expressed through these smart discourses.

2.4. Practices of Smart Citizenship: Doing, saying, acting

In this section, I further develop the socio-technical ecology framework of studying smart citizenship through the concept of practices. By this, I refer to social theories of practices as a "routinised type of behaviour" enacted by different bodies that in turn shape or form "structures of action" (Reckwitz, 2002, p. 244). In other words, I

focus my analysis on the 'doing' of 'actually-existing' forms of citizenship (Shelton and Lodato, 2019) in smart cities. To do so, I follow Isin and Ruppert's (2015) notion of digital citizenship as a diverse set of practices that are "enacted by what we do in relation to others and things" (p.10). Theorising smart citizenship through practices means considering what Isin and Ruppert refer to as "speech that acts" as "not only in or by saying something we are doing something but also that *in or by doing something we are saying something*" (p.71, emphasis added). Citizenship is enacted through routinised patterns of discursive and embodied practices, several of which are materialised through engagements with smart or digital technologies and infrastructures in cities (Luque-Ayala and Marvin, 2020a) (see Section 2.5). I argue theorising smart citizenship through the lens of practices adds to my conceptual framework by engaging with the empirical diversity of socio-technical relations that emerge in smart cities.

Much of the critical smart city literature thus far focusses on *participatory* practices of citizenship enacted in smart cities (Cardullo and Kitchin, 2018; Hemment and Townsend, 2013; Shelton and Lodato, 2019; van der Graaf, 2014), an aspect I critiqued earlier in Section 2.2. I also argued this literature overemphasises the *discursive practices* of 'communicative action' and prioritises forms of political voice or visibility (Chilvers and Kearnes, 2016b). That said, there are multiple ways in which participation is discursively practiced or embodied with cities, provincial or regional governments and nation-states (Calzada, 2020b; Cardullo and Kitchin,

2019; Tenney et al., 2020; Zandbergen, 2017). For example, Calzada's (2017a) study of four European cities identifies several partnership frameworks used to frame the involvement or devolution of decision-making to citizens (Calzada, 2020a), such as the triple and quadruple helix models of engagement (see Chapter 5). Discursive practices of participatory citizenship are framed differently in the UK context, where the idea of the 'urban lab' is framed as an experimental form of engagement with smart (Cowley and Caprotti, 2018; Karvonen et al., 2020). I therefore argue there are diverse forms of participatory engagement discursively practised in smart cities, that tropes like 'grassroots' or 'bottom-up' citizenships do not fully convey (Burns and Welker, 2022).

Practices are also the "interconnectedness of bodily routines of behaviour, mental routines of understanding and knowing and the use of objects" (Reckwitz, 2002, p. 258). In their ethnographic study of an air quality sensor project in Amsterdam (Netherlands), Uitermark and Zandbergen (2019) describe practices of sensor and data gathering through 'Smart Citizen Kits' which produce experiences of different forms of citizenship. The first is 'cybernetic citizenship' which affectively engages citizens with imagined urban environments of informational flows; the second is the 'republican' (or, participatory) citizenship, which empowers citizens through data to engage in political debates. Sensing and data collection practices enacted through these kits facilitated individual forms of empowerment (via cybernetic imaginaries of digital environments) while frustrating others who had engaged with the project

in order to make political claims on the local state. Practices therefore produce multiple citizenship forms, which connects with frameworks I introduced earlier to "capture broader ecologies or systems of participation" (Pallett et al., 2019, p. 592).

As previously discussed in relation to Datta (2019a), the smart city also facilitates and encourages engagements with online practices or "digital acts" of smart citizenship. Rose and Willis's (2018) study of the circulation of smart city images on social media platforms like Twitter make visible specific types of citizens and affects: "people who *participate* in smart events, people who *learn* about smart and people who *anticipate* smart futures" (p.13, emphasis added). Networked images therefore centred on practices of *doing* smart citizenship that involve forms of smart city value, such as photos from international conferences, events, or other arenas where the 'advocacy coalition' of smart is consolidated (Kitchin et al., 2017b). In this example, practices or "digital acts" of engagement is about who 'participates' online but also what citizenships are made visible and imagined as constitutive of the smart city.

In this section, I have highlighted how smart citizenship involves multiple and varied *practices* of doing, saying, and acting in relation to the smart city. I argue practices is an important component of the socio-technical ecology approach in highlighting the "relational dynamics of diverse interrelating collective practices and spaces of participation which intermingle and are co-produced with(in) wider

systems and political cultures" (Chilvers et al., 2018, p. 202). Practices are highly interrelated with discourses and materials which shape the different forms of citizenship illuminated by the socio-technical ecology approach.

2.5. Smart Citizenship as Material: Technologies, devices, data

In this section, I continue to unpack the socio-technical ecology framework I use in this thesis by arguing that smart citizenship is enacted *materially* through everyday embodied engagements with smart technologies and infrastructure. I primarily draw on STS scholars like Noortje Marres (2012) to argue studies of smart citizenship can be furthered by drawing on object-oriented theories of engagement. This approach illuminates "the objects which give rise to, mediate, or are produced through public involvement" (Chilvers et al., 2018, p. 201), such as energy meters or smartphones. In a smart cities context, technologies or devices like air quality sensors have largely been understood and valued as mediating participatory practices of smart citizens, particularly in relation to producing or mobilising data (Gabrys et al., 2016). There continues to be important debates on the citizenship implications of smart/platform technologies in enacting forms of corporate surveillance, control, or data extraction (Greenfield, 2013; Sadowski, 2020; Zuboff, 2019). My focus in this section is instead on materialities of smart citizenship that co-produce forms of engagement with the smart city.

Material technologies or devices like instructional toolkits or post-it notes have been described as "analogue" media that signify particular practices of smart citizenship centred on participatory or deliberative processes (Mattern, 2020). A toolkit is a "judiciously chosen collection of tools and materials designed to script a particular process, aimed to serve a particular purpose (or purposes, plural), and to do so with minimal waste and frustration" (S. Mattern, 2021). Toolkits are deployed as guidelines of what is considered 'best practice' and thus reinforce assumptions of practices of engagement by design. Toolkits thus enact participation as a set of "standard procedures" that "tries to produce a particular experience – especially a natural, organic, or authentic one – of participation" (Kelty, 2019a, p. 45; S. Mattern, 2021). Analogue materials like post-it notes are often part of the design of citizen engagement by smart cities. But authors such as Mattern and Chantry (2022) claim in cases like Sidewalk Labs that this "feign[s] meaningful engagement" by instead invoking participatory processes which does not necessarily lead to actions.

Early scholarly interest in traffic control centres like in Rio de Janeiro, Brazil typifies this focus on material forms of smart city governance through the convergence of connected digital infrastructures, software, and real-time data (Kitchin, 2014a; Luque-Ayala and Marvin, 2016; Wiig, 2015). As some argue, control centres typify the operational logics of optimisation and control (Kitchin et al., 2017c), that produce citizens as passive data points governed under the panoptic gaze of automated forms of surveillance. Sensed citizens are considered by some to be a

“constitutive element of the emerging “urban computational apparatus” (Gabrys, 2014a).

Both of the literatures on smart and platform urbanism emphasise the relative importance of smartphone devices as mediating forms of smart citizenship. The smartphone is considered “a highly personal, relational interface that activates performativities of platform intermediation within spaces of everyday encounter” (Barns, 2019, p. 8). In their study of operations centres, Luque-Ayala and Marvin (2016) show how smartphone apps like ‘Waze’ generate real-time traffic data that together with other smart city infrastructure expand the capabilities of citizens to collectively provide varied indications of everyday urban mobility. Reflecting on the design of local smart city apps in Milton Keynes, Rose *et al*. (2020a) evidence the implicit assumption of smart citizens as mobile subjects or as ‘bodies on the move’ whose embodied mobile interactions are mediated by smartphone devices.

In this section, I applied STS perspectives which centre object-oriented insights to consider ways citizenships are produced in relation to the smart city. My analysis showed the multiplicity of technologies or devices which mediate forms of smart city engagement, while highlighting some of the normative assumptions with which these have been assessed (i.e., sensors = ‘passive’ citizens, post-it notes = ‘active’ citizens). I have repeatedly challenged these perspectives throughout this review. Extending the socio-technical ecology framework to include materialities of smart

citizenship “encompass material, embodied, visceral, private, every day and mundane forms of public engagement” (Chilvers and Kearnes, 2016b, p. 16).

2.6. A Conceptual Framework of Smart Citizenship

My analysis of this work argued that there is significant emphasis placed on the figure of the participatory ‘smart citizen’ who ‘actively’ engages with cities in rather conventional political forums or settings. I also showed how ‘passive’ citizenship forms were discredited as reinforcing state or corporate power on individuals as subjects of surveillance or control. Yet, the literature further recognises the ongoing and diverse emergence of smart cities and technologies (Caprotti and Cowley, 2019; Datta, 2018b; Kitchin, 2022b; Shelton et al., 2015), which transform citizenships in turn. Therefore, I proposed a ‘socio-technical ecology’ approach as a far broader framework of studying the ‘actually existing’ forms of citizenship that emerge in a UK smart city.

To do so, I explained the three key terms that underpin this conceptual framework of studying smart citizenship through *discourses*, *practices* and *materialities*. Inspired by Jasanoff (2004), I first argued that smart cities are discursive *imaginaries* that project ideals or anticipate the practices of citizens in digitally-mediated cities. I then described smart citizenship as a diverse set of *practices* based on Isin and Ruppert (2015) and their account of citizenship as continually enacted through ways of doing, saying, and acting. I lastly illustrated the *material* objects that mediate or

facilitate forms of citizenship in smart cities, following Marres (2012) account of technologies of participation. Though this review was organised in a way that addressed these aspects discretely, I understand these terms represent overlapping, interconnecting, and interrelating dimensions of the smart city citizenships I later elaborate in the thesis. Discourses, practices, and materialities are co-constitutive relations that shape one another and that together form multiple citizenships I associate with this socio-technical ecology approach.

My analysis of this literature has therefore informed the theoretical framing of citizenship I undertake in this thesis. The literature review also contributed to the overarching aim of exploring the 'actually-existing' ways in which smart cities and citizenships emerge in a UK city. It has also informed the framing of three research questions:

RQ1. What different enactments of citizenship emerge from smart city projects in the UK county of Oxfordshire? This refers directly to the multiplicity of possible forms of smart citizenship.

RQ2. What forms of discourse, practice, and material devices underpin the way citizenships are being articulated within smart city projects in Oxfordshire? This will enable me to specify in some detail different forms of citizenship.

RQ3. What implications do these enactments and logics have for different forms of democratic citizenship? This displaces the dichotomous assessments of citizenships as passive or active.

The structure of the thesis is devised in such a way to address these research questions by identifying multiple forms of smart citizenship being enacted in Oxfordshire. In Chapters 4, 5, 6, and 7 I unpack these cases. Chapter 4 describes '***informational***' citizenship in relation to the significance of participatory forms of engagement with Oxfordshire County Council iHUB projects. Then, Chapter 5 elaborates the '***beneficiary***' citizenship as a primarily discursive position that emerges from OxLEP's living lab proposals. It is imagined that citizens in the present benefit from experiments with digital technologies that are framed as solutions to anticipated societal challenges. In Chapter 6, I detail the '***expert***' citizenships valued by the Smart Oxford board at networking events which is centred on forms of 'local' knowledge. Chapter 7 explains machine learning methods of analysis that produce '***sim***' citizenships in a digital twin used to test Automated Driving Systems virtually. This chapter show that not all smart citizenships will necessarily be 'human' in digitally-mediated cities.

Before moving to these chapters, I detail the methodology of this thesis.

Chapter 3

Methods for Researching Citizenship in a UK Smart City

3.1. Introduction

In this methodological chapter, I provide a detailed explanation of the approach I took towards exploring smart citizenship as a 'socio-technical ecology' within a UK smart city. I outline a systematic set of procedures implemented in the field following the research questions posed at the end of Chapter 2 and in response to existing smart city literatures. I describe the messy, granular, thought-provoking, frustrating, surprising, and complex dynamics involved in this fieldwork and throughout the completion of this research. I am inspired by and appeal to feminist epistemologies that not only critically engage with the partiality of knowledge-generating practices, but also recognise and appreciate the emotive or affective experiences of conducting academic research (Haraway, 1991; Rose, 1993; Smith and Delamont, 2019). I discuss multiple occasions where I had to reconsider and re-evaluate aspects of the research design, adapt to unanticipated challenges and unprecedented circumstances, and perhaps most importantly, reflexively engage with aspects of my positionality. I further detail the significant and substantial body of empirical data that was generated from what I identify as that four case studies of smart citizenship emerging in Oxfordshire. I couple this with an explanation of the analytical techniques and procedures used to interpret this data and in generating

its findings. In sum, I argue the qualitative approach I detail in this chapter enabled me to trace the socio-technical ecology of discourses, practices, and materialities that were involved in enacting the smart citizenships I uncovered.

In Section 2.6 I proposed three main research questions arising from a review of the existing smart city literature:

RQ1. What different enactments of citizenship emerge from smart city projects in the UK county of Oxfordshire?

RQ2. What forms of discourse, practice, and material devices underpin the way citizenships are being articulated within smart city projects in Oxfordshire?

RQ3. What implications do these enactments and logics have for different forms of democratic citizenship?

These questions directly inform the research design and methodology I outline in this chapter. In order to adequately answer these questions, I interpreted smart citizenship using the following three terms: *discourses*, *practices*, and *materialities* (Asen, 2004; Isin and Ruppert, 2015; Jasanoff and Kim, 2015; Marres, 2012). As discussed in Chapter 2, these terms form part of what I've termed a 'socio-technical ecology' approach to studying smart citizenship (Chilvers et al., 2018). The approach I take expands from existing assessments of 'participatory' citizenships (Cardullo and Kitchin, 2018; Shelton and Lodato, 2019) to offer an account of the complex and interconnected citizenships that are enacted in smart cities. I argue

such an approach challenges the dichotomies formed in the literature that evaluates 'active/passive' forms of citizenship and relates this to 'top-down/bottom-up' smart cities. Drawing on scholarship inspired by a Foucauldian approach, I understand this is a way of illustrating the descriptions, categories, groupings, and framings used to constitute citizenships in the making (Dudley et al., 2019; Isin and Ruppert, 2015; Rose, 2020; Zandbergen and Uitermark, 2019). I argue the way people '*talk*' about citizenship is fundamentally related to the frames, conditions, and democratic possibilities of its *enactment*, both *practically* and *materially*. I therefore adopt the three-pronged qualitative research methodology I detail in this chapter involving interviews, observations, and grey literature (e.g., promotional material, research project reports, policy documents).

The remainder of this chapter is divided into seven sections: Section 3.2 identifies how existing methods for researching citizenship inspired or justified the approach undertaken in this thesis. Section 3.3 and 3.4 provides a detailed rationale for both the research contexts and case studies I identified. Section 3.5 maps the overall research design and describes a robust set of research methods to systematically collect data. Section 3.6 describes the ethical considerations and implications of conducting this research. This includes reflections on the impacts of the COVID-19 pandemic in terms of amplifying the salience of research themes as well as the concomitant impacts of a global health emergency on myself as a researcher. Section 3.7. details the analytical procedures used to interpret the research data and

thus generate its findings. The chapter concludes by summarising how these case studies of citizenship map onto the four empirical chapters of this thesis.

3.2. Researching the smart city: From vision statements to participatory practices

Existing geographical research on smart cities adopt a range of methodological approaches and methods to study smart citizenship.

As previously mentioned, the focus of early studies on state and corporate smart cities involved methods of analysing citizenship through discourses in visionary planning and white paper documents, promotional videos, press releases, newspaper articles, and other textual sources produced by these actors (Cardullo and Kitchin, 2019; Datta, 2019a; Gabrys, 2014a; Joss et al., 2017; Vanolo, 2016; Wiig, 2016). Some of these assessments take a comparative approach using grey literature to identify trends, compare key characteristics, or provide assessments of a number of smart city cases together (Angelidou, 2017; Caprotti et al., 2016a, p.; Cowley et al., 2018; Joss et al., 2019). Initially, I thought such sources of discursive analysis might risk overemphasising 'elite' perspectives, negating alternative voices, or being strongly disconnected from what 'actually existing' smart cities and forms of citizenship look like practically. I later realised just how important these sources were given the significance of socio-technical discourses of smart in shaping smart. I discuss the importance of this later in Section 3.5.

More recent studies have also begun to unpack the ways 'actually existing' smart citizenship is enacted using methods like participant observation. This evidences how citizens are practically and materially engaged with smart activities, as well as citizenship discourses that underpin this (Gabrys et al., 2016; Shelton and Lodato, 2019; Zandbergen and Uitermark, 2019). As I discussed earlier, some studies focus almost entirely on discursive practices of participation (Allen et al., 2020; Cao and Kang, 2022; Cardullo and Kitchin, 2018), while others have emphasised the importance of material digital technologies like smartphones or air quality sensors (Gabrys, 2016). I draw on observational methods in the design of this research as an effective method to map participatory citizenships, but also to accommodate wider sets of citizenships too (Chilvers et al., 2018; Pallett et al., 2019).

The 'socio-technical ecology' framework I develop in this thesis necessitates the adoption of three main research methods which are also used by other smart city researchers. Before detailing these methods however, the next section explains the contexts and case studies of this research.

3.3. Oxford: The (Smart) City of Dreaming Spires?

I was primarily interested in exploring smart city activities being conducted in the UK city of Oxford and county of Oxfordshire in the south-east of England. There were several reasons for this. Existing studies of UK smart cities had already

identified empirical cases like Bristol, London, Manchester, or Milton Keynes and research on these cities had been well-established by others (Anthopoulos, 2017; Calzada, 2017b; Cowley et al., 2018; Joss et al., 2017; Valdez et al., 2021). This was also the case for cities like Glasgow or Peterborough as two major recipients of UK government funding through the Future Cities Demonstrator Competition; an early effort to stimulate innovation policies on smart cities (Taylor Buck and While, 2017). Oxford had appeared in Caprotti *et al*.'s (2016a) comparative study of UK 'smart-eco' cities but it was excluded from a final selection of 10 detailed case studies after assessing its substantive city plans and practical activities. However, I did not interpret this to be a limiting factor in choosing Oxford for this study given the high degree of discursive and practical variability I had observed in UK smart cities (Caprotti and Cowley, 2019). I questioned whether a wider selection criterion of sources in Caprotti and Cowley's study might involve smart city documentation from other local actors like universities or community groups and if this would have challenged their assessments of UK smart cities like Oxford.



Figure 3.1: A typical view of the historical City of Oxford featuring the Radcliffe Camera. Permission to reproduce this image has been granted by OxLEP.

In terms of Oxford, I was particularly interested in ways 'smart' was entangled in the projection of the city as a centre for world-leading research and innovation activity. Previous studies had already evidenced the success of both the Oxford City Council and the Oxfordshire County Council in securing funding from sources like the UK government's Department for Transport (DfT) and Innovate UK as well as council involvement in mediating multi-stakeholder partnerships, especially in a mobilities context (Hopkins and Schwanen, 2018; Schwanen, 2015). Some of these activities had taken place at several established business and technology centres clustered in south Oxfordshire (i.e., Harwell, Milton Park, and the Didcot Growth Accelerator), which form part of the Science Vale UK zone. This area is known for hosting businesses in sectors like engineering, energy, ICT, aerospace, and pharmaceuticals. Less is known about how research or innovations tested or developed at these sites

is used or adopted in Oxford city, if at all. Likewise, I was aware of active efforts by Oxford University to nurture a community of student entrepreneurs and tech start-ups via the opening of its 'Oxford Foundry'[2] building in late 2017. Schemes run by the Foundry like 'All-Innovate' were regularly encouraging or eliciting competitive, entrepreneurial spirit amongst Oxford University colleges and its student body. At the time, it was unclear whether there were strong connections between these innovation-intensive practices with other tech-led programmes or if there was a comprehensive smart city initiative in Oxford tying these efforts together.

I was also consciously aware of a set of pervading geographical imaginations associated with Oxford city related to its historical buildings, landmarks, and institutions (Maccannell, 2016). A significant part of this relates to Oxford's affinity with two reputable universities: the University of Oxford and Oxford Brookes University. These institutions directly shape and contribute to the city's globally influential reputation and brand. For instance, images of historical buildings owned by Oxford University and its constituent colleges have almost become entirely synonymous with the city itself, like the Radcliffe Camera library (or 'RadCam') known for its oxidised copper blue dome or the spires on top of older Oxford college buildings alluded to in poetry or visualised in art and imagery of the city's skyline

[2] Established by Oxford University's Saïd Business School, the Oxford Foundry is a co-working space in the centre of the city open to students and alumni interested in venture start-ups, leadership mentoring, and upskilling in areas like coding, blockchain and AI. It was officially opened by Apple's CEO Tim Cook and supported by LinkedIn co-founded Reid Hoffman who donated $1 million dollars to support its opening.

(see Figure 3.1). Indeed, much of Oxford's city centre is comprised of University-owned land with wealthy colleges like Christ Church, Magdalen, and St. John's owning considerable portions of the city[3]. The contrast between intensely affective geographical imaginations generated from the city's historical architecture with the visual renderings of 'smart' I was familiar with that visualise highly interconnected, digitally mediated, data saturated urban environments made me question the contextual specificity of smart as it related to Oxford.

Lastly, it was pragmatically advantageous to choose Oxford while being based centrally in the city as an Oxford University DPhil (PhD) student. My primary aim was to conduct a prolonged and sustained engagement with multiple smart projects or activities, which would enable me to identify different citizenships. Practically, this required completing time consuming tasks like uncovering the stakeholder networks I was interested in, building higher degrees of rapport with organisations and institutional groupings, and negotiating deep levels of access with a diverse range of gatekeepers. It was far easier completing tasks like this in a location where I was deeply embedded and situated both in a professional and personal capacity. Indeed, I was aware of both the University and the School of Geography and the Environment working collaborative with the City and County councils on a number of research projects, like a Transport Studies Unit (TSU) study on on-street electric car charging infrastructure (Hampton et al., 2019). I had many informal and

[3] See: https://www.whoownsoxford.org/thefringe

informative conversations with departmental colleagues on collaborations or partnerships like this throughout the research process.

Altogether, these factors contributed to the overall rationale for identifying Oxford as the site for this fieldwork and study. The next section provides brief contextualising summaries for Oxford city and Oxfordshire respectively to consolidate my rationale and provide further details that support my choice of fieldwork sites.

3.3.1 The City of Oxford

Oxford is a relatively small UK city with a population of 162,100 people and a total area of about 46km^2 characterised by pockets of dense urban development alongside corridors of protected parks and conservation areas within its green belt (Oxford City Council, 2022). The city is divided into 24 constituent wards of varying demographic makeup. There is an immense amount of inequality within and between these wards with 10 out of 83 neighbourhoods amongst the 20% most deprived in England (see Figure 3.2). The city's population is relatively young compared with other UK cities with an estimated 32% of Oxford's population aged 18-29 years old compared with 16% for England and Wales. Students enrolled in full-time studies at Oxford's universities comprise a significant proportion (21%) of Oxford's total population based on the ONS 2021 Census (Oxford City Council,

2021). Oxford's largest employer is the University of Oxford who employ 14,478[4] staff in academic teaching, professional administrative and clerical roles, research, and teaching and research support roles (University of Oxford, 2020). While there is a high concentration of people who work in the knowledge sector, there are further industry and sectoral strengths in car manufacturing, publishing, and tourism. The employment composition in Oxford have been the subject of several studies (Lawton Smith, 2003; Lawton Smith et al., 2005; McDowell and Dyson, 2011). Another of Oxford's major employers – 'Plant Oxford' – is based in Cowley in the southeast periphery of the city. This is a car assembly and mass production facility for the BMW MINI brand, and now operates as a business park too. Behind prevalent perceptions of Oxford city as a confluence of affluence, privilege, and prestige, it is important to consider and counterbalance perceptions by acknowledging the city's demographics, inequalities, and socio-spatial geography to foreground where and how the city's smart activities unfold.

[4] This figure does not include staff employed solely by Oxford University's 45 colleges, by Oxford University Press, casual workers or those employed on variable hours contracts.

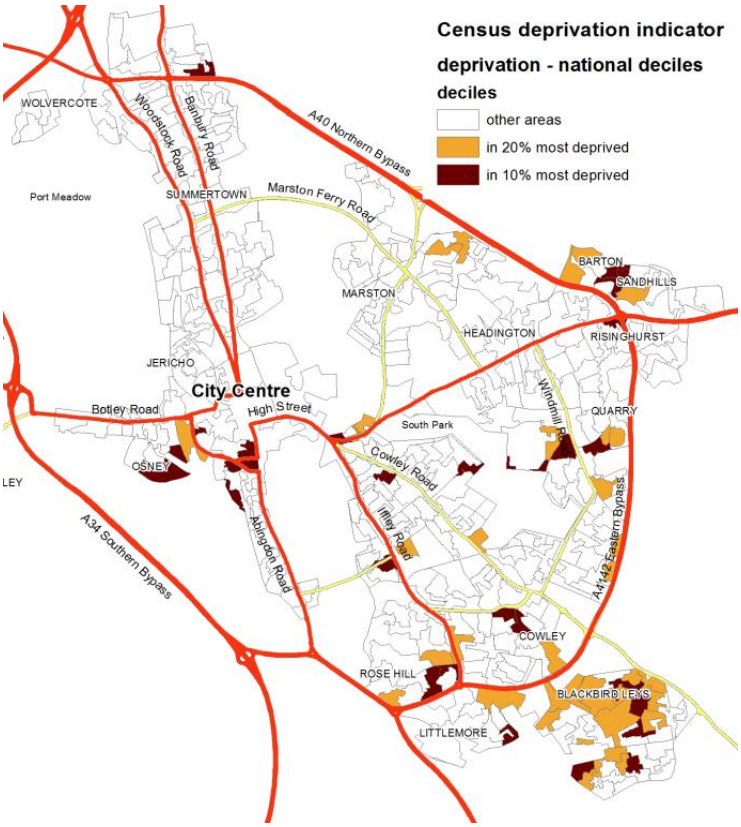

Figure 3.2: Census deprivation map showing areas in Oxford in the 10% and 20% most deprived in England. Permission to reproduce this map has been granted by Oxford City Council. © Crown Copyright and database right 2014. Ordnance Survey 100019348. Data: 2011 Census, Office for National Statistics.

3.3.2. The County of Oxfordshire

Oxford city is one of several districts in the wider county of Oxfordshire, which is known for its areas of rural countryside alongside smaller population centres like Banbury, Bicester, Kidlington, Wallingford, and Witney. There are around 678,000 people living in the county in total with 31,000 VAT registered businesses clustered and distributed in several business districts, science parks, and commercial retail centres (OxLEP, 2021). Administratively, it is important to note that particular forms of policy and decision-making in the region are devolved into five district councils (Oxford City, South Oxfordshire, West Oxfordshire, Cherwell, and the Vale of White Horse) and a county council (Oxfordshire County Council), supplemented

by civil parishes and electoral wards (see Appendix A). District councils are principally responsible for *local services* like planning applications, leisure and recreation, housing, environmental health, and waste collection. Comparatively, the county council is in charge of *policymaking*, long-term planning, strategies, delegating power, debating local issues, receiving public petitions, transport, and so on. Under conditions of austerity, there have been heavily disputed calls to reform and restructure this two-tier system of local government towards forming a unitary Oxfordshire council (Corder, 2020; Oxford City Council, 2020).

Organisational and administrative divisions were certainly an influential factor in shaping how discussions on 'smart' unfolded between people and stakeholders in Oxford and Oxfordshire. An example of this was the significant crossovers between people who were employed at both the Oxford City Council and the Oxfordshire County Council to work on specific projects or policy areas like electric vehicle (EV) integration (see Section 3.4.2). There were also examples of interview participants directly addressing challenges of organisation between these councils. In sum, this section provided illustrative summaries of both Oxford city and Oxfordshire county with background context that situates its smart activities in relation to the wider social, political, and economic context, an important aspect of grounding smart discourses (Aurigi and Odendaal, 2021; Kitchin, 2015a).

3.4. Multiple ways of organising smart in Oxfordshire

The smart city manifests in many different ways in Oxfordshire. There was not a unified body or organisation nor was there a singular programme driving smart like in corporate or state versions . Rather, smart activities were organised by a complex and distributed ecology of actors, that did not conform to or follow the conventions of local government I detailed above (Cowley and Caprotti, 2018; Datta, 2019b; Ho, 2017; Taylor Buck and While, 2017). Oxfordshire County Council and Oxford City Council were the two local authorities most involved with smart, though both had limited overall strategic authority for these activities. This was reflected in various claims made by partners that smart operated either at the scale of the city or at the county-level. A far more complex and broader institutional landscape characterised how smart emerged in Oxfordshire, which again challenges the verticality of power that is implied by hierarchical assessments of 'top-down/bottom-up' governance.

Most smart activities were organised at the unit of the individual '*project*', in line with the urban lab and 'projectification' model more generally (Karvonen et al., 2020; Torrens and von Wirth, 2021). Projects were organised in the form of multi-sectoral partnerships (or, *consortiums*) supported by competitive state and private funding, typically short-term with no guarantees of extension. There were many successful bids secured for smart city projects this way which cut across various technological priorities, interests, and testing capabilities in Oxfordshire, such as expertise in Connected and Autonomous Vehicles (CAVs) or smart energy systems.

The Oxfordshire County Council and the Oxford City Council played a facilitative role in establishing projects or relationships between a wide range of stakeholders, including public or civic institutions, corporates, and other actors. However, there were also exemptions to the project model in Oxfordshire with groupings of institutional actors formed around developing strategic economic justifications for central government investment in the innovation capabilities of Oxfordshire. In this section, I seek to unpack the organisational diversity, institutional groupings, and modes evident in enacting "actually-existing" forms of smartness in Oxfordshire.

Building on insights gained from preliminary fieldwork, I identified four organising bodies or institutional groupings that represent the broad remit of activities using or adopting the 'smart' label in the context of Oxford and Oxfordshire. From these exemplars, I planned to select a number of citizenship case studies that emerged from this wider ecology of citizenship forms. The research design was therefore guided by the principles of a multi-case study approach (Flyvbjerg, 2006; Tight, 2010; Yin, 2013). The four exemplars I identified were: 1) the Smart Oxford board and programme; 2) the Oxfordshire County Council's Innovation HUB team; 3) the OmniCAV project consortium led by Oxford University spin-out company Latent Logic; and 4) the Oxfordshire Local Enterprise Partnership and its development of the Local Industrial Strategy report (see Table 3.1). I treated these organising bodies and institutional forms as exemplar of the overlapping discourses, practices, and materialities evident in processes of making Oxfordshire smart.

In being attuned to these different forms, I sought to move past identifying a definitive definition of what '*the*' smart city constituted by instead recognising how the 'actually existing' smart city exists in many forms (Rose, 2020; Shelton et al., 2015). From this position, I was able to better locate this wide network or ecology of connected actors from local authorities, businesses, and organisations involved in coordinated project partnerships, R&D consortiums, initiating or facilitating living lab or testbed experiments, or developing the socio-technical discourses of smart circulating in the region.

Table 3.1 categorises these four different forms by indicating the types of smart activities, key partners, funding sources, and locations. The table shows quite significant crossovers, interconnections and interrelations between case studies, particularly in regard to partners and locations where activities took place. There were several occasions where participants recruited from a particular case study were able to speak to their involvement in multiple other ways in which smart was enacted. This inevitably informed the data collection process and the analytical procedures I adopted throughout all stages of this research, which is one of the principle design challenges of adopting a multi-case study approach (Stake, 1978).

In many ways, the organisational and institutional complexity of smart evident in Oxfordshire contributed to and informed the 'socio-technical ecology' metaphor I

formulated earlier in Chapter 2. In fact, I describe the smart city as an 'ecology of institutions' (Chilvers and Kearnes, 2016a) that represent a wide range of people and technologies that enact smartness in Oxfordshire through intertwined relations of discourses, practices, and materialities, all of which I unpack in the following chapters.

Table 3.1: Four exemplar organisational and institutional arrangements of 'smart' in Oxford and Oxfordshire. Table based on interviews and ethnographic fieldwork undertaken between 2018 to 2019.

Case Study	Mode and Activities	Partners	Funding Sources	Key Locations
1. **The Smart Oxford Board & Programme** (2015 – ongoing)	**A networking group** for local stakeholders seeking to facilitate and initiate new local partnerships aligned with its smart city vision. In practice, this includes quarterly board meetings, horizon scanning, identifying local opportunities, connecting partners, running SME/start-up workshops, organising networking events, and promoting Oxford as a smart city both in person and online.	Oxford City Council, Oxfordshire County Council, Oxfordshire Local Enterprise Partnership (OxLEP), Oxford Strategy Partnership (OSP), University of Oxford, Oxford Brookes University, Nominet, Science Oxford, UK Atomic and Energy Authority/RACE, Oxford Academic Health Science Network (OAHSN), EDF Energy, and the Lucy Group	EU Regional Development Fund (ERDF); Oxford City Council	Oxford Town Hall; County Hall; Oxford City
2. **The Oxfordshire County Council Innovation Hub (iHUB)** (2015 – ongoing)	An R&D team actively involved in and contributing to multi-stakeholder **consortium partnerships**, mostly in the context of transport/mobility innovation. The iHUB initiates and mediates new local partnerships, facilitates the experimental practices of others, establishes shared data agreements with partners, proposes strategies and policies aligned with its vision, and	Oxfordshire County Council, the Smart Oxford Board, Mobility Oxford CIC, various project-specific consortium partners (see Table 3.2)	Department for Transport (DfT); Innovate UK; Centre for Connected and Autonomous Vehicles (CCAV); European Investment Fund; European Commission's Horizon 2020 programme; Office for Low Emissions Vehicles (OLEV); European Innovation Partnership; UKRI Small Business Research Initiative	County Hall; Oxford City; Oxfordshire County; UK Atomic and Energy Authority (UKAEA) testbed

	promotes Oxfordshire as a smart county both in person and online.		Scheme; Highways England; Oxfordshire County Council	
3. **The OmniCAV Project** (2018 – 2022)	A **high-tech** multi-stakeholder consortium partnership using simulation techniques to test automated vehicles systems in a digital twin of roads in Oxfordshire. The project aim is to develop both a verification tool and policy package that can be used to safely test CAV systems.	Latent Logic (Lead), Oxfordshire County Council, Warwick Manufacturing Group, Admiral, Arrival, Aimsun, Arcadis, XPI Simulation, Ordnance Survey, United Kingdom Atomic and Energy Authority (UKAEA), Thatcham Research	Innovate UK	Oxford City; the UK Atomic and Energy Authority (UKAEA) testbed; Oxfordshire County
4. **The Oxfordshire Local Enterprise Partnership** (2011 – ongoing)	A business-led partnership between local authorities and local private sector businesses with significant collective influence to identify **local economic priorities**, including developing Oxfordshire's innovation capabilities. This is coordinated through a set of targeted stakeholder meetings, SME/start-up workshops and feedback, and cross-collaboration with local authorities.	The Oxfordshire Local Enterprise Partnership (OxLEP)	UK government Regional Growth Fund	OxLEP Offices; Oxfordshire County; Oxford City

The diverse mix of case studies I identified is indicative of the relatively piecemeal adoption of smart evident in other UK cities too (Caprotti et al., 2016a; Cowley and Caprotti, 2018; Rose, 2020). As previously mentioned, there is not a singular programme or wholesale transformation envisioned by the UK state like in India (Datta, 2015), Singapore (Ho, 2017), or South Korea (Halpern et al., 2013) to name a few. Nor is there a major corporate intervention like in the Sidewalk Labs case in Toronto (Goodman and Powles, 2019). What this begins to show is that there is no unified or standardised way of integrating smart into existing cities (Sadowski and Maalsen, 2020). The decentralised mode of smart city governance evident in the UK manifests in this combination of short to medium-term projects or partnerships, often funded via competitive bidding (Taylor Buck and While, 2017), as well as the orchestration of strategic planning groupings who coalesce around the smart city.

The experimental framing of many projects in Oxfordshire is also demonstrative of the urban living laboratory model (Evans, 2016; Karvonen and van Heur, 2014) that is evident in other UK cities and that I later elaborate in Chapter 5. Therefore, the 'ecology' of smart activities I unpack in the following subsections is representative of these diverse efforts to make Oxford 'smart' in terms of the variegated discourses, practices, and materialities that constitute this here. These different forms align with the variety of smart citizenships I anticipated being able to explore as different forms of smart city making produce different versions of 'smart citizenship', which I later address in the empirical chapters.

3.4.1. The ‘Smart Oxford’ Board

From June to September 2018, I began a preliminary period of fieldwork designed to uncover the recent background and context of ‘smart’ emerging in the city while I negotiated access to initiatives run by the primary organisation of interest at the time: the Smart Oxford board. I started with the Smart Oxford board as it appeared to be a cohesive strategic partnership of local stakeholders. It outwardly acted and presented as an organising grouping for a wide portfolio of smart projects, and I thus interpreted it to be a possible springboard to identify multiple projects and thus citizenships. A principle aim of this scoping period was to systematically identify a network of actors or stakeholders involved in implementing initiatives as well as prior evidence of key policies, decisions, or actions mobilising the notion of ‘smart’ already in progress. I uncovered a much wider set of smart activities than I had anticipated as a result of my early engagement with members of the Smart Oxford board. As a result, I re-evaluated my initial assessment of following a single organisation, body, or project, and instead pursue the four that follow. This subsection details this process and introduces Smart Oxford as the first case study.

Early interest in developing ‘smart city’ ideas or plans appeared in the minutes of meetings held by the Oxford Strategic Partnership (OSP) in September 2014. The OSP is an organisational grouping of local stakeholders drawn from public, business, community, and voluntary sectors. Its core members comprise of the Oxford City Council; the Oxfordshire County Council; the National Health Service; and the

Thames Valley Police. Steering group members represent organisations deemed to be key in delivering the group's vision of Oxford. A few examples include: the University of Oxford; the Westgate and Castle Quarters; and the Oxford Civic Society. Minutes from OSP meetings reveal a number of internal discussions and documents scoping smart opportunities, visions, and strategies for Oxford. One of these documents was a report commissioned by the OSP's 'Economic Growth' steering group proposing to advance smart city plans for Oxford, comparing its relative strengths and position with other cities like Bristol, Glasgow, and Milton Keynes (Aldridge et al., 2015). Rankings and indexes are a common way cities are compared to each other, though not without scepticism (Acuto et al., 2021; White and Kitchin, 2021). An interesting aspect of this report however was the significant emphasis placed on "rigorous, meaningful citizen engagement", particularly for those who live, work, and visit the city. The OSP responded by establishing the 'Smart Oxford' board who would be responsible for bringing forward a number of recommendations to launch an integrated programme under 'the learning city for the 22nd century' rubric.

At the start of preliminary fieldwork in June 2018, I had developed a research design that proposed a single case study approach based on the Smart Oxford board as I understood this to be a unitary programme actively implementing a suite of smart city initiatives in Oxford. There were evidently board member representatives from local authorities (the Oxford City Council; the Oxfordshire County Council; the

Oxfordshire Local Enterprise Partnership), academia (the University of Oxford; Oxford Brookes University; the Oxford Academic Health Science Network), businesses (Nominet; Lucy Zodion), and a UK science research centre (the UK Atomic and Energy Authority), clearly listed and visible on the Smart Oxford website (oxfordsmart.city). At the time, the website homepage showed a cascade of loosely connected, technology-focussed projects, such as a local Internet of Things (IoT) sensor network intended to accurately predict flood incidents in the city (the 'Oxford Flood Network') or local infrastructure initiatives aimed at increasing broadband connectivity (the 'Super Connected Oxford' and 'Digital Connectivity for Oxfordshire' schemes) (see Figure 3.3). The Smart Oxford Twitter account (@OxfordSmartCity) was somewhat active and occasionally posted updates to circulate events of interest or to share articles and blog posts related to innovation in the city. Elsewhere, there was mention of specific Smart Oxford events such as a one-day start-up accelerator organised with Nominet (the 'Oxford Smart Challenge') in September 2015 as well as an arts-based competition on the theme of 'the shared city' finalised in January 2018 (the 'Smart Oxford Playable City', see Figure 3.4). The 'Learning City' programme was further associated with an online local government open data dashboard (www.oxopendata.uk). It thus appeared as if the Smart Oxford board had become a well-established, well-resourced programme introducing a convincingly comprehensive set of smart city initiatives or activities to the city of Oxford.

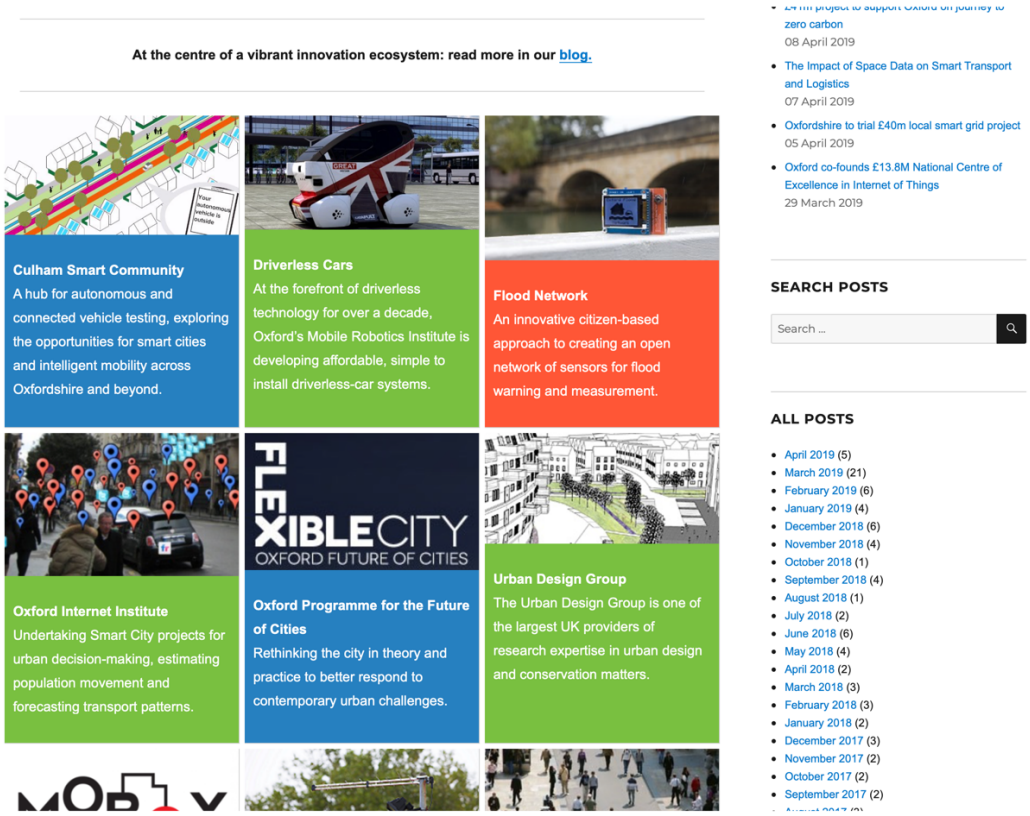

Figure 3.3: A screenshot of the Smart Oxford board website homepage. Author's Own.

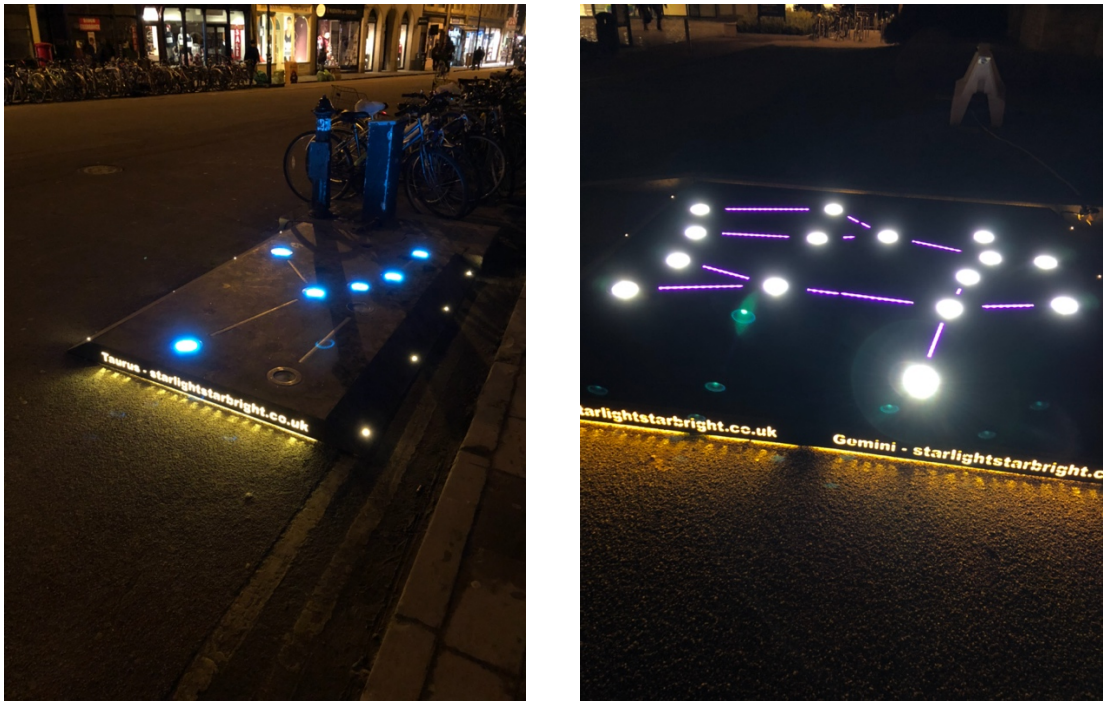

Figure 3.4: Two of five 'Star Light, Star Bright' platforms commissioned by the Smart Oxford board and temporarily installed on Broad Street and outside the Mathematical Institute at Oxford University in the city centre. Author's own image.

I initiated contact with the Smart Oxford board via email and arranged to meet with a member of the Oxford University Research Services' Knowledge Exchange and Impact Team (or 'KEIT') in part to discuss and negotiate access. I was subsequently invited to one of Smart Oxford's quarterly board meetings held a week or so later at the Oxfordshire County Library (June 2018). It was at this meeting that a recently appointed 'Programme Manager' was introduced to the Smart Oxford board, who was employed in a full-time position in-part funded by the Oxford City Council and the European Commission's European Regional Development Fund (ERDF) scheme. After this introduction I relied heavily on this Programme Manager to access board meetings, and shortly after he informed me of his 'preference' for me to not attend meetings at all. The precise reasoning for this remained unclear, particularly as he later invited me to specific networking events and activities, like the Oxford Technology and Media Network (OTMN) event. In fact, I was invited to several private meetings organised by Smart Oxford the following year as I was perceived to contribute an 'academic perspective' on his ideas. The other board members at this meeting volunteered their time and were primarily employed by their respective representative organisations, not Smart Oxford.

Much of the meeting entailed discussions of a presentation offered by the Programme Manager outlining his understanding of Oxford's current smart city status, including plans to co-opt and synthesise the Oxford City Council's 'Oxford 2050' vision (2017) as a framework for future smart ideas. His immediate plans

involved assessing then narrowing the scope of Smart Oxford set within his priorities of establishing a sustainable business model in order to become an independent, fully funded organisation. It gradually became clearer to me that the Smart Oxford board operated far more as an informal *networking* group for likeminded organisations who share an enthusiasm for *constructing* Oxford as a smart city as opposed to being an authoritative body acting in a coordinated manner towards *implementing* ideas or ideals in and of itself.

Though Smart Oxford's website advertised multiple smart projects developing applications of smart city technologies in Oxford, like IoT sensor networks, the board had limited to no administrative oversight over any of these projects. Instead, these were a set of loosely connected but disparately organised projects that only really ever involved specific board members in their capacity as individual organisations. For instance, Nominet, the UKAEA, and the Oxfordshire County Council sat as consortium project members on DRIVEN, and the Smart Oxford board were not listed or involved in this project practically in any way at all. Principally, then, it appeared as if the Smart Oxford board were responsible for projecting a visionary narrative of Oxford (and, at times, Oxfordshire) as being 'smart' framed or articulated through the R&D and innovation activities of others.

Unlike in some UK cities like Bristol or Peterborough where city administrations have established formal decision-making bodies for smart projects (Caprotti et al.,

2016a; Cowley and Joss, 2020), the ad-hoc and loose organisational structure of the Smart Oxford board meant much of its internal influence was fragmented across Oxfordshire councils and businesses. This corroborates with problems smart city advocates face in 'bridging the last mile' where "smart city ideas and ideals [have] only become partially embedded in city administrations" (Kitchin et al., 2017a, p. 7). Even in meetings with local stakeholders, it was clear the Programme Manager was heavily reliant on waning enthusiasm from others to voluntarily progress ideas into action. This was later reflected in an interview where the Programme Manager told me, "I have no resources, I have no funding, I have no organisation…I need to create a funded organisation with an agreed business plan that can actually do something deliverable" (July 2019). The Programme Manager attributed his peripheral sphere of influence as well as the inability of the Smart Oxford board to 'deliver' tangible technological initiatives as a result of its limited funding, resources, or operational base.

I therefore began to question whether focussing on the Smart Oxford board as a case study was an effective means of encountering the material, tangible smart city activities taking place in the city. I returned to the literature on smart where a rapidly growing amount of empirical cases and contexts made clear the variety of ways smart urbanism develops within the UK and around the world (Caprotti et al., 2016a; Cowley et al., 2018; Datta, 2015; Halpern et al., 2013; Ho, 2017; Joss et al., 2017; Taylor Buck and While, 2017). Much of this differed from preconceived ideas I

had formulated based on the existing literature at the time of an archetypal version of smart centred on the confluence of big tech companies, panoptic-like control rooms, or concerns over tech-led or data-intensive practices (Hollands, 2015; Kitchin, 2014a; Wiig, 2015). Uncovering further details on the context of the Smart Oxford board therefore provided fruitful opportunities to reappraise the research design and identify additional case studies that strongly reflected the variety I had uncovered in Oxford and Oxfordshire.

Nevertheless, the Smart Oxford board remains an important case study in this research as it epitomises the *networking* mode of smart activity evident in Oxfordshire and thus reflects the significance of storytelling in constituting a city's smartness. Events organised by the board like SME/start-up workshops, 'hackathons' and 'accelerators' were part of connected efforts to build a close network of skilled tech workers, identity new opportunities and mediate partnerships with Oxford councils. These activities fell within the remit of the ERDF funding the Oxford City Council had secured to fund a Programme Manager to run an innovation business support programme.

Networking was also an opportunity to formulate and project a wider smart city vision for Oxford, one that specifically addressed the sectoral strengths of Oxford's innovation network and embracing of tech entrepreneurship. This was evident in other case studies too. Likewise, the Smart Oxford website and social media were

clearly treated as forums for smart city discourse, an aspect I address in greater detail in Chapter 6 in relation to organising and promoting smart events. I therefore argue the Smart Oxford board produced a case study of *expert* citizenships imagined via both the storytelling practices evident in the grey literature and the networking events organised by the board which justifies its selection in this research.

3.4.2. The Oxfordshire County Council Innovation Hub

In 2016, the Oxfordshire County Council formalised one of its internal transport policy groups to become a centralised R&D department named the 'Innovation Hub' (iHUB). Its initial remit was broad, seeking to build and develop new collaborations with private sector organisations, academia, and local stakeholders. Starting off with a handful of members, the iHUB rapidly grew into a 24-person team by 2018 that had members in a range of positions such as 'Lead Technologist', 'Data Scientist' or 'Community Engagement Officer' among others. These roles attracted people with a vast array of professional experiences and backgrounds, such as in chemistry, software engineering, data science, computational physics, psychology, and teaching. Likewise, a couple of members had been seconded from other roles and positions within local authorities in Oxfordshire. For instance, a member of the EV Integration team had been transferred from the Oxford City Council following an early pilot in order to develop a county-wide implementation strategy for charging points.

With the backdrop of local authority responses to conditions of austerity leading to cuts in local services, the iHUB received significant protection and backing from senior councillors given that the team had a relatively self-sustaining operating model of sourcing external funding and investment. However, this meant most employees at the iHUB worked on short-term rolling contracts, bar members of the senior leadership team. The iHUB also lacked any kind of formal workspace while being based at County Hall in the Castle Quarter of the city; and it later moved to a dedicated workspace in the Westgate County Library in the autumn of 2019. This was considered by many as a pathway towards greater visibility or recognition of its activities.

Converging with ongoing discussions with the Smart Oxford board and developments within the associated Mobility Oxford company, the iHUB actively adopted and promoted a 'smart county' brand, which encapsulated its raisons d'être that its projects operated in suburban and rural parts of Oxfordshire (see Figure 3.5). The iHUB claimed this was particularly novel at the time given trials of technologies like CAVs tended to focus on urban areas. Since its initiation, iterations of the iHUB's project brochure position the Oxfordshire County Council as a leading, innovative local authority. It was regularly repeated that the Oxfordshire County Council were the first local authority in the UK to establish a Connected and Autonomous Vehicles team attracting the highest level of funding outside of

London. These compelling claims sought to consolidate Oxfordshire as a world-leading centre for R&D activities.



Figure 3.5: Logo branding for the Oxfordshire County Council iHUB and the Smart Oxford board. Source: Oxfordshire County Council.

Most iHUB projects were actively being delivered by '*consortiums*' as a specific type of multisectoral partnership between local authorities and key stakeholders (see Table 3.2). Consortiums involving the iHUB were principally organised by a nominated lead partner with responsibility for specific deliverables or work packages distributed amongst others in the project. Though the iHUB could only ever be identified as a collaborative partner[5], it most frequently acted as an interlocutor or enabler for specific experiments as well as a key data provider given the Oxfordshire County Council's role as the transport authority for the region. It was also one of the key promoters of smart projects in the county.

[5] Local authorities and academic institutions cannot be named as a lead partner on Innovate UK funded projects. Projects must be led by a UK registered business of any size or a research and technology company.

Each project encompassed various partner/stakeholder combinations including local authorities, universities, technology companies, small and medium-sized enterprises (SMEs) and start-ups to test and develop smart city technologies or carry out feasibility studies and demonstrations of concepts like Mobility as a Service (MaaS). Typically, these short-term research projects were funded through UK government agencies such as the Department for Business, Energy, and Industrial Strategy (BEIS) or Innovate UK, alongside specific bodies like the Centre for Connected and Autonomous Vehicles (CCAV) or the Office for Low Emission Vehicles (OLEV). These bodies organised rounds of competitive funding for bidding in much the same way as other larger UK smart city competitions like the Future Cities Demonstrator (Cowley and Joss, 2020; Taylor Buck and While, 2017). In many instances, match-funding was provided by partners to supplement awarded grants. In the case of CAVs, successive phases of funding offered by Innovate UK and CCAV were clustered into key themes or priority areas, such as the experimental mode of a project or the 'levels' of autonomy it demonstrated, represented, or experimented with (CCAV, 2018; Hopkins and Schwanen, 2021). Similarly, the plethora of EV projects operating in Oxford was indicative of the various ways in which charging infrastructure was being integrated into the city (e.g., home charging, on-street, off-street parking).

Other funding sources for these types of partnerships came from the European Commission's CITIVAS and Horizon 2020 R&D programmes, which were designed

to act as responses towards European Union policies on key issues like climate change or economic competitiveness. Access to this funding has thus far remained in place following the UK's departure from the European Union (Brexit) in 2020. In sum, consortiums were the dominant type of local state and market collaboration evident in Oxford and this arrangement structures how most 'actually-existing' smart activities unfolded in the region. Most projects were legitimised through discursive claims of investing in areas of proclaimed or anticipated technological innovations.

Table 3.2: Projects at the Oxfordshire County Council iHUB, identified from fieldwork undertaken between 2018 to 2019.

	Thematic Area	Project Examples	Project Types	Primary Funding Sources	Key Sites
Oxfordshire County Council iHUB	**Connected and Autonomous Vehicles (CAVs)**	DRIVEN MaaS:CAV MultiCAV OmniCAV* CAVL4R Air.Car NM^2 HARMONY NEVFMA Congestion Tool Traffic Predication for CAVs	Trials Feasibility studies Demonstrations Proof of Concept Modelling	Department for Transport, UK Innovate UK Centre for Connected and Autonomous Vehicles (CCAV) UKRI SBRI (Small Business Research Initiative) scheme Highways England	City of Oxford UKAEA/RACE Culham Science Park Science Vale Area Didcot Parkway Bicester Village Milton Park Greenwich, London
	Integrated Mobility	CATCH! CASPAR Zipp.to Multimodal Journey Planner MaaS Alliance	Software development Networking group	Innovate UK Department for Transport	Oxfordshire
	Healthcare	Keyworker MaaS (Mobility as a Service) COACH – Connecting Older Adults to Care & Health	Pilots Modelling	N/A	Oxfordshire
	Unmanned Aerial Vehicles	Hospital Delivery Applications LiFE (First Emergency Traffic Control) EIP Urban Air Mobility	Trials	European Innovation Partnership (EIP)	City of Oxford

	Electric Vehicles (EV) Integration	Park and Charge Virgin Park and Charge (VPACH) V2GO (Vehicle to Grid) GoUltraLow Oxford ELECTRA EV HelloEV	Trials Collaborative R&D Feasibility Studies	Innovate UK European Investment Fund Office of Low Emission Vehicles (OLEV)	City of Oxford
	Smart Cycling	Smart Cycling Detection Open Oxfordshire: Cycling Infrastructure Evaluation (CIE)	Pilots Demonstrations	Open Data Institute (ODI) Oxfordshire County Council	Oxfordshire West Oxfordshire
	Data Driven	WAZE oneTRANSPORT: A oneM2M-based Open Ecosystem for Nationwide Transport Integration The Better Cities project 5G Heart Harmony	Proof of Concept Pilots Collaborative R&D	Innovate UK European Commission's Horizon 2020 CIVITAS R&D Programme	Oxfordshire
	Citizen Focussed	Cities-4-People Playable City	Pilots Art installation	European Commission's Horizon 2020 CIVITAS R&D Programme Watershed/Smart Oxford	Barton, east Oxford City of Oxford
	Smart Energy Systems/Green Fuel	Project LEO DIMES – Distributed Integrated Multi Use Energy System for Urban Developments	Collaborative R&D Feasibility Studies	Innovate UK	Oxfordshire Bicester
Ongoing involvement with the Smart Oxford board and Mobility Oxford (MobOx) CIC. Key advocate in developing the 'living laboratories' approach in the OxLEP 'LIS' (See below)					

Notably, there were a handful of exceptions to the consortium model of public-private partnerships emerging at the Oxfordshire County Council. An example of this was a partnership between the iHUB with WAZE; a real-time, sat-nav-esque navigation software company and subsidiary of Google. The Oxfordshire County Council had partnered with WAZE as a 'Connected Citizens Partner' (CPP) run by Google. This meant both organisations were involved in two-way real-time data exchanges that aggregates traffic data from the WAZE platform. The original intent of the partnership was to develop rapid responses to traffic congestion, incidents or crises, and to speed up journey times in the city. This city partnership with WAZE appears to be more consistent with the corporate-driven model of smart city partnership, though the CPP scheme has received less notable critical attention from smart city scholars compared with the IBM 'Smarter Cities Challenge' or Google 'Sidewalk Labs'[6] project in Toronto, Canada. The iHUB/WAZE partnership typifies two dynamics at play in cities. First, it indicates the significance of platform companies in arranging and re-arranging the collection and use of big data for city decision-making (Barns, 2019). Second, it demonstrates burgeoning connections between forms of smart and platform urbanism that are mediated through these types of partnership. I actively decided to focus on the most prevalent model of smart city making at the iHUB, which was typified by the consortium approach.

[6] Interestingly, Sidewalk Labs pulled out of the partnership to develop the Toronto Waterfront in December 2021 citing the 'economic uncertainty' caused by the Covid-19 pandemic. See: O'Kane (2022) for a detailed breakdown of this withdrawal.

The Oxfordshire County Council iHUB is best described as a case study of the 'urban laboratory' approach to smart city making (Caprotti and Cowley, 2017; Evans, 2016; Karvonen and van Heur, 2014). This strategy has generated multiple successful bids by various consortia for smart projects, as is evident in Table 3.2. For example, the DRIVEN consortium was awarded a 2.5-year £3.6 million grant from Innovate UK to bring together expertise from Oxford University spin-out company Oxbotica with local authorities (Oxfordshire County Council; Transport for London), academia (Oxford Robotics Institute), re/insurers (AXA XL), mobile and telecommunication companies (Nominet; Telefonica O2 UK), independent consultancies (Transport Research Laboratory; Cicero Group), and a government-funded research facility (UKAEA's RACE facility). This specific project involved deploying a fleet of six CAVs in urban areas and on motorways in order to test and demonstrate an end-to-end journey between Oxford and London (see Hopkins and Schwanen, 2018). It could be argued that other forms of experimentation were exhibited in projects like Cities-4-People. In this project, relationships between local stakeholders were deepened by consortium partners as part testing a range of participatory engagement approaches (see Chapters 4 and 5).

Previous accounts document the significance of university campuses in mediating urban laboratory or testbed experimentation (Evans et al., 2015; Karvonen et al., 2019b). This was consistent with Oxfordshire to some degree. Indeed, the co-

location of two Oxford universities (the University of Oxford; Oxford Brookes University) was connected with investments in new science and business facilities and credited as a major contributing factor in attracting 'global talent' to the city. This informed the ways in which members of the iHUB understood the proliferation of experimental testbed activity in Oxfordshire as the configuring of a complex network (or, perhaps, an 'ecology') and confluence of technical experts.

In sum, the Oxfordshire County Council iHUB exemplifies the project consortium model of enacting smart, in line with projectification and urban experimentation literatures (Bulkeley et al., 2018a; Evans, 2016; Torrens and von Wirth, 2021). I differentiated the iHUB from the Smart Oxford board as different organisational forms given aspects like funding, its vision of Oxfordshire as a smart county, and its project model of delivery. The project model produces a wide range of citizenship discourses, practices, and materialities. While some projects like Cities-4-People produced a fairly recognisable version of participatory citizenship, I was also interested in unpacking the citizenship dynamics of projects with less familiar characteristics like CAV experiments or smart cycling pilots. I thus identified from iHUB projects a wider ecology of intersecting citizenship forms, which includes the *participatory* and *sim* citizenships that I later elaborate in Chapters 4 and 7.

3.4.3. The OmniCAV Project

OmniCAV is a UKRI Innovate UK-funded project initiated in December 2018 as part of its CAV:SIM competition funding. The project aimed to develop a 'realistic' and comprehensive simulation model of a 32km loop of Oxfordshire road, which would then be used as a virtual environment to test Automated Driving Systems (ADS). It was a 3-year project consortium initially led by Oxford University and Department of Computer Science spin-out company 'Latent Logic'[7]. It was delivered by a 10-partner consortium including software and technology companies (Latent Logic; Aimsun; Arcadis; XPI Simulation), re/insurers (Admiral/Thatcham Research), research centres (Warwick Manufacturing Group; the UKAEA RACE facility), a UK mapping agency (Ordnance Survey), and a UK local authority (the Oxfordshire County Council). The list of partners reflects the diverse expertise configured in this partnership, from explicitly technical to legal and regulatory actors. The latter contributed to the OmniCAV goal to provide a recognised framework of certifying ADS using simulation. I am primarily interested in machine learning methods of analysis deployed in the OmniCAV project and how deep learning constitutes human and non-human citizenships in what is described as a 'digital twin' of Oxfordshire.

The OmniCAV project paired traffic and monitoring data with LiDAR/imagery data to construct and calibrate a 'digital twin' replica of urban, suburban, and rural roads

[7] Latent Logic was later acquired by Alphabet's (Google) Automated Vehicles subsidiary company 'Waymo' in December 2019, which included its 'Imitation Learning' IP (University of Oxford, 2019). Latent Logic were subsequently withdrawn from the OmniCAV consortium and replaced by Aimsun as the lead partner. This change will have inevitably shifted the technical scope of the project.

in Oxfordshire. It did so by first combining various types of geospatial data to produce the visual component of the simulation, including LiDAR point cloud, aerial imagery, and mobile mapping data. Then, the simulation was populated by AI-trained 'smart actors' or '*sims'* from categories of road users (i.e., vehicles, cyclists, and pedestrians). Actor behaviours were created using machine learning methods associated with the field of Computer Vision to analyse digital images and videos. To do this, deep learning algorithms identified and traced objects in CCTV traffic data. Using this alongside Latent Logic's proprietary 'imitation learning' technique created the human behaviour models necessary to train AI actors who were then used as part of road traffic scenario testing in the digital twin.

The combination of computational techniques here is what contributed to the project's aim of producing a 'high-fidelity' simulation model and become a "world-first simulation platform that can be used by accreditation bodies, insurers and manufacturers to accelerate the development and certification of AVs" (OmniCAV, 2018). The OmniCAV project is a highly technical case of a smart city project with several aspects of its implementation run by engineers and its outcomes focussed on simulation testing of ADS.

It served as an interesting comparison with the experimental practices of other iHUB projects, including other CAV projects I was interested in, because the OmniCAV project provided a compelling case of the ways in which various data-

intensive smart city technologies and infrastructures entangle people not merely as participatory citizens but also as a sensed collective whose cumulative experiences of moving in the city produce virtual actor behaviours exhibited in the model. In Chapter 2, I noted how scholarly accounts differently characterise citizen-government interactions mediated through sensing technologies or networks (Gabrys, 2007; Johnson et al., 2020b; Powell, 2021; Zandbergen and Uitermark, 2019) as well as the computational ways in which cities are currently being understood (Luque-Ayala and Marvin, 2020a; Mattern, 2017). According to Iveson and Maalsen (2019), the data produced from new interactions with digitally networked infrastructures integrated in cities create datafied '*dividuals*' oriented towards service delivery, behavioural maintenance, or even social control. The OmniCAV project provided an interesting case in which to assess these analyses of smart citizenship as well as to evaluate other non-human forms of citizenship.

3.4.4. The Oxfordshire Local Enterprise Partnership and the Local Industrial Strategy

The final exemplar organisation in this research relates to the Oxfordshire Local Enterprise Partnership (OxLEP) and involved following its production of the 'Local Industrial Strategy' (LIS) document (2019). Introduced by the Liberal-Conservative coalition government in 2010, Local Enterprise Partnerships (LEPs) are organised as business-led partnerships and groupings between local authorities and local private sector businesses. The primary purpose of LEPs is to establish and determine local

priorities, especially in relation to economic growth, job creation, workforce skills, and improving infrastructure. The OxLEP is part of an extensive network of 38 LEPs across the UK. While some LEPs cover wide areas crossing administrative county or electoral lines, others like the OxLEP operate within conventional boundaries like in Oxford. A mixed use of spatial vocabularies are therefore used to portray LEPs as at once a local and regional policy or decision-making body.

Recognised as a 'trailblazer' LEP by the UK government's Department for Business, Energy, and Industrial Strategy (BEIS), the OxLEP was tasked with developing one of the UK's first 'Local Industrial Strategies' alongside other LEPs in the 'first wave', which included Greater Manchester and the West Midlands. The LIS was presented as an opportunity to set out plans for future economic growth and development in the region and to calibrate local priorities with national agendas, such as the UK government's set of 'Grand Challenges' (see Chapter 5). The production of the LIS was closely overseen by the BEIS department and the National Infrastructure Commission as these reports were designed to reflect and succeed the publication of the National Industrial Strategy in 2017 (Great Britain and Department for Business, 2017). In practice, this involved OxLEP circulating multiple 'working papers' of the LIS, online and offline discussions with stakeholders, and a series of government-run events where various ideas or ideals were consolidated. The OxLEP Local Industrial Strategy report was a primarily discursive mode of imagining smart in terms of economic growth priorities and development strategies not too dissimilar

to the Smart Oxford board or the Oxfordshire County Council. All three articulated socio-technical smart discourses through anticipatory visions or imaginaries in ways I am interested in this thesis. A key difference in this case were organising practices of developing the LIS report as well as the spatialities and temporalities the report covered in its imaginaries of Oxfordshire.

Various stakeholders involved in producing the OxLEP Local Industrial Strategy were also involved in organisations, projects, or activities from prior case studies. For instance, at one of the OxLEP roundtable meetings I attended there was a rather familiar cohort of representatives from organisations like the Oxfordshire County Council iHUB and the Smart Oxford board; people from the KEIT team at the University of Oxford and Oxford Brookes; those I'd previously met from Siemens and EDF Energy; and one of the main gatekeepers from Mobility Oxford (MobOx). I credit accessing meetings like this as a direct result of building a higher degree of rapport with this closed network of stakeholders.

The OxLEP Local Industrial Strategy was subsequently published and officially launched in the Blavatnik School of Government at the University of Oxford in early September 2019. Intersecting themes from other Oxfordshire strategies originating from the Oxfordshire Growth board, such as the Housing and Growth Deal, were part of the overriding narrative of the LIS. This was based on a long-held ambition of the OxLEP to position and promote Oxfordshire as a 'top three global innovation

ecosystem' by 2040. Its main tenet was that innovation is a catalyst for economic growth and this was channelled into its plans covering five foundational areas: ideas, people, infrastructure, business environment, and places.

While there are several interesting aspects of this 100-page document, I decided to focus on proposals to develop Oxfordshire as a 'living laboratory' (or 'living lab') where 'smart pilots' of emerging technologies would generate solutions and deliver forms of economic growth to the UK. Familiar terms like 'testbed' were adopted in the LIS that clearly echoes the experimental framing in other UK smart cities too (Evans, 2016; Karvonen and van Heur, 2014). A key difference here was that OxLEP proposals included rural testbed areas rather than an explicit urban focus associated with other types of smart experimentation. Indeed, the proposal drew heavily on the iHUB CAV projects to evidence the success of existing multi-sectoral partnerships and established testing infrastructure capabilities as well as to showcase Oxford's competitiveness with other global R&D districts like Silicon Valley. In this sense, the LIS extended claims made by others that Oxfordshire leads the 'race' towards accelerating innovations like vehicle automation.

The LIS justified expanding smart living lab testing as part of prior commitments to bolster the regional influence of Oxfordshire using this spatial metaphor of the 'Oxford-Milton Keynes-Cambridge'[8] arc (or 'OxCam Arc'). This geographical

[8] Many jokingly associated various stylings of the 'Ox-Cam' or 'Cam-Ox' arc with archaic institutional rivalries and competitiveness between these two elite university cities.

grouping bands together cities and towns in the south-east from Oxfordshire, Buckinghamshire, Bedfordshire, and Cambridgeshire viewed as a 'strategic belt' of knowledge and innovation productivity in the UK. I elaborate on this idea in Chapter 5. In sum, I selected the OxLEP LIS as a case study for this research in recognition of its importance as a strategic visionary document that projects a set of ideas and ideals on the future smartness of Oxford and Oxfordshire, which has significant implications on how smart citizenship is imagined. I was also interested in the process of producing the LIS that involved practices of arranging and re-arranging combinations of smart stakeholders to draw on their expertise.

To conclude, this section identified four organisations and institutional groupings from which follows four citizenship case studies. This encapsulates the multi-case study approach of this fieldwork. The overlapping and interrelated efforts to make Oxfordshire a smart city produce this 'socio-technical ecology' of smart citizenships I articulate through four case studies. These reflect the diverse discourses, practices, and materialities of these forms. The first case is a *participatory* form of citizenship I largely associate with Oxfordshire County Council iHUB projects. The second case is the *beneficiary* form of citizenship that I relate with the OxLEP's Local Industrial Strategy, which imagines citizens accruing benefits from living lab experimentation. The third case is *expert* forms of citizenship that I discuss in relation to the Smart Oxford board, where networking practices with SMEs, start-ups, entrepreneurs, and other local actors discursively constitute this smart 'community'. The fourth case is

the *sim* citizenships produced from the OmniCAV project. OmniCAV is an unusual example of an iHUB consortium project that involves bringing together physical and digital forms of testing ADS via a digital twin. I find OmniCAV interesting as the *sim* citizenship it produces reflects the complex interweaving of relations between smart city infrastructure, data, machine learning algorithms, humans, non-humans, and digital systems. Though I connect each case study to its exemplar organisational or institutional arrangements, I understand these different forms of citizenships reflect an interrelated and interconnected ecology of relations between smart discourses, practices, and materialities. I have thus illustrated the necessity to adopt a multi-case study approach to provide a fuller account of different ways Oxfordshire is being made smart and its citizenships implications.

3.5. Methods of engaging with smart citizenship in Oxfordshire

With an epistemological orientation towards interpreting citizenship in terms of discourses, practices, and materialities, I decided it was necessary to underpin this research with a qualitative methodological approach (Isin, 2017; Isin and Nielsen, 2008; Marres and Lezaun, 2011). I used three main methods: semi-structured interviews, ethnographic participant observation, and a systematic analysis of grey literature.

I utilised semi-structured interviews as "conversations with a purpose" (Cloke et al., 2004, p. 152) as a way of exploring concepts, imaginaries, meanings, and practices

that constituted smart city citizenship in a range of contexts. Interviews were a suitable method in enabling case study comparisons too (Ruddin, 2006; Stake, 1978). Using interviews as the primary research method was pragmatically justifiable in terms of the varied or limited access I was granted to people or places relevant to each case study. Factors like this narrowed the scope of some of my early ideas on developing an ethnographic approach to studying 'smart citizenship' which would have built upon existing literature that examines affective or experiential ways of 'being' in a smart city (Anthopoulos, 2017; Rose, 2017; Zandbergen and Uitermark, 2019).

I also drew on the observational traditions of ethnography when in attendance at several different smart city events, meetings, or other in-person activities, and this reflected how many of my participants experienced the smart city too. Furthermore, I sourced and retrieved a significant corpus of grey literature such as smart city documentation or videos and this was a supplementary data source for interview themes. This section recounts the specific methods and procedures followed in conducting this research.

3.5.1. Interviews

I conducted 55 semi-structured interviews ranging in length between 25-80 minutes between June 2018 and September 2019 (see Table 3.2). Interviews were recorded using a dictaphone device with the audio file immediately transferred to a secure

external hard drive afterwards. I recruited participants using a combination of purposive and snowball sampling to identify the wide network of actors who were involved in a number of different smart city activities in Oxfordshire.

I started this process during a preliminary stage of fieldwork where I focussed first on interviewing members of the Smart Oxford board. I did not find it necessary to specify a precise selection criterion at this point in order to avoid unnecessarily predefining precisely who was considered an 'actor' or 'stakeholder' involved in making Oxford smart.

Interviewees eventually included: several members of the Smart Oxford board, including some formerly involved in closed or completed initiatives; most of the Oxfordshire County Council iHUB team responsible for coordinating smart city projects, including the Director of Innovation and other senior officials; specific spokespersons for partners on the OmniCAV project consortium; and various organisational representatives at meetings to develop OxLEP's Local Industrial Strategy. There were substantial overlaps between those involved in each case study with participants involved in multiple different groupings or boards. For instance, senior iHUB officials were involved in multiple smart projects while also involved being involved in OxLEP roundtable meetings, in these instances as organisational representatives (see Appendix B). At times, this made it challenging to discretely distinguish between each case study, especially in interviews and then later in the

analysis. Yet, this illustrated precisely how deeply interconnected, entrenched and embedded various smart networks or groupings were in making possible the range of activities being implemented in Oxford and Oxfordshire. I further concluded that semi-structured interviews were an appropriate research method given the range of temporalities addressed in each case study, from implementing 'actually-existing' projects to reflecting on past activities to developing strategic future plans.

Table 3.3: Number of interviews conducted per case study

Case Study	**Interviews**
The Smart Oxford board	10
Oxfordshire County Council iHUB	16
OxLEP Local Industrial Strategy	25
The OmniCAV project	4
Total	55

My entry point for organising most interviews was based on either meeting potential participants at various meetings and activities or directly contacting people via email. I often received personal recommendations (i.e., snowballing) during interviews and online presence or visibility made contacting specific individuals easier. Access to an Oxford University-affiliated email address undoubtedly advantaged me as a researcher in this respect. In some instances, I argue it generated a perception of credibility, a degree of competency or an element of rapport with some of my interviewees, and particularly with those who were Oxford alumni.

During in-person events or activities I was able to nurture conviviality or rapport by exchanging business cards or elaborating on the research background and aims rather than deliver the short 'pitch' I had styled and rehearsed in email invitations. In several instances, I organised interviews via personal assistants or secretaries via email exchanges and then booking confirmatory e-calendar invites using Microsoft Outlook. Typically, I was then greeted by these assistants onsite on the day of the interview. I would then be asked to wait in the reception area or escorted to an office meeting room. I used fleeting opportunities like this to briefly ask assistants initial background or contextual questions. I was often restricted to the schedules of interviewees, and I had limited preparation time in spaces I was accessing as an outsider. Without the mediating labour of PAs or secretaries, it would inevitably have been harder to obtain some of the insights I gained during the course of conducting 'elite' interviews (Harvey, 2010; McDowell, 1998; Smith, 2006). I recognise this here as it is often hidden in accounts of qualitative research practices.

Most interviews were conducted in-person in a range of locations within Oxford city either in workplace offices, university buildings, or local cafés. I was aware of how interview locations influence the interview process. Though it was preferable to meet in 'neutral locations' (Ostrander, 1995), I interviewed 28 participants at their workplaces in offices, meeting rooms or canteens. Some caution this risks reinforcing asymmetrical power relations between participants and academic researchers, especially in 'elite' interviewing (Mikecz, 2012). Indeed, I was given far

less agency to choose interview locations or timings instead reliant on participant schedules and generosity. I was also aware this might elicit 'front stage' responses in the interview reflecting 'official' PR or bureaucratic positions, though I mitigated against this by waiting to interview some participants once I had gained a greater degree of trust with them through other networks.

There were other advantages in holding interviews at participant workplaces too. To begin, it elicited interesting discussions on how the office space was organised or how office space is delegated between council teams; it snowballed into additional interviews with relevant colleagues; it meant participants could retrieve and share useful documents or show me things on work laptops; and I was able to gain a greater appreciation of precisely 'where' the smart city was being enacted: in these mundane, quotidian office spaces in the city. Three interviews were conducted at the UKAEA Culham Science Centre in south Oxfordshire, two of which while being given a tour of the CAV testbed grounds and while watching a 'live' experiment. It was difficult to respectfully navigate the power dynamics of this situation to direct conversation away from rehearsed forms of commentary or to distract from other activities.

The 23 interviews I held in Oxford cafés presented an alternative set of issues like background noise or interruptions. That said, I always arrived early to try and identify quieter areas, then carry out thorough preparations and jot down any initial

observations. A possible advantage of taking participants 'outside' of workplaces was accessing more critical reflections they may not have offered elsewhere. Finally, I conducted two telephone interviews and, with permission, used the loudspeaker to record our voices via the dictaphone. Signalling issues affected how these interviews ran with inconsistent audio quality disrupting conversational flow and I had to ask participants to repeat themselves or hang up and reconnect the call more than once. It was impossible to gauge visual or bodily prompts during phone interviews too. In future, I would consider using video software platforms like Microsoft Teams, Skype, or Zoom as an alternative to telephone interviews.

In order to draw analytical comparisons between case studies, I developed a general interview guide structured around four primary areas or themes (see Appendix G). This was informed by literatures examined in the formative stages of the research as well as the research questions posed at the start of this chapter. Mainly, this addressed the organisational and operational dynamics of smart city activities; the ways in which urban experimentation or test-bedding was preconfigured in smart; how 'citizens' were directly or indirectly involved in projects as well as how ideas on 'citizenship' were being understood; and the wider relevance of smart and/or innovation activities in Oxford and Oxfordshire and its future. There was a high degree of flexibility in adopting this semi-structured approach and I adapted or tailored questions to each participant and case study. I regularly made notes and

posed follow-up questions after listening to responses as a way of eliciting further discussion.

A challenge I faced regularly in interviews was decoding and familiarising myself with the acronyms, abbreviations, or references used by participants. I interpreted this as a type of specialist language circulating amongst the 'epistemic community' of smart stakeholders. I had to become accustomed to this discourse and its relation to concepts or approaches in the smart cities literature (Kerr et al., 2007; Kitchin et al., 2017a, 2017b). During interviews, I verified the use of specific acronyms with participants, that at times prompted thoughtful reflections on how smart projects were discursively framed. I found this was particularly useful with the data scientists or engineers I interviewed who tended to use industry acronyms I was unfamiliar with. A salient example was when I asked a participant to explain why he listed CAV projects in order using the Society of Automotive Engineers (SAE) 'levels' of autonomy (Hopkins and Schwanen, 2021). He explained that he associated different 'levels' with competitive rounds of funding issued by Innovate UK with the Centre for Connected and Autonomous Vehicles, which in turn reflected the practical scope or aims of different forms of testing.

While completing the research, I was aware of discursive shifts in terminologies or vocabularies used by academia, industry, policy, and media stakeholders to refer to specific technologies, like 'autonomous' or 'automated' vehicles. The descriptors or

categories assigned to new or emerging technologies are not necessarily fixed or stable terms of reference. For example, the British Standards Institute (2022), a body who provides regulatory support to UK partners, have released four iterations of its terms of reference for autonomous vehicles so far. As noted by Hopkins and Schwanen (2021):

> within this work [on autonomous vehicles], a variety of terms, including 'automated', 'autonomous', 'self-driving', 'driverless', 'connected and autonomous' and 'connected cooperative automated vehicles' have been used, often interchangeably to describe public, private and service motor vehicles with the capacity to move without human-driver intervention for all or some driving tasks (p.1)

Throughout the thesis, I have explicitly chosen to adopt terms or acronyms used by interview participants, like 'CAVs', as a way of positioning organisations, ideas, and technologies according to the temporal and contextual specificity in which it was researched and discussed. I have included a terminology glossary at the start of the thesis to reflect this (see page xi).

Some may argue the interview sampling strategy risked either strongly projecting 'elite' perspectives or simply replicating existing local networks via contacts shared with me directly (Cochrane, 1998; Hopkins and Schwanen, 2022). For this reason, I made several attempts to locate alternative smart networks starting with a list of social and voluntary groups (CAGs) or citizen forums, like the Oxford Democracy Café, the Oxford Civic Society, and the Low Carbon Hub. Few groups were familiar

with or deployed terms like 'smart city' nor was there any direct involvement[9] of CAGs in previous smart projects I identified. I was surprised by this given Oxford was the first UK city to hold a citizen's assembly on climate change in September and October 2019 where there were relevant discussions on future transport and energy.

3.5.2 Ethnographic Participant Observation

Ethnography is an embodied, experiential practice that seeks to uncover the dynamics of social phenomenon through methodologically reflexive, first-hand encounters (Hammersley and Atkinson, 1989). It is appropriate to state the degree of caution I took to fully embodying this research method here. Rather, I opted for an ethnographic *approach* to attending 15 in-person events, which included closed-door or private meetings, roundtables, seminars, conferences, and public engagement or networking events (see Appendix B). A core component of ethnographic practice is participant observation used to intimately study people in places, how relations are organised, or the particular nuances of social phenomena. In that sense, it felt like an acutely appropriate method in exploring precisely how citizenship was enacted by people in situ and within the smart city projects I was able to follow. An example where this method was most effectively deployed was during observations of 'Citizen Mobility Labs' organised by the Cities-4-People

[9] I was later made aware of a partnership between the Oxfordshire County Council iHUB, the Smart Oxford board, smart bike light company See.Sense, and the local cycling group Cyclox using bike light sensors to collect cycling data, which was launched in December 2019 (See.Sense, 2019).

project where I was able to observe the specific engagement 'tools' (i.e., a set of participatory *practices*) pivotal to implementing its 'People Oriented Transport and Mobility' (POTM) approach.

At other times, adopting ethnographic methods became more challenging. For instance, I was asked by the Smart Oxford board at an early stage of the fieldwork to produce a document that ranked local Community Action Groups (CAGs) on the relative degree of importance of each group and the potential for collaborative opportunities. Though completing this task may have led to deepened levels of access, I refused to complete this task as it would have involved making value judgements and/or influencing decisions beyond the immediate site of the ethnography. Relatedly, I agreed to produce written summary notes in order to attend meetings organised by one of my gatekeepers that were later circulated to those in attendance. Instances like this furthered my need to deeply reflect on my embeddedness as a researcher within the spaces and people I interacted with. I did this through regular written notes in the form of a research diary where I kept a detailed first-person account of interactions I experienced with participants.

In light of the COVID-19 pandemic, I developed an even greater appreciation of the significance and salience of in-person or face-to-face encounters given the highly restrictive lockdown measures introduced by governments around the world to mitigate viral transmission. During the first national lockdown introduced by the UK

government, I revisited several of my data sources such as field notes in the research diary and supplementary grey literature gathered at events. I found this illuminated a number of new themes and ideas I had previously discredited or dismissed, which I discuss later in Chapter 6. Though I had already completed a systematic analysis of my interview research data, I did not consider it detrimental to the analysis to repeatedly or iteratively reflect on observations or experiences garnered from ethnographic encounters, especially when these were no longer conceivable during an unprecedented public health crisis.

3.5.3 Grey literature and digital materials

At the ideation stage of this research, I was largely interested in analysing smart citizenship as a set of practices given the early focus on citizenship discourses produced from textual sources (See Section 3.2). During the course of the fieldwork, it was very apparent how significant these materials were in shaping the citizenship practices I had observed. In turn, I collated many images, infographics, promotional videos, brochures, leaflets, logos, press releases, maps, and reports either directly from or specifically on smart in both Oxford and Oxfordshire. Some of these materials were produced as part of public dissemination efforts required by bodies like Innovate UK for its funded projects. For instance, the OmniCAV project used its website as a platform to share updates or circulate published papers. Examples from the OmniCAV website in the thesis include summative infographics, animated icons, and YouTube videos detailing aspects of the programme's 3-year programme

of implementation and describing its technical novelty. Figure 3.6 is an example of the types of infographic sourced from the OmniCAV site that shows a 'roadmap' for the project and its completions, used as a metaphor for readying automated vehicles for use on public roads.

In other contexts, textual sources like information leaflets were distributed at designated citizen engagement events, such as Cities-4-People meetings. While some of these materials generally comprised of descriptive information on overall project aims or listing consortium partners, the composition of these dissemination tools provided complimentary insights into the framing of citizenship and the tools or technologies of participation used by smart actors. Additionally, I retrieved several promotional videos on the Culham Smart Community, the Millbrook CAV testbed, and the People in Autonomous Vehicles in Urban Environments (or 'PAVE') project directly from a UKAEA/RACE representative. Other videos were widely available on different YouTube channels including those for the Oxfordshire County Council, the Smart Oxford board, and the OxLEP. Videos were used in conference talks or during events to summate and distil ideas on Oxford as a smart city.

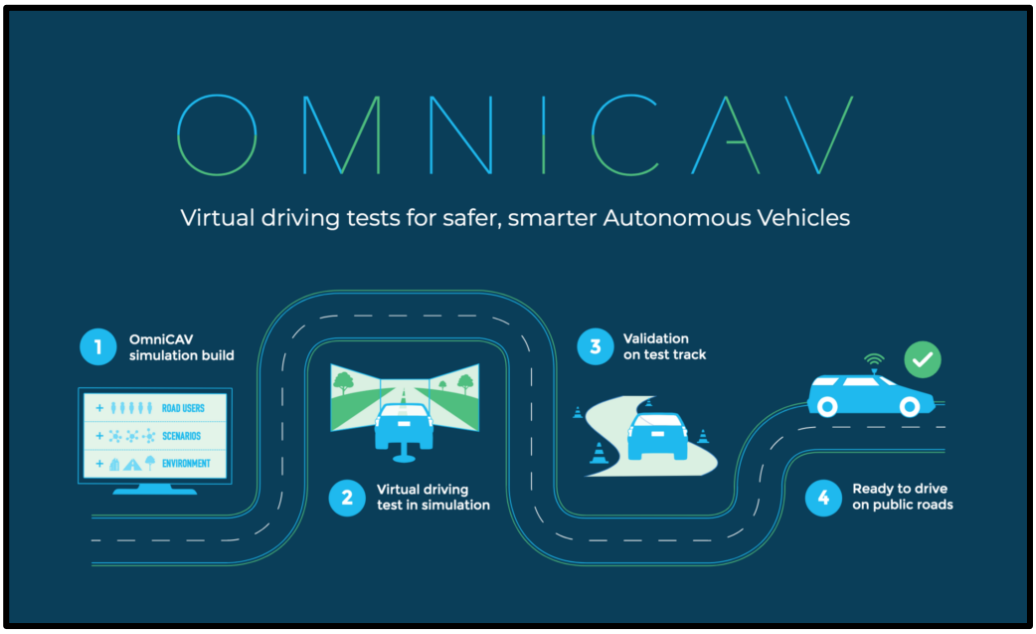

Figure 3.6: Infographic detailing core components of the OmniCAV project (2019). Permission to reproduce this infographic has been granted by Aimsun and the OmniCAV Project.

I am inspired by several studies that engage with a plethora of visual material produced and circulated by smart cities, like data visualisations, CGI imagery and commercial videos, and content posted online or on social media (Hind, 2019; Kinsley, 2010; Rose and Willis, 2018; Wigley, 2021). It was beyond the scope of this research to strictly follow a visual methodology. However, I interpreted visual materials to explore smart citizenship discourses or meanings imbued within photos, videos, or other visual data I collated as part of this study (Rose, 2016).

3.6. Ethical Considerations and Implications

The research received approval from the Central University Research Ethics Committee (CUREC) at Oxford University in June 2018. The intention of this approval process is to demonstrate how research requiring human participation will be conducted according to the highest ethical standards with responsible,

appropriate, and reflexive research design. The application submitted as part of this research factored in timely updates to data handling practices and procedures instituted through the European Union's General Data Protection Regulation (GDPR) introduced earlier that year. A key aspect of this was providing explicit details to participants on the purposes and relevance of research data collected as part of this study as well as the secure data processing procedures detailed below. Rather than simply treat this review process as a procedural rite of passage granting access to the field, I repeatedly referred to the professional standards and principles of CUREC in assessing my approach to the ethical challenges arising in this research. This section elaborates on the ethical procedures involved in conducting this research along with its implications.

3.6.1. Informed consent and interview procedures

I secured informed consent from all participants. The procedure for this started by sharing the Information Sheet and the Consent Form with participants which contained written explanations of the research purposes, procedures, and contact details for the Principal Investigators and Oxford University's research ethics body. I emailed these forms at least 24 hours prior to meeting participants. This was particularly useful in cases where participants had issued time-limited appointments as it minimised time spent reading and completing forms in person. I gave interviewees physical copies of both forms when we met with a verbal reminder of its contents. These were signed and dated before proceeding with the interview. I

explained the risks of participating in the study as well as options for opting-out at any stage before, during, or after the interview as well as the possibility of withdrawing from the study entirely. I closed all interviews with a final reminder of this right of withdrawal from the study.

There were no personal or sensitive questions involved in this study. There was no financial compensation for participating either. I organised follow-up interviews with some participants where I either repeated the above procedures and/or secured oral consent instead. I was attuned to personal risks associated with conducting research in Oxford and Oxfordshire and implemented measures for reporting my whereabouts to supervisors or close contacts at all times. I was contactable via my phone and kept location sharing on with family and friends. At all times, I followed the professional standards and ethical guidelines instituted by CUREC in addition to association guidance[10] and funder requirements.

After each interview, I briefly noted down some immediate thoughts reflecting on both the interview content, its procedures, and any emerging themes. I consider this to be an early stage in the analytical process for researchers in processing any significant observations or filtering ideas from discussions. It is also a chance for researchers to consider how interviews unfold and/or revise specific questions and

[10] This includes: the Royal Geographical Society (RGS: Research Ethics and Code of Practice); the Association of American of Geographers (AAG Geographers Statement on Professional Ethics); ESRC Research Funding Guide.

procedures. Most of my field notes were completed either in at the interview site, in nearby Oxford cafés, or in transit via local buses or trains. These were fleeting opportunities to record ideas between sips of coffee or with an eye on the next stop. I would later compile notes into a Word document in the form of a research diary.

I would then begin transcription. I started by transferring the audio file from a Dictaphone device to an external hard drive then permanently deleting the original recording. I mixed manual transcription with the use of an automated transcription service to produce transcript texts from audio files. I performed manual transcription by iteratively playing and stopping short clips of audio, rewinding where necessary, then typing out what I had heard clicking between a Word document and the QuickTime Player on my laptop. I did this for 24 interview audio recordings. I found manual transcription an exceptionally time consuming, laborious, and physically demanding task causing eye strain and back pain. The initial frustration I invested in this process was not necessarily conducive to how pivotal this stage of data handling was to conducting analysis. There were also some issues with background noise that made deciphering speech difficult.

I therefore decided to use QSR's automated transcription service[11] for 24 other interview audio recordings. This involved uploading the audio file to an online

[11] I used the QSR International 'NVivo Transcription' service provided in the NVivo 12 (12.6.1) software package released in 2018. Other popular providers include Otter.AI or Amazon Transcribe. These automated transcription services are not free and most charge a bulk fee or a fixed rate per

portal which generated an online transcript draft within an hour. I had some initial concerns that I raised with the departmental CUREC Officer regarding how audio data is handled by automated transcription platforms. I was aware some use original files for AI voice recognition training purposes in exchange for service use. Perhaps this is overlooked by some as policies are deeply embedded in the terms of use or privacy statements, but I believe this requires stronger ethical assessment from researchers in the future. I made direct contact with QSR's Data Protection Officer who confirmed that transcription audio data is not used for voice recognition training purposes. One of the challenges of using an automated transcription service was the inability of its algorithms to fully recognise voices with strong accents or distinguish voices where there was background noise. The automated service was also unable to learn or detect acronyms used by participants, which was an important aspect of how participants communicated with me. This meant it was necessary to edit automated transcripts to improve its accuracy and I performed this while listening back to the original audio recording. I found this was a fruitful analytical exercise in starting to make sense of interviews as I briefly made notes or listened back to parts I found interesting. The service I opted for automatically deleted audio files after 90 days and I deleted transcripts from the platform once it had been retrieved. All transcriptions were completed within a month of the original interview date.

minute of transcribed audio. This excludes researchers without adequate access to fieldwork funding or financial support to use such a service.

Prior to starting fieldwork, I completed the Oxford University's School of Geography and the Environment DPhil training programme (06/2018) and passed the Social Sciences Division 'Fieldwork in Practice' course (05/2018) too. I also attended two data analysis courses on using NVivo (11/2018) and professional practices (11/2019) from the Oxford University IT Services. I have previously received ESRC-approved research ethics training at BA, Masters, and DPhil level.

3.6.2. Data Management and Pseudonymisation

For me, the analytical process is inclusive of the following data management practices and procedures. The first step in this was to organise the substantive body of data I collected during fieldwork. As previously mentioned, this comprised of 55 recorded interviews, 57-pages of field notes, and over 30 documents, photos, and videos. I held all this data on an external hard drive which was securely stored off-site when not in use. The data was organised into several encrypted and password-protected folders on the hard drive. I used a secure Excel spreadsheet I set up during fieldwork to log and discretely categorise data based on relevant case studies or attributes, and I assigned unique IDs for each file. These IDs did not correspond with any identifiers used elsewhere. I regularly updated the spreadsheet throughout the fieldwork and used it to track the partial or full transcription of audio files. I would then permanently delete the audio file from the hard drive once this was completed. In a few instances, I used an audio editing software named Audacity to import an audio file and filter out background noise as a way of easing the interpretation and

transcription process. I ensured edited audio files were permanently destroyed after this. I manually scanned physical copies of the grey literature provided to me by interviewees, like brochures, leaflets, and event programmes, imported this directly onto the hard drive and stored physical copies off-site in a secure folder. I treated this data with the same sensitivity as audio and interview data. It became even clearer to me throughout this continuous auditing process that there were notable interconnections or themes emerging between case studies, reflected in the discomfort I felt with strongly demarcating or categorising data that had relevance to more than one mode of smart city making.

I introduced a set of measures to securely handle participant information and respect confidentiality as per the CUREC and GDPR regulations I followed. Before starting fieldwork, I concluded I could not fully guarantee anonymisation for all participants. I informed everyone of this at the point of agreeing to be interviewed and/or signing the Consent Form. I issued unique numerical IDs to audio files immediately after interviews for the purposes of data handling. Again, this did not match those used elsewhere like in the Excel spreadsheet above. As far as possible, I removed easily identifiable information in interview transcripts and field notes. I later issued pseudonyms to participants which were indicative or characteristic of their organisational position or role (e.g., 'Director' or 'Team Member'). Several participants shared similar pseudonyms as a result of this, hence making it harder for the majority of individuals to correctly identify themselves. A few participants

either asked to review direct quotations before publishing or refused entirely. I accommodated both of these requests: I followed up with participants to share proposed quotations used in the thesis agreed upon before publishing and I did not include direct quotes from those who asked. I will store all non-identifiable data for 5-10 years in the University's secure data repository (ORA) following the completion of this research.

3.6.3. Gatekeeping and accessing the Cities-4-People project

Gatekeeping is a significant methodological challenge for academic researchers who are required to repetitively negotiate, secure, and justify access to field sites and participants. This subsection details gatekeeping and access issues I faced while following one of the Oxfordshire County Council iHUB projects pitched by the iHUB manager as the 'citizen-focussed' project I would find most interesting. I elaborate on this here not only because it was a significant ethical challenge to this research, but also because it led to me to further explore other innovation projects that were not classified in iHUB brochures as 'citizen-centric'.

I began fieldwork with the Oxfordshire County Council iHUB from September 2018 having already spent just over 2 months meeting with Smart Oxford board members for interviews and at meetings or events. By this point, I was in a stronger position to negotiate or deepen access to specific projects with the Head of Innovation. It was at this meeting that we agreed I would closely follow the 'Cities-4-People'

project given its resonance with my research questions and as an exemplar of the consortium model of smart city partnership. From September to December 2018, I began following the Cities-4-People project and I was copied into project updates or emails circulated by members of the iHUB team. Funded via the European Commission's Horizon 2020/CIVITAS initiative, Cities-4-People was a 3-year research and innovation programme operating across five European locations: Trikala (Greece), Budapest (Hungary), Istanbul (Turkey), Hamburg (Germany), and Oxfordshire (UK). Its principal aim was to test its 'People Oriented Transport and Mobility' approach (POTM) in order to "co-create sustainable urban mobility solutions for local transport and mobility challenges" (Cities-4-People, 2017). Its extensive and exhaustive list of 13 consortium partners drew together city authorities or municipalities with universities under the leadership of the Copenhagen Business School in Denmark.

The Oxford branch of the project joined together the Oxfordshire County Council with the Institute of Health Equity at University College London (UCL) alongside input from local stakeholders like Oxford Brookes University and the Oxford Bus Company. I began engaging with the Cities-4-People project during its second year of operation at the point where it had already begun initiating its 'Citizen Mobility Labs' as part of efforts to engage east Oxford residents in its 'co-creation' process. I had previously agreed with the Oxfordshire County Council iHUB that I could conduct participant observations of Citizen Mobility Labs alongside other project

meetings as well as schedule interviews with a very small sample of workshop attendees. I discuss the specific participatory techniques or mechanisms employed by Cities-4-People partners elsewhere (see Section 4.2.1), but here I reflect on the fundamental issue of gatekeeping and what this indicated about the nature of smart city partnerships.

By mid to late-November 2018 I had attended a handful of 'Citizen Mobility Labs' held at the Barton Neighbourhood Centre and organised by the Oxford branch of the Cities-4-People consortium. At this point, several 'pilots' had been identified by local residents and stakeholders designed to strengthen access to the 'Pick Me Up' on-demand bus transit service launched by the Oxford Bus Company earlier in the year. This was informed by a very small group of local residents in attendance with local stakeholders, such as a spokesperson from the Oxford Neighbourhoods Partnership. I was subsequently invited to a closed-door meeting at the County Hall where a working group of local stakeholders 'co-designed' one of these pilots. It was at this meeting that I met for the first time two academics from the Institute of Health Equity from UCL as partners on the consortium. I was received with a high level of disdain and confusion by these academics as they begun to question why I was in attendance, for what purposes, and whether I was a qualified researcher. I was handed a business card and told to message one of the academics later that day. In email communications, I began by offering a careful explanation of what were already agreed arrangements with gatekeepers at the iHUB. Until this point, I was

under the impression the iHUB team at the Oxfordshire County Council had either informed the UCL academics of my involvement or had overriding authority to grant me access to the project as they appeared to be the primary organisers for activities in Oxford thus far.

Shortly after a series of intense email exchanges between my gatekeeper at the Oxfordshire County Council iHUB and the UCL academics, I received a formal letter from the Copenhagen Business School and the Waag Society in their role as lead partners for the Cities-4-People project. In this letter, I was instructed to cease conducting research on the project until after its implementation as it was believed I could "interfere with and jeopardise the work the consortium is conducting" (see Appendix D). As Hammersley and Atkinson (1989) state: "even in formal bureaucratic organisations it is not always obvious whose permission needs to be obtained, or whose good offices it might be advisable to secure" (p.63).

For the UCL academics, there were two main concerns with my ongoing involvement. The first was that I could dissuade members of the public from participating in the project by placing excessive demands to participate in both studies and the C4P project. The second was that they demanded publishing autonomy over anything mentioning Cities-4-People or its outcomes until its completion in March 2020. Given their status as senior academics at a UK institution, they would have been fully aware of the standard length of a PhD

programme and the restrictions this would place on my ability to conduct a retrospective analysis of the Cities-4-People project. Reflecting on this process, it is clear to see the ways in which gatekeeping can involve constant (re)negotiation, dialogue, contestation, and exchange.

Following the project's conclusion, partners from the Oxford-branch of the Cities-4-People project published a paper in an academic journal unpacking its 'co-creation' approach alongside its associated impacts. Ironically, the paper claims its 'Citizen Mobility Community' approach was "inclusive of all community voices and interests including local citizens, local authorities, *researchers*, designers, developers, commercial providers and *students*" (Bell et al., 2021, p. 4, emphasis added). I would argue that their epistemological orientation towards introducing and developing 'inclusive' or 'participatory' approaches in the co-production of knowledge was not necessarily one that extended to junior or early career researchers. This raises important questions in relation to citizen participation in the 'co-creation process', especially if academic partners are able to draw lines between who is included or excluded from a 'citizen-focussed' project in this way.

Furthermore, the issues I faced with gatekeeping and negotiating access raised how emotions shape fieldwork experiences as I was left feeling frustrated, disappointed, and with perceived failure. This corroborated with Smith and Delamont's (2019) edited collection of ethnographies that 'go wrong' where they describe the emotive

sense of loss engendered through similar types of fieldwork encounter. To overcome these sentiments, I embraced Strauss and Cobin (1998) assertion that "a researcher should never become upset by not being able to choose a site or obtain access to a theoretically relevant site or person(s)", and I went on to "make the most out of what is available to him or her" (p.210). I renegotiated access this time to cover multiple iHUB projects within different research teams and project areas. This opportunity to re-evaluate the research design meant I was able to explore citizenship practices across a wider set of smart city projects that were not necessarily or directly branded as 'citizen-focussed' by the iHUB, such as CAV or cycling projects. It also enabled me to forensically examine the consortium model by comparing how projects with other thematic interest areas were organised. I continued to be influenced by issues accessing the Cities-4-People project in reflecting on citizen participation and the power dynamics inherent in different types of smart city partnership.

3.6.4. Positionality

I acknowledge my position as a cisgender, white, British male who interviewed and observed a group of people that, in the majority, shared similar educational backgrounds and/or experienced the 'smart city' as part of their professional working lives or careers. I felt a strong sense of responsibility because of this, and I have selectively used quotes and described from interviews or participant observations purely within the remit of this study. A few observations were of local

residents in east Oxford who were in a position of relative disadvantage, and I explicitly and purposefully avoided retelling any personal remarks or sensitive information shared with me there.

I recognise my privileged position as a current Oxford University DPhil student with the symbolic reputational weight this carries and access to resources I was afforded in turn. I lived in St. John's College in the city centre throughout the fieldwork period and this is a high level of advantage in itself. I was familiar with and comfortable in otherwise intimidating Oxford University college spaces, like in a senior common room I was invited to hold an interview in. I was received with a high level of enthusiasm by most gatekeepers pleased that an academic researcher was interested in studying this topic. At times, I was asked to contribute views or insights in recognition of my perspective as well as introduce interviewees to my academic supervisors. That said, I was regularly perceived by others as being much younger than I was based on my physical appearance and one interviewee questioned my level of academic qualification.

I took deliberate steps to alter aspects of my self-presentation during fieldwork in order to be read differently in professional work contexts. I started wearing black trousers and white shirts to 'blend in' where interviews were held in offices or during events. I even styled my hair differently opting for a much shorter cut during this time. I am disclosing this here as a way of recognising how differently some

(junior) researchers experience the field based on perceptions of credibility or appearance. Throughout the fieldwork and writing up process, I have repeatedly considered how the methodological or theoretical decisions I made could be improved in future studies and the limitations of my overall research approach. I cover this in detail in the concluding thesis chapter.

Dispersed throughout this thesis is mention of the COVID-19 pandemic which has had a relative impact on completing this research and on myself as a researcher. Measures introduced by the UK government to reduce viral transmission (i.e., full, or partial lockdowns) restricted everyone's ability to connect or socialise in-person. From mid-March 2020 onwards, Oxford University had asked all UK students to leave student accommodation, move to family homes, and continue to work remotely. At this time, I was based at the University of Kentucky, USA as part of an academic visit where I had planned to write a paper on this research. I cut short this trip to safely return home. Subsequently, I was not allowed to collect belongings, academic books, or notes held in Oxford until later in July 2020.

As with my peers, the first UK lockdown collapsed all defining distinction between leisure and workspaces and adapting to conditions like this was a challenge. When I then returned to Oxford in September 2021, my work and study conditions were shaped by successive local lockdowns and University policies to manage or limit access to departments, libraries, and other facilities. Shifting circumstances like this

frustrated the writing-up process, let alone the health implications on myself of contracting COVID-19 twice. In terms of the research, I recognise how fortunate I was to have completed fieldwork prior to the first UK lockdown. In fact, I was able to revisit field notes at stages to further reflect on recorded observations from in-person events or to re-read interviews. I was also able to check on any online updates posted about case studies, and I updated my reading of the literature in light of developments here too. Henceforth, I do not provide this explanation as a way of qualifying the thesis, nor of evidencing my resilience as a researcher, but merely to document the abnormal conditions under which this thesis was completed.

3.7. Data Analysis

To analyse my fieldwork data, I used the Computer Assisted Qualitative Data Analysis Software (CAQDAS) mentioned earlier: NVivo 12. This software is widely used by social scientists as it provides a way to systematically code qualitative data including textual (interviews, grey literature) or visual (photos, videos) material. I was initially sceptical using this software as my training had emphasised just how differently researchers use its analytical features and how variably data can be interpreted. Nevertheless, I decided to use NVivo given its relative strengths in handling the vast array of data I had collated and its options for specific analytical outputs. I imported most of my data into the NVivo project, except any data with an excessively large file size as this compromises software speed and compatibility. I

questioned how best to organise the data repository in NVivo as I knew this was another challenge of using a multi-case study approach. I ultimately decided to embrace coding all data together.

On reflection, I found this made it far more challenging to isolate key similarities or differences in NVivo, like between smart city projects or the citizenships associated with organisation, especially as I was beginning to distinguish citizenships from my fieldwork notes. I performed iterative rounds of coding in NVivo that purposefully started with highly descriptive codes and then built up to higher order or theoretical codes. This is an inductive coding method following a grounded theory approach (Saldaña, 2009; Strauss and Glaser, 1968) whereby theoretical constructs are derived directly from data and its analysis.

The first stage started with rounds of descriptive coding to build a broad set of codes that gathered together conceptual terms or collected important contextual information. This ended up being quite a lengthy process and I invested a considerable amount of time into reading, rereading, reflecting, then synthesising this substantial body of data into a group of thematic or descriptive codes. As anticipated, I produced a large quantity of codes that I then needed to sift, sort, or group and I began selectively condensing or adding new codes too. This represented the second stage of coding. Throughout this process, I used memos to track coding procedures I followed and record any thoughts or analytical reflections too. Once I

had an organised codebook in place, I ran several code queries which were used for specific text searches or to gauge word frequencies from coded interviews or documents (see Figure 3.5). This was a relatively instructive method of verifying vocabularies for key terms like ‘citizenship’ or ‘smart city’ and I used this to revise or identify secondary or tertiary codes too. Altogether, I found NVivo was most useful as an analytical tool for interpreting citizenship as discourse as opposed to distinguishing or describing a set of practices from observational data, which required further analysis or reflection elsewhere.

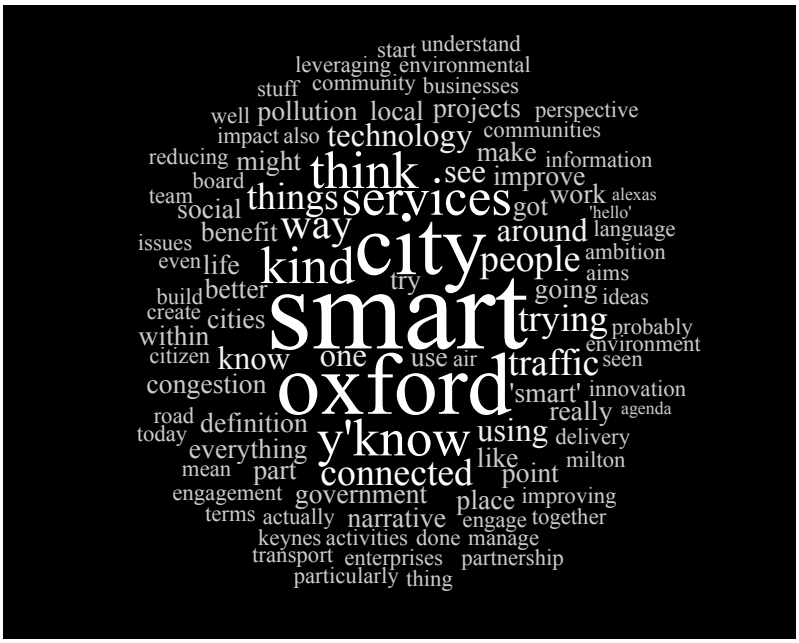

Figure 3.7: An example of a word frequency cloud from a definitional 'smart city' parent node.

Later, I decided to use another method of analysis once I had a stronger sense of how I would organise thesis chapter arguments and to make decisions on illustrative quotes. I decided NVivo was not appropriate for this given the methods I had already used to analyse case studies and the format I was interested in. Instead, I developed a three-column table template that I copied into four Word documents where I

posed the following questions: 1) what's happening here? 2) what does this indicate/suggest? And 3) what is the key concern and how does this data relate to existing literatures? I imported short quotes or passages highlighted from NVivo in column one; I added some critical reflections in column two; and I discussed how this material related to the existing literature in column three. Essentially, I carried out a manual method of data analysis. I continued using the iterative approach I had rehearsed in NVivo of reading and re-reading transcripts, highlighting significant information, then adding theoretical clarity or reflections alongside each quotation.

By pairing both data analysis procedures, I began to sketch out the main findings of this research. I identified four interrelated forms of smart citizenship that reflect its diverse discourses, practices, and materialities in smart cities. Using the 'ecology' metaphor at this stage provided a way for me to explain how I understood relations between the citizenships I had identified and seek dis/connections between socio-technical discourses underpinning these terms. This analytical work is presented within the following four empirical chapters.

3.8. Conclusion

This chapter detailed and explained my methodology for studying smart citizenship as a socio-technical ecology in a UK smart city. I started by identifying four organisational forms exemplar of ways Oxford and Oxfordshire is being made smart and therefore to smart citizenships emerging in the city and county. I then outlined

the three components of my qualitative approach: first, I conducted 55 semi-structured interviews with people who were involved in making Oxford smart, to explore socio-technical discourses of citizenship; second, I performed ethnographic observations of over 15 events, to examine actually-existing ways in which smart citizenship is practiced; and thirdly, I collated a sizeable portfolio of grey literature and digital materials to further show how citizenships were discursively elaborated. I generated original research findings by following the data analysis procedures detailed above. These findings are organised into four empirical chapters that respond to and answer the research questions posed in Chapter 2.

The proceeding chapters are structured around four overlapping modes of 'smart citizenship'. Each of these emerged from one or more of the four case studies I described earlier in this chapter. In Chapter 4, I explore what I've termed an '*informational*' type of citizenship, which was strongly evident amongst Oxfordshire County Council iHUB projects. I describe the significance of fairly conventional understandings of participatory citizenship through vocabularies and practices of engagement, inclusion, or co-creation. I explain in the chapter why I group these participatory practices with the 'informational' term.

Then, I discuss in Chapter 5 a primarily discursive position that stages citizens as '*beneficiaries*' of projected living laboratory experiments, specifically linked to the OxLEP Local Industrial Strategy. This chapter starts by discussing anticipatory

logics that underpin such experiments and the services, skills, or technologies this promises. I then describe a far more technocratic and instrumental citizenship that frames citizens as users or consumers of prototyped technologies in the present and who provide the conditions for developing future solutions.

In Chapter 6, I consider another form of smart citizenship by examining the role of '*expertise*' in smart cities. There are two components to this chapter. I first explain how experts discursively constituted the participatory and beneficiary citizenships I elaborate in Chapters 4 and 5 in spaces where this was enacted (i.e., a Citizen Mobility Lab, an OxLEP roundtable meeting). I then describe how *local* knowledge was valued as a form of expertise by the Smart Oxford board at networking events and innovation conferences involving those partners. I argue expertise shapes the terms of who, how, and where forms of citizenship engagement take place in smart cities.

The final chapter refers to a type of '*sim citizenship*' based on the OmniCAV project, in which a type of machine learning was used to create behavioural profiles for sims using smart city data, which are then used in digital twins for CAV systems training.

In mapping these different citizenships, I initiate a series of reflections, propositions, and provocations in the concluding chapter on the direction of future

scholarship on smart cities and citizenship as well as identify possible limitations of this research.

Chapter 4

The Informational Smart Citizen: Engagement, participation, feedback

4.1. Introduction

As Chapter 2 demonstrated, smart cities are no longer simply about integrating software and data-driven decision-making into city management in a top-down, managerial fashion. It has now become commonplace for initiatives to be heralded as bottom-up, 'citizen-centric' or 'citizen-focussed'. This shift in focus has in some ways been amplified by critiques of smart cities as led by corporate and state interests over citizens (Cardullo et al., 2019; Hollands, 2015; Zandbergen, 2020). There have also been notable cases of significant citizen resistance to smart urban redevelopments, like Sidewalk Labs (Mann et al., 2020; O'Kane, 2022; Tenney et al., 2020). The trend towards citizen-centricity is reflected within the literature where significant attention has been paid to the figure of the 'smart citizen' (Calzada, 2020b; Datta, 2018c; de Waal and Dignum, 2017; Gabrys, 2014a; Zandbergen and Uitermark, 2019). For some, the relative absence of 'actual' citizens from smart city policy or decision-making arenas is a cause for concern; it is believed that citizens "might call into question the kinds of unproblematised assumptions and generally paternalistic approach" (Shelton and Lodato, 2019, p. 11) of those involved in governing the city. In other instances, there remains scepticism over whether

'actually-existing' forms of smart citizenship mediated by the smart city foster the conditions for expressions of citizen power (Cardullo and Kitchin, 2018). Instead, it is claimed that smart citizenship appears through 'tokenistic' forms of participation that frame and produce citizens as consumers, users or recipients of technologies or services. To this end, it has been claimed that smart city discourses of citizenship amplify the neoliberal logics of consumerism, individualism and market-led solutionism that underpin the smart city (see for example: Cardullo et al., 2019; Grossi and Pianezzi, 2017; Kitchin et al., 2018).

Nevertheless, it remains a critical endeavour of geographers and social scientists more widely to continue engaging with the diverse forms of smart citizenship which emerge in different cities and contexts. A growing number of studies examine precisely how 'actually existing' smart citizens are enrolled in smart initiatives in diverse ways (Calzada, 2020b; Cardullo and Kitchin, 2018; Granier and Kudo, 2016; Powell, 2021; Zandbergen and Uitermark, 2019). As I previously noted in Chapter 2, the literature has thus far understood or conceptualised citizenship in terms of the notion of 'participation' and how this is enacted.

Following these accounts, this chapter maps multiple ways that smart citizenship is enacted as participation in smart projects that follow the consortium partnership smart city form. Throughout the chapter I demonstrate how a fairly conventional understanding of participatory citizenship was shared by smart stakeholders where

well-rehearsed practices of ‘consultation’ or ‘engagement’ were considered to be an ideal for engagement. I characterise a set of participatory positions held by citizens as ‘co-creators’, ‘data generators’, ‘informed’ and ‘consulted’ citizens, and elucidate the various ways in which this was discursively constituted, practiced, and materialised.

The chapter is based chiefly on smart projects from the Oxfordshire County Council’s Innovation Hub (iHUB), hence its explicit focus on the consortium partnership arrangement of making cities smart. As I previously illustrated in Section 3.3., the iHUB projects I identified address a range of ‘priority’ areas which includes ‘smart’ health, transport, energy, innovation, and digital infrastructure (see Figure 3.3). I selectively draw on a subset of iHUB projects in this chapter. In doing so, the overall aim of this chapter is to provide a qualitatively nuanced account of the participatory citizenships that emerge from a diverse group of smart projects, rather than exclusively focus on projects assigned or ascribed as ‘citizen focussed’ or ‘citizen led’ in some way.

The chapter's main arguments unfold in several sections that follow a brief review of the participatory turn in the smart citizenship literature in Section 4.2. From Section 4.3 onwards, I examine how citizens were constituted as ‘participatory’ using four terms: first, as ‘*co-creators’* who participate in a mix of democratic, deliberative processes which were enacted as part of the Cities-4-People project in east Oxford

(Section 4.4); second, as '*data generators*' where citizens participated in a crowdsourcing project to collate cycling infrastructure data in west Oxfordshire (Section 4.5); third, as 'informed' citizens who attended and issued feedback at the end stages of project dissemination as part of the DRIVEN project (Section 4.6); and finally as 'consulted' citizens who expressed their views as part of a structured form of participatory process (Section 4.7). The chapter also asks why smart projects that follow a consortium model of smart city making produce participatory positions for smart citizens and reflects on the organisational dynamics that produce this interpretation. I end by questioning whether evaluating smart citizenship in terms of participation is necessarily useful in determining whether a smart city is deemed 'citizen-centric', 'representative', or 'democratic', and I ask in what other ways smart city politics can be evaluated?

4.2. Understanding smart citizenship as 'participation'

In Chapter 2, I argued that the existing smart city literature heavily emphasises the notion of citizen 'participation' as a democratising antidote to top-down, corporate-led smart cities. I disputed the claim that more 'active' civic participation in smart cities necessitated 'more' democratic outcomes given the structural conditions that produce the discursive and deliberative practices of citizens (Chilvers and Kearnes, 2016b). That said, the figure of the 'participant' who is readily engaged or included in smart city decision-making has remained widespread in scholarly assessments or stakeholder framings of smart citizenship (Cardullo and Kitchin, 2018; Ho, 2017;

Joss et al., 2017; Kelty, 2019a). This section takes seriously these approaches in order to consider what precisely constitutes 'participation' in smart cities.

One of the most influential approaches for understanding citizenship in terms of 'participation' is the 'ladder of participation' (see Figure 4.1), originally formulated by Sherry Arnstein (1969) in the context of planning processes and regeneration programmes. Arnstein's ladder has eight categories or 'rungs' that measure the form or level of citizen participation. At the lower ladder rungs are levels of 'non-participation' (i.e., 'manipulation' and 'therapy') that direct citizens in a top-down, formal, or managerial manner. The next set of rungs involve 'tokenistic' forms of engagement (i.e., 'informing', 'consultation' and 'placation') where citizens are given a higher degree of participatory agency to voice or directly contribute to decision-making or plans. The difference between the tokenistic rung and the higher levels is that citizen feedback does not require or assure action, and thus potentially upholds the status quo of stakeholders. In the final ladder rungs are forms of 'delegated power' and 'partnership' where citizens have a highly active or participatory role being granted greater degrees of action and responsibility. Accordingly, Arnstein's argument places greater significance or value on citizens who have 'deeper' or 'higher' degrees of participatory agency. I identified and posed several critiques to this linear assessment in Chapter 2. The ladder still remains a highly influential typology, model, or heuristic. It is widely and uncritically used in

multiple contexts to evaluate citizen involvement and participation, and this has more recently included smart cities too.

Table 4.1: Sherry Arnstein's (1969) original 'ladder of participation', reproduced from Cardullo and Kitchin (2018).

Form and level of participation	
Citizen power	Citizen Control
	Delegated Power
	Partnership
Tokenism	Placation
	Consultation Informing
Non-participation	Therapy
	Manipulation

The reformulation of Arnstein's 'ladder' into a 'scaffold' by Cardullo and Kitchin (2018) has widened its applicability to the context of citizen participation in the smart city (see Figure 2.1 for a full explanation). In their version, Cardullo and Kitchin add the position of the 'consumer' as a distinct rung, add columns that describe the 'political discourse' or 'framings', and assess the 'modality' underpinning degrees of citizen involvement. The scaffold was used in this paper to categorise citizen positions in a number of Smart Dublin projects. The implication of the scaffold approach was that projects where citizens are framed as 'co-creators' or 'decision-makers' were more likely to be inclusive, bottom-up or empowering compared with other positions that produced citizens as 'consumers' or 'residents', which were more likely to be implemented in a top-down, paternalistic manner.

However, I argued that there are some key limitations in using this tool as a way of measuring forms of smart citizen participation as with its earlier incarnation. For instance, the scaffold assumes that citizens share the same degree of agency or capacity to challenge those involved in governing the city. There is also the assumption that citizens act beyond their own self-interests; if projects cast citizens as decision-makers, will it necessarily mean their decisions are more inclusive or collective on account of how those decisions are made? As Shelton and Lodato (2019) showed, the 'actually existing' citizens of smart city workshops are often involved or invited in their capacity as professionals or experts. I suggested there are other ways to assess the effectiveness of citizen participation as 'passively' creating sensor data is generative of smart city actions too. I further argued that the scaffold reinforces a rather dichotomous reading of smart cities that casts initiatives as being either 'bottom-up' or 'top-down', 'market-led', 'paternalistic' or 'empowering', and so on. As Burns and Welker (2022) observe, there are a multitude of 'interstitial' stakeholders that operate within smart cities too. Following Arnstein, the argument that Cardullo and Kitchin make is that reorganising smart cities towards citizen participation or engagement is a necessary precondition towards fostering democratic alternatives to neoliberal models of smart urbanism (Kitchin et al., 2018). 'Meaningful' participation is therefore lauded as a mode of engagement that acknowledges or advances the empowerment, inclusion, and civic rights of smart citizens (Cardullo et al., 2019; Kitchin et al., 2018).

Another account of citizenship being interpreted in participatory terms differentiates between the 'traditional and 'transactional' forms of citizen engagement with governments going smart. Johnson *et al*. (2020a) describes two categories of citizen participation outlined in smart city proposals: the first is the *traditional* form of participation which is rooted in "active" deliberative processes like focus groups, surveys, workshops, or public discussions, with some "passive" forms of information delivery via websites, videos, leaflets, or newsletters. This type of government outreach is perceived to be a slower, longer-term, and lengthier set of processes. In comparison, the *transactional* form of citizen participation utilises online or digital engagement tools like third-party platforms. This is considered a way to speed up citizen-government interactions. While the focus of smart cities is often on implementing new or emerging technologies, Johnson *et al*. (2020a) show how smart city proposals place greater discursive emphasis on 'traditional' modes of citizen engagement. They then question whether the traditional type "may create a smaller total number of deeper engagements, compared to a larger total number of shallower, click-type transactions" (p.413). In their view, there is a need to critically reflect on the assumption that transactional forms of citizenship atomise or reduces participation compared with traditional deliberative processes and that, instead, the volume and depth of different citizenship methods should be evaluated together.

A similar typology is introduced elsewhere by Johnson *et al*. (2020b) where they identify four transactional modes of citizen engagement: the 'type', 'tap', 'tweet',

and ‘pass’ (see Table 4.2). Each mode is characterised by its direction, intention, and the mediation type between citizens and government. For instance, the ‘type’ mode is most similar to ‘active’ civic participation as an intentional or direct transaction initiated or asserted by citizens to contribute to or communicate with governments. The pass mode is comparably passive as a transaction mediated by sensor technologies as a government-initiated mode (see Chapter 7). This is yet another example that problematises the type of participation mediated by smart technologies and that emphasises the default position that advocates for ‘more interactive’ or traditional types of citizen-government relation.

Table 4.2: Characteristics of modes of citizen-government transactions. Reproduced from Johnson et al. (2020b).

	Type	**Tweet**	**Tap**	**Pass**
Asserted/Implied?	Asserted	Asserted	Asserted	Implied
Citizen/Government?	Citizen	Citizen	Government	Government
Mediated/Direct?	Direct	Mediated	Direct or Mediated	Mediated
Limits?	Yes	No	Yes	No

There has clearly been an overwhelming interest in categorising or cataloguing the participatory methods or engagement procedures practised or materialised by smart cities in the literature (Calzada, 2020b; Engelbert et al., 2022; Goodman et al., 2020; Mann et al., 2020; Przeybilovicz et al., 2022; Tenney et al., 2020). The roles, levels, types, processes, or models I have described exemplify different definitions of what

constitutes ‘good’ participation (civic action/control or values/meanings/qualitative input). A number of studies have begun to engage with ways smart participation is then experienced by people in actually existing smart cities (Datta and Thomas, 2021; Gabrys, 2022; Powell, 2021; Zandbergen and Uitermark, 2019). The purpose of this chapter is to engage with the qualitative diversity of participation positions in smart and how this is then practiced.

We can see that aspects of the smart city literature offer a specific account of smart citizenship, in which ‘participation’ is a central process. Different forms of participation are ranked as better or worse, depending on the extent to which they match an ideal set of participatory characteristics and thus demonstrate a greater degree of citizen agency. This is understood through the extant citizens engage, control, or create meaning from smart. As this chapter will now demonstrate, this framing was key to the way in which the Oxfordshire County Council iHUB constituted citizenship in smart projects, both discursively and materially. The ambition of this chapter is to provide a more nuanced and detailed account of smart citizen participation that builds on the ‘socio-technical ecology’ approach I outlined in Chapter 2.

4.3. Citizen participation in iHUB smart city projects

The following sections explores four ways that smart citizenship was considered a type of ‘participation’ in a number of Oxfordshire County Council iHUB smart

projects. I identify four participatory positions (see Table 4.1) that reflect the different discursive framings, practices, and materialities of participation emerging from these projects. The participatory positions I describe are not necessarily exclusive to any one individual project. For instance, the characteristics I detail for the 'data generator' participatory position were also evident in another smart cycling project from Table 3.7. It is therefore possible to use the positions I identify to make sense of citizenships in other projects that follow this consortium partnership mode. I argue that most projects in this chapter discursively evoked a strongly participatory model of democratic citizenship. This was practised through a broadly procedural set of participatory activities, like the workshops, deliberative consultations, or public engagement events I describe. Participatory citizenship reflects well-established values or conventions of 'public engagement' held by the Oxfordshire County Council too. As this section demonstrates, the notion of participation remains an important way in which smart cities are constituted as being 'citizen focussed' or 'bottom-up', and I aim to unpack in greater detail how this is the case here.

The Oxfordshire County Council established the 'Innovation Hub' or 'iHUB' in 2014 as an internal research and policy group focussing on transport innovation. It has since developed into an R&D team involved with coordinating a number of smart projects across the city and county. There are four main iHUB teams that oversee the involvement of the Oxfordshire County Council in smart city partnerships.

These are: the Automated Transport team; the EV Integration team; the Innovation and Research team; and the Health and Care Innovation team (see Figure 4.1). The iHUB also includes representatives from the Smart Oxford board and the Mobility Oxford CIC who hold joint positions with the Oxford City Council.

The majority of iHUB projects are funded by external bodies like the UK government's Department for Transport, the Centre for Connected and Autonomous Vehicles (CCAV), or Innovate UK, and through intergovernmental bodies like the European Commission via its flagship 'Horizon 2020' research and innovation programme. Funding bodies have an influential role in structuring the organisational arrangements, agendas, and incentives of smart projects at multiple scales (Calzada, 2020c; Engelbert et al., 2019). For instance, there are conditions of funding from bodies like the European Innovation Partnership on Smart Cities and Communities (E.I.P-S.C.C.) related to the notions of scaling and replication considered important in making pilot projects economically sustainable (van Winden and van den Buuse, 2017).

As elucidated in Chapter 3, the Oxfordshire County Council iHUB reflects the consortium partnership mode of smart city making by multi-stakeholder partnerships. Partnerships typically involve a combination of local authorities, universities, research institutes, technology SMEs/start-ups, insurance companies, business parks, and other local stakeholders. Each consortium configures a mix of

stakeholders with diverse technical, strategic, and organisational expertise or professional backgrounds too (see Chapter 6). I previously described how this smart city mode is indicative of a wider trend of framing smart cities as 'experiments' (Caprotti et al., 2016b; Evans et al., 2018). Many European smart experiments are organised as 'projects' which involves allocating a priori specific funding, time-frames, and organisational roll-outs (Torrens and von Wirth, 2021). This is similarly reflected in studies of UK smart cities that puzzle together project funding in this way (Caprotti et al., 2016a; Caprotti and Cowley, 2019; Valdez et al., 2021). 'Pilots', 'demonstrations', 'living labs', and 'trials' are connected terms suggestive of the socio-technical arrangements, experimental forms, and practices of smart projects. The four examples I explore in this chapter are typical in this regard. Together, the Oxfordshire County Council iHUB frames smart projects as part of efforts to make Oxfordshire a 'smart county' in a multitude of ways.

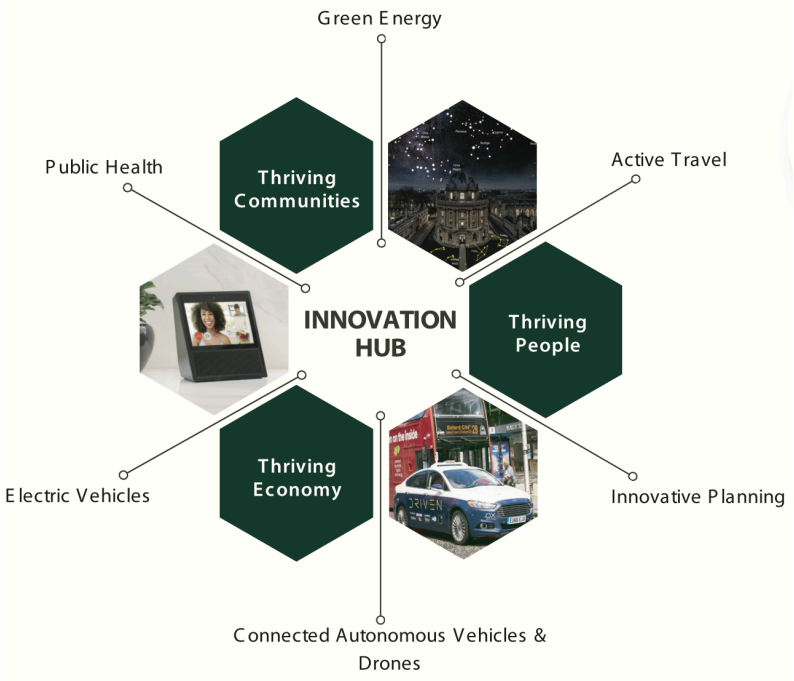

Figure 4.1: Innovation Hub priority areas. Source: Oxfordshire County Council iHUB brochure (2019).

The following sections address the different dimensions of participatory smart citizenship emerging from the example projects I have identified. I draw on the socio-technical ecology approach elucidated in Chapter 2 to provide a nuanced account of the participatory positions associated with this smart city mode.

Table 4.3: Four participatory positions in four Oxfordshire County Council iHUB projects. Adapted from the iHUB brochure (2019) and authors notes.

Participatory Position	Example Project	Partners	Locations
1. Co-creators, leaders, and decision-makings	Cities-4-People (June 2017 – May 2020), European Commission Horizon 2020 programme	Copenhagen Business School (Denmark, Lead). UK branch: WAAG Society (Netherlands); Oxfordshire County Council, Oxford (UK); University College London Institute of Health Equity (UK); Municipality of the City of Budapest (Hungary); Institute for Transport Sciences Non-Profit Ltd (Hungary); City of Hamburg and District Office Of Hamburg Altona (Germany); HafenCity University Hamburg (Germany); E-Trikala SA (Greece); Q-PLAN International PC (Greece); Üsküdar Municipality (Turkey); Istanbul University (Turkey); WhiteResearch SPRL (Belgium)	Barton, Blackbird Leys, Littlemore, Rose Hill; Oxford city
2. Data generators	Open Oxfordshire: Cycling Infrastructure Evaluation (October 2018 – March 2019), Open Data Institute/Innovate UK	Oxfordshire County Council (Lead); SystèmeD; Hanborough Parish Council; Windrush Bike Project; BikeSafe; Trail Unknown with Oxford Brookes University	Hanborough, Enysham, Witney
3. Informed citizens	DRIVEN: Insuring, Ensuring and Exporting Fleet Wide Level 4 Connected Autonomy (July 2017 – December 2019), Innovate UK	Oxbotica (Lead); Oxford Robotics Institute, University of Oxford; AXA XL; Nominet; Telefonica O2 UK; Transport Research Laboratory; the UK Atomic Energy Authority's RACE; Oxfordshire County Council; Cicero Group; Transport for London	Oxford city and Oxfordshire; London
4. Consulted citizens	Go Ultra Low Oxford (July 2017 – June 2019), Office for Low Emission Vehicles	Oxford City Council (Lead) with Oxfordshire County Council; Transport Studies Unit, University of Oxford; the Centre on Innovation and Energy Demand; Ubitricity; Zeta; Co-Wheels Club; the Low Carbon Hub	Oxford city

4.4. Citizens as co-creators, leaders, and decision-makers

One of two 'citizen focussed' projects identified in the Oxfordshire County Council iHUB brochure (2019) is the 'Cities-4-People' (C4P) project (see Figure 4.2). This is a 3-year project[12] led by the Copenhagen Business School and funded through the European Commission under the Horizon 2020 'Societal Challenges' programme. As detailed in Chapter 3, the Cities-4-People project follows the consortium-led mode of smart city partnership, which involved specific aims and objectives, timelines, and associated 'deliverables' tied to Horizon programme funding. For instance, the Commission's 'Research and Innovation Action' funding strand places significant emphasis on terms like interdisciplinarity, innovation, and impact in programme assessments.



Figure 4.2: Project logo branding for the Cities-4-People project. Source: Cities-4-People website (2017).

The C4P consortium partnership was comprised of 13 international partners from 8 different countries that cover 5 'pilot' areas, namely in Oxfordshire (UK), Hamburg

[12] The Cities-4-People project received a 6-month funding extension (November 2020) due to the COVID-19 pandemic. Due to fieldwork time constraints, the original project length is detailed here.

(Germany), Trikala (Greece), Budapest (Hungary) and Istanbul (Turkey). Each of these pilot areas had tailored trials or schemes. The consortium group would then regularly meet for overall project progress updates. In Oxford, one of the project's principal aims was to "solve real mobility issues [in Oxford] through a collaborative framework in which a community of citizens, local authorities, mobility providers and innovation experts can create mobility solutions that have a low ecological footprint and a sharing mentality" (iHUB Brochure, 2019, p.11). The collaborative framework referred to here is the 'People Oriented Transport and Mobility' (or 'POTM') approach of the C4P project, which is based on nurturing and fostering a 'participatory', 'inclusive', and 'transparent' innovation process.

The POTM framework of the C4P project emphasised the citizenship ideal of 'co-creation' as a bottom-up approach to urban mobility policy or decision-making by involving citizens as smart city stakeholders. The paradigmatic principles informing its co-creation approach were shaped by social innovation, digital social innovation, and Open Innovation 2.0 paradigms identified in previous European Commission studies. I briefly summarise these frameworks in Table 4.5. These co-creation and co-production frameworks were identified by Cities-4-People partners as a group of overlapping civic 'paradigms' and conceptual foundations. These informed the participatory epistemology of its POTM approach to identifying urban mobility solutions.

Common amongst these paradigms is the ideal that by participating, citizens will be able to vocalise their opinions and establish an authoritative decision-making role in processes of innovation. In a C4P report, the POTM framework is further elaborated as an:

> "approach for systematically co-creating urban mobility interventions based on the meaningful collaboration of all quadruple helix city stakeholders. In other words, the POTM framework offers local citizens the opportunity and the means to work together with urban mobility authorities as well as with research and industry stakeholders, with a view to co-develop, prototype and pilot innovation and smart mobility solutions that address pressing and real urban mobility challenges"

Table 4.4: Co-creation frameworks shaping the POTM approach of the Cities-4-People project. Adapted from multiple sources.

Innovation Framework	Definition	Participatory terminologies
1. Social Innovation	"new ideas that meet social needs, create social relationships and form new collaborations"[13]	▪ open to all ▪ multi-disciplinary ▪ participative and empowering ▪ demand-led ▪ tailored
2. Digital Social Innovation (DSI)	"a type of social and collaborative innovation in which innovators, users and communities collaborate using digital technologies to co-create knowledge and solutions for a wide range of social needs and at a scale and speed that was unimaginable before the rise of the Internet"[14]	▪ open hardware ▪ open networks ▪ open data ▪ open knowledge ▪ open access ▪ collaborative economy ▪ e-participation ▪ open democracy ▪ funding acceleration or incubation for co-working spaces ▪ mass mobilisation ▪ collective deliberation
3. Open Innovation 2.0	Based on the triple helix (TH) and quadruple helix (QH) models where "innovation is the outcome of an interactive process involving different spheres of actors, each contributing according to its 'institutional' function in society. Traditional protagonists of the TH are University, Industry, and Government. Civil society is the additional sphere included in the QH. Contribution to innovation is envisaged in terms of sharing of knowledge and transfer of know-how, with the helices models assigning and formalising a precise role to each sphere in supporting economic growth through innovation"[15]	▪ all stakeholders ▪ citizen empowerment ▪ participatory processes ▪ living lab spaces ▪ blurred distinguishing of user/citizen ▪ triple helix and quadruple helix models

[13] European Commission (2011) "Empowering people, driving change : social innovation in the European Union." Available at: https://data.europa.eu/doi/10.2796/13155.

[14] European Commission (2015) "Growing a digital social innovation ecosystem for Europe: DSI final report." Available at: https://data.europa.eu/doi/10.2759/448169.

[15] European Committee of the Regions *et al*. (2016). Using the quadruple helix approach to accelerate the transfer of research and innovation results to regional growth. Available at: https://data.europa.eu/doi/10.2863/408040.

Direct citizen involvement here involves events, workshops, and other engagement activities typical of the 'traditional' participatory politics described by Johnson *et al*. (2020a). The purpose of testing the C4P's POTM approach was to design a common 'toolkit' or a set of definitions, metrics, indicators, and co-creation methods that could then be 'scaled' elsewhere. Participation is framed in instrumental terms this way (Kelty, 2019a) as a collection of procedures that produce specific participatory experiences. Like toolkits, the C4P project instrumentally deployed co-creation and co-production frameworks by adopting participatory methods designed to elicit ideal forms of citizen engagement. Scaling 'solutions' is a criteria of EU-funded pilot projects (Engelbert et al., 2019; van Winden and van den Buuse, 2017), and this is evidently inclusive of citizen-focussed projects. Funding therefore requires familiarity or expertise of co-creation frameworks in which this smart project is embedded (see Chapter 6). It subsequently reinforces this tension between the 'contextual specificity' of projects with universality, one-size-fits-all claims. The project therefore placed significant discursive emphasis on positioning citizens as active participants, decision-makers, or co-creators akin to other city stakeholders and where citizens were central to the process of developing mobility solutions representative of their diverse interests.

Encouraging citizen participation in the Cities-4-People project was seen as an essential criterion for its success. In an interview with an iHUB team member it was stated that,

> Before I became involved in this project and I heard the term 'smart city', to me the 'smart city' was very much involved with technology. So, there's ample examples of more efficiently using city services through the use of sensors and monitoring the functioning of the city through sensors. The sexy projects are always autonomous vehicles and how they can be incorporated. This is how I envisaged smart cities before I became involved with the project. I think [Cities-4-People] looks at a more unsexy, but perhaps more important aspect of a smart city which is [*short pause*] I don't want to say using citizens, but perhaps partnering with citizens would be better, as perhaps the best sensors we can use. Our community is aware of the successes and failures of our city better than sensors and actually their perceptions may be more important in reality…[T]his project looks to tap into that and use the knowledge and understanding that citizens have that we often devalue and dismiss to make a smart, smarter, better city (Innovation and Research Team Member, October 2019).

This interviewee makes a number of interesting observations about the value of citizen participation in the smart city in this quotation. Firstly, they compare 'sexy' aspects like autonomous vehicles with 'unsexy' aspects of citizenship. This reflects the way that technological innovations have played a central role and are dominant in socio-technical imaginaries of the smart city, perhaps in place of addressing pre-existing social issues (Greene, 2021; León and Rosen, 2019; Marvin et al., 2016). Civic participation is thereby evaluated as less exciting than experiments with emerging technologies or smart projects that address other city efficiencies.

Secondly, the interviewee states that citizens are 'the best sensors we can use'. This phase may suggest that he views the lived experiences and perceptions of citizens in the city as being just as important in making a city smart compared with the wholly technology or data-centric versions (Hollands, 2015) of smartness privileged among other projects or activities. Rather than preferencing or relying on particular types of data to inform transport decisions in the city, the interviewee describes citizens

as generating sensor data based on their subjective perceptions, understandings, and experiences in Oxford. Describing citizens as 'the best sensors' demonstrates a desire from this officer to directly engage people with the Cities-4-People project, and perhaps improve their experiences of the city.

Thirdly, the interviewee describes 'partnering' with citizens in the Cities-4-People project. The implication of this being that there is equitable weight given to citizen perceptions, experiences, and knowledges to inform decision-making. This is a form of participation that he identifies as the best way to engage with citizen experiences with the city. The co-creation frameworks that inform the partner position in C4P are situated in the vocabularies of collaboration and empowerment that nurture a participatory version of smart cities.

Similarly, the iHUB team emphasised the notion of the 'community' as an important part of the civic participation enabled by the Cities-4-People project. The invocation of community was used as a proxy for Barton residents in east Oxford who were recruited to test the project's POTM approach. According to one interviewee:

> What we found is the most successful projects that we've had have been ones that haven't got the 'wow' factor but have got the community factor. Ones that have reached out to the community and done a proper, *proper* community engagement, like it might have taken a year or so. But you've really got what the community needs. And one of our projects called Cities-4-People, which is a European project, was about looking at how do you bring communities on board with next generation transport systems and innovation? And it's with those hard-to-reach communities (Innovation and Research Team Member, August 2019, emphasis added).

According to this interviewee, the iHUB projects with 'proper' community engagement like Cities-4-People were considered more successful despite their relatively slow implementation. Note that 'community' is used to accommodate the inclusion of 'hard-to-reach' citizens, which in this instance meant deliberately targeting marginalised people. The implication is that there was a higher level of engagement with local needs and the mobility disadvantages of east Oxford residents. It may be suggested there was an uneven apportioning of highly participatory agency towards east Oxford residents by the C4P project who had the time-burden of validating its 'co-creation' aims compared with other iHUB projects mentioned later. The quotation similarly reinforces the ideals of participatory citizenship and the 'bottom-up' smart city too, which stresses that increasing access or inclusion in smart is a criterion for its success (Greene, 2021).

In actuality, the Cities-4-People project experimented with several citizen participation methods or procedures as part of its POTM approach. The Oxfordshire branch of the project targeted people in Barton in east Oxford in order to develop solutions to the issue of transport cross-connectivity between areas on the outskirts of the city of Oxford like Barton, Blackbird Leys, Cowley, and Rose Hill. They needed better transport links because of the 'hub-and-spoke' system of public transport that heavily focusses on access to Oxford city. One of the approaches used to engage citizens was described as 'Citizen Mobility Labs'. These were essentially workshops or deliberative forums that were held in a local community centre. People, mostly

local residents, were invited to attend and contribute to labs as empowered citizens who would help to identify sustainable mobility solutions (see Figure 4.3).



Figure 4.3: Promotional poster for the Cities-4-People project. Source: Cities-4-People website (2017).

The C4P poster used the rhetorical phrase 'by the people, for the people' to advertise its highly participatory approach. Described elsewhere by an interviewee as 'learning labs' the purpose was to "learn from the community what their challenges were" (Innovation and Research Team Member, November 2018). Unlike with 'hackathons' or 'hack days' that specifically target people with desirable

technical skills like coders or entrepreneurs (Irani, 2015; Robinson and Johnson, 2016), the Cities-4-People project valued citizens' experiential knowledge of Oxford city transport (see Chapter 6).

The structure and format of a typical mobility lab was as follows: the labs started with brief updates or presentations from project consortium partners and other key stakeholders. There would then be short breaks with refreshments supplied by the council. This would then be followed by a predetermined set of engagement activities like the 'ambition ranking' task. The task involved taking a set of ideas identified elsewhere by local stakeholders during a targeted workshop and getting citizens to rank ideas in order of participant support using colourful post-it notes stuck onto A3 flipchart sheets (see Figure 4.1). The sheets were purposefully displayed on workshop meeting room walls to encourage individuals to actively move around the room from sheet to sheet to perform the ranking exercise. The group would then take time to discuss ranking outcomes.

Throughout this activity, then, participation was defined in terms of the collective consensus making practises made possible from deliberating the priority or positioning of ideas to be taken forward as potential mobility solutions in the project. The participatory aesthetics of this activity echo what Mattern (2020) terms 'mapwashing' in the citizen engagement efforts of Alphabet's 'Sidewalk Labs' project in Toronto, Canada. She describes how analogue media like post-it notes,

index cards, and rough architectural models act as visual signifiers of smart city democratisation. It was through activities like this that the iHUB and C4P enabled the collaboration or co-creation of local transport solutions with Oxford citizens.

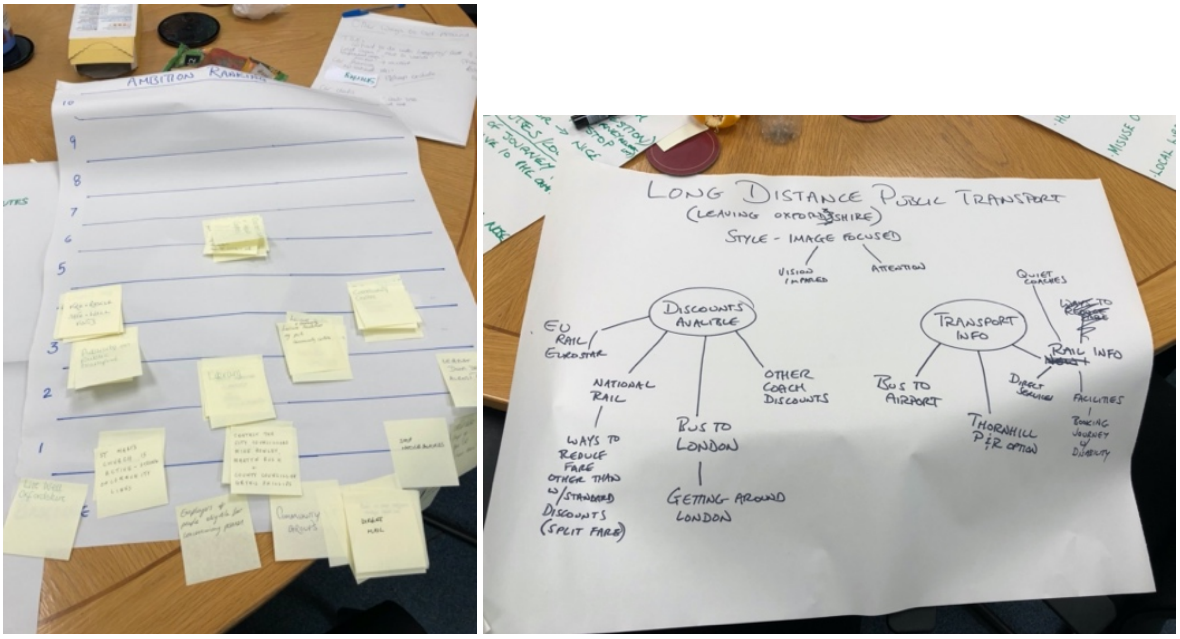

Figure 4.4: 'Ambition Ranking' and brainstorming exercise. Authors own image.

However, aspects of the Cities-4-People project and its implementation in Oxfordshire did not necessarily align with its discursive ambition to foster this POTM approach. In the early stages of the project, the iHUB hosted a 'co-creation workshop' with local authority stakeholders to identify the location and mobility challenges that the Cities-4-People project would focus on (Froes et al., 2019). This resulted in the Oxfordshire County Council inviting a local transport stakeholder, the Oxford Bus Company, to develop, prepare, and launch its on-demand bus transit

service with the C4P. The app was named 'Pick-Me-Up'[16] and was framed as a technological solution to the mobility challenges identified by Barton residents (see Chapters 5 and 6). Launching and testing this service became a central feature of the Cities-4-People project as "[the Oxford Bus Company] were looking for a place to locate and we said we've put all this research to show there's a community here that really want you" (iHUB Team Member, August 2019). Despite the C4P project targeting Barton due to the relatively high levels of socio-economic disadvantage here, the on-demand bus transit smartphone app was ushered in as a service to increase residents public transport links across the eastern arc of the city. The reason why this is important is that it showed how citizens lacked the ability to act to determine precisely what solutions were being piloted as this was being influenced far more by local partner priorities (Engelbert et al., 2019). This was contrary to the discursive styling of the Cities-4-People project.

The partnership between the iHUB and the Oxford Bus Company had an effect on the way the Cities-4-People project was conducted as 'Citizen Mobility Labs' became a space that generated user feedback or evaluated the utility of the app rather than for solutions to be identified directly by citizens. Indeed, one of the workshop meetings was disrupted by two attendees who stated their only interest in attending the workshop was to learn how to use the 'Pick-Me-Up' smartphone app. There were also positive implications. The project designed face-to-face app

[16] The Pick-Me-Up bus app endorsed by the Cities-4-People project ended operations in Oxfordshire from June 2020 due to funding shortages.

training pilots in order to develop the digital literacy of Barton residents (see Research Diary). In a sense, it became clearer that decisions were upstream and were predetermined by the C4P consortium, the scope of this partnership, and the tech solutions framing of the Oxford Bus Company app.

Overall, then, the Cities-4-People project discursively framed participatory citizens as co-creators, leaders, and decision-makers in developing the project's POTM approach. The project called forth a strongly participatory conception of political agency based on the principles of civic deliberation and collective decision making. Citizens were designed to be 'empowered' through a number of theoretical models or frameworks of engagement instrumentalised by the C4P consortium as part of its approach. The Citizen Mobility Labs framed participation as an 'event' to engage citizens and where participation was practised and materialised. This was the space where the active, deliberative methods or tools of the project were deployed. C4P partners constituted this as a way of nurturing 'bottom-up' decisions by directly delegating aspects of local transport and mobility decision-making to citizens.

Participation did not necessarily conform to the procedures or processes adopted by the C4P in practice. The pairing of the C4P with the Oxford Bus Company's Pick-Me-Up app realigned citizens towards issuing design feedback or identifying ways of expanding its usage (e.g., app training). Citizens were also omitted from stakeholder workshops where programme decisions were being made to progress the C4P project

and its key deliverables. While the project discursively conformed to the bottom-up principles of participatory citizenship valued by the literature, its enactment shows the limitations of participation as a form of citizen power in this smart partnership.

4.5. Citizens as data generators

This section identifies a second way in which smart citizenship was enacted as a form of participation, where political agency was assumed through the crowdsourcing of citizen feedback via a smartphone app. The example I use is the 'Open Oxfordshire: Cycling Infrastructure Evaluation' (CIE) project, which is listed as one of the iHUB's 'smart cycling' projects (see Table 3.2). I differentiate the position of citizens as 'data generators' from the sim citizenship I detail in Chapter 7, due to the voluntary basis in which citizens were mobilised, the participatory practices associated with its enactment, and how key stakeholders were configured in this project. I similarly argue the CIE project evokes a participatory model of citizenship defined here by a set of sensing practices mainly facilitated by two devices: the bicycle and smartphone. To this end, I highlight how citizens enact participatory citizenship combining their embodied practices of cycling with the process of encoding observations using a smartphone app.

The 'Open Oxfordshire: Cycling Infrastructure Evaluation' was a 6-month project run between October 2018 and March 2019 by a member of the Innovation and Research team at the Oxfordshire County Council iHUB. The CIE was funded by the

Open Data Institute (ODI) as part of its innovation programme with Innovate UK. The project team included: the Oxfordshire County Council; SystèmeD; the Hanborough Parish Council; the Windrush Bike Project; BikeSafe; and Trail Unknown with Oxford Brookes University. The iHUB managed almost all aspects of the project's implementation, including the creation of an app and the survey framework. SystèmeD provided OpenStreetMap consultancy and expertise. The other remaining members formed the data crowdsourcing team. Its stated aim was to generate a new and open digital geospatial dataset that evaluated cycling infrastructure using crowdsourcing "for the benefit of local government, institutions, community organisations and the wider public" (Report, 2019, p.4).

The specific project area covered three west Oxfordshire villages and parishes, namely Hanborough, Eynsham, and Witney. These areas were identified by the iHUB for a number of reasons: the significant amount of inward commuter journeys coming into Oxford city; the bus services and cycle routes to Hanborough station being poorly connected with other commuter populations in Witney and Eynsham; the existing desire to improve cycle access and resolve existing stress on traffic infrastructure; as well as plans for local housing developments and 'Park & Ride' sites that would put further strain on existing traffic conditions. The CIE project thus sought to collate open data that mapped the state of existing cycling infrastructure in these areas and demonstrate the utility of crowdsourcing as a way to inform publics and policy makers in the process.

To complete the crowdsourcing component of the project, the iHUB developed the 'Digital Cycle Route Audit Tool' (DCRAT) which was a smartphone app used to input citizen observations of important road features and traffic conditions as data plotted along common cycle routes. The app was created by the County Council as part of its existing license with the mapping platform ESRI. Figure 4.3 shows two screenshots of the 'collector' app interface. Data auditors would start the data collection process by filling in survey data for their respective cycle route recording descriptive details using multiple drop-down menus, including on route type, surface condition, gradient, street lighting, cycle lane width and length, and traffic flows. There was also the option for text comments in a separate field to add information not captured from data inputs. Survey elements were adapted from the Oxfordshire Local Cycle and Walking Infrastructure Plan (LCWIP) that was already being conducted by the Oxfordshire County Council at the time. The survey data therefore complimented existing data collection practices on cycling and walking infrastructure. Data auditors would plot a cycle line route via the app map, which was synced to other users[17] to display routes in real-time on all other devices (left image).

Once the survey data and route map were complete, the cycle route hazards could then be recorded (right image) and combined with the original survey data. All data

[17] Crowdsourcing in the CIE project differed from an aggregate style commonly associated with the term. Data auditors would not repeat observations of cycle routes completed by other auditors.

auditors received a reference sheet to standardise the breadth of survey responses, increase observation accuracy, and to enable statistical forms of data analysis. The app was designed to allow citizens to record and edit data without being physically on their cycling route, thus minimising a reliance on mobile data and factoring suboptimal weather conditions. Data from the collector mobile app was then displayed in real-time on a live map hosted on the ESRI mapping platform, which was accessible online. According to the CIE project report (2019), the data auditing process produced over 4000 items of data and approximately 900 geospatial data points overall (p.20). All survey data was held by Oxfordshire County Council and as the DCRAT app was built by its GIS team the data could be repurposed in future too.

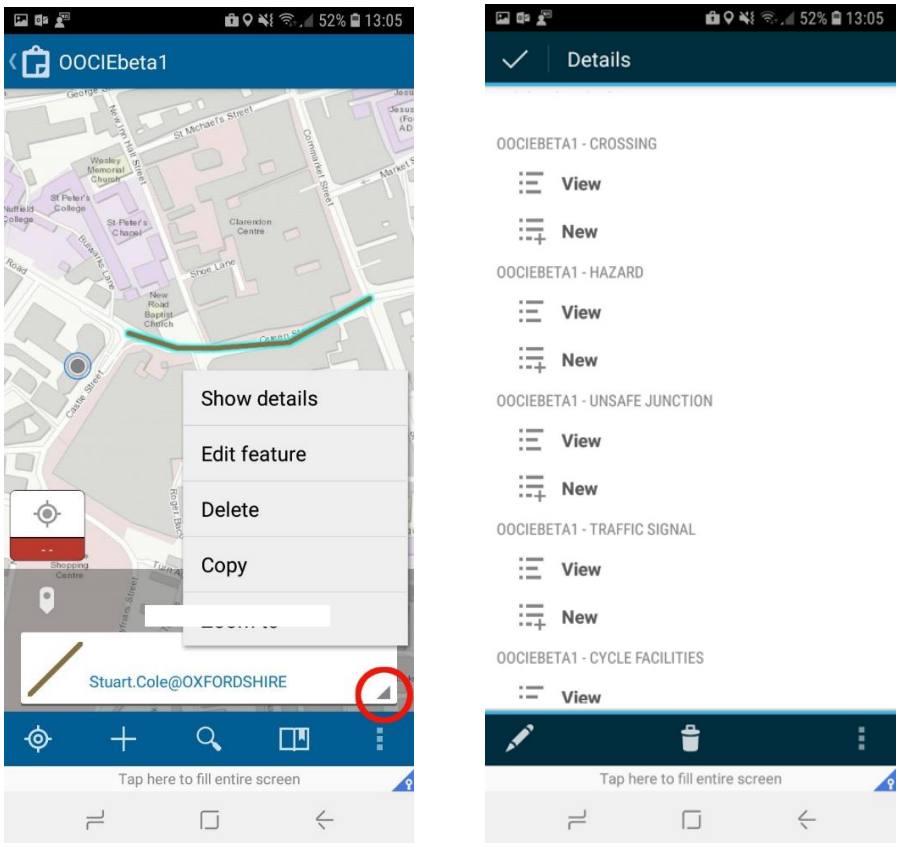

Figure 4.5: Two screengrabs of the Oxfordshire County Council's CIE app interface. Source: CIE report (2019). Permission to reproduce these images has been granted by the Oxfordshire County Council iHUB.

For the CIE initiation, the iHUB ran a training workshop with data auditors to trial a beta version of the DCRAT app, review relevant documentation, consider crowdsourcing skills or requirements, and discuss project aspirations. Auditors were then able to map their respective areas and weekly discussions were held to check in on progress. The volume of data auditing was weighted to the number of hours commissioned over the 3-month period (110 hours overall). Several auditors contributed extra outputs like short reports, radial route cycle maps, and spreadsheets to fill any of the remaining hours. The iHUB also reimbursed auditors with a financial contribution to their nominated community groups.

In an auditor feedback report, a volunteer raised a key limitation of the DCRAT app: they were unable to enter data on specific experiences of using cycle lanes, that they thought shaped what route a cyclist takes over another. Traffic conditions and roadside interactions are an important factor in how commuting is experienced by cyclists (e.g., having to avoid roadside foliage, interacting with other commuters). The app therefore arguably provided a partial account of cycling as cycling is a lived, bodily, and experiential practice (Bissell, 2018a) shaped as much by physical infrastructure as the emotions tied to mobile transit.

To an extent, the DCRAT app functioned similarly to other 'civic apps' like 'FixMyStreet' used by many UK councils. This app allows citizens to identify and report urban street problems, like potholes, lighting, or overgrown vegetation.

Citizens carry out environmental monitoring in the FixMyStreet app and generate data on local infrastructure repairs. By doing so, it is argued citizens "become interchangeable with sensors, they even *become* sensors" (Gabrys, 2014, p. 233, original emphasis). These kinds of apps encourage a unidirectional mode of participation that is enabled by and enacted through digital devices, platforms, and infrastructures. This aligns with the 'tap' type of transactional interaction (Johnson et al., 2020b) described earlier between citizens and government. Like FixMyStreet, the DCRAT app makes what are otherwise discursive local government tasks into a set of material-political feedback mechanisms that can be effectively mobilised by citizens. It could therefore be a useful way of enacting participatory citizenship as the app provides information for local authorities to act upon to improve on-the-ground issues identified by citizens, though there have been problems with this in other contexts (Elwood and Leszczynski, 2013).

The 'crowdsourcing' term used in the CIE project report and in interviews evokes a collective spirit of 'community' participation, despite the relatively small number of auditors actually involved in generating its data. There were 6 data auditors in total recruited from local government sources, and the community and cycling groups from west Oxfordshire. This was described as a "grassroots approach to data generation with auditors emerging from within the local community" (Innovation and Research Team Member, August 2019). Here, the 'grassroots' metaphor is used to describe a strategy of targeting 'affected publics' as those who predefined by their

direct involvement in or existing political concerns with local cycling infrastructure (Chilvers and Kearnes, 2016b). This model of engagement assumes that those most likely to be affected by an issue are more likely to directly participate in a project. Indeed, it was considered to be an advantage if auditors were local to the area that they recorded data on to 'leverage' their local knowledge and experiences when evaluating paths both within towns/villages and on commuter routes too.

A strongly participatory ideal of smart citizenship was projected by the CIE project. It was claimed that citizens were better able to vocalise policy demands or further calls to action empowered by crowdsourced data and new skills. It was claimed that:

> through a process of training and information sharing, the CIE has demonstrated capacity to upskill local communities, open a window for informed opinion to engage in policy development and provide data for evidence-based decision-making and funding applications from a hyperlocal level up (Innovation and Research Team Member, August 2019)

The CIE project is attributed with 'upskilling' citizens as part of the crowdsourcing training mentioned in this quotation. It was seen as a way to strengthen local action by enabling local communities to improve bidding applications and "do their own work, in their own area" taking responsibility via their self-improvement. Upskilling is an explanation used to justify smart activities elsewhere too (see Chapter 5). Citizens acquired greater authority to express an 'informed opinion' and engage in policy developments on cycling infrastructure as a result of their participation in the project. This is somewhat different from the way that citizen's lived experiences of city transport and mobility was attributed with participatory agency in the Cities-4-People project. Citizens in the CIE project needed to acquire specific skills to

meaningfully participate. In practical terms, most of the project impacts reported were attributed to auditors from Hanborough Parish Council who already had a direct policy influence. They mobilised crowdsourced data by submitting a bid to Great Western Railway (GWR) to fund a feasibility study on improving bridge access to the train station. This resulted in £37,000 provided to the council in April 2019. This shows that there are some practices of participatory citizenship that produce affective forms of political engagement that improve citizens' lives.

In the CIE project, citizen participation was constituted through the figure of the 'data auditor' which was used to describe individuals cycling and recording their observations or assessments of infrastructure encoded into the DCRAT app. Crowdsourcing from auditors was described as a form of collective sense-making granting citizens greater political agency to mobilise new skills and data for local action.

4.6. Citizens as informed

In this section I identify another participatory position related to the ways citizens are 'informed' about what is happening in the smart city. The act of being informed is a unidirectional relation led by smart stakeholders which involves sharing project information or communicating with wider publics. The participatory role of citizens is to actively engage with the events, activities, websites, and other materials shared in the process of practising this engagement. I refer to the DRIVEN project which is

one of several CAV projects associated with the Automated Transport team at the Oxfordshire County Council iHUB (see Table 3.2). I argue a narrower conception of participatory agency emerged from the DRIVEN project premised on retrospectively informing citizens of the actions or decisions of local stakeholders in conducting CAV experiments. Informing citizens is ranked fairly lowly according to previous participatory measures as tokenistic. I elaborate on this assessment here by considering processes of informing citizens practised by the DRIVEN project.

DRIVEN was a 2.5-year £8.6 million funded Innovate UK[18] multi-stakeholder partnership led by Oxford University spin-out company Oxbotica. The project sought to test and trial a fleet of 6 'fully' autonomous vehicles in urban areas (Oxford, London) and on connecting motorways. The consortium had an assortment of stakeholders that included academic partners (Oxford Robotics Institute), local authorities (Oxfordshire County Council; Transport for London), re/insurers (AXA XL), mobile and telecommunication companies (Nominet; Telefonica O2 UK), independent consultancies (Transport Research Laboratory; Cicero Group), a government-funded research and testing facility (UKAEA's RACE testbed); and a public relations firm (Westbourne Communications).

[18] DRIVEN was funded from the CAV2 stream of Innovate UK projects which focussed on technical solutions for CAV features for 'real-world benefits to users' (CCAV, 2018). The CAV2 funding had a number of strategic priorities including testing an SAE Level 4 vehicle capable of operating in different road environments.

I earlier described how the DRIVEN project exemplified the 'urban laboratory' model of smart experiments with new or emerging technologies (Evans et al., 2018; Karvonen and van Heur, 2014). One way this took place in DRIVEN was through the *in vivo* testing or piloting of vehicles to experiment with Oxbotica's automated vehicle software and test its operational capabilities (Hopkins and Schwanen, 2018). DRIVEN was initiated to tackle the SAE Level 4 of automating vehicles tasks. The intention was therefore to develop the driving conditions under which a CAV could perform. Level 4 was also described by iHUB members as a level where a degree of 'vehicle-to-vehicle' communication is tested.

The testing regime for the DRIVEN fleet of CAVs henceforth took place under a mix of traffic/road conditions. For example, the UKAEA RACE testbed in Abingdon, a private research centre that specialises in robotics and autonomous systems, is a segregated site with a controlled test ground and roads (i.e., the 'Pit Lane'). The *in vivo* testing conducted on roads here will be vastly different from the public roads in Oxford city and in Greenwich or the motorways tested for the end-to-end project journey. The DRIVEN consortium was largely framed and understood in terms of demonstrating the technical performance of this CAV fleet rather than the explicitly participatory framing of the Cities-4-People or Cycling Infrastructure Evaluation projects.

Members of the Automated Transport team at the Oxfordshire County Council iHUB described citizen involvement in CAV projects like DRIVEN in terms of 'public engagement'. They identified four types. The first was roundtable meetings, as the most tightly managed type of event directed towards people with specialist skills or institutional knowledge valued by smart city consortia (see Chapter 6). The second was professional networking events like innovation conferences (e.g., VentureFest[19]) where industry and technical conversations could take place between smart stakeholders. The third was open public engagement events purposefully designed to inform wider publics (e.g., the DRIVEN exhibition, discussed below). The fourth was digital and media outlets like the council website, mailing lists, newsletters, LinkedIn blog posts, local newspapers, or magazines. The Automated Transport team regarded this set of engagement activities as a way of demonstrating the 'value' of CAV experiments to wider publics. Participation was treated largely as a practice distinct from CAV testing or the socio-technical arrangements that were in place for smart projects.

One of the public events coordinated by the Automated Transport team was an exhibition in the Oxfordshire County Library at the Westgate retail centre in Oxford city. The event was organised by the Mobility Oxford group alongside DRIVEN consortium partners in early December 2019. The event was primarily shared and

[19] 'VentureFest Oxford' is an annual showcase event intended to encourage networking between businesses, investors, and entrepreneurs in Oxfordshire. The 2019 edition of the event was held at the Headington campus of Oxford Brookes University.

circulated via personal email invitations, despite being positioned as an event 'open to everyone' on the event-hosting platform Eventbrite. This resulted in there being a highly selective audience at the event that comprised of individuals already involved with local CAV projects. The format of the event was structured in the following ways. It started with a short presentation that summarised the project's findings from speakers representing the DRIVEN consortium. Attendees were then encouraged to walk upstairs to visit the project exhibition.

The exhibition included 6 pull-up poster banners displayed on the library top floor. The posters provided brief summaries of the project aims and the role of each partner in its coordination (see Figure 4.1). The text on the posters were highly technical using specialist terms like 'distributed map management' or 'navigation-pertinent data' that would be unfamiliar to non-AV experts. The banner images showed partner branding, images of an Oxbotica/DRIVEN vehicle, and illustrative graphic art to accompany the text. Though the event was hosted in a public location, it was unclear whether there were any established efforts or plans to interact or engage with exhibition visitors.



Figure 4.6: The DRIVEN Exhibition at the Westgate Library. Author's own images.

The DRIVEN exhibition was organised as part of the public dissemination efforts associated with its Innovate UK funding. This meant the exhibition was organised after CAV experiments or trials had been completed and separate from the vehicle demonstrations at the Lee Valley 'VeloPark' in London's Olympic Park. According to the iHUB, the main way citizen participation was enacted in the project was in public events run after the technical tests or experiments were complete. Participation was not necessarily being understood by the Automated Vehicles team in terms of how publics interacts with CAVs at the test or demonstration stages either. Vehicles were driven on public roads in both Oxford and London as part of DRIVEN trials (see Figure 4.7) hence the 'real-world' evidence claimed by the project. This is what Marres (2020a) describes as the 'environments of participation' that are enabled by street tests of CAVs which not only evaluate the technical aspects of automation but also its societal function. In Chapter 7, I further elaborate on the citizenships enabled by automated vehicles testing.



Figure 4.7: An Oxbotica vehicle driving in Oxford city. Author's own image.

Being 'informed' is a distinct participatory practice in this instance that is characterised by citizens receiving carefully managed or constructed information on the project after its implementation. The participatory agency of citizens was thus rather narrow in comparison with previous examples in this chapter. Unlike with the Cities-4-People or CIE projects, there was not a direct elicitation of participation, nor its material enactment enabled by participatory objects like post-it notes or smartphone apps. Being informed was a rather peripheral position in DRIVEN. Nevertheless, this type of participation was central to the way the Automated Transport team understood public engagement in CAV projects.

4.7. Consulting Citizens

"All of these meetings and amazing projects happen, but what happens at the next stage? How do you keep them alive? How do you make them actually real day-to-day stuff or be able to use results if it hasn't been a successful project?" (Innovation and Research Team Member, July 2019)

Many Oxfordshire County Council iHUB projects utilise well-rehearsed deliberative and consultation practices or procedures deployed by UK local authorities. This is hardly surprisingly given the relatively piecemeal and incremental approach taken to smart city making in the UK (Caprotti et al., 2016a; Cowley and Caprotti, 2018). The 'partial traction' of the smart city in city administrations means that projects or programmes have been partially embedded or worked into councils (Kitchin et al., 2017a), as opposed to the wholesale or 'greenfield' examples seen elsewhere (Datta, 2018b; Ho, 2017; Shwayri, 2013). This was the case with the iHUB where a senior councillor told me its activities had been purposefully 'tucked inside' the transport department for a number of years. The iHUB projects I have considered were therefore folded into and integrated as part of existing local highway authority and council regulations. Following on from this, I examine the well-established set of 'consultation' practices used by the Oxfordshire County Council in its role as a local authority, as this informed how participation was enacted in a number of smart projects. I consider a case of an Electric Vehicles trial in Oxford city as consultation was mobilised as a participatory process similar to the longstanding engagement practices of UK councils.

In the case of smart mobility, several iHUB projects followed 'Traffic Regulation Orders' (TROs) as a standardised procedure for UK road and highway management and as a way to progress schemes. Local transport authorities can use TROs to introduce short-term, temporary restrictions to prohibit, restrict, or regulate traffic, including 'temporary' or 'experimental' orders (Butcher, 2020). A necessary component of introducing a TRO is that the local authority publicises and conducts a public consultation within 21 days of its issue. This was the case with a number of Electric Vehicles projects including the iHUB's 'Go Ultra Low Oxford' project. This was a £816,000 multi-phase trial funded by the UK government's Office for Low Emission Vehicles (OLEV) to install and test 5 types of EV charging infrastructure and technologies with Oxford city residents. The consortium was led by the Oxford City Council in partnership with the Oxfordshire County Council, as well as academic researchers (the Transport Studies Unit, University of Oxford; the Centre on Innovation and Energy Demand), EV manufacturing and energy companies (Ubitricity; Zeta), and other local stakeholders (Co-Wheels Club; the Low Carbon Hub). The project was framed as an experimental trial that involved testing a mix of EV charging technologies, such as lamp columns, gutter cabling, and on-street bollards that were distributed fairly evenly across areas in Oxford city.

The Go Ultra Low Oxford project had to therefore conform to the TRO process. This is because EV charging infrastructure installations had subsequent implications on the parking restrictions and conditions (i.e., introducing EV parking bays) of Oxford

residents. One of the EV project team members at the iHUB described the TRO process to me in the following way:

> That [TRO] order is delivered to properties on the affected street and any nearby streets if they are within a sort of reasonable walking distance. It's also advertised in the local paper and people have a chance to respond to [that] consultation. It's information about what we propose to do and then opportunities to give feedback as part of a formal consultation and there's usually at least a month we'd allow people to come back to us and all of the responses are collated. If there's no response then we go ahead and assume that nobody has any objections and go ahead (Innovation and Research Team Member, August 2019)

The EV project spokesperson explains a fairly standard and procedural public consultation process. This is typical in a government institutional context. The process involves publishing of proposals and the invitation of opinions from the wider publics that reflect the anticipated impact of experimental traffic trials or schemes. The TRO consultation process is "a process of elicitation, a mechanism for extracting relevant opinions and incorporating them into the process of government" (Lezaun and Soneryd, 2007, p. 292).

The Go Ultra Low Oxford project utilised consultation as a mode of engagement that targeted the 'most affected' citizens, which was determined by the direct impact of EV infrastructure installation areas. A leaflet for the project encourages engagement with the online consultations run by the Oxfordshire County Council "if you'd like to support our project or tell us about a concern regarding [this] location" (see Figure 4.7). This was in reference to installing an EV charger and bay in a specific Oxford city street. Participation was thus being regarded and framed through a 'public problems' lens in which the emergence of a 'public' was contingent on the

degree of contestation or objection and support for the trial (Chilvers and Kearnes, 2016b). The assumption of this approach was first that there is an equitable distribution of participatory agency to vocalise these claims and second that publics fall under the positions of being for/against this cause.



GO ULTRA LOW OXFORD

Electric car charging is coming to Oxford

Go Ultra Low Oxford is a government funded* project led by Oxford City Council in partnership with Oxfordshire County Council to provide electric car charging for people who have to park on the street.

By 2027 more people could be buying electric cars than petrol or diesel; our project will help us prepare for the future.

20 drivers living in Oxford will trial different types of electric car charger.

All our volunteers have to park their car on the street as they don't have a driveway; making charging an electric car a real challenge.

We would like to put an electric car charger and bay on Hawksmoor Road.

Oxfordshire County Council approved an electric charging bay at the eastern end of Hawksmoor Road following public consultation in 2017.

Due to technical issues we need to move the proposed bay to the Western end of Hawksmoor Road.

* Funding for the Oxford project is from the Office for Low Emissions Vehicles (OLEV)

The project will help make Oxford:

CLEANER: We can help to reduce air pollution by making it easier for people to drive electric cars.

SAFER: Local people will have a safe way of charging electric cars without creating trip hazards by leaving wires across pavements

FOR EVERYONE: If you choose to drive electric in the future and don't have a driveway, our chargers could help you!

FAQs:

Q. Why do you want to put a charger on Hawksmoor Road?

A. We chose Hawksmoor Road as a volunteer for the trial lives nearby, and we want to install a charger close to where they live.

Q. Will we lose a residents' parking space?

A. We would like to use part of a residents' bay for the charging space. We believe the impact on parking will be minimal, as the space will be used overnight by local residents who already park in the area.

Q. Will other EV drivers be able to use the charging bays?

A. Yes; during the day, the charging bays will be open to anyone with a special cable to use for charging an electric car for up to 3 hours. The cables can be purchased from the charger company Ubitricity.

Q. What will the charger look like?

A. You can see a picture of the charger on the front of this leaflet. The charger is a socket fitted to and existing lamp column.

Go Ultra Low Oxford is led by Oxford City Council in partnership with the University of Oxford and Oxfordshire County Council.

If you'd like to support our project or tell us about a concern regarding this location please visit the Oxfordshire County Council consultation pages via: www.oxfordshire.gov.uk

For general information about the project contact Oxford City Council via: www.goultralowoxford.org

OXFORDSHIRE COUNTY COUNCIL

OXFORD CITY COUNCIL

Figure 4.8: Information leaflet for the 'Go Ultra Low Oxford' project with consultation details. Source: Oxford City Council.

It is important to note that the TRO process was not the only means of gathering feedback in the Go Ultra Low Oxford project. Academic partners from the TSU at Oxford University employed several research methods (e.g., interviews, surveys, charging point use data, observations) to gather data on trial participants and stakeholders at various project stages (Hampton et al., 2019). This reflected their

role as the academic partners in the project. In a final project report, TSU partners explained the practical challenges of using TROs with stakeholders and residents, including delaying the trial, and suggested options for avoiding its future use.

Through the TRO consultation process and feedback gathered by the Oxfordshire County Council iHUB and Oxford University, the Go Ultra Low project contributed important forms of evidence to developing a strategic plan for implementing EV charging points across Oxfordshire. In that sense, citizens were participants co-constructing the material infrastructure form of the smart city by communicating with organisers of the EV trial. This again shows how some forms of participatory citizenship are effective means of engaging citizens with issues in smart cities.

In this section I have shown how participation in an EV project at the Oxfordshire County Council iHUB followed an existing consultation procedure: the TRO. The Go Ultra Low Oxford trial used consultation to measure local advocacy for or against proposed EV parking bays and infrastructure changes. It was not necessarily the intent of the trial to foster the 'bottom-up' ideals of citizenship advocated in the literature of delegated control or empowerment. Instead, this participation enabled the progression of the scheme and acted as a form of social research too.

4.8. Conclusion

In this chapter, I mapped multiple ways in which smart citizenship is enacted as participation in Oxfordshire County Council iHUB projects, both discursively and materially. I showed how smart spokespersons and projects held fairly conventional understandings of citizenship as participatory in terms of the deliberative or consultative engagement practices enabled by public events or workshops as well as practices of informing citizens. Whether citizens were discursively positioned as 'co-creators', 'data auditors' or 'informed' subjects in smart projects, I showed how decisions on the degree of citizen engagement tended to be made by partners in early funding bids or project plans, which was typical of the consortium model of partnership at the iHUB. This meant the participatory form of citizenship had already been determined and established expectations of engagement formulated by design. Claims of 'citizen-centricity' in projects like Cities-4-People related far more to a predetermined set of participatory methods, mechanisms of engagement, and ways of mediating participatory collectives (Chilvers and Kearnes, 2016a). The CIE project similarly identified a participatory framework to meet aims of crowdsourcing cycling data. Likewise, the DRIVEN partners had programmed citizen participation as a form of public engagement following the project and its implementation. The GULO project was the exception here where facilitating a set of public consultations was a necessary prerequisite to advance EV trials.

Sections 4.4 to 4.7 have shown that there is a strong variation in the ways in which smart citizenship is understood and enacted as 'participation' at the iHUB. Some projects like Cities-4-People or the CIE discursively framed citizens in terms of their participatory role as 'co-creators' or 'data generators', which is enacted via what the smart city literature would term 'bottom-up' participatory methods or procedures. Participation was enacted materially via analogue objects (i.e., post-it notes) or digital devices (i.e., smartphones). These acted as technologies of participation (Chilvers, 2012). Both the Cities-4-People and the Cycling Infrastructure Evaluation projects were widely understood in participatory terms whereby citizens gain greater political agency in their participatory role to directly contribute to policy or decision-making processes. The last two examples were evidence that the strongly technological framing of testbed experiments or trials produced a narrower framing for participatory citizens. Trials were not necessarily being designed with the same understanding of what constitutes 'bottom-up' or 'citizen centric' projects, and this was reflected in ways citizens were engaged. I further elaborate on this in the next chapter. Being informed of what is happening in the smart city or being consulted were both structured ways of organising smart participation, albeit an effective way to communicate smart project progress. The consortium model was thus not the only factor that shaped how smart citizenship was being discursively constituted or enacted in smart projects. The diverse participatory models I evidenced throughout this chapter reflect the different purposes or assumptions of citizen engagement in smart cities.

I understand the participatory positions I identified as expressions of an 'informational citizenship' in smart cities. By this, I mean that participation is not only a way to vocalise rights claims or follow democratic procedures, as per prior participatory assessments, but that it is also about the practices and objects that generate new relations between citizens and cities. Participatory citizens in this chapter were conduits to provide iHUB smart projects with information, whether in the form of responsive discursive feedback, crowdsourced data, or as recipients of information.

I argue when looked at in detail, as a socio-technical ecology, these examples complicate the existing dichotomous assessment of 'top-down' or 'bottom-up' smart cities described earlier in the thesis. It suggests that increased levels of participation does not necessarily equate to the more agentic or democratic ideals as advocated in the literature (especially in Cardullo and Kitchin's (2018) 'scaffold' model). I have challenged these assumptions in this chapter by demonstrating the qualitative nuances of enacting participation in smart cities. Citizens overall had limited capacity or agency to autonomously establish smart agendas, visions, or ideas outside of the parameters of organised projects that individuals were invited to engage with. The smart projects I considered nurtured informational citizenship by eliciting forms of participation by sharing data (e.g., experiential knowledge, crowdsourced observations, or deliberative opinions) towards transport-related

means but that did not necessarily guarantee data would be acted upon by those with overall decision-making authority.

It is worth noting that participatory citizenships I described in iHUB projects can also contribute to the introduction of technological solutions that explicitly address citizens mobility needs or facilitate further forms of political engagement with the Oxfordshire County Council. In regard to the former, I discussed how the Cities-4-People project introduced and developed the Pick-Me-Up app with residents from east Oxford to address cross-connectivity in the city. In regard to the latter, I highlighted how data auditors involved with the CIE project used its data to apply and secure local infrastructure funding.

The principle aim of this chapter was to provide a more nuanced account of smart citizenship as participatory drawing on the three terms – discourses, practices, and materialities – that form the 'socio-technical ecology' approach in this thesis. I further argue most iHUB projects in this chapter reinforce a highly participatory model of citizenship whereby greater political agency is gained through 'active' civic participation, public deliberation, or community decision-making. The Cities-4-People project typified the civic ideals of co-creation modelled and rehearsed in Citizen Mobility Labs as a deliberative practice. As I showed, citizens do not always conform with the language, protocols, or expectations of participation and this can lead to the disruption of conventions and redirect attention to citizens immediate

interests or needs (i.e., smartphone app training). I also showed that the political agency of citizens as 'co-creators' or 'leaders' took place in allocated participatory spaces, like community centres, as opposed to other decision-making forums like stakeholder workshops at County Hall. Citizens in the GULO project could also be considered as 'co-creators' as their participation, enabled by a more structured consultation form, were treated as a model for further EV trials. The position of citizens in DRIVEN highlighted that projects based principally on testing technical capabilities of CAVs can lead to somewhat tokenistic forms of public engagement. I also explored the data auditing practices of citizens in the CIE project, which was largely materialised by bikes and smartphones as technologies of participation. The project discursively mobilised participatory ideals of citizenship by suggesting the crowdsourcing informs and subsequently empowers citizens to challenge cycling infrastructure decision-making with local government.

I also explored some of the underlying dynamics shaping varied understandings of smart citizenship as participation emerging from project teams at the iHUB. I argued factors characteristic of the consortium partnership mode of smart city making (i.e., funding bid requirements, short implementation periods, technical scope of projects) led to a varied degree of emphasis being placed on fostering citizenship. There was certainly a stronger comprehension of participatory agency held by projects like Cities-4-People where 'citizen engagement' was an explicit criterion of EU Horizon programme funding compared with some Innovate UK projects where

the focus was on testing the technical parameters of emerging technologies. While sourcing funding from external sources was viewed as an innovative approach of resourcing smart projects at the Oxfordshire County Council, this had implications on the citizenships made possible by iHUB projects or teams.

The next chapter turns to a form of citizenship that has been given much less attention in the literature but which emerged from my analysis as an important form distinctive from participatory/republican forms. It looks at how the future living lab strategies discursively construct citizens as 'beneficiaries' of experiments in Oxfordshire. By anticipating a set of urban futures, the chapter shows citizens are expected to 'participate' differently to ways explained in this chapter.

Chapter 5

Citizens as Smart City Beneficiaries

5.1. Introduction

Cities adopting smart city projects, policies or programmes frame and anticipate that these interventions will result in positive outcomes for a wide range of urban actors involved in those interventions. For cities, this is typically tied to advancing existing agendas related to environmental sustainability, improving IT infrastructure and connectivity, developing and managing efficient transport systems, fostering city competitiveness, or stimulating economic growth (Alizadeh, 2017; Haarstad and Wathne, 2019). For businesses, the positive outcomes of the smart city are typically associated with the profit-making motives of tech or platform companies, especially due to the significant role of corporates like IBM in promoting smartness to sell products and/or services (Sadowski and Bendor, 2018; Söderström et al., 2014). For citizens, the smart city has also been imagined as an opportunity to widen participation in democratic processes, policy, or decision-making (de Waal and Dignum, 2017; Hollands, 2008; Joss et al., 2019). This is the way that smart citizenship was evaluated in the previous chapter.

In this chapter, I focus on a primarily discursive position that frames citizens as '*beneficiaries*' of smart experimentation constructed by those involved in producing the Oxfordshire Local Enterprise Partnership's (OxLEP) 'Local Industrial Strategy' (LIS) report. Published in September 2019, the Local Industrial Strategy is designed to "set a strategic framework for the economic ambitions of Oxfordshire through to 2040" (OxLEP spokesperson, May 2019). It is a document intended to align local stakeholder interests or agendas with UK government priorities. To a degree, there are parallels of the LIS with the 'master plans' of other cities related to the format and rhetoric of innovation evident in these documents (Goodman and Powles, 2019; Watson, 2015) A core component of the LIS was plans to develop a 'living laboratory' approach to processes of research and innovation in Oxfordshire. This idea was discussed in three broad ways. First, to expand the capacities or capabilities of testbed pilots with new and emerging technologies. Second, to 'co-create' or trial new products or services with 'real-world' users or communities. Third, as an approach enabling the growth of Oxfordshire's innovation-led economy. Living labs were drawn from a wider aspiration held by OxLEP partners to position Oxfordshire as a world-leading 'innovation ecosystem' by 2040, to accommodate tech entrepreneurs or businesses to apply, scale, and export solutions elsewhere.

I deploy the notion of the 'beneficiary' to capture the ways in which both the Local Industrial Strategy and those involved in its production discursively constructed the benefits and advantages citizens might directly or indirectly accrue from living

laboratories. OxLEP partners rationalised living laboratories in the LIS in terms of the anticipated benefits of this approach. I argue these benefits followed the three ways in which living labs were being conceived. I start with the ways citizens were imagined as engaged users who 'co-create' the conditions to test and develop new or emerging technologies and services. Citizens benefit from early intervention in the 'solutions process' by exploring user applications or scenarios in real-world living lab pilots (Juujärvi and Pesso, 2013; Leminen, 2013). Next, the ways citizens benefit from new local or regional innovation partnerships enabled by a living lab approach (Kronsell and Mukhtar-Landgren, 2018). I discuss this in regard to the projected skills or employment opportunities citizens are expected to benefit from. Finally, I describe a shared discourse of living labs providing new digitally-mediated experiences of travel for citizens based on emerging technologies piloted in smart experiments. A living lab approach will thus enable the anticipated futures envisioned in Oxfordshire.

The chapter also describes how OxLEP partners expressed in the Local Industrial Strategy report the importance of 'innovation' as an economic growth 'imperative' for the future development of Oxfordshire. Unlike the recent emphasis of cities as the loci of experimentation and innovation (Evans et al., 2018; Florida et al., 2017; Shearmur, 2012; Zukin, 2020), the Oxfordshire living lab proposals covered other spatial scales or geographies (e.g., the 'rural' or 'regional') not so far addressed in this literature. I show how the scaling logics expressed in the 'Oxford-Milton

Keynes-Cambridge Arc' concept, for example, promises citizens enhanced infrastructural and technological connectivity enabled by living lab innovations.

The contribution of this chapter lies in its examination of specific ways that the living laboratory is seen as a spatial arrangement that – while being tied to this longer-term vision of Oxfordshire's economy being centred on innovation – is imagined as producing positive benefits for citizens through experiments with new technologies or services. While there are some similarities with the participatory version of smart citizenship discussed in the previous chapter, this chapter argues that the beneficiary form of citizenship is distinct because it is based on discursive imaginaries of citizenship that position citizens as primary beneficiaries of testbed or living lab approaches to innovation. I evidence how a far more technocratic and instrumental interpretation of citizenship was elaborated by the councillors and technologies I spoke to. Far more emphasis was being placed on citizens as 'users' or 'consumers' of imagined technologies who act as experimental subjects in testbeds. Citizens 'co-produce' differently in living labs by interacting with technologies and thus emulating real-world conditions that later evidence the commercial value of technical solutions. Rather than vocalising ideas or using devices to engage with smart cities, *beneficiary* citizens are imagined primarily as users who benefit from early access to new services or solutions.

The chapter's arguments are organised into two main sections that follow a brief review of relevant literature. Section 5.3 unpacks three logics that underpin how OxLEP partners frame the living laboratory approach. I suggest the anticipatory logics I identify provide the discursive rationale for present action to benefit citizens widely. Section 5.4 addresses the beneficiary notion in more detail. I analyse spokespersons' interviews and videos used by OxLEP partners to unpack the future-oriented imaginaries of Oxfordshire.

5.2. Conceptualising the 'living laboratory'

In this section, I critically evaluate the literature on the experimental city (key references include: Bulkeley et al., 2018; Evans, 2016; Karvonen and van Heur, 2014; Kullman, 2013), which is closely tied with literatures on smart. I start by providing a brief overview of the 'experimental turn', the characteristics of living labs, and the spaces of experimentation detailed in the literature. I then identify a set of citizenship positions evident in living labs that I argue overlap with notions of participatory citizenships. Promoters of living labs proclaim this centres on the pragmatic aspects of 'doing' innovation in smart cities, in such a way that blur the figures of 'citizen', 'user', or 'consumer' (Cardullo, 2022). I suggest the 'beneficiary' term captures the discursive framing of living lab experiments and its implications on citizenship based on the analysis that follows.

Both Chapters 3 and 4 discussed the growing trend of smart cities being designed, organised, and understood as 'experiments' where ideas or technologies are tested, trialled, and demonstrated (Engels et al., 2019; Evans et al., 2018; Halpern et al., 2013). Several of the iHUB 'projects' mentioned in Table 3.8, for instance, were being framed as smart experiments or pilots (Torrens and von Wirth, 2021), and later repackaged as 'living lab' or 'urban lab' examples (i.e., DRIVEN). The living lab term is fairly nebulous. The European Network of Living Labs (ENoLL), a growing advocacy coalition similar to its smart city affiliates (Kitchin et al., 2017b), defines living labs as a "user-centred, open innovation ecosystem based on a systematic user co-creation approach, integrating research and innovation processes in real life communities and settings" (2020). This definition frames living labs as an approach that intervenes in processes of organising, producing, or applying experimental knowledge or innovation (Baccarne et al., 2014; Karvonen and van Heur, 2014).

Amongst academic accounts, the living lab is understood slightly differently as "a space for the co-production of experimental knowledge by bringing together multiple urban stakeholders who share a common interest in addressing specific urban problems or improving the urban condition more generally" (Evans, 2016, p. 437). In this definition, living labs follow a problematisation of the city that identifies urban challenges to be resolved through coordinated action with urban stakeholders. In both scholarly and practitioner accounts, the 'co-creation' and 'co-production' terms imply a heightened degree of citizen agency equivalent to the

participatory vocabularies in the previous chapter. Living labs are henceforth viewed by some scholars as an applied model of organising more participatory smart city projects, particularly by engaging citizens in the process of innovation.

Living labs imply a blurred distinction between experiments conducted under laboratory settings with tests conducted in the 'real-world' (Caprotti and Cowley, 2017; Evans, 2016). Laboratories have conventionally been constructed as the site of controlled and managed scientific experiment in which generalisations about the world are abstracted (Gieryn, 2006). Comparatively, the idea of living labs is to test or experiment with technologies 'in the wild' (or, *'in-vivo'*) in order to encounter the 'messy' variables or parameters of cities (Muniesa and Callon, 2007). It is believed that digital technologies should be tested in urban settings with users as a way to accelerate the innovation process (Dutilleul et al., 2022). Urban labs are also understood as socialising citizens with technologies in the prototyping process of development (Marres, 2020a). Cities, as centres of innovation activity, arguably enable the conditions or ideals of living labs to be fully realised (Florida et al., 2017; Lovell et al., 2018; Shearmur, 2012; Zukin, 2020). The living lab is thus 're-cast' smart cities as a '*beta-version*' (Cardullo, 2022, p. 79) in need of testing through *in situ* experimentation with citizens.

The critical literature on living labs highlights three characteristic logics that underpin this approach to the smart city. First, is the pervading 'project' logic of

arranging living lab experiments, which is the organising mode of EU schemes like the EIP-SCC, Horizon 2020, or the ERDF. Smart projects are measured against pre-set performance criteria, structured by temporary funding, and implemented via a prefixed set of tasks (Torrens and von Wirth, 2021). Second, is the 'scaling' (or 'upscaling') logic apparent in living lab strategies, where significant concern is placed on expanding pilots of smart technologies or policy solutions (Torrens et al., 2018; van Winden and van den Buuse, 2017). This is an imperative induced by pilot funding in order to identify successful business models or cases and, subsequently, deliverables (Cardullo and Kitchin, 2019). Relatedly, is the third logic of 'replication' which aims to recognise exportable approaches, policies, or technologies able to be transferred to other cities or contexts (Calzada, 2020c). This is fundamental to the EU's strategy of distinguishing 'Lighthouse' and 'Follower' cities for example (Haarstad and Wathne, 2019; Späth and Knieling, 2020), which is based on demonstrating then spreading solutions asynchronously. Replication and scaling are both evidently spatial and temporal logics of smart cities based on the generalisability and policy mobility of living lab experiments (Wathne and Haarstad, 2020), which in turn appeal to the strategic conditions of EU programmes. Citizen inclusion adds to the discursive rationale for projects, scaling, and replication.

Living lab experiments emerge in diverse places or contexts. Universities, for instance, have a significant mediating role in organising and facilitating living laboratory experiments on campuses (Karvonen et al., 2019b; Powells et al., 2018).

University campuses are considered to be an ideal space to test-bed innovations in urban-like environments given that these are 'bounded' spaces already enrolled in applied research and teaching activities. Both Hodson *et al*. (n.d.) and Evans *et al*. (2015), for instance, discuss the incorporation of academic teaching and learning in sustainability experiments along the Oxford Road corridor of Manchester University. The campus represents a well-resourced environment in which to convene stakeholder partnerships towards the ideals of knowledge co-production.

'Boundedness' is a similarly important feature of tech-driven living labs, especially with CAV trials, where the degree of control or exposure is an important testing criteria (Hopkins and Schwanen, 2018; Marres, 2020a). Testbed sites also configure the technologies and expertise to demonstrate and then articulate the scalability of CAVs (Marres, 2020b). In other cases, living lab spaces are established and proliferate in vacant properties in cities in order to host tech events, like citizen science or hackathons (Cardullo et al., 2018). This case further entrenches the well-established argument that smart cities follow a neoliberal model of growth (Hollands, 2008; Vanolo, 2014). In all, the above examples demonstrate the organisational and experimental conditions that factor into the spatial contexts in which living labs emerge.

Living labs as an approach to smart city making can enact the forms of participatory citizenship identified in the previous chapter (Cardullo, 2022; Engels et al., 2019).

This is evident in the organisational and methodological principles of the 'triple', 'quadruple', and 'penta' helix frameworks (see Figure 5.1) deployed in EU schemes. These frameworks design in a strategic role for civic society engagement in innovation processes (Calzada, 2020b), with the implication being increased citizen agency from passive to proactive stakeholders. The democratic dimension of the penta-helix framework, for instance, mobilise the civic ideals of citizenship ownership and data commons (Calzada, 2020a). The vocabularies of 'co-creation' or 'co-production' used in living labs similarly evoke a highly participatory model of citizenship in experiments, as in Cities-4-People (see Chapter 4). It implies living labs incorporate citizens decision-maker. Indeed, the living lab examples in Cardullo and Kitchin's (2018) scaffold rank favourably as a form of citizen power, which is surprising given inclusion in hackathons is generally premised on tech skills or expertise (Irani, 2015). Broadly, then, the living laboratory appears to be discursively framed or understood as different to 'top-down' smart cities by nurturing citizenship agency in experimental cities.

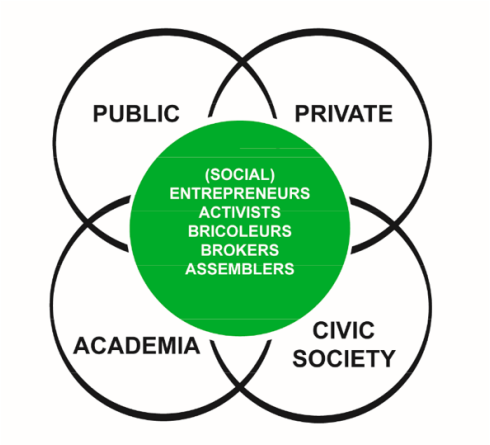

Figure 5.1: The 'penta-helix' multistakeholder framework. Reproduced from Calzada (2020a).

In some contexts living laboratories are specifically framed as 'user-centric' experiments that emphasise product testing or service pilots and development (Schliwa and McCormick, 2016). In other cases, however, citizens become incremental to market-validation exercises or are treated as passive experimental subjects. Users are valued as consumers whose designated role is to provide system feedback as test recipients of prototyped services (Leminen, 2013). The 'centricity' of users in this instance relates far more to the implied benefits of downstream inclusion via agencies enabled by technology or service experiments.

This section identified some common characteristics of living laboratories from the experimental city literature. I argued that the living laboratory approach largely reinforces the 'bottom-up' ideals of smart citizenship, by adopting co-creation, inclusion, or participation ideals. There is a tension between the 'citizen-centric' and 'user-centred' framing of living labs that casts citizens as service or technology consumers to accelerate technology or service design. I propose developing the 'beneficiary' term as an analytical category to understand ways citizenship is enrolled in the discursive justification of experimental action.

5.3. Understanding the 'living laboratory' in Oxfordshire

I now turn to the empirical context in which living laboratories were being discussed in Oxfordshire. I start in this section by identifying three logics that underpin the living lab concept shared by local Oxford spokespersons, many of whom contributed

to developing the LIS. To do so, I draw on Anderson's (2010) notion of 'anticipatory action' to interpret living labs through the lens of 'precaution', 'pre-emption', and 'preparedness'. This is a conceptual heuristic originally designed to understand the programmatic responses of liberal democracies to identified potential threats, like major events, crises, or emergencies. Anticipatory logics provides a language to understand how actions (or 'calls for action') are rationalised. These actions are henceforth ways to "prevent, mitigate, adapt to, prepare for or pre-empt specific futures" (p.779). While the empirical contexts used in Anderson's formulation were based on crises of global warming, terrorism, war, or pandemic outbreak, this framework has been used for more quotidian contexts too (e.g., Kinsley, 2012), and including smart (White, 2016). It has also used by others to unpack the multiple temporalities or 'timescapes' of smart cities (Datta, 2018b; Kitchin, 2019). I argue living laboratories were explicitly framed by Oxford spokespersons through this set of anticipatory logics as a way of justifying short-term experimental action, aligning the conditions of technological futures, and attracting UK government interest or investment.

In addition to the LIS itself, I draw on observations from a roundtable meeting that convened a number of local spokespersons where ideas for developing Oxfordshire as a living laboratory were further discussed. The spokespersons at this meeting were identified as a result of their previous participation in roundtable events or closed-door meetings coordinated by OxLEP and Mobility Oxford partners. The

meeting convened a wide range of people representing the city and district councils, the Oxfordshire Growth Board, the Smart Oxford board, the Science and Technology Facilities Council (STFC), both Oxford University and Oxford Brookes, the UK Atomic and Energy Authority (UKAEA)/the RACE facility, and multinational businesses including EDF Energy and Siemens. None of the 80 local Community Action Groups (CAGs) in Oxford were invited to this event, nor to others I was able to access. The roundtable organisers described attendees at this event as 'high-level' candidates to progress the living laboratory approach and to later formalise a leadership board (see Chapter 6). During the event, the principles and ideas of the living laboratory concept were fleshed out and then refined in several meetings, email communications[20], and the LIS drafts that followed. This resolved in a definition of living laboratories as a "user-centred, open-innovation ecosystem, operating in a territorial context, that integrates concurrent research and innovation processes within a public-private-people partnership" (Field Notes, Smart Oxford Presentation, July 2019). This is relatively consistent with the living lab definitions I introduced in Section 5.2.

My analysis of the anticipatory logics of living labs unfolds in three subsections. First, I discuss how living labs were invoked in the LIS as an urgent response to a set of imminent urban crises, such as an ageing population, sustainability, or climate

[20] After the roundtable, I was included in a short email thread with a small group of spokespersons where a protracted discussion was prompted by a BBC news article on 'Sidewalk Labs' and the appropriateness of the 'living laboratory' term. Spokespersons generated several alternatives like 'Connected Innovation Partnerships' or 'Embedded Innovation Communities'.

change. Living labs were framed as an approach to enable experimental partnerships and enhance the innovation capabilities of Oxfordshire to address pre-empted 'Grand Challenges' in the UK. Second, I explore how Oxfordshire was considered a model or representative site for living lab pilots to be 'scaled' or 'replicated' elsewhere. Pilots completed in Oxfordshire were considered specifically valuable to be extrapolated or exported as 'solutions' to larger UK cities. Thirdly, I argue living labs were packaged as part of the innovation imperative expressed by OxLEP partners and the LIS. A living lab approach was considered to be a pre-emptive step towards the economic opportunities incited by anticipated technological advancements. This includes new regional infrastructure proposals.

Citizens were generally discursively presented as beneficiaries of anticipated living lab action. Living labs prepare citizens for crises responses by incrementally introducing technological changes. Living labs prepare for economic change by providing citizens with upskilling training for opportunities in Oxford's innovation ecosystem. And living labs enable citizens to 'co-create' solutions in living labs by providing the test conditions with other smart partners. Altogether, I argue that the anticipatory logics of living labs provide a discursive rationale for developing such an approach in Oxfordshire to advance normative visions of the smart futures I address later in this chapter.

5.3.1. The living lab as an urgent response

Living laboratory experiments conducted in Oxfordshire were framed by OxLEP spokespersons and the LIS as an urgent response to anticipated crises and a pre-emptive step towards technologically-mediated urban futures. The purpose of the LIS was described by spokespersons as a way of calibrating and aligning local agendas with those held by the Department for Business, Energy, and Industrial Strategy (BEIS) and the UK government. A key feature of this was joining together economic priorities of innovation in Oxfordshire with national objectives found in the UK's industrial strategy (2017). Of particular importance were the UK government's four 'Grand Challenges' (see Table 5.1), which were presented as strategic priority areas for future industrial and economic activity. These were identified in a Green Paper based on a consultation with the Government Office for Science, UK Research and Innovation (i.e., UKRI, Innovate UK), the Council for Science and Technology, and national academies. The four Grand Challenges were: 1) the artificial intelligence and data revolution; 2) a shift towards clean growth; 3) leading the future of mobility; and 4) meeting the needs of an ageing society. The challenges were a mix of responses to predictable crises (e.g., an ageing population, the effects of climate change) and a call to prepare for uncertain futures (e.g., issues of sustainability, technological change). Table 5.1 summarises how grand challenges were being posed as opportunities to position the UK as 'world-leaders' in a number of areas, like being at the 'forefront' of AI or data-driven technologies. Similarly, the LIS weaved in grand challenges with the Oxfordshire ambition to be "one of the top

three global innovation ecosystems by 2040" (p.4). Grand challenges were therefore provocations or framings that indicate how crises generate or give rise to economic opportunities aligned with the competitive agendas of Oxfordshire and the UK.

In interviews with OxLEP spokespersons, it was made clear to me that Oxfordshire was being prioritised by the UK government as a prime location to respond to these challenges. The reason for this was that Oxfordshire was considered a 'trailblazer' region by the UK government and its BEIS department, alongside the West Midlands and Greater Manchester LEPs. This meant Oxfordshire was part of the first 'wave' of LEPs to provide Local Industrial Strategies in 2019 with 2 waves planned in March 2020 (LEP Network, 2020). Hence, it was imperative to demonstrate and consolidate how grand challenges would provide the "discursive backdrop" (Caprotti and Cowley, 2019, p. 5) to action in these exemplar strategies.

Table 5.1: The UK government's 'Grand Challenges' for the Industrial Strategy. Adapted from the UK Industrial Strategy (2017).

Grand Challenge	**Summary**
1. Clean Growth	- Developing smart systems for cheap and clean energy in areas like power, heating, and transport - Transforming construction techniques to improve efficiency - Making energy-intensive industries competitive in the clean economy - Put the UK at the forefront to high-efficiency agriculture - Make the UK the global standard-setter for finance that supports clean growth
2. The Future of Mobility	- Positioning the UK as a world leader in the future of mobility - Establishing a regulatory framework for new modes of transport and business models (e.g., self-driving cars by 2021) - Moving from hydrocarbon to zero emission vehicles - Prepare for new mobility services, increased autonomy, journey-sharing, and a blurring of the distinctions between private and public transport - Using data to accelerate development of new mobility services and enable the more effective operation of transport systems
3. An Ageing Society	- Leveraging the 'business opportunity' of an ageing population in the UK - Using health data to improve health outcomes - Supporting care providers to adapt business models and encouraging new models of care - Responding to new demands for technologies, products, and services from ageing populations
4. The AI and Data-driven Economy	- Positioning the UK as a global centre for artificial intelligence and data-driven innovation - Adopting artificial intelligence in six priority sectors of cybersecurity, life sciences, construction, manufacturing, energy, and agricultural technology - Investing in training and skills programmes - Establishing a government advisory board for the ethical use of data and artificial intelligence

Table 5.2: Proposed 'living laboratories' in Oxfordshire. Adapted from the Local Industrial Strategy (2019) and author notes.

Living Laboratory Priority Area	**Suggested Locations**	**Description**
Data and Mobility Living Lab	- Culham Smart Village - West Oxfordshire - Oxford City - Didcot Garden Town	"This will explore new solutions and technologies, such as autonomous vehicles and smart infrastructure to support improved connectivity and mobility across the ecosystem. They will explore the use of integrated transport services that reduce reliance on private vehicles while promoting independent living and reducing congestion"
Clean Growth Living Lab	- Harwell Business Park - Bicester Garden Town - Culham Smart Village	"Working with Oxford-Cambridge Arc partners at sites including Harwell, Bicester Garden Town and Culham Smart Village to pioneer new forms of locally generated low carbon energy technologies and solutions. Oxfordshire will work with partners to develop, evaluate and pilot innovative low-carbon energy technologies and solutions for new housing settlements and business locations including the development of off-grid and new fuel services. These labs will support Oxfordshire's commitment to a 50 per cent reduction in CO2 emissions by 2030 compared to 2008, and its wider vision for net zero emissions by 2050"
Health and Wellbeing Living Lab	- Global Health and Life Sciences Quarter - Milton Park - Harwell Business Park	"This will provide pioneering resources and innovation, and support other life science hubs across the ecosystem…into health services within existing communities and the new Garden Towns, Garden Village and other settlements with a focus on delivering improved outcomes arising from an ageing society"

The LIS presents developing Oxfordshire as a 'living laboratory' as its approach to tackling the UK government's grand challenges. This approach takes many forms. Firstly, the living laboratory is presented a set of physical testbed sites to carry out 'smart living pilots' across Oxfordshire (see Table 5.2). This fits the conventional and rather territorial understanding of living labs whereby action takes the form of physical experiments or trials (e.g., DRIVEN). I refer to this as the 'testbed living lab' version. Secondly, the living laboratory enables processes of 'co-creation' to involve 'user communities' at earlier stages in designing or testing technologies. The emphasis of living laboratories here is about expanding the scope of pilots to accelerate and validate products, services, or solutions through scenario testing, concept validation, or design. I refer to this as the 'co-creation living lab' version. The emphasis of both the testbed and co-creation versions was that experiments were designed to develop technological 'solutions' to grand challenges with citizen input. Thirdly, living laboratories would enable new innovation partnerships or collaborations by enhancing testing capabilities or capacities in Oxfordshire, and thus attracting tech expertise. I refer to this as the 'partnership living lab' version. All three living lab versions I describe relate to a set of interconnected responses articulated by OxLEP partners and the LIS to solve the UK's grand challenges.

Testbed living labs were a specific type of anticipatory action that seeks to 'speed up' the process of testing, developing, and deploying emerging technologies. Using slides from a PowerPoint presentation given at a corporate event, a RACE/Culham

Science Centre spokesperson talked me through his understanding of living labs. He described living labs as an opportunity to 'disrupt' sequential models of innovation diffusion (see Figure 5.4). Systematic models like this argue that the diffusion of ideas or technologies follow a linear pathway starting at the 'niche' stage with 'innovators' and 'early adopters' through to the 'market transformation' stage with 'late majority' and 'laggard' adopters. According to the spokesperson, living labs intervene in the 'chasm' between the early and majority stages. This is a classic techno-economic understanding of innovation. One way this is achieved is by "socialising" citizens with technologies or services to rapidly gather user feedback, explore emerging applications, or understand user behaviours. The spokesperson stated that living labs, "helps you explore why people in their right mind would buy this [product]. It's a game finding out what people value in the product they buy rather than actually the technical brilliance of [a technology]" (Interview, July 2019). According to this definition, the testbed version frames citizens as passive subjects in the design and testing process (Schliwa and McCormick, 2016), whose patterns of adoption or usage are critical to rapidly identifying market opportunities.

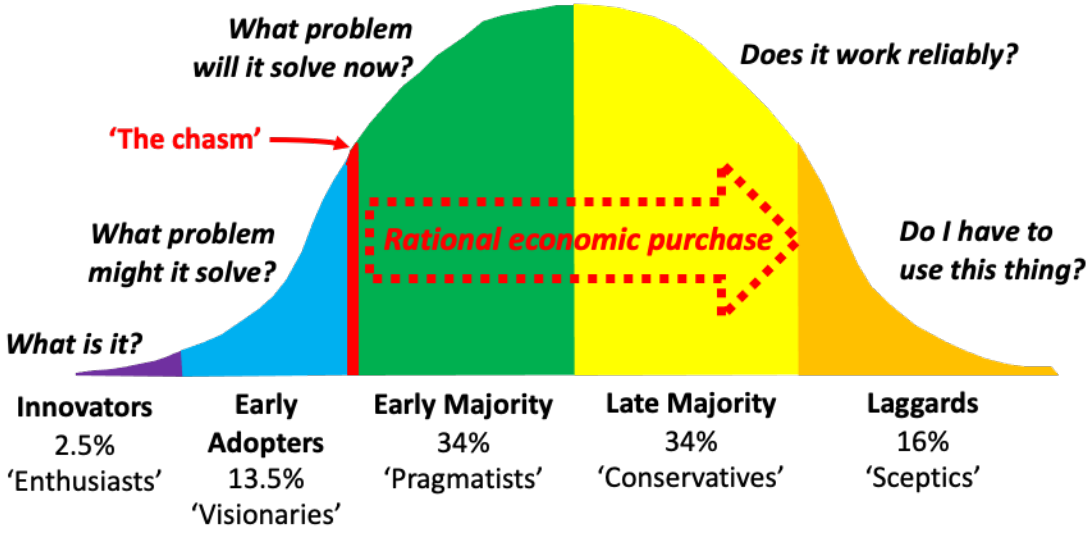

Figure 5.2: Diagram of Everett Roger's (1995) theory of innovation diffusion that seeks to explain how new ideas or technologies spread. Source: Interviewee PowerPoint.

Living labs were also considered a way of enabling new innovation partnerships to bring together expertise and collectively address anticipated challenges through technology solutions. The thematic labs identified in Table 5.2 were a way of upgrading innovation capabilities in Oxfordshire in several ways, like creating 'future-ready' testbeds or 'pioneering' resources. Labs were also a way to bring together 'multidisciplinary, multi-sector teams' that enable R&D at the Oxford, Harwell, Milton, and Culham Science Parks, as well as other strategic partnerships. Oxfordshire was argued to be uniquely positioned to undertake this approach. For instance, a spokesperson from the West Oxfordshire District Council stated that:

> "We're going to have quite a lot of change in the future. We've got quite a lot of cutting-edge research and businesses as well. Can we put those things together to test out new ways of doing things…[and] testbed new ways of solving problems?" (Interview, July 2019).

The quotation was typical of the suggestion that the present 'innovation ecosystem' in Oxfordshire meant it was acutely capable of solving future challenges through

living labs as a pre-emptive approach. Again, the idea that anticipated crises give rise to economic opportunities was further mobilised here to present Oxfordshire as an ideal place in which to develop living lab partnerships and solve these problems.

The final framing of living laboratories I discuss in this section relates to the way crises were being experienced at national and local scales. In the Oxfordshire County Council iHUB brochure, the living lab approach was identified as a way to address the UK's 'present infrastructure needs' in thematic areas like energy, health, transport, and housing. The claim that "Oxfordshire has these pressures now, just like many areas of the country" (Oxfordshire County Council, 2017a, p. 21) implies that Oxfordshire will develop 'solutions' exportable to other UK cities. The local response was necessary to address challenges experienced at other scales. The quotation heightens a sense of local urgency by situating crises in the Oxfordshire context, thus making relevant the need for local action. I elaborate on this further in the next section where I discuss the significance of scale in living lab experimentation.

5.3.2. The living lab as a scalable case

Another claim made by OxLEP partners invested in developing Oxfordshire as a living laboratory centred on the notions of 'scalability' or 'replicability' inherent in experiments or trials (see Section 5.2). I earlier identified how both of these logics assume that locally-tested technologies can be easily expanded or exported in other

contexts as ‘solutions’ (Pfotenhauer et al., 2021; Torrens and von Wirth, 2021; van Winden and van den Buuse, 2017). The principle is that technologies are highly mobile rather than situated specifically in the contexts it is tested. The scalability and replicability claims were based on an argument that Oxford city faced the same challenges to those in other UK cities, albeit experienced at a smaller scale. This was elaborated further in the OxLEP Innovation Strategy (2017). The document describes Oxford city as a “compact landscape” which “shares many of the same challenges of a larger city”, but that “we also have the capacity and capability to develop, test and deploy the technologies that can help address them” (p.31). There were two distinctions being made in this statement. Firstly, Oxford is positioned in relation to larger cities through its shared ‘challenges’ to indicate that the city and its particular configuration gives rise to similar problems. The emphasis here is not on the particularity or specificity of Oxford, but on its generalisability. Oxford is evoked as a ‘compact landscape’ in which to prototype technologies, which is suited to upscaling claims as a place to model solutions. In the second half of the quotation, Oxford is distinguished from other cities due to its ‘capacity’ or ‘capability’ to test responsive technologies. The concentration of university research, expertise, and business/science parks in Oxford were attributed to this advantage. This is typical of ways UK smart cities identify sectoral strengths to discursively narrate local visions of smartness (Caprotti et al., 2016a; Caprotti and Cowley, 2019). Similar to the previous section, the OxLEP claim that Oxford is particularly suited to living lab experimentation was based on a contradictory

tension between the generalisability and specificity that enables technological replicability or scaling.

Other OxLEP spokespersons affirmed this idea of Oxford being suited to living lab experimentation due to the scale in which urban crises were experienced. An OxLEP spokesperson stated that, "Oxford is a small city but with some big city challenges and demographics…what we meant by that is congestion is a challenge, air quality is a challenge. Some of the social challenges, structural challenges of Oxford are big city challenges." The suggestion that challenges faced in Oxford are emblematic of those in larger UK cities further adds to the living labs justification as: "if you get it right here you can pretty much be confident that you can scale it up and replicate it [a solution] elsewhere, and it has commercial value to work everywhere" (OxLEP Representative, June 2019). In this quotation, both the upscaling and replicability logics promised future benefits from developing 'solutions' not just to Oxford citizens, but also to cities that share its challenges. Again, Oxford was envisioned as a template in which to prototype technologies then scale or replicate to other UK cities.

In addition to these logics, OxLEP partners argued Oxfordshire was best suited to develop a living lab approach as there were already demonstrable partnerships enabled by experimentation. CAV projects like DRIVEN and Multi:CAV were used as testbed exemplars in the LIS. The existing experimental practices of these projects

were linked with the economic development aims of Oxfordshire (Hopkins and Schwanen, 2018). Existing smart projects were evidence of the partnerships made possible by local authorities, universities, and businesses adopting this living lab approach. It was also deemed important to build on existing R&D and testing capabilities at key sites. This is why several proposed living labs were in science or technology parks like Culham, Harwell, or Milton Park (see Table 5.2). The co-location of living labs with these parks was again about the aim of Oxfordshire being a top innovation ecosystem. Existing smart projects were therefore demonstrating that Oxfordshire had the capabilities to demonstrate how the partnership living lab approach could be implemented.

5.3.3. The living lab as facilitating regional partnerships

In this subsection, I identify how developing a living lab approach in Oxfordshire contributed to a strongly economic rationale of extending regional and strategic partnerships. Living laboratories were packaged as part of a wider economic growth plan that centres innovation in Oxfordshire as well as the partnership opportunities that emerge from the regional concept of the 'Oxford-Milton Keynes-Cambridge' arc. I discuss how regional partnerships are part of the anticipatory imaginary of economic growth in terms of the innovation 'imperative' expressed by OxLEP partners in the LIS. By this, I mean the significant discursive value placed on expanding the influence of Oxfordshire and its innovation 'ecosystem'.

The logic that living laboratory experiments would further economic growth in Oxfordshire was often tied to particular spaces designated as suitable sites to develop its testing capacities or capabilities. This often related to pre-existing networks and partnerships between institutions, researchers, companies and local government. For instance, the University of Oxford was seen as having a key role in determining the availability of infrastructure for innovation with an additional two innovation districts outlined in its University Strategic Plan (Oxford University representative, July 2019). These innovation districts would contribute to an existing network of Science and Business Parks as part of the 'Science Enterprise Zone' which includes the Oxford, Harwell, Milton and Culham centres. It was understood that local companies would be encouraged to accelerate product developments through strategic partnerships with major companies, such as Siemens, Bosch, EDF Energy, and BMW using living laboratory facilities to accelerate testbed experiments and commercialisation. This connects with the assertion in the literature that evidences the importance of university campuses in facilitating and hosting living laboratory experiments (Coletta et al., 2019; Evans et al., 2015). Advancing the competitiveness of Oxfordshire in terms of material spaces of innovation was important to OxLEP in order to secure further investment from central government and bolster the economic growth of the region.

Interviewees described the LIS as co-ordinating with a wider regional economic geography through the Oxford-Cambridge Arc (or the 'Cambridge – Milton Keynes –

Oxford corridor'). Figure 5.3 shows a map of this south-easterly region which also involves Northamptonshire and Bedfordshire. The 'arc' is constructed around the idea of connecting the cities of Oxford and Cambridge via Milton Keynes and other settlements across the south-east. Until recently, the UK government deemed the arc to be an area of national strategic importance as a centrally-driven project for economic growth in the near future. The initial push for the idea was the National Infrastructure Commission who proposed that the south-east of England could become a major high-tech industrial zone if there was significant investment in major infrastructure and collaboration between universities, cities and LEPs. The NIC report estimates that the Arc could produce 335,000 new jobs by 2050 and increase economic output by £85 billion per annum (National Infrastructure Commission, 2019). One interviewee described the Oxford-Cambridge Arc as a "new geography" for local planning and decision-making, but one where the expertise of regional stakeholders can be drawn together in order to support the development of 'transformational' technologies. In a similar way, a senior manager at the Oxfordshire County Council described the "real opportunity for Oxfordshire to influence the arc" (August 2019), furthering my earlier point on the importance of building a narrative of Oxfordshire as a centre for innovation.

Specifically, one interviewee suggested that living laboratory experiments conducted in Oxfordshire could contribute to an ambition to 'future-proof' infrastructure between locations in the Ox-Cam Arc. The interviewee claimed that

CAV testbeds at the Culham, Milton and Harwell business park were an 'end node' or 'western node' for the arc offering the potential to scale trials. They said, "a CAV link between Harwell and Culham is the start of a CAV link between Harwell and Cambridge. And so, you're slowly expanding your range…maybe actually the important thing is how we design that road from a digital perspective. How do you future-proof that corridor?" (UKAEA Representative, July 2019). The perspective of this interviewee was that Oxfordshire would be able to scale existing CAV testbed capabilities across spaces in the Ox-Cam Arc.

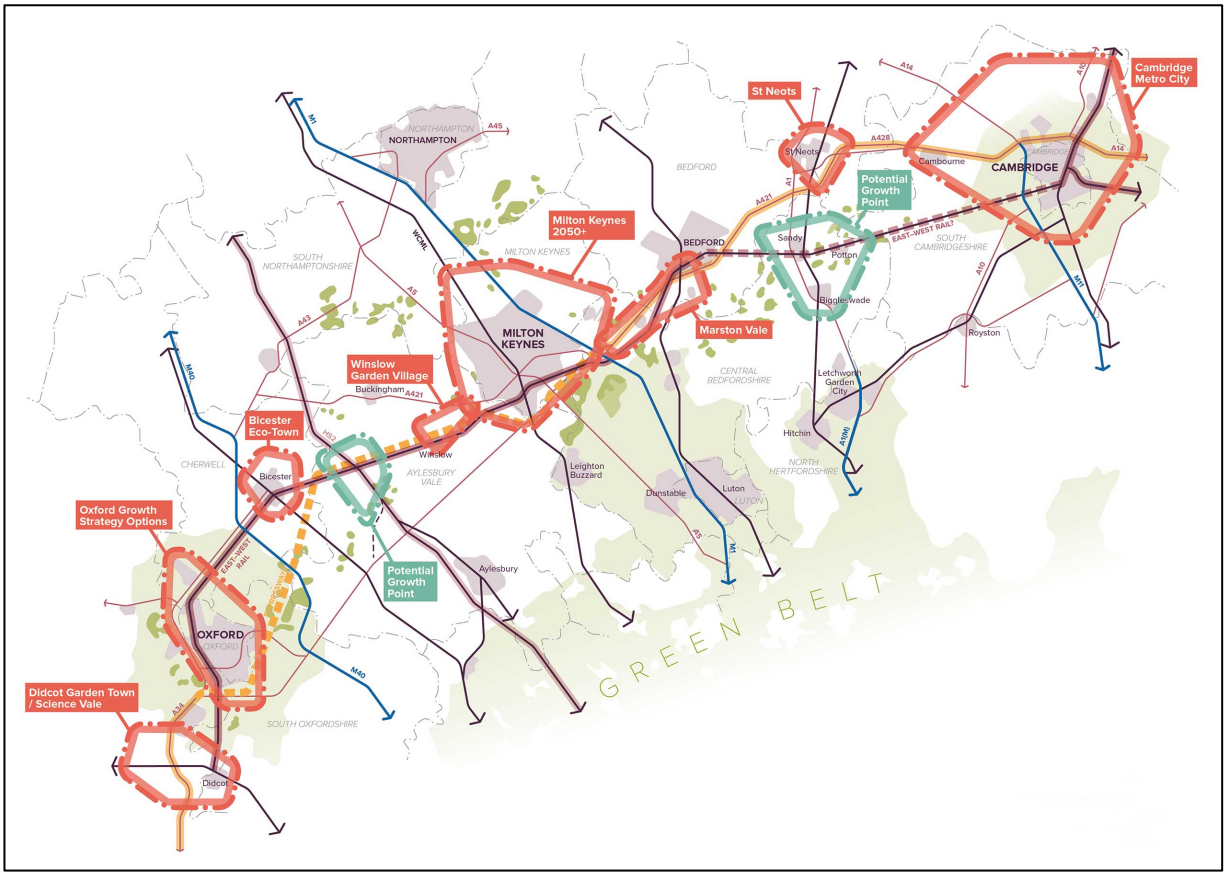

Figure 5.3: Map of the Oxford-Milton Keynes-Cambridge Arc. Provided with permission from © David Lock Associates (2020).

For others, the Ox-MK-Cam Arc was an opportunity to build and consolidate regional partnerships between LEPS, local authorities, universities, and other interested partners. An interviewee stated that that, "stronger relationships between Cambridge and Milton Keynes and between Oxford and Milton Keynes, that's where we need build up some of the interlinking and some of the relationships" (West Oxfordshire District Council Representative, June 2019). They then describe these cities as 'independent little islands' as "there isn't that connectivity between them that maybe there ought to be." This shows that the Ox-Cam Arc is as much about the physical infrastructure required to connect cities like Oxford to Milton Keynes, that it is also about possible partnerships between these institutions in this region. This was a sentiment shared by a senior representative at Oxford Brookes University: "we also have a regional agenda which is about collaboration with stakeholders in the Oxfordshire area and further afield including the Oxford Cambridge Arc" (September 2019). Both the living laboratory component of the LIS and the Ox-Cam Arc concept were repeatedly discursively constructed as opportunities to build Oxfordshire's innovation capabilities through relationships, strategic partnerships, and shared regional agendas. The innovation capabilities of Oxfordshire are then materialised through physical testbeds or living labs as sites that demonstrate where experimentation takes place.

In all, OxLEP partners had constructed multiple ways in which a living laboratory approach acted as an urgent response to the set of anticipated crises identified by

the UK's Grand Challenges. The three living lab versions I identified called forth different spatialities or temporalities of such a response. For instance, the testbed and co-creation living lab versions were both about building testing capacity at *physical sites* to enable new or *faster* approaches to developing technologies with citizens. This was mostly a short-term response to enabling experimentation at existing Oxfordshire sites. Comparatively, the partnership version was about a far more strategic vision of living laboratories to advance the global competitiveness of Oxfordshire as a reputable innovation ecosystem. The 2040 date cited provided a benchmark in which to achieve this ambition. Pre-empted challenges in the *present* were opportunities for future action to converge tech expertise or bolster innovation opportunities in Oxfordshire in the *future*. The living laboratory approach discussed in the LIS was not simply a matter of tech-washing urban crises by prescribing preparative 'solutions' as responsive measures. Rather, I argue it demonstrated a set of discursive logics held by OxLEP partners on ways of organising innovation in Oxfordshire, like experimenting with new R&D partnerships, facilitating testbeds capabilities, or identifying economic opportunities in Oxfordshire and the UK.

5.4. Citizens as beneficiaries of living laboratories

Thus far, I have identified a set of logics that underpinned proposals by OxLEP partners in the LIS to develop Oxfordshire as a living laboratory. The three living lab versions I earlier identified– the testbed, co-creation, and partnership labs – were evident in the OxLEP imaginary of living labs. Living lab citizenship discourses in

Oxfordshire were largely based on the figurative positions of the 'users' or 'co-creators' who take part in testbed pilots or experiments. In this section, I elaborate further the notion of citizens as 'beneficiaries' of living labs. I first discuss how living labs were conveyed as a measure to prepare citizens for anticipated changes aligned with future visions. Living labs help to convince or persuade citizens of a set of technological futures, which is mostly achieved through this mode of demonstration. I then analyse the two promotional videos of Oxfordshire that visualise and anticipate the benefits of future mobility modes in digitally-mediated imaginaries of Oxford. This demonstrates the deterministic presupposition of the OxLEP partners involved in the LIS of the technologies and services likely to be implemented in the future. By visualising what future technologies citizens will be able to benefit from in the future, OxLEP partners convince others of the necessity to develop a living laboratory approach.

5.4.1. Future-proofing the beneficiary citizen

In this subsection, I elaborate ways the Local Industrial Strategy framed citizens as 'beneficiaries' through the notion of 'future-proofing', which I argue reinforces the anticipatory logics of living labs. The idea of 'future-proofing' here differs from the way it was described in the previous section in terms of scaling regional testing infrastructures. I show the notion of future-proofing citizens was built in the LIS as a precautionary action, one which uses testbed pilots to introduce technical solutions gradually or incrementally, thus preparing citizens for imminent

technological changes. This is a technological determinist discourse that assumes the imminent inevitability of anticipated innovations aligned with visions held by local stakeholders like the Oxfordshire County Council and MobOx (see Section 5.5). I return to the Cities-4-People project too to evidence the temporalities of future-proofing benefits accrued by citizens in existing testbed pilots.

Another way that the living laboratory was constructed as positively benefitting citizens was by 'preparing' citizens for proposed long-term technological shifts in urban mobilities. The Local Industrial Strategy repeatedly states a commitment to "work with industry partners to develop pioneer communities that act as living labs, preparing communities for technological and environmental change" which includes "the advent of connected and autonomous travel, all electric energy, smart homes and sustainable living" (p.82). The four examples reflect thematic priorities identified in Table 5.2. Living labs were encouraged as a preparative approach that expects the 'advent' of new technologies to pose challenges citizens will help identify. As I described in Section 5.3.1, the tech-centred discourse of the living lab assumes the early intervention of citizens who will enable the accelerated scaling or replication of innovations, and thus its value. This logic undergirds the 'preparative' claim. Further to this, an OxLEP spokesperson referred to living labs as a way to "demonstrate how these new technologies, these emerging technologies can be implemented into our everyday lives" (July 2019). This claim is a projection of the quotidian contexts in which anticipated technologies will take place in Oxford. It is

an assumption of the contexts and temporalities being imagined by OxLEP partners of ways 'solutions' like autonomous vehicles will be implemented. Living labs in this way can be far more paternalistic or stewardship terms than what was evoked by 'co-creation' earlier.

In an interview with an OxLEP spokesperson, they stated the living laboratory was part of a 'wider conversation' shared between policymakers on building connections between citizens and their understanding of the 'Oxford' brand as a place known for its innovation capabilities. They stated that a key challenge for OxLEP in developing the Local Industrial Strategy was "the degree to which Oxfordshire's local communities are aware, engaged and then embrace the location, the place that is Oxfordshire" and by this they mean that the centrality of its innovation activities should be recognised as central to what Oxfordshire is. They go on to explain that there is a "distance between all of the world's leading science and technology and innovation and all of this sort of stuff that is bursting out of our ears…and local people who live in the county and who aren't exposed to it" (OxLEP Manager, May 2019). This suggests that there is an interest from the OxLEP to develop an understanding of innovation activities being coordinated in Oxfordshire with a wider set of publics. In turn, this would encourage researchers, citizens, companies and local government to support the wider agenda of Oxfordshire as a world leading centre for innovation.

One way that citizens would benefit from the living laboratory is through their advanced access to piloted technologies, products or services, which are expected to make "places more 'liveable' and enabling every citizen to engage with all the services on offer, public as well as private, in a way best suited to his or her needs" (OxLEP Innovation Strategy, p.31). This quotation casts citizens as users and consumers of services produced through experimental practices. To some extent, there are examples of these dynamics at play at the Oxfordshire County Council iHUB with the pairing of the Cities-4-People project with the launch of the Oxford Bus Company's 'Pick-Me-Up' app service. The app was designed as a demand responsive transit (DRT) service for residents in east Oxford to build connectivity between areas in Oxford city. The app interface is similar to other apps like Uber as it enables users to geolocate using GPS and plot a journey (see Figure 5.4). The pilot was cited as evidence of Oxford's openness to experimental trials, which was partly guided by citizen feedback. The initial service area covered, for example, was expanded based on user demand. To this end, there was certainly evidence of citizens benefitting from experimental practices mediated by this approach to Oxfordshire as a laboratory.

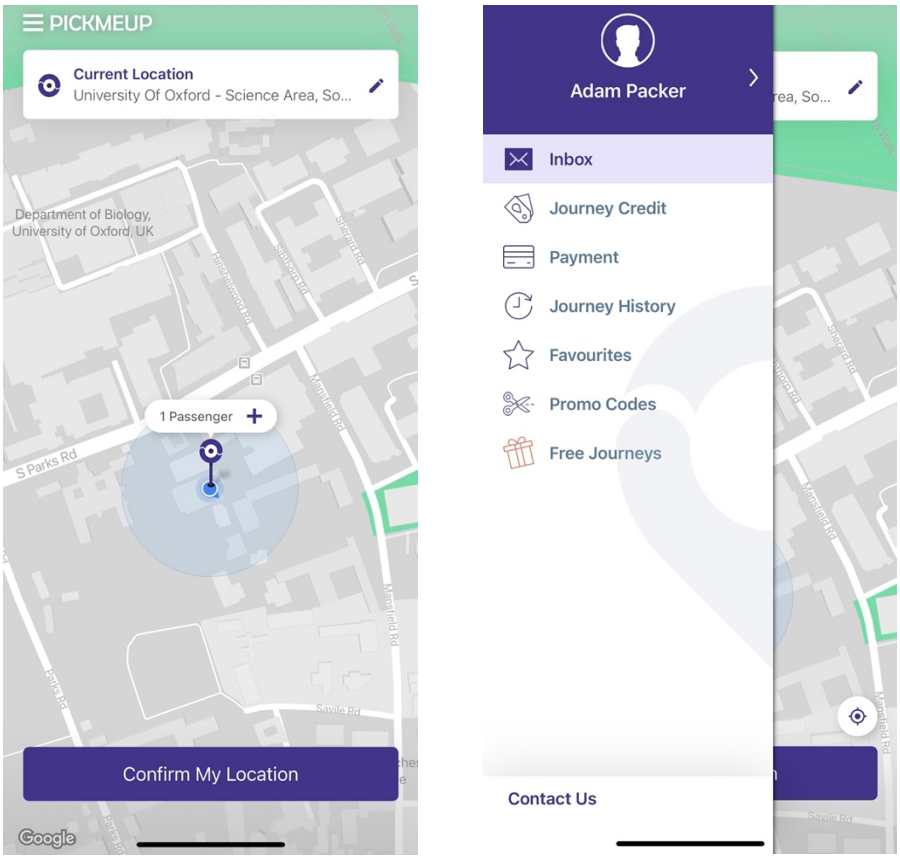

Figure 5.4: The 'Pick-Me-Up' smartphone app interface, the Oxford Bus Company. Authors screenshot of interface from iPhone device (2020)

Benefits accrued from living lab experiments with new digitally-mediated services like the Pick-Me-Up bus app might not necessarily last as technological solutions for citizens in the long term. 'Pilots' are funded as part of temporary grants or subsidies and thus rely on securing additional funding to continue to be financially self-sustaining and/or to scale-up operations (Torrens and von Wirth, 2021; van Winden and van den Buuse, 2017). This is not always possible. After running a two-year pilot, the Oxford Bus Company withdrew[21] the Pick-Me-Up bus app service from Oxford in its entirety, which the company attributed to a lack of external

[21] The 'Pick-Me-Up' service was withdrawn by the Oxford Bus Company in June 2020 due to a lack of external funding. The Oxford Bus Company stated the app was downloaded by "more than 38,000 people" and that "more than 300,000 journeys" were made through the service (2020).

funding or stakeholder support (Oxford Bus Company, 2020). Smart technologies, new digital services, and ideas tested in living labs are then reframed as *temporary* solutions where the commercial viability (or the 'business case') of the trial might have failed, but where essential forms of learning might enable future uses. Initial benefits of the new app or service were then revoked from citizens, which in this instance impacted already poorly serviced residents in east Oxford that the app was designed to benefit and connect. In the context of living labs, failed pilots like the Pick-Me-Up service are recast as evidence of the cyclic 'learning' process accommodated by 'doing' innovation as experiments. Failure further reinforces the OxLEP partners' justification of living labs to accelerate real-world trials to produce the local benefits of emerging innovations with other apps, connectivity, or mobility schemes. To be a beneficiary citizen means long term benefits accrued from smart tech in the purely imaginary and anticipatory sense articulated by OxLEP partners.

5.4.2. Imagining mobility futures in Oxfordshire

Throughout this chapter, I have shown how living labs were understood through a set of anticipatory logics used to justify experimental practices, materialise living lab testbeds, or discursively construct Oxfordshire's innovation capabilities. I have also shown how citizens were positioned as beneficiaries of living labs, mostly as users of prototyped technologies or services. I build on and develop this here by addressing visions of technology-driven change in Oxfordshire imagined by OxLEP partners. I analyse two promotional videos that I interpret as 'socio-technical

imaginaries' (Jasanoff and Kim, 2015) of 'smart' in Oxfordshire. The analytical approach I take is inspired by previous studies of smart city images and digital visual materials (; Rose and Willis, 2018; Wigley and Rose, 2020). Both videos centre on and propose futures that address a set of identified problems using networked modes of mobility linked with living labs.

The first video is from the UKAEA/RACE Culham Science Centre of the 'Smart Village' planned in south Oxfordshire. This is imagined as a 'real-world' testbed in which to pilot CAV technologies. The second is a video from the Oxfordshire County Council that visualises two future mobility scenarios that envision integrated Mobility as a Service (MaaS) solutions. I interpret these smart city visuals in relation to living lab discourses that emphasise benefits accrued from citizens as users or consumers of technical solutions. I show that the videos embed values of time, speed, or efficiency to show how technologies intervene in the organisation and mediation of mobility in the future.

In Section 5.3 I identified the 'Culham Smart Village' as a suggested location in the Local Industrial Strategy in which to develop the testbed living laboratory approach (see Table 5.2). The village is a proposed 3,500-housing development set opposite the UKAEA/RACE Culham Science Centre in south Oxfordshire and connected to Oxford city via the Culham railway station. I earlier showed how OxLEP partners viewed this site as a place to expand or upscale the innovatory capabilities of the

Culham centre to build on its CAV testing facilities and robotics expertise. The 'Data and Mobility' lab reflects the existing experimental focus and practices of CAV pilots associated with iHUB projects (e.g., DRIVEN) too. Culham had also previously received a £5.8 million investment in testbed facilities by OxLEP with the UK Centre for Connected and Autonomous Vehicles (CCAV) for a 'Pit Lane' test facility. This is a set of four industrial-style workspaces used to host CAV companies with private roads to perform controlled systems testing.

The LIS explains how the Culham Smart Village will be developed as a testbed site to benefit citizens. The site is described as a 'rare opportunity' to:

> explore digital-enabled living by building an inclusive all age connected-community; shared mobility ownership and first mile-last-mile intermodal transport; integrated data services including a community data trust; drone and autonomous vehicle delivery services linking local retail and community facilities with larger hubs in Oxford and Didcot/Reading; digital health/ GP services; integrated education with the adjacent European School; off grid energy, water, recycling and sewerage. These Living Labs will leverage the Housing Infrastructure Fund investment by resolving local congestion issues, building high-need housing as well as attracting multi-national attention and investment. Companies including Siemens, EDF, Bosch, Williams, Oxbotica, Arrival, Amey, Telefonica, Nominet would join UKAEA, University of Oxford and Oxford Brookes University in creating a world-class cluster building on the huge depth of scientific capability and capacity (p.81)

The LIS details a broad range of advantages of the 'digital-enabled living' imagined in the Culham Smart Village. First, is a set of mobility ideals including 'intermodal' or 'shared' transit which anticipates the rational behaviour change of citizens who are concerned with efficiency (Bergman et al., 2017). Second, are the technological delivery services that pilots of drones or autonomous vehicles provide to citizens. It follows the expectations of these emerging technologies as opportunities for service

or commercial value. Third, the Culham Smart Village is intended to 'attract multi-national attention and investment' as a reputable innovation 'cluster' following the OxLEP rationale of economic growth.

In the promotional video for the Culham Smart Village, the living lab is visualised in terms of the intended benefits citizens accrue from technical pilots of solutions. The video, which is widely available on the 'Smart Oxford' YouTube channel (2016), is a mix of text-based slides and 2D animations that show the 'digitally-enabled living' promised in Culham, which includes CAV-enabled mobility. The video starts by overlaying a map of the village site with key infrastructure features like roads or cycle lanes to connect the residential area to the existing science centre. Then, a slide for 'Mobility' introduces the Culham Village as a place, "where autonomous vehicles function in the 'real world' providing a robust environment for testing and delivering sustainable movement, particularly between living and working environments." The distinction of Culham as a 'real world' testbed implies that the co-presence of citizens improves how 'robust' the testing regime is for CAVs. The video then follows the scenario of a commuter journey. It starts with a smartphone notification indicating a vehicle arriving to pick up passengers from the Culham Smart Village (see Figure 5.5). The video shows a vehicle travelling to the Culham train station then dropping off a passenger who arrives in time for a train to London (see Figure 5.6). Then, another passenger is taken to the UKAEA Science Centre in time for an 11am meeting. The significance of this scenario was that CAV transit is

time-efficient, and that a multi-modal commute was reliable. In a similar way to other automated vehicles visuals (Wigley and Rose, 2020), the video imagines citizens in their capacity as users who readily uptake new app services as part of their commuting practices or behaviours. CAVs are imagined as meeting the needs of a commuter, as time-constrained, income-generating journeys (Singh, 2020, p. 834). The time reliability of the CAV-enabled commute provides the rationale for piloting the autonomous service in Culham, thus justifying the testbed approach.

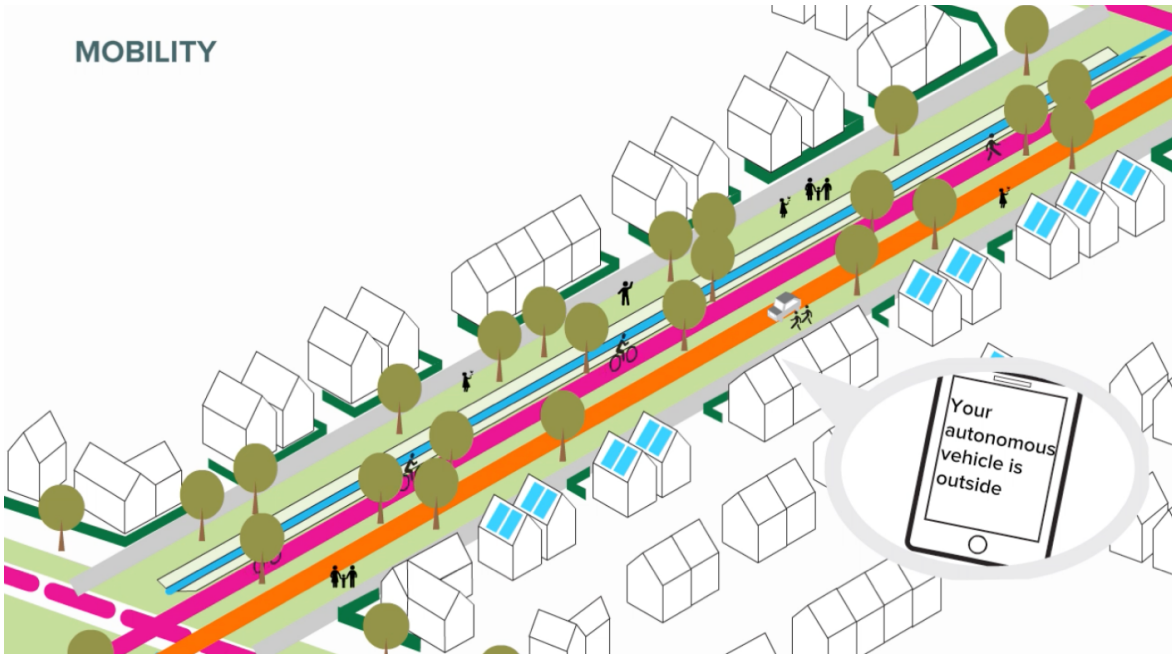

Figure 5.5: A visualisation of the smartphone-enabled CAV mobility service envisioned for residents in the Culham Smart Community, south Oxfordshire. Source: UKAEA Culham Science Centre.

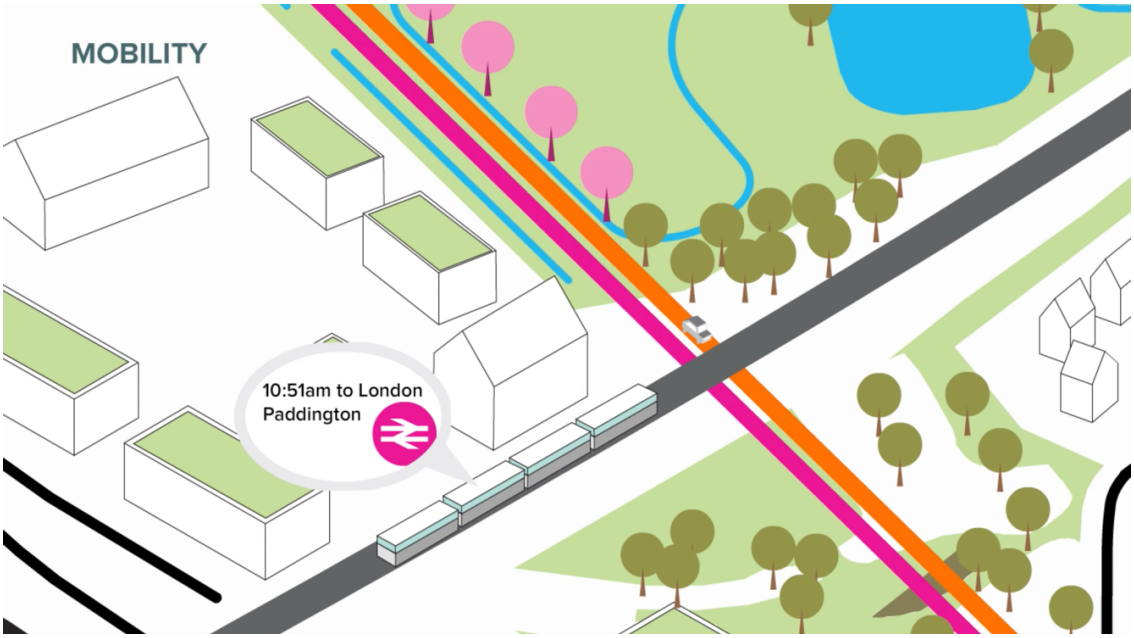

Figure 5.6: A visualisation of the CAV-enabled commute in the Culham Smart Village. Source: UKAEA Culham Science Centre.

Additionally, the video introduces the concept of a 'community trust' as a way of organising civic engagement with living labs, which includes the notion of data 'security' and 'control'. There were far fewer discussions on the precise constitution of a 'data trust' in the OxLEP living lab roundtable. Spokespersons described data trusts as a matter of privacy to ensure data was not 'abused' or to encourage open access policies. The idea seemed more like a discursive placeholder to signal a solution to the data politics of testbeds in light of notable cases like Sidewalk Labs.

Citizens were instrumental to the experimental conditions of 'real-world' living lab trials imagined in the Culham Smart Village. In the video, it was assumed citizens would willingly adopt and integrate a CAV-enabled shared mobility service, and that this would be integrated as part of a Mobility as a Service (MaaS) solution. The smartphone became a mediating platform for a CAV commute to schedule or notify

users of service updates, which will be further illustrated in the next video. Linking the Culham Smart Village with the Science Centre was thus presented as an opportunity to demonstrate the technical and commercial viability of technologies, hench the value of undertaking a living lab approach. The opacity of the data trust concept was indicative of its subordinate position compared with other commercial concepts or ideas. In all, the video aimed to persuade others that the benefits of developing the Culham Smart Village as a testbed were directed towards citizens by visually demonstrating the mobility agencies of technical solutions.

Similarly, the Oxfordshire County Council's '*Travelling into Oxford's future'* (2017) video, created by UK-based animation studio Blink Image, visualises two possible transport scenarios in Oxfordshire. The video, which was paired with an earlier proposal titled the 'Oxfordshire 2050 vision' (2017b), explains the current and future transport plans of the council to the National Infrastructure Commission. The NIC is an agency that advises the UK government on major infrastructure challenges. Ideas in the video and the report clearly inform parts of the OxLEP Local Industrial Strategy, like the anticipated ideas or solutions associated with living labs. Similar visuals were later used in the planning and consultation stage run by the Oxfordshire County Council in 2019. I argue the video is also a socio-technical discourse of Oxfordshire that aims to convince others of the proposed technologies or ideas evident in the OxLEP LIS. The video similarly highlights relative advantages

or benefits of imagined technical solutions to urban challenges much like previous sections of this chapter.

Similar to the OxLEP living lab proposal, the Oxfordshire video starts by identifying a number of challenges (e.g., congestion, air pollution, connectivity) that transport infrastructure innovation is best suited to address. It claims a series of measures like introducing new forms of rapid transit, creating a rail link across the Ox-Cam arc, or innovating new technologies will provide 'definitive' solutions to these problems. A simple narrative of cause and effect is given in the video to legitimise support for these ideas (Beckert, 2016). The video then relays two future scenarios of travel into Oxford city for 2031 and 2050 respectively. Both scenarios start with a MaaS-platform app interface which is based on a multi-modal shift in mobility. Multi-modal journeys are based on the incremental introduction of anticipated smart mobility modes, like CAV taxis or mass transit metros. The purpose of this being an incremental turn from a model of vehicle 'ownership' to 'usership' to increase traffic and mobility efficiencies. The options are ranked and calculated using live data to recommend a journey on time and cost efficiency. The functionality is similar to apps like CityMapper app or Google Maps, while the subscription model is similar to platform services like Uber. The perspective of this part of video is told from a future user who clicks to select their preferred journey (see Figure 5.6). Citizens are rational actors in this vision who faithfully adopt the MaaS app platform in order to organise a commute. The example of a commute is perhaps the easiest to visualise

as a journey viewed as one taken from A to B. The real-time data that the MaaS platform relies on implies an intensely connected, highly integrated transport network. This matches ideals of the Oxfordshire County Council (2017) elsewhere. The vision of MaaS portrayed here does not make visible the data flows or sensing infrastructures facilitating the reliability, convenience, or ease of the service. Nor does it demonstrate how a modal shift is encouraged to make this transition from individual to shared forms of transit suggested in the video.

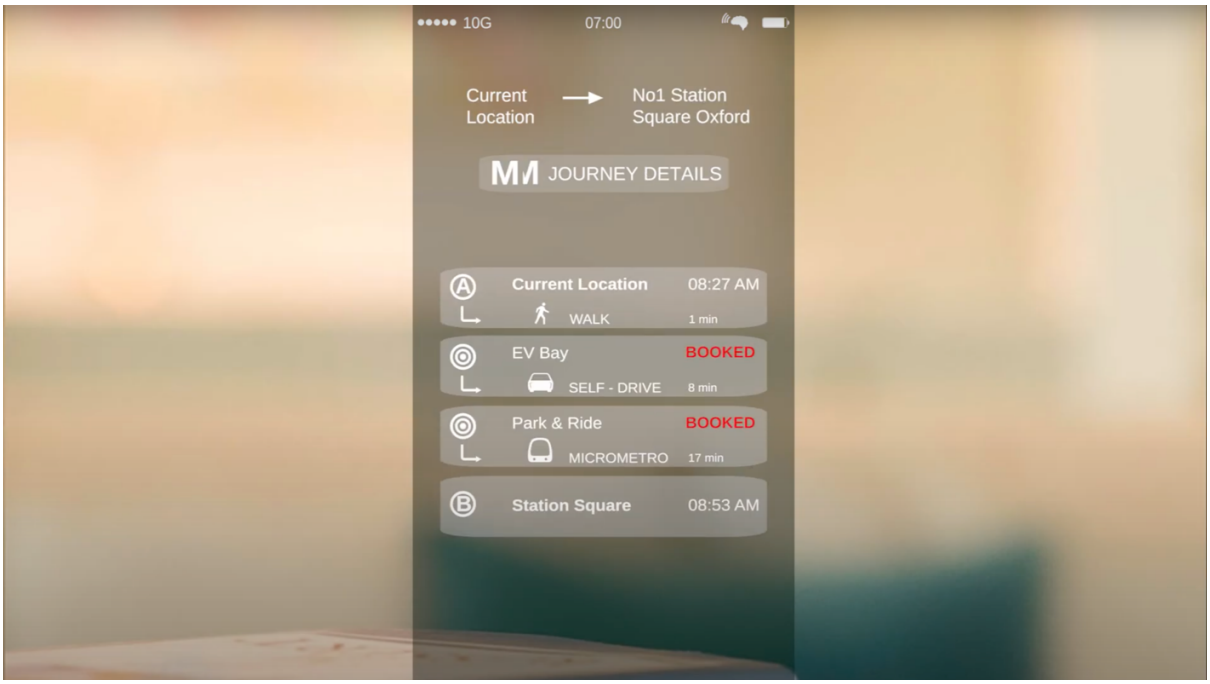

Figure 5.7: A multi-modal journey booked in a MaaS app platform envisioned for Oxford in both 2031 and 2050. Source: Oxfordshire County Council YouTube.



Figure 5.8: Automated vehicle transit in Oxford. Source: Oxfordshire County Council YouTube Video (2017).

Multi-modal transit in both Oxfordshire scenarios is depicted as a smooth, seamless, or time efficient journey with a digital clock in the right-hand corner displaying the passage of time between each mode (see Figure 5.8). Both journeys are based on a work commute into Oxford city with a ghost-like grey figure arriving in time for a scheduled meeting. Temporal vocabularies of speed and optimisation provide the discursive rationale for future travel in Oxfordshire visualised through the rapidity of vehicles in the video.

Both 2031 and 2050 are set as benchmark dates in the video for imagining stages of progressive infrastructural and technological change in Oxfordshire. The dates act as temporal metrics or time horizons in which to measure the goals, priorities, or growth ambitions of the Oxfordshire County Council. Other council groupings and planning proposals similarly adopt these timelines. Using dates as a measurable

metric enables the council to claim or set future visions as 'strategic' frameworks that will 'deliver' on potential economic growth opportunities, as is evident in the accompanying 2050 vision report (2017b). These dates are expressed as predictive, conditional, and contextual indicators in which to guide policy and provide the rationale for action (Kitchin et al., 2015). It expresses a particular temporality to the anticipated rate of change for how citizens will travel at stages in Oxfordshire's future, which is accompanied by the 'real-time' data, projected 'flows', or 'rapid changes' anticipated of passenger commuting practices.

To conclude, this section has explored 'socio-technical imaginaries' of Oxfordshire held by partners including the Oxfordshire County Council. I argued videos 'anchor' a set of 'fictional expectations' (Beckert, 2016) of anticipated innovations treated as inevitable solutions. Much like in the LIS, framing technological concepts like the MaaS-enabled CAV service in the quotidian context of the commute was a powerful way of staging benefits promised to citizens. Transport imaginaries thus reflect a set of agendas held by smart actors who seek to persuade others of the need to centre projected solutions or ideas through forms of demonstration.

5.5. Conclusion

In this chapter I have explored ways that citizens were positioned as future beneficiaries of proposed living laboratories, which was seen as an approach to advance OxLEP agendas of innovation-led economic growth. The multiple living lab

approaches I identified initially implied a systematic role for citizens in research or innovation processes. Terms like ‘co-creation’ or ‘partnership’ echo civic ideals of participation valued in the previous chapter. However, a far more technocratic and instrumental interpretation of these terms were elaborated by the councillors and technologists I spoke to. Far more emphasis was placed on citizens as ‘users’ and ‘consumers’ of prototyped technologies who act as experimental subjects in testbeds. Citizens are ‘co-producers’ in living labs by interacting with technologies and thus emulating real-world conditions that later evidence the commercial value of technical solutions. Rather than directly ‘participating’ via the conventions of democratic deliberative forums, the living lab citizenship ideals were circumscribed to the test parameters of labs and the logics of such experimental practices.

I interpreted the Local Industrial Strategy framing of living labs in terms of the anticipatory logics that justify this approach. In Section 5.3, I elaborated the logics that underpin the living laboratory that centre on predicted crises and preparative actions of experiments. This was fairly typical of smart city discourses in other contexts (Caprotti and Cowley, 2019; Joss et al., 2019; White, 2016). Coupled with the videos I then analysed in Section 5.4, it is clear how OxLEP partners sought to persuade or convince citizens of living labs by explaining the relative benefits or advantages of this approach. This was also packaged alongside responses focussed on identifying technical ‘solutions’ to the UK government’s Grand Challenges agenda and bolstering the innovation goals of OxLEP partners. In that sense, the

discursive position of citizens as beneficiaries was broadly embedded in political-economic framework of smart cities centred on neoliberal values of city competitiveness, economic growth, or innovation (Hollands, 2008). This chapter has therefore evidenced that the participatory discourses of smart cities are mobilised differently in the context of living labs. Rather than participating through discursive deliberative means, the participatory discourse of living labs is about citizens as users or consumers of promised solutions, optimisation, or efficiency.

Chapter 6

Understanding smart city citizenship through expertise

6.1. Introduction

The COVID-19 pandemic, like other global crises, has drawn attention to the extent in which experts are used to shape policy or decision-making outcomes in response to rapidly evolving emergencies, like climate change, trans-species epidemics, terrorism, or public health (Åkerman et al., 2020; Anderson, 2021; Lavazza and Farina, 2020). Virologists, epidemiologists, immunologists, statisticians, public health researchers and behavioural scientists have become critical in tracking and monitoring the spread of the virus and then developing measures to counteract this. In the UK, the Behavioural Insights Team (or "nudge" unit) draw on psychology and communications techniques to predict public responses to COVID as well as design public health messaging. Typically positioned as scientific advisors to governments, these experts have been heavily involved in communicating the relative importance of unpopular preventative measures (e.g., face coverings, social distancing, national lockdowns), explaining developments in treating and managing severe illness or hospitalisation (e.g., ventilation, dexamethasone), or providing information on the safety and efficacy of multiple novel vaccine treatments and roll-out programmes. Before the pandemic, the "nudge" unit were also involved in projects that developed measures related to increasing timely tax payments, encouraging adoption of loft

insulation take, and other similar interventions. Regularly, the prevailing views of experts have been heavily contested or resisted by other public health professionals, politicians, journalists, conspiracy theorists, online groups, or politically-motivated individuals. The heightened discursive conflicts that arise from this are the result of challenges to these dominant claims of expertise.

The pandemic has once again exposed the fragile relationship between science, technology, and society. Moreover, anti-lockdown sentiments, vaccine hesitancy, and the spread of misinformation highlight how the subversion of expertise can threaten social stability and order. As Jasanoff (1996) has argued, the prevention of 'civic dislocation' in the UK is reliant on conditions like certainty on 'objective facts' or identifiable expert knowledges. The pandemic has thus far reaffirmed my earlier observation that there has been relatively little work on smart city experts. This is in spite of clear similarities in the discursive framing of interventions through (perhaps less imminently consequential) urban crises, like climate change, ageing populations, or austerity (Caprotti and Cowley, 2019; Sadowski and Bendor, 2018). There are two parts to this chapter. First, I bring into focus the significance of experts by exploring their role in constituting the participatory and beneficiary citizenships I detailed in Chapters 4 and 5. Second I highlight how the Smart Oxford board constitutes local forms of knowledge as valuable in forming communities of *expert* citizens. In the process, I identify two important dynamics: the coordinated boundary work of experts to position or differentiate themselves in relation to

others; and the expert claims of those whose local knowledge, professional, or social networks establish their authority to constitute smart citizenships in Oxfordshire.

Expertise is more or less implicit in smart city scholarship. Approaching this literature through the lens of expertise could bring attention to: the corporate framing of smartness by IBM and Cisco and the promotion of technical and professional expertise as a necessary precondition in becoming 'smart' (Alizadeh, 2017; IBM, 2017; Söderström et al., 2014; Wiig, 2015); the assembling of a new set of 'urban technocrats' whose domain and professional expertise reflect and embed smart city ideas or ideals into city authorities, like Chief Technology, Innovation, and Data Officers, project managers, consultants, engineers, designers (Kitchin et al., 2017a, 2017b); the role of expertise as a determining factor in the inclusion/exclusion of 'actually existing smart citizens' from smart city workshops or activities (Shelton and Lodato, 2019); the necessity of 'upskilling' in order for citizens to use digital services introduced by city authorities, including smartphone apps, air quality sensor kits or open data platforms (Datta, 2019a; Leorke et al., 2018; Manchester and Cope, 2019; Rose, 2020; Rose et al., 2020b; Wiig, 2016); and how hackathons invite participants to apply their specialist, technical skills or knowledge to solve grand, ubiquitous challenges under intensely pressurised conditions (Irani, 2015; Perng et al., 2018). These diverse examples highlight how expertise can take many forms in smart cities.

There are also several ways in which smart city expertise relates to questions of urban citizenship. One example of this is citizen sensing projects in exposing the tensions and contestations that arise between expert claims of citizens against those with existing policy and decision-making authority in response to issues of air quality and pollution in cities (Feick and Robertson, 2021; Hecker et al., 2018). Illustrative of this is Gabrys *et al*.'s (2016) work on forms of political agency mediated through environmental sensing. They show how standards set by regulatory bodies can be used to call into question data produced from low-cost and low-tech sensors deployed by citizens undertaking environmental monitoring. Political agency is qualified by existing 'experts' through the scientific validity of data: its measurement, precision, and accuracy. In turn, Gabrys *et al*. (2016) argue that, "if citizens were to proceed with the use of technologies and protocols that simply follow regulators' practices they could shut down the very possibilities that citizen monitoring might have the potential to open up" (p.11). This includes forms of 'cybernetic citizenship' that encompasses playful or individualised experiences, relations and meanings generated through air quality sensing practices (see, for example: Zandbergen and Uitermark, 2019). In this example, it is clear expertise has implications on how smart citizenship is constituted thus shaping its democratic possibilities.

In this chapter, then, I aim to unpack how expertise is discursively constituted and practised in various forms in the process of making Oxford a smart city. To do so, I

draw on ethnographic and discursive analysis of the dynamics of roundtable meetings, conferences, and public engagement events where aspects of the smart city were discussed and debated. I build on examples from Chapters 4 and 5, including the Cities-4-People project with the Oxfordshire County Council iHUB as well as the OxLEP/Mobox roundtable, to describe the kinds of expert claims made through and during implementing smart activities and the implications this has on notions of citizenship. I adopt a relational approach to expertise to unpack how this is discursively practiced. By this, I mean how people establish, express, and assert their status as an 'expert' through powerful claims of knowledge, skill, and competency. I also offer reflexive commentary throughout the chapter on my positionality as a researcher with first-hand experiences of attending, observing, and participating in these activities.

I divide the chapter's arguments into a number of sections: in the first, I summarise approaches towards understanding experts and expertise by drawing together a typology characterising its various forms. Building on this, I outline an analytical approach where expertise is viewed in relational terms as discourse that is claimed and enacted by actors in various ways. The second section then provides a series of vignettes to explore a range of practices that establish smart city expertise in Oxfordshire. I supplement this with interview material that reinforces the implications expert claims have in positioning, constituting, and shaping notions of

citizenship. In the conclusion, I evaluate the utility of expertise as a framework towards understanding the social dynamics of smart city spaces.

6.2. Understanding smart city expertise

What precisely *is* expertise? What is the relationship between experts and expertise? The theoretical debates exploring how various forms of expertise are (re-)produced, operated, negotiated, and contested begins to unpack this by distinguishing between 'realist' and 'relational' approaches. In the realist tradition, expertise is understood as "the *real* and *substantive possession* of groups of experts" and that "individuals acquire real and substantive expertise through their *membership* of those groups" (Collins and Evans, 2009, p. 3, *emphasis added*). This implies there are a specific set of rules, skills, and knowledges an individual must gain or acquire in order to become an expert, often by virtue of being *socialised* into a group of other similar experts. For instance, on a rudimentary level, to become a software engineer you must acquire the technical knowledge of software production and processes before being recognised as one. This interpretation of expertise emphasises dynamics of power and hierarchy that result from the boundary work by determining who is considered an expert or not by the acquisition of specialist knowledge or skills. In the *relational* approach, expertise is viewed as a matter of an experts' position in relation to people, arrangements, and objects. This relational approach is considered a far more fluid definition of expertise; it has therefore been

critiqued on the basis it requires *attributors* to retrospectively assign 'expert' labels as opposed to experts existing independently of others.

6.2.1. A Realist Approach to Expertise

In favouring the realist approach, Collins and Evans (2009) develop a typology or a 'periodic table' of real, substantive expertise. This includes: 1) everyday/ubiquitous expertise; 2) specialist/domain expertise; and 3) interactional/meta-expertise. The progression from ubiquitous to specialist to meta-expertise is generative of smaller and smaller groups of people for whom share deeper levels of 'esoteric' or specialised knowledge. This is summarised in Table 6.1. reproduced from Barley *et al*. (2020) who similarly categorise expertise in this way, albeit with the addition of 'process' expertise. In the last row, I have categorised different types of experts identified by Kitchin *et al*. (2017a) in their paper on new professionals, positions and roles drawn together in smart city administrations. I categorised data scientists, software engineers and IT project officers as exemplar cases of domain expertise as these roles require a degree of technical (or domain) skills and capabilities. I grouped Chief Technology Officers, Chief Operations Officers, and Programme Coordinators under process expertise. This is because these roles often related to an ability to manage and coordinate multiple project partnerships communicating within and between domains of expert knowledge. I also included researchers and academics under interactional expertise as this resonated with my experience of learning the acronyms, terms and language adopted by project consortiums during

the fieldwork. While there is some utility in matching up characteristics of these smart city positions to attributes in Table 6.1, I find this process of categorisation does not necessarily or adequately reflect the situated, social dynamics of expertise enacted in smart city spaces.

***Table 6.1*:** Three different types of expertise. Modified from Barley et al. (2020) and Kitchen et al. (2017a).

	Domain Expertise	**Interactional Expertise**	**Process Expertise**
Forms of knowledge	Deep familiarity with a specific domain of knowledge, sufficient enough to take action or to actively practice in that domain.	Familiarity with the language of a domain of knowledge, sufficient to communicate effectively with domain experts.	Familiarity with structures, practices, and processes present in a context, sufficient to manage communication both within and across domains of knowledge in that context.
Role in expertise coordination	*Application* – Deploying esoteric knowledge to address problems within their domain.	*Translation* – Capacity to facilitate translation across knowledge domains.	*Coordination* – Capacity to evaluate a situation to determine which experts need to coordinate, and to process information such that translational processes can occur effectively
Nature of knowledge	*Transferable* – Domain experts can apply their knowledge in any context relevant to their domain of expertise (e.g., a software engineer coding at a computer)	*Relational* – Although interactional expertise allows experts to speak with domain experts in a particular domain, it does not necessarily transfer to interactions with experts in other domains	*Situated* – Process knowledge is highly localised to the particular social and structural context. *Expirational* – Process knowledge becomes outdated quickly as aspects of structure, membership, and practice shift in their social contexts.
Smart City Exemplars **Drawn from: Kitchen *et al*. (2017a)**	Data scientists, software engineers, IT project officers	Researchers, academics, politicians, event organisers	City administrators, consultants, Chief Technology Officers/Chief Data Officers/Chief Information Officer, Programme Coordinators

6.2.2. A relational approach to expertise

For Eyal (2013) there is a distinction to be made between literatures that address the sociology of *professions* and those that address the sociology of *expertise*. The sociology of professions reflects this realist approach of describing expertise as the attainment of pre-existing background practices, skills, or knowledges. On the other hand, the sociology of expertise explores the ways people narrate, claim, perform and enact expertise in a variety of contexts. In other words, the sociology of expertise asks:

> "Not only who controls a task and how jurisdictional boundaries are assembled but also what arrangements, devices, concepts, and other actors are necessary if an expert statement or performance is to be formulated, reproduced, and disseminated as an immutable and combinable mobile" (p.899).

This analytical distinction is useful in describing two forms of power: 1) the ability to form autonomous expert monopolies based on powerful, authoritative claims of knowledge, skills, and competencies, and 2) the conditions and social work necessary to frame issues as expert tasks. It is by approaching expertise as something that is *practiced* rather than simply a discrete technical skill that we can examine the interactional and performative qualities of expertise.

Approaching expertise as something that is *practiced* requires a consideration of how expertise is enacted by people in smart cities. This builds on the approach I have taken to unpacking citizenship thus far in the thesis (Isin, 2017; Isin and

Nielsen, 2008; Kock and Villadsen, 2017), which has thus far been interested in identifying the ways engagement is mediated whether through familiar forms of discursive practice (e.g., public deliberation) or through materialising participation via things (e.g., post-it notes or smartphones). The reason why this approach is useful in order to adopt a relational approach of studying expertise is these terms do not assume pre-given expert status rather expertise is informed by such relations. A useful example of performative claims of expertise is detailed in Sweet and Gifford's (2020) study of 'antithesis performances'. They describe sets of stories, narratives, and ritualised enactments used to transform expertise by distinguishing between 'good' and 'bad' experts. Using an example of feminist anti-violence organisations in the 1970s, they explore the rejection of psychiatry and psychotherapists as 'bad experts' based on psychiatry and psychotherapy being male-dominated disciplines whose practices, cultural and institutional authority were considered dangerous to women. Feminists established a network of domestic violence shelters and drop-in centres where there was an emphasis on an ethics of care and mutuality that directly contrasted cold, clinical encounters associated with psychotherapy. Here, antithesis performances involved the narration of expertise through "experience' as a woman, stories about the psychotherapist as bad expert, the creation of new institutional spaces, and public representations of shelters as sanctuaries" (p.10). The notion of 'experience' enabled these feminists to frame a new set of actors as 'good' experts in opposition to the 'bad' experts. This example shows the utility of understanding expertise in relational terms highlighting the cultural performances and narratives

that shift professional practice and reposition or re-constitute expert claims of knowledge.

In this chapter, however, I am interested in exploring a set of empirical examples that highlight minutiae-scale interactions evident in smart city spaces that establish (non-)expertise. Kerr *et al*.'s (2007) ethnographic study of several public engagement events on genetics provides a useful methodological template to study the talk and social context of expert claims. In this paper, there are several examples of narrative and dialogue techniques used to establish scientific expertise and produce the lay position of citizens. An interesting example is the self-deprecating way a social scientist asserts their technical, situated, and experiential expertise during a speech on gene therapy. They mix references to statistical and practical knowledge and then further legitimate this through their network of contacts to invoke their expert position in relation to the audience. It is this close analysis that is attentive to interactional dynamics of expertise that I adopt in the next section.

In summary, this section has evaluated the key advantages and disadvantages of two approaches to understand expertise used within the STS literature: the *realist* and the *relational*. There are three reasons why I find a relational approach useful for understanding the emergence of smart city expertise: first, that this builds on the socio-technical ecology approach I have used throughout this thesis to engage with emerging discourses, practices, and materialities rather than fixed notions of what

constitutes an expert through classifications, labels, or titles; second, that relational approaches recognise that expertise does not pre-exist before its doing, rather it is something that is continually redone; and third, that forms of expertise are valued dependent on their context. The analysis that follows draws on terminology used in Table 6.1. based on realist categories. The empirical focus is on analysing the social dynamics in which expert claims are made and its implications on citizenship in a variety of smart city contexts.

The next section presents a series of vignettes based on four types of smart city activity: a project workshop, a roundtable meeting, a public engagement event, and a conference. These short vignettes provide thick descriptive and illustrative examinations of a range of spaces where expertise was being claimed, performed, and enacted. Yet, this is not necessarily exhaustive of where and how 'smart' expertise was claimed given that there were other spaces I was unable to access or actively excluded from. Examples of this were monthly team meetings at the Oxfordshire County Council iHUB or quarterly meetings with the Smart Oxford board. Nevertheless, the spaces I encounter here illuminate the importance of expertise in constituting notions of citizenship.

6.3. The co-constitution of experts and participatory citizenships

While some of the Oxfordshire County Council's iHUB projects discursively emphasised the technical expertise involved in developing various smart city

technologies, there were other projects that valued expressions of non-technical, experiential knowledge. In the Cities-4-People project, for instance, the aim of developing its 'People-Oriented Transport and Mobility' (POTM) approach required consortium partners taking seriously the lived experiences of residents in east Oxford during public engagement activities. In one of the community workshops (branded as 'Citizen Mobility Labs') held at an early evening in November 2018 at the Barton Neighbourhood Centre, residents were actively encouraged to share their views on potential pilot schemes that aimed to increase mobility between eastern areas of the city. Pilot schemes were previously devised at a 'stakeholder' meeting and included face-to-face app training, partnering with supermarkets on a bus service, and providing information to concessionary pass holders on eligibility for the 'Pick-Me-Up' bus app service (see Chapter 4).

Later reflecting on this mobility lab, a member of the iHUB team leading the Oxford-branch of the project commented, "I think what citizens got out of it [the Citizen Mobility Lab] was an understanding that the local authority was appreciating their input, treating them as valuable partners and not dismissing their opinion…because they are the experts in the community" (Interview, iHUB team member, July 2019). In this quote, it is claimed that the purpose of mobility labs was to position citizens as 'valuable partners' in the project by virtue of their views as relative experts within 'the community' in east Oxford. The community, as I have previously discussed, is a term that is again mobilised here to signal the role of Oxfordshire County Council to

uphold values of democratic engagement. That said, the interviewee does not state or elaborate how citizens views will be actioned upon by Cities-4-People partners, and rather that the local authority offers assurances views are 'appreciated' and thus not 'dismissed' by the council. Much like in the literature, then, this quote signals a democratising model of smartness by evoking efforts to engage citizens, but without necessarily substantiating such claims (Cardullo and Kitchin, 2017; Shelton and Lodato, 2019).

To some extent, the facilitation of Citizen Mobility Labs reflected efforts to bring together citizens with local partners and provide time to mediate deliberative and critical conversations between these groups. Co-creation activities like post-it note ranking, brainstorming, or open discussion were activities designed to air people's views, whether engaged as citizens or representatives from stakeholder groups. For instance, I was provisionally invited to join in with ranking exercises irrespective of my position as a researcher. Post-it note ranking (or 'Ambition Ranking') was the most used activity in the first workshop I attended. This involved rounds of ranking people's 'ambitions' or priorities by plotting multicoloured neon post-it notes on A3 paper charts as a way of gauging democratic consensus on several ideas. Practically, this involved individuals physically moving around the meeting room, evaluating their personal position on a set of predetermined pilot schemes, generating short, written responses, and then sticking post-it notes onto a chart based on an assessment of its degree of importance. Stakeholder groups like the Oxford Bus

Company and the Oxfordshire Neighbourhoods Trust and myself as a local researcher were actively invited to take part in this activity.

Accumulating post-it notes on the chart in this way visibly and materially established the "Blue Sky aims" (Froes et al., 2019) of the project as a way of weighing up people's priorities. In this instance, then, the post-it note and its associated procedures became an everyday technology of material participation (Marres and Lezaun, 2011; Mattern, 2020) intended to mediate individual expression of ideas, views or opinions irrespective of a person's knowledge, skill or expertise. Plotting post-it notes on A3 charts became the main mechanism of decision-making during this activity enacting a perceived form of democratic and majoritarian consensus.

Another way of interpreting co-creation activities deployed by the Cities-4-People consortium is to be critical of the project's attempt to formalise or proceduralise participation processes. The agency of local residents was confined to expectations or behaviours associated with participatory practices introduced by the project's organisers. At another one of the Citizen Mobility Labs held at the Barton Neighbourhood Centre, the workshop began with a project update from a number of council representatives which then led into another co-creation group activity. Following the initiation of this part of the workshop, a local resident in attendance with their elderly mother asked one of the council representatives if and when

someone would assist them in learning how to use the 'Pick-Me-Up' bus app on their smartphones. Having then been told that app training was simply a pilot scheme under consideration during the workshop's wider brainstorming session, the women expressed their uninterest in participating in this activity and left the community centre shortly after this.

For these citizens, their disinterest in validating the meta-aims of the consortium's POTM approach was shaped by their individual needs, rather than an innate interest to represent a form of citizen empowerment, express creativity, or validate the co-creation principles of the project. Rather, their desire was to develop technical skills and competencies to download and access an app introduced through the project, which served as a technological solution to the transport needs of local people in east Oxford. By leaving the centre, these citizens failed to meet the participatory expectations of Citizen Mobility Lab designed by project stakeholders. The tools to produce highly engaged individuals willing to contribute ideas or speak on behalf of others (Felt and Fochler, 2010) had failed.

The moment therefore represented a 'misfire' from the archetypal figure of the participatory citizen discursively constructed by the C4P project. By this, I mean there was a breach that disrupted the conventions of the 'proceduralised' participation (Kelty, 2019b) being tested in the Mobility Lab. The theoretical

models of co-creation had failed having a 'counterperformative' effect (Butler, 2010), in so doing revealing the performativity of these participatory practices.

Misfires were not a rare feature during the project's 3-year implementation. One of the participatory techniques used to gauge opinion was an e-democracy website called 'YourPriorities' which is a platform where ideas can be up/down voted and commented on. This was used earlier in the project to identify and evaluate twelve ideas to improve the Pick-Me-Up bus app service, such as the aforementioned app training and supermarket partnerships. However, there was significantly lower turnout on the website compared with 'traditional' or conventional in-person engagement methods used in the project, despite its wide circulation amongst local groups on social media sites like Facebook. A council representative offered two explanations for this: 1) that there was lower digital literacy in communities targeted by the project, and 2) that people preferred 'traditional' engagement methods as a way of 'feeling' as if their participation was valued. The councillor assumed that citizens have a greater emotive response via conventional methods of eliciting participation rather than by using digital engagement tools. The councillor's explanations were also examples of expertise being discursively asserted. This is further evidence of citizen-government interactions mediated through '*type*' technologies like e-democracy tools exposing the enduring challenges of digital access (Johnson et al., 2020b). This also resonates with Kelty's (2019b) critique of approaches to participation that neglect its immediate,

emotional, and affective registers in favour of analyses that centre participation as a concept or procedure.

The ‘co-creation’ approach to participation tested and developed by the WAAG Society and C4P partners was considered a form of expertise (Waag, 2022). Knowledge of ‘citizen’ and ‘community’ engagement processes were an area of domain expertise that required an understanding of the procedures, methods, or tools to implement this. Based in the Netherlands, the Waag Society is an interdisciplinary R&D media lab who experiment with new concepts or technologies in the form of public events that invite end-users to express themselves using new media. The Society’s insights contributed to the organisation of Cities-4-People engagement activities. One of the project’s main deliverables on this was the development of an online toolkit and ‘replication guide’ detailing methods, case studies and best practices drawn from participating cities in the study (Cities-4-People, n.d.). Released at the end of the project, the toolkit displays implementation timelines for each city and lists examples of events or tools that were deemed to be most effective. For instance, the Oxford timeline features co-creation activities trialled in Citizen Mobility Labs like the ‘Ambition Ranking’ activity and ‘Your Priorities’ voting tool mentioned earlier.

The intent behind this related to the project’s funding requirements and commitments under the EU Horizon 2020 programme to create replicable, scalable

smart city engagement processes (van Winden and van den Buuse, 2017). The toolkit provided 'follower' cities with an instructive guide to a set of participatory methods for 'citizen-centric' smart city decision-making. The development of the toolkit also reflected how consortium partners constituted citizenship as a set of replicable procedures developed by *experts* that can be adopted in the future implementations of future smart transport and mobility schemes. Alike with the technological interpretation of 'replication' detailed in Chapter 5, it was understood that participation tools could be unproblematically exported from one place to another, from one community to another.

In sum, the Cities-4-People project framed co-creation approaches to forms of citizen engagement as an area of expertise that can be practiced with sufficient understanding of the tools and tactics necessary to elicit citizen views. The POTM approach that C4P partners developed reflected several participatory frameworks that emerge from a European interest in values of co-design. Citizens were also framed as experts to a degree as their experiential knowledge was valued by C4P partners as providing lived experiences as insights. Experts are therefore important in the Cities-4-People project as they constitute participatory citizens as having local experiential knowledge to make democratic decisions. They also constitute engagement practices as a form of expertise through the tools, techniques, and approaches they draw on.

6.4. Assembling experts at smart city meetings

In Chapter 5, I analysed the ideas discussed and debated regarding the concept of 'living laboratories' at a roundtable meeting hosted by the MobOx group with the Oxfordshire Local Enterprise Partnership in April 2018. That chapter focussed on unpacking the discursive figure of the beneficiary citizen enrolled in plans to pilot or testbed technologies in Oxfordshire. I highlighted future ideas of smart mobility like MaaS that require user engagement in present tests to be made possible. In this short vignette, I return to the roundtable to explore how OxLEP partners established, asserted, or enacted their expertise, especially as attendees were invited due to their organisational affiliation or expert status. Unlike with the Cities-4-People project, OxLEP partners were far less concerned with constituting participatory notions of citizenship. Nor did they use the participatory tools and techniques which established expertise in those workshops. Additionally, I provide reflexive commentary as an ethnographic researcher on my position relative to others throughout this meeting and thereafter.

Partners from MobOx and the OxLEP hosted the "Establishing the Oxfordshire Living Lab Framework" roundtable at an early evening in April 2019. The meeting was held at The Jam Factory; a light and artsy café-cum-bar in close proximity to the Oxford train station and city centre. A week or so prior to this, I had been invited to meet with a MobOx spokesperson and the Smart Oxford programme manager to discuss arrangements for the event. Here, they curated an invitee list with some

extra input from an OxLEP spokesperson. Invites were then circulated via email shortly thereafter. Their aim was to gather a group of representatives that they considered to be 'high-level' candidates to establish a living lab leadership board.

A cluttered collage of institutional spokespersons was invited to participate in the roundtable. The meeting was framed as a discursive process in which to shape the OxLEP innovation agenda for living labs in the LIS. It was also therefore deemed important the board involved spokespersons critical to acting on ideas following further communication with the UK's BEIS department. The invited spokespersons represented a range of policy and decision-making institutions, including people from the Oxfordshire's' county and district councils; Oxford's two universities; research funding agencies; and three multinational software and technology companies who had expressed a vested interest in living laboratories. The was a group being constituted by MobOx and OxLEP organisers as organisational experts engaged in the governance of local experimentation and innovation. Two policy planners from Oxfordshire district councils were invited by the OxLEP. Their professional expertise was deemed necessary to evaluate the longer-term policy conditions necessary to enable living lab experiments in planned housing developments, like Culham. Other attendees had backgrounds in planning policy, innovation strategy, or worked in local government. It was surprising there were few professionals from computing, data science, or IT backgrounds given living labs was driven by aspirations of technological change. Nevertheless, the MobOx and OxLEP

spokespersons believed the “big personalities” (Research Diary, 2019) at the roundtable shared the necessary expertise to translate ‘living laboratories’ from concept to action.

Upon arrival at The Jam Factory, I was directed to a private meeting area at the back of the venue. This was a naturally lit, medium-sized meeting room with a set of long tables in the centre. After a short period of small talk between the attendees over a selection of refreshments, the OxLEP and MobOx spokespersons instigated the start of the meeting. They began with formalities, outlining the background and purpose of the meeting, then moving to introductions. While attendees were introduced by the chair in terms of their area of expertise or institutional association, I was issued as the meeting’s notetaker in place of my position as a PhD student or ethnographic researcher.

Being identified in such a way raised some interesting methodological questions for me at the time in relation to gatekeeping, negotiating access and consent. For instance, I questioned whether my gatekeeper fully understood the role I was undertaking in encounters like this as a participant observer, even though I had previously explained this was a condition for me carrying out menial tasks. I also questioned whether I had clearly articulated or demonstrated familiarity with the technical or specialist terminology necessary to convincingly build rapport or appropriately communicate with stakeholders in these settings. In other words, I

questioned the degree to which I had developed forms of interactional expertise with professionals. This requires a high degree of familiarity with multiple domains of esoteric knowledge. While I was not necessarily framed as a 'layperson' by the chair, I was a 'non-expert' in relation to other attendees. At one stage in the meeting, however, I was asked to comment on young people's views on issues of data privacy. This was in response to remarks on my youthful appearance and age in relation to other roundtable attendees. In this instance, I was positioned by some attendees as having an authentic perspective that could be extrapolated to represent the views of others.

After introductions were completed, there were two 45-minute sessions structured around the themes of 'connecting communities' and 'policy and planning' and then the 'living lab leadership board' and 'workstreams'. It was during the first session that a spokesperson from the OxLEP directed specific questions on planning policy towards two attendees as senior planning officers at two of the district councils in Oxfordshire. His deflection was demonstrative of the relational ways in which expertise was asserted as these officers were constituted as experts based on their 'domain' knowledge or skills. In response, one of the planners identified the varied temporal dimensions of the aspirations constructed by living lab proponents, like enabling short-term experiments or the longer-term, strategic planning processes necessary for infrastructural changes. They argued that thoughtful planning would be necessary to uphold the shared vision of the 'digitally-enabled' future held by

OxLEP partners. Indeed, this prompted a discussion on whether there had been an effective breakdown between institutional and organisational 'siloes' to pursue a holistic approach that addresses urban problems beyond perceived technical demands. This conversation reflected Kitchin *et al*.'s (2017a) discussion of the 'last mile' problem faced by urban technocrats where ideas, policies, and technologies gain "partial traction" (p.5) amongst city bureaucracies. Their discussion reflected possible tensions between the translational capacity of expert domains involved in arranging smart city responses and service delivery.

Addressing the theme of 'connecting communities' the roundtable discussion turned to issues of community engagement and focussing on issues of data sharing and privacy. It was a concern that 'communities' may be sceptical of the 'living lab' as "another form of growth" or "community pushback" on data (Research Diary, 2019). A member of an Oxfordshire district council flagged that there was an extensive network of Community Action Groups (CAGs) absent from the meeting. They framed these groups as having shared knowledge, skills, and expertise that with effective engagement could enable living labs to be built from the 'ground up'. Several questions were posed by the group in relation to types of engagement with relative consensus of the need to involve 'the community' whether to speed up the adoption of technologies or for greater democratic accountability. While there were important aspects to this discussion, the deployment of 'the community' was

indicative of the way in which notions of citizenship were generally framed in the meeting.

During the second half of the roundtable, a senior academic from Oxford University interjected to provide an unprompted thematic summary and general overview of the group's discussion. He formulated and proposed ten principles (or 'the asks') required of the OxLEP to the UK government's BEIS department to progress their ideas. Examples of this involved establishing the principles of data governance, to set up a data platform or data trust, or to establish a common set of data principles amongst stakeholders. He attributed parts of his summary to his experiential knowledge from working on another smart project: the Project LEO. He also emphasised his enthusiasm for the term 'flourishing' as an alternative to 'living labs' after comments were made by a local councillor on the potential framing of citizens as experimental subjects (i.e., as beneficent citizens). His intervention was a clear display and assertion of *process* expertise or his ability to manage information and ideas and coordinate across or between different knowledge domains. The senior academic effectively and powerfully practised his competency and capacity to discursively intervene then shift the direction of the meeting and to determine a rationale for progressing a living laboratory framework. In essence, then, he became de facto chair for the meeting by pivoting the discussion towards his principles and framework.

Following the roundtable meeting and later in the fieldwork period, I was made aware by my supervisor that they had been invited to a follow-up meeting on living laboratories at the UKAEA Culham Science Centre. Some of the invitees were from this roundtable with the addition of representatives from multinational corporations (e.g., Bosch, EDF, Siemens, Ocado) and UK research institutions (e.g., EPSRC, STFC, the Connected Places Catapult). The event agenda followed earlier roundtable meetings seeking to generate 'concrete actions' and 'next steps' in developing living labs in Oxfordshire. The original invitation described attendees as an 'eclectic group' who were likely to disagree with one another; perhaps recognition of the group's overlapping and conflicting areas of vested interests and expertise. Interestingly, the event agenda included 20 minutes to discuss the 'social science viewpoint' which was likely expected to be contributed by my supervisor. I was often asked prior to interviewing people if I could put them in direct contact with my supervisor. Inviting my supervisor over me suggested or indicated how the smart city experts I encountered valued the expertise of more senior or established others.

6.5. Building a network of local expert citizens

The Smart Oxford board primarily used meetups and networking events to fulfil its broad remit of creating a city "where innovative ideas, active citizens, and aligned stakeholders come together to co-create a better Oxford" (Smart Oxford, 2020). These events were an important way for the Smart Oxford board to build a local-

level smart city 'epistemic community' to provide endorsement for its ideas and ideals (Haas, 1992; Kitchin et al., 2017b). One of these events was organised in conjunction with the Oxford Technology and Media Network (OTMN) group and held at the Modern Art Oxford gallery in the centre of the city at an evening in late-2018. The event was titled 'Lord of the Ring Roads: Making Oxford a Smart City?' playfully parodying the 'Lord of the Rings' films in reference to the dual carriageway road that circles Oxford city. It was almost exclusively advertised via the OTMN's Eventbrite page and mailing list[22] with admission free for OTMN group members and a £32.93 registration fee issued for non-members (see Figure 6.1).

Membership of the OTMN group was reserved for Chief Executive Officers (CEOs), Chief Technology Officers (CTOs), and directors of media and technology companies who live and/or work in Oxfordshire (2021). For this reason, the OTMN website claims it has members from well-known technology companies and organisations like Cisco, Microsoft, LG, Nominet, Oxford University Innovation, the BBC, Channel 4, and more. Some of its members were affiliated with both of Oxford's universities too, including the Programme Manager of Smart Oxford who is an Oxford University alumnus. The purpose of the event was twofold: first, it was one of OMTN's four annual networking events for its members. Second, it was an opportunity for Smart

[22] Interestingly, I was only made aware of this event by a colleague at the Oxford Internet Institute (or OII) who was forwarded an invite from their colleague at the Saïd Business School, both departments at Oxford University. As far as I am aware, access to this event was predicated on a person's combined access to internal mailing lists, their professional and social networks, and valued institutional affiliations.

Oxford to 'leverage' a perceived local concentration of expertise to identify "something unique" (Eventbrite description, 2018) for future projects to focus on in making Oxford smart. In partnering with the OMTN, the Smart Oxford board framed its members as having a particularly valuable combination of locally situated knowledge as residents of the city along with the technical expertise necessary to meaningfully evaluate Smart Oxford's plans.

The event itself followed a fairly conventional conference session-style format in comparison with other types of smart city activity like hackathons or workshops. Following a short introduction from the Programme Manager of Smart Oxford, there were presentations from four speakers, then a panel session with audience questions and ending with a wine reception in the gallery café where attendees were encouraged to network. The session speakers included a technology innovation manager from the Future Cities Catapult[23], a director of an independent and international smart cities advisory business, and the founder of a smart city consultancy for UK cities.

All three speakers had technical backgrounds in computing and extensive experience working for technology and software companies like BT and Microsoft. The conversation that followed reflected this as there was a rather technology-

[23] The Future Cities Catapult is part of a cluster network associated with Innovate UK responsible for nurturing and mediating innovation and research-industry relationships. In 2019 the Future Cities Catapult merged with the Transport Systems Catapult to form the Connected Places Catapult, which is now based in Milton Keynes and London.

heavy and technical debate on possible ways Oxford could be made smarter through city-wide internet infrastructure, Internet of Things (IoT) applications and 5G testing capabilities. An exception to this came from the fourth panellist whose presentation was on an audio-based smartphone app that uses 3D audio cues to increase blind and partially sighted people's mobility in urban environments. This was framed by Smart Oxford as an exemplar case of 'Tech-for-Good' alike to an Oxford-based app 'SociAbility' regularly praised in presentations by board members.

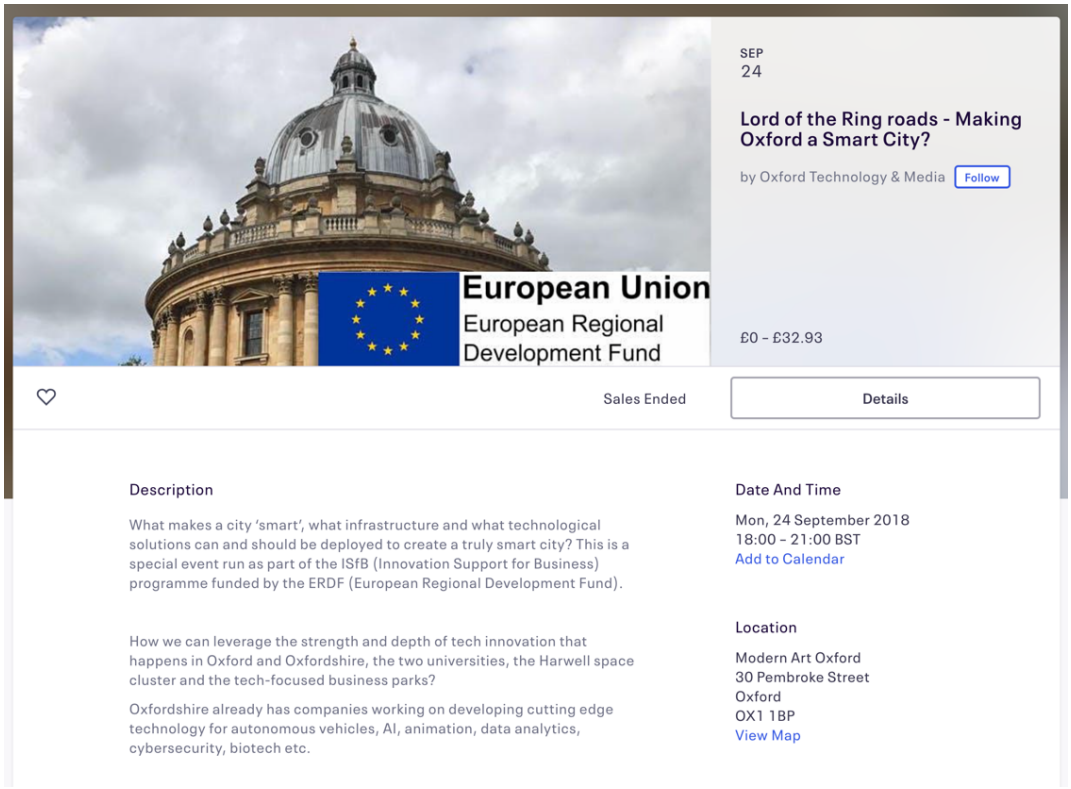

Figure 6.1: The Oxford Technology and Media Network (OTMN) Eventbrite sign-up page for the ERDF-funded 'Lord of the Ring Roads: Making Oxford a Smart City?' event (2018).

During the Q&A session an audience member raised the Programme Manager's interest in using technologies to address social issues. For instance, the event handout described "the extreme social deprivation that exists in some parts of the

city" (Field Notes, Smart Oxford Handout, 2018) as a potential priority area. I later discussed this with him during an interview and he reasserted his claim that future smart city projects should address aspects of inequality in the city:

> "The other fact of Oxford is that it is the second most unequal city in the UK in terms of rich and poor divide. We have very, very rich areas and very, very poor and deprived areas. So, if technology can be used in any way to help address those issues, help the worse-off communities to engage, get jobs, engage economically with the rest of the city that's important to me. The fact that Oxford is such a small city and is such a hugely unequal city is just disgusting and shouldn't happen, but it does…And I guess because of Oxford and Cambridge universities we have some very, very rich communities, very well-off communities, but next door to that within a very short distance we have some of the poorest communities in the country. And the lowest educational attainment and all these other issues. That would be great, if I could find a way of using technology to help address those issues. And it may only be smartphone apps that help employability or continuing education or whatever. But it's got to be a bottom-up thing. You've got to help those communities to help themselves. You can't dictate services; you can't dictate solutions to them. You have to provide them with the infrastructure, with the tools, and say, "go address your own, go and fix your own problems" and that's really where I'm coming from now" (Interview, July 2019)

Here, the Programme Manager describes issues of wealth inequality in Oxford as a motivating factor in adopting smart city technologies. He claims that smartphone apps that focus on employability or continuing education would help to connect those from 'very, very poor and deprived areas' to new opportunities in the city. In doing so, he draws on a popular geographical imagination of inequality within Oxford where the city centre is associated with opportunities generated in part from an elite university while poorer areas are clustered and bounded in the city's eastern arc.

There are several other assumptions implicit within this Programme Manager's response. First, is this idea of poorer communities having similar degrees of access to smartphone devices for the purposes of education or skills training. Second, is this use of 'upskilling' as an individual act that necessitates access to economic opportunities in line with labour demands. Third, he postures this degree of technological solutionism understanding technology as a 'quick fix' to otherwise deeply entrenched spatial inequalities. My critique here connects strongly with Greene's (2021) ideation of the 'access doctrine' to describe the framing that, "the problem of poverty can be solved through the provision of new technologies and technical skills, giving those left out of the information economy the chance to catch up and compete" (p.5). This doctrine places significant emphasis on individuals taking responsibility for their own economic marginalisation or hardship using self-improvement to reach desirable, competitive jobs and technical roles. In this instance, then, the Programme Manager places significant emphasis on finding ways for 'worse-off citizens' to train or develop their technical skills or knowledge and in doing so address economic inequality in the city.

There were several exclusionary effects associated with the event dynamics beyond rudimentary measures like an attendance fee or OTMN membership condition. On a practical level, the event was organised outside of working hours and reaching into the late evening. This may have excluded those (most likely, women) with caring commitments or responsibilities and there was certainly a highly gendered ratio

between men and women (50:12) attendees. Relatedly, Perng and Maalsen (2016) argue that the timing and format of hackathon events "ignore the opinions and experience of local residents, whose everyday lives are to be analysed, programmed and reconfigured and potentially altered and disrupted" (p.191). This is also pertinent to this event given that the OTMN members represented a highly affluent citizenry of Oxford whose views were actively consulted on to shape future smart city initiatives.

These citizens may have shared interests in areas of the smart city industry related to their work as well as biases or (mis)understandings towards citizen needs in Oxford. For instance, there was some recognition of areas in the city considered to be 'deprived' such as Blackbird Leys or Barton but without a nuanced discussion of the factors shaping these inequalities. This is a critique Shelton and Lodato (2019) make on the "categorical and systematic homogeneity" (p.13) of smart city workshop attendees in Atlanta, Georgia which resulted in limited discussions of citizenship, inequality and difference in cities. This lack of social, ethnic and gender diversity at the Smart Oxford and OTMN event inevitably shaped the way the smart city was framed as a promising solution to issues of 'extreme social deprivation' in Oxford. That this was identified as a '*possible*' priority by the Smart Oxford board rather than a *necessity* is emblematic of this.

In sum, the networking event I described in this section was designed by the Smart Oxford board to assemble technical experts with 'local' knowledge of the city and its innovation capabilities. In this example, the "community" term was deployed as the participation of local industry professionals whereas in Chapter 4 the "community" in smart projects like Cities-4-People were Barton residents. Elsewhere, the Smart Oxford programme manager constituted his knowledge of Oxfordshire as expertise to justify his ideas of various technological solutions.

6.6. Conferences as the grounds of smart city experts

Conferences are particularly insightful discursive and institutional sites to examine performances of expertise in a space where it is often assumed attendees share a degree of technical skill, specialist knowledge, or interest. Various ritualistic practices, social conventions and structured forms of socialisation are exhibited at conferences, like mingling, networking, presenting, listening, questioning, exchanging ideas, and so on. During a conference, people are positioned in roles as either a speaker, panellist, chair, or audience member for whom their attendance structures the dynamics of the event. By now, there are numerous international smart city conferences or forums designed to convene a wide set of professionals concerned with smart ideas or ideals from city administrations, governments, NGOs, industry, and academia. Events like the Smart City Expo World Congress (SCEWC) held annually in Barcelona (SCEWC, n.d.) are considered to be sites for the consolidation of a smart city 'epistemic community' that substantiate the

multidisciplinary niche of 'smart' (Kitchin et al., 2017b; Wang, 2017). In this section, I focus on a conference held annually at the Headington campus of Oxford Brookes university in the late summer of 2019: the VentureFest conference. I build on ideas illustrated throughout this chapter related to expertise to show how aspects of the conference structured social interaction through performances of entrepreneurialism centred on communicating individual technical skill, knowledge, and expertise.

VentureFest is an annual conference organised by The Oxford Trust and held on campus at Oxford Brookes university. The purpose of the conference is to "celebrate successes in the knowledge economy in the region" by providing "a focal point for the local innovation ecosystem" (VentureFest, 2019). It convenes start-ups, SMEs, venture capitalists, business advisors, multinational technology corporations and local authorities who share a mutual interest in technology and innovation activities in the region. This was another example of a ticketed event that costed between £40 to £50, though there was free entry for students.

The theme of the 2019 conference was 'Inward Investment, Global Growth' to reflect the region's ambition as a potential growth market for innovation. This tied in with several speaker sessions that spoke to the UK government's four 'Grand Challenges' from its national industrial strategy (see Chapter 5). For instance, the MobOx CIC organised and sponsored a panel session on the 'Future of Mobility'

with selectively invited speakers from the Oxfordshire County Council's iHUB team, Streetdrone, OxWash and DS Techeetah Formula E team. These were all companies with personal and professional connections with MobOx. In sum, the VentureFest conference was a space to both convene local stakeholders involved in innovation and to promote the region's broader economic growth agenda for the city.

Most of the activities at the conference were designed to encourage or elicit spontaneous interaction between people whether that be through networking, showcasing, competing, or pitching business ideas, products, and expertise. The physical layout of the conference space facilitated this with the ground floor area having multiple purposes: 'The Forum' had exhibition stalls, held innovation showcases, acted as a networking hub, and was proximate to the café; the 'Union Square' included the 'entrepreneurship village' where stands showcased local business enterprises supported by the Oxford Brookes in-house pitching competition and enterprise support programme; and the 'Union Bar and Gallery' which was a technology showcase area. This led into a conference auditorium where most of the panel sessions were held. During the course of the day, I felt a sense of expectation from others to enact this sense of self-confidence and motivation of being a well-networked individual since it was assumed I was interested in start-ups opportunities or to seek information from potential angel investors.

Pitching was a skill inherently associated with the performance of entrepreneurialism exhibited at the VentureFest conference. This practice is reliant on an individuals' interactional expertise with the capacity to judiciously articulate the technicity, novelty, commercial value, or business case of ideas to venture capitalists or 'angel' investors. There was several 'Pitching for Success' sessions run by the conference where start-ups and small businesses competed for cash prizes, perks and corporate endorsement. For instance, the successful start-ups of this competition received either a cash prize of £1,000 or access to other 'expert' knowledge crudely valued at £10,000, including business mentoring, tailored IP reviews, commercial strategy, or professional virtual office services. These prizes were provided by corporate sponsors like KPMG, Freeth Solicitors and Metro Bank. In addition, winners were also granted the opportunity to pitch at the Oxford Investment Opportunity Network (OION) Ltd Showcase following the event. This corporate involvement echoes the way hackathons are often sponsored by companies as a way to identify and recruit new 'talent' or receive feedback on investable business ideas (Perng et al., 2018; Zukin, 2020). To this end, pitching is a discursive practice that provides start-up companies with opportunities to access and persuade investors of the value of their expert knowledge.

6.7. Conclusion

This chapter endeavoured to reveal various ways in which expertise is discursively constituted and enacted during four types of smart city activity: a project workshop;

a roundtable meeting; a public event; and a conference. Most of these activities centred on expertise established through specialist and technical knowledge or by virtue of professional networks. At times, this was associated with a need to have the right kind of mix of expertise to generate ideas or move forward plans like with the Cities-4-People workshops or the MobOx/OxLEP roundtable meeting. There was also evidence where experiential knowledge was valued as bringing an authentic perspective to smartness. This was illustrated in both the Cities-4-People project and the Smart Oxford event where being considered 'local' was a favourable condition of participants in legitimising their perspectives. In writing this chapter, I have also recalled the methodological challenges associated with conducting this research and how I came to realise these by reflecting on this question of expertise. In particular, I needed to acquire the translational capacity to communicate within and between the set of expert domains I encountered in the field. In sum, there have been both empirical and methodological advantages of exploring the role of experts and expertise in smart cities.

I found the connection between expertise and citizenship to be most explicit in Section 6.3.1. Here, I showed how the Cities-4-People project characterised 'citizen participation' and 'community engagement' as a set of procedures to elicit citizens' views systematically and methodically. As part of developing its replication toolkit, the project consortium framed procedures it had developed as a set of politically promising activities that enrol citizens as eager, engaged, and empowered

participants. The aim of these practices was to perform participation by extracting information on the lived experiences and local knowledges of local residents whose perceived marginalisation from the city provided the justification for the project's POTM approach. In the Citizen Mobility Labs, people were preconfigured through this idea of an archetypal participant expected to act in a critical, conscientious manner and work in the interests of 'the community'. While these activities were effective to some degree – like in generating ideas for pilots or feedback on the Pick-Me-Up app – there were also instances of slippages or misfires from citizens disrupting the norms, expectations and conventions placed upon them as participants. This exposed their disinterest in the meta-aims of the project. This empirical observation is interesting as it challenges the normative view that highly participatory initiatives offer an effective or democratic alternative model of smart. Participation is not simply a procedural practice; in this case, it required emotional investment from citizens to communicate their experiences of marginalisation from the city. Smart city critics tend to raise the data intensive, extractive practices of digital technologies or concepts like the Internet of Things as leverage to call for citizen-centric or bottom-up alternatives. As I've shown with the Cities-4-People project, the 'tools' or technologies of participation associated with 'citizen-centric' projects involve highly time-consuming, emotionally extractive practices that act as a means to qualify technological solutions to urban problems.

Chapter 7

Sim Citizenships and Digital Twins: The Case of Automated Vehicles

7.1. Introduction

Thus far, I have deployed the socio-technical ecology framework to theorise a much wider set of citizenships that emerge in a UK smart city. To do so, I deployed three terms: discourses, practices, and materialities (Isin, 2017; Isin and Nielsen, 2008; Isin and Ruppert, 2015; Marres and Lezaun, 2011). In Chapter 4, I explored notions of 'participatory' citizenship that were central to Oxfordshire County Council iHUB smart projects. These used a set of engagement strategies or techniques to involve citizens as co-creators, data collectors, or informed citizens. Then, in Chapter 5 I introduced the idea of citizens as 'beneficiaries' of imagined technological advances enabled by living lab or testbed experimentation conducted physically across spaces in Oxfordshire. The focus in this section was on the discursive figures of the 'user' or 'consumer' that emerge from visions of 'innovation-led' economic growth that were articulated by OxLEP partners. This was followed by a discussion in Chapter 6 of the constitution of local knowledge as a form of expertise discursively practiced by the Smart Oxford board at events, mostly through claims of specialist or experiential knowledge. This chapter is the final case study of the smart citizenships I introduce.

‘Digital twins’ have recently gained prominence amongst smart city practitioners as a concept that binds together the logics of systems thinking with the data capture and software capabilities of ubiquitous sensing infrastructures in cities. Like many of its derivatives (e.g., the ‘smart’ city), there are varied, broad, loose, or ambiguous ways in which the notion of a digital twin has been deployed (Batty, 2018). Broadly, the concept of a digital twin refers to computer simulation modelling approaches of integrating real-time processes related to social or economic systems (e.g., traffic data) in combination with physical assets or systems. Digital twins are framed as “digital representations” or “virtual replicas” (Nochta et al., 2021), which through processes of abstraction, reductionism, and simplification aid policy or decision-making and provide analytical insights into largely *urban* systems or processes.

Digital twins take many forms. There are City-scale Digital Twins (CDTS), Building Information Modelling (BIMs), AI agent-based models, micro-simulations, spatial interaction models, and so on. Pervasive across those forms is a technology-driven emphasis on real-time sensory data, 3D visualising software, and big data analytics, that together generate the ‘artificial world’ of the digital twin model (Crooks et al., 2021, p. 888). In agent-based simulation modelling, these generative digital worlds are described as being ‘inhabited’ by *autonomous* and *heterogenous* agents whereby interactions are understood as a set of spatial ‘patterns’ or ‘systems’ of behaviour.

Developers of Automated Driving Systems (ADS) consider this type of simulation modelling performed in digital twins to be fundamental to providing others with confidence and trust in the rigour and safety of Automated Vehciles (AVs) to drive on public roads. Unlike with distance-based approaches of ADS testing (Hopkins and Schwanen, 2018), AV developers claim simulation modelling will speed up safety validation and verification processes by expanding scenario testing capabilities and identifying 'edge case' risks. One of the key challenges of training ADS is being able to anticipate the actions of others and determining appropriate responses in real-time (Hind, 2022). There is therefore a need to create 'realistic' simulation models that captures the movement of different road actors.

Social scientists from a range of disciplines including Science and Technology Studies (STS), sociology, social psychology, urban planning, anthropology, social policy, and urban geography are increasingly involved in and engaging with critical debates on the development of CAVs (Bissell et al., 2020; Cohen et al., 2020). This literature raises significant societal questions related to ethics, accountability, physical and digital infrastructures, and data politics (Aoyama and Alvarez Leon, 2021; Bissell, 2018b; Dowling and McGuirk, 2020; Pfotenhauer et al., 2021; Stilgoe, 2020). This chapter builds on these debates by theorising what I describe as *sim* citizenship emerging from the OmniCAV project: a multi-stakeholder partnership involved in constructing a 'virtual testing environment' (digital twin). This project combines digital visualising techniques with machine learning methods for the

purposes of testing and validating an automated driving system (ADS) via simulation modelling. In this chapter, I interpret OmniCAV as projecting a socio-technical imaginary of social life and order via the approaches its partners take to generating sims for a digital twin model of Oxfordshire roads. I argue the way they frame computational methods of analysing 'human' behaviour is based on logics of deduction and categorisation to understand both human and non-human behaviour.

The structure of this chapter is as follows: Section 7.2 reintroduces the OmniCAV project. The chapters arguments then unfold in four sections. Section 7.3 shows how Latent Logic frame humans as complex problems for ADS to rationalise its solution of simulation modelling providing optimised forms of vehicle testing. Sections 7.4. and 7.5. unpack assemblages of human, infrastructural, and algorithmic agency in the OmniCAV project. Section 7.4. describes data *acquisition*. By this, I mean how ubiquitous sensing infrastructures (e.g., traffic sensors) capture data on quotidian movement in cities. Section 7.5 discusses the automated processes of *recognition*, *tracking*, *extraction* and *conversion* performed by Latent Logic to generate behaviour models that calibrate virtual '*sims*' for digital twins. I draw together Amoore (2020), Kronman (2023) and others to challenge assumptions of how algorithmic systems perceive and interpret objects. My argument is that OmniCAV partners project a socio-technical imaginary of machine capabilities of perception, which extract and produce both human and non-humans *sims* from patterns of 'behaviour'. I summarise these arguments in Section 7.6.

7.2. OmniCAV, Simulation, and Digital Twins

In Chapter 3, I introduced the OmniCAV project as one of several smart consortium partnerships focussed on automated vehicles emerging in Oxfordshire. OmniCAV is a £3.9 million project funded by Innovate UK with the Centre for Connected and Autonomous Vehicles (CCAV) from the 'CAV:SIM' round of competitive funding launched in January 2018 (CCAV, 2018). The project is principally led by the Oxford University spin-out company Latent Logic, alongside a 10-partner consortium. The consortium includes: the Oxfordshire County Council iHUB; the UKAEA Remote Applications in Challenging Environments (RACE) research site; the Warwick Manufacturing Group (WMG) at the University of Warwick; the UK mapping agency Ordnance Survey; car insurance company Admiral; motor insurance researchers Thatcham Research; and software companies XPI Simulation, Aimsun, and Arcadis. OmniCAV typifies the project model of governing smart experimentation (Torrens and von Wirth, 2021), familiar in other AV contexts too (McAslan et al., 2021). The project was organised into 10 discrete work packages with deliverables, involving collating historical traffic data, the capture and processing LiDAR imagery for the physical infrastructure of the digital twin model, as well as conventional closed-track and public road testing to validate simulation modelling techniques as a heuristic for ADS validation.

The project's remit was broad (see Figure 7.1). The principal aim was to develop a highly detailed simulation (i.e., a modelling system) as a virtual test environment

for validating ADS. Simulation is now widely recognised as a fundamental part of testing the safety of ADS (UK Government, 2020). The simulation would henceforth provide a 'certification tool' as evidence to guide regulatory or accreditation bodies, insurers, and manufacturers to "accelerate the safe development of CAVs" (UKRI, 2022). The simulation system, or 'virtual testing environment', is based on 32km of Oxfordshire roads, covering a loop of 'urban', 'peri-urban' and 'rural' roads, from Oxford city, the historical market town of Abingdon and nearby rural villages (see Figure 7.2). Justifications provided for this area were wide ranging from logics of technological replicability and scalability to other UK roads as well as the possible societal implications of CAVs to connect rural communities to Oxford city via MaaS transit.

The simulation 'architecture' was constructed using LiDAR, aerial imagery, mobile mapping data and other digital visualising technologies. The intention here was to create a high-fidelity 'digital twin': or a detailed visual and spatial computational system that replicates Oxfordshire roads. The simulation would be populated by what Latent Logic described as 'smart actors' or *sims* that would be calibrated on behaviour models developed from deep learning analysis of CCTV data. Sims are categorised into vehicles, pedestrians, and cyclists as three 'smart actors' in the simulation model. Together, the digital twin represent intersecting relations of software, hardware, institutions, people, and other non-human actors (Amoore, 2020).

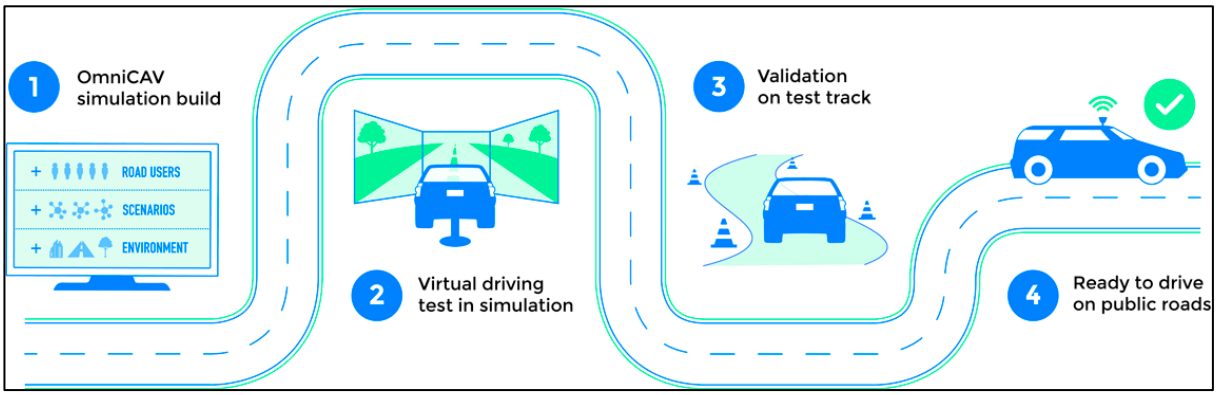

Figure 7.1: Infographic for the OmniCAV project deliverables (2019). Permission to reproduce this infographic has been granted by Aimsun and the OmniCAV Project.

Simulation modelling is frequently positioned as a safer, faster and more effective alternative to real-world experimentation or testbed trials of automated vehicles in the form of '*in vivo*' testing (Zhang et al., 2021). Real-world trials requires processes of negotiating road access with government authorities, physically piloting and managing the vehicle, limitations with test route design, and other high-level risks (Aoyama and Alvarez Leon, 2021). Meanwhile, it is argued simulation modelling is capable of enacting iterative forms of ADS testing, with a wide range of scenarios minimising the threat of 'edge cases' critical to safety. For instance, Waymo claims 2.5 billion miles were driven using their 'Simulation City' software compared with 3 million miles driven on public roads by self-driving cars in 2016 (Waymo, 2021). Similarly, a project by the UK government's Department for Transport with the Connected Cities Catapult have invested in creating a traffic scenario library in preparation for virtual testing of ADS (UK Government, 2020). This report positions several technology companies or start-ups like Latent Logic, Immense AI and Humanising Autonomy as 'market innovators' for AI agent-based modelling in

transport and mobility contexts. In sum, some might argue simulation is starting to be positioned as an 'obligatory passage point' (Söderström et al., 2014) in processes of safety verification.

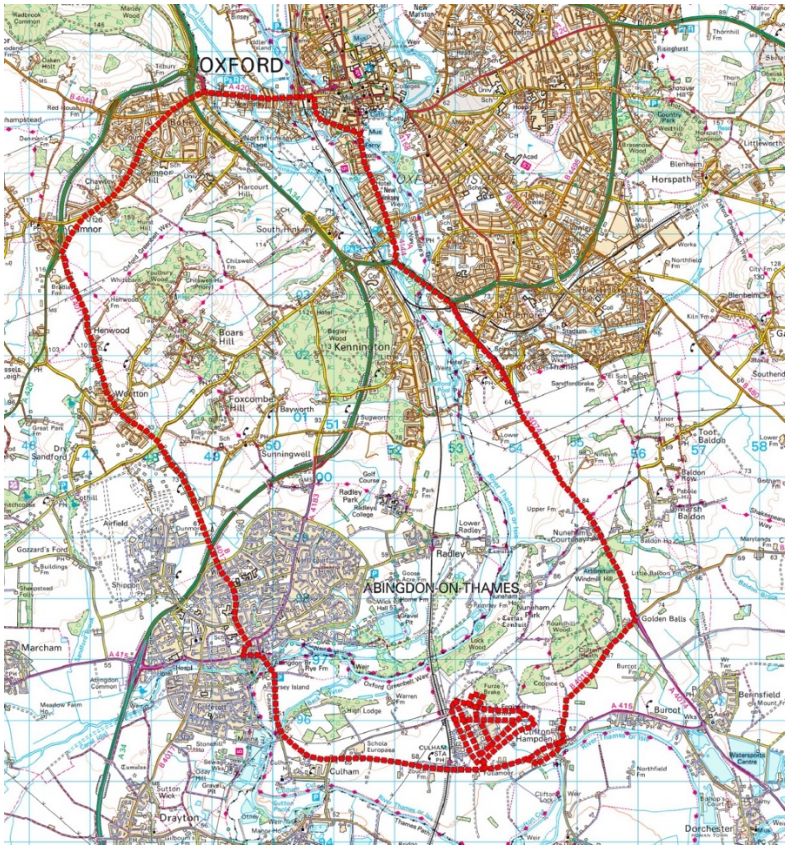

Figure 7.2: Simulation 'loop' of Oxfordshire road used by OmniCAV partners. Provided by OmniCAV, © Crown copyright and database rights 2023.

Publicly available information on the OmniCAV project remains fairly limited. One of the main sources used in this analysis is published academic papers or conference proceedings where some of the technical parameters related to machine learning or simulation modelling were elaborated in greater detail (see Behbahani et al., 2019; Brackstone et al., 2020; Holland et al., 2020). Academic papers are a dissemination form for OmniCAV partners to communicate specialist knowledge garnered through this institutional grouping of multi-sectoral partners. Other secondary data sources

like project and partner websites, press releases, articles in industry magazines, and YouTube videos provided supplementary, albeit partial, information on OmniCAV at various stages.

I was also able to interview spokespersons for some consortium members in the first few months of OmniCAV and its implementation in mid-2019. I relied heavily on interviews and material gathered prior to the full implementation of the project, at a stage where ideas or concepts had not yet been fully delivered. Recruiting people to speak about the project was notably challenging (see: Hopkins and Schwanen, 2022). There were fairly limited amounts of widely available information on the project and its progress was unclear at the time. I attended two academic and business conferences (VentureFest; GEO Business) to observe presentations from Latent Logic spokespersons. Hence the empirics of this chapter strongly reflect the imagined and projected capabilities of technologies like digital twins or machine learning algorithms discursively projected by the OmniCAV project and its constitutive partners. This is a methodological recognition of the temporality in which claims I present in this chapter are situated.

In sum, this section has reintroduced the OmniCAV project and detailed aspects of its project scope. I have summarised some of the challenges I faced researching this specific project, especially given its emergent form at the time.

7.3. Problematising the 'human' in CAVs

Earlier, I highlighted several ways in which CAV actors frame humans as 'problems' in order to discursively justify the adoption of CAV technology. For instance, I detailed the discourse of 'public acceptance' deployed by government policy stakeholders to frame humans as barriers to accelerated CAV use. I also showed how technology companies invested in developing CAVs market the potential of this technology to significantly reduce road traffic collisions related to problems associated with human driving. A third way I've shown how humans are treated as problems for CAVs relate to testbed trials, that seek to socialise pedestrians and cyclists with AV technologies (Marres, 2020a, p. 546). In this section, I address a slightly different way in which Latent Logic characterise humans as 'problems' for CAVs as a way to explain the value it places on simulation modelling.

Latent Logic frame humans as '*problems*' for CAVs differently from earlier examples where physical interventions like trials or demonstrations were meant to increase public trust or acceptance. Rather, Latent Logic focus on improving confidence in CAVs through the technical performance parameters of automated systems tested using simulation. It is claimed this method leads to optimal forms of computational learning and responsiveness to humans. Pitching Latent Logic's 'Imitation Learning' intellectual property at an international innovation event, the founder and CEO of the company stated:

> "We help autonomous systems, starting with self-driving cars, to *understand* us humans. So, we don't make self-driving cars, but we are focussed on the

> biggest worry that keeps self-driving car companies awake at night, which is how do I know that my car is *safe* with us humans. There's *only* one way you can test if your car is safe and that is to use simulation…so if humans are the problem, and you know you need to use simulation to know that your car is safe, what does this mean you need? You need a *realistic* model of human behaviour in simulation. And that's where my company comes in" (Plug and Play Presentation, December 2018, emphasis added)

In this quotation, Latent Logic's CEO asserts that automated driving systems need to 'understand us humans' as 'humans are the problem' in knowing whether an autonomous system is safe or not (see Figure 7.3). The implication is the safety of CAVs is contingent on the capability of its systems to be able to correctly recognise and predict 'human behaviour' (see Hind, 2022 for an explanation of why machinic capabilities of ADS are a priority) which can only be achieved using Latent Logic's simulation modelling techniques. The term 'realistic' is important in reinforcing the view that simulation is able to render human behaviour knowable. In particular, this framing reinforces a view of roads as complex systems and where movement is capable of being computationally interpreted and understood through simulation.



Figure 7.3: A screenshot of the Latent Logic pitch at 'Plug and Play' in 2018, YouTube Video.

Another way Latent Logic suggest their approach can solve the 'human problems' in CAV simulation is by capturing or understanding both 'good' and 'bad' behaviours of road users. In an online profile for the company, the founder and CEO describe its virtual actors as "realistic, diverse and massively scalable" trained on real traffic data as "realistic virtual humans, displaying bad behaviours as well as good ones, are critical for anyone building an AV, or needing to test it and prove its safety" (Tech Nation, 2019). Much like the promise that CAVs will reduce traffic incidents or collisions caused by humans, Latent Logic argues its human behaviour models better understand humans by being trained on 'bad' behaviours exhibited by road users. This reflects this desire to understand variation in road use. Humans are discussed as problems for CAVs here as systems must be trained to respond to habitual practices, deviations from road conventions or rules, and near-misses that reflect 'bad' behaviour in traffic environments (Latham and Nattrass, 2019). In that sense, simulation is presented as a solution to problems with autonomy as ADS must be able to grapple with complex decisions made by human road users.

7.4. Sensing infrastructures and the acquisition of movement

Ubiquitous and connected smart city infrastructure like traffic sensors or CCTV cameras generate significant quantities of (big) data based on everyday forms of movement and mobility in cities. Driving towards a set of traffic lights at an intersection might, for instance, activate a traffic counter in the ground that triggers

a set of decisions on whether the light should stay green or not. Alternatively, forms of automated image analysis might categorise you as a 'cyclist' shortly after you've been videoed pedalling past a traffic camera. Or, perhaps, you open a letter issuing you with a fine a few weeks after an ANPR (Automatic Number Plate Recognition) camera automatically detects your vehicle was parked too long in a carpark. Apart from traffic cameras, most of the sensors involved in everyday encounters like this go generally unnoticed, neatly embedded in the surface of pavements or affixed to lamppost columns tucked relatively out of view (see Figure 7.4). For Johnson *et al*. (2020b) scenarios like those detailed above are characterised as a type of passive or indirect citizen-government transaction reliant on movement in 'instrumented space' and mediated by sensor technologies as part of data capture programmes (p.5). Indeed, Alphabet/Google's plans for the 'Sidewalk Labs' development in Toronto, Canada were driven by imaginaries of an 'ambient' network of urban sensors embedded in material urban infrastructure (Hodson and McMeekin, 2021). Another metaphor used to imagine this type of sensored urban environment is the 'digital skin' of cities (Rabari and Storper, 2015), although this term implies horizontal blanket coverage rather than a more fragmented or 'splintered' deployment of sensing infrastructures (Robinson and Franklin, 2021).

Distributed networks of sensing technologies like this link with smart city operation and control centres under the guise of providing real-time traffic optimisation, that most associate with the case of Rio de Janeiro (Kitchin, 2014b). Equipped with the

capacity to monitor and manage roads and other types of public space, these centres and its associated infrastructures have largely been understood in relation to surveillant and panoptic-like qualities of control (Iveson and Maalsen, 2019; Kitchin, 2014a; Luque-Ayala and Marvin, 2020a; Sadowski, 2019). An example that recognises citizen enrolment in generating data on movement and mobility in cities has shown how users of the smartphone app 'Waze' contribute real-time data to control centres that hereby produces citizens as 'sensors' themselves (Luque-Ayala and Marvin, 2016). Here, the network logics of logistical control converges with the nodal logic of the control room towards the maintenance of 'flow' in monitoring urban circulation. Citizens therefore become an "urban infrastructure of data production" (Luque-Ayala and Marvin, 2020b) continuously producing operational data that is mobilised by smart cities for infrastructural, political, or financial value.



Figure 7.4: Traffic cameras and air quality sensors in the centre of Oxford city. Author's own image.

Several accounts draw on the field of 'cybernetics' to critique this particular reading of the networked or data-oriented smart city as centred on surveillant power or control (Gabrys, 2014a; Krivỳ, 2016; Zandbergen and Uitermark, 2019). For Uitermark and Zandbergen (2019), they posit the term 'cybernetic citizenship' in order to refer to the affective experiences of using sensing technologies with citizens who narrate individualised engagements with immersive informational environments as part of an air quality project in Amsterdam. Here, playing with sensors enabled citizens to "imagine themselves as part of an urban environment consisting of informational flows to which they [citizens] could attune their senses" (p.10). Citizens adopt an individualised approach to sense-making through an affective cybernetic environment whereby playful engagements with data call into action real-time decentralised action. In that sense, the sensed citizen is not always the subject of state or corporate power; a point I have repeatedly made.

The Oxfordshire County Council's Urban Traffic Management Centre (UTMC) carries out much of this operational work and produces vast quantities of traffic and sensor data on everyday movement and mobility across the city and county. The UTMC collects data from over 50 CCTV cameras spread across the road network in Oxford and uses this for "observing traffic monitoring and optimising the use of road network on the public highway" and to "monitor traffic congestion, manage incidents and mitigate for these where possible" (Oxfordshire County Council,

2021b). A further use of this data is in iHUB projects where historic data is shared under agreements with consortium partners working on mobility models or simulation, like with the OmniCAV project. The acquisition of data, then, is a highly valuable asset for the Oxfordshire County Council iHUB beyond its value for real-time decision-making or optimisation towards future-oriented areas and innovations like automated transport.

In this section, I have explained the acquisition of movement data from ubiquitous sensing infrastructures deployed by the Oxfordshire County Council as a transport authority as well as the sharing of historical CCTV data with the OmniCAV project. I have begun to illustrate the complex socio-technical relations involved in processes of acquiring such data. The next section unpacks the machine learning techniques used by Latent Logic to analyse this data.

7.5. Machine learning, image extraction and conversion

Using 'historic' CCTV data, Latent Logic deploys machine learning methods developed in the field of computer vision called object recognition and scene analysis. Methods like these are capable of labelling and describing specific features or objects in a scene, often based from a training dataset. These methods generally take the form of a convolutional neural network[24]. Devices like smartphones use and

[24] A Convolutional Neural Network (or 'CNN') is a deep learning algorithm used to segment and classify objects in images, often via a bounding box. Other applications of CNNs include image analysis, facial recognition, and cultural heritage classification (Parthasarathy, 2017).

integrate such methods to analyse a vast array of images and videos (Pereira, 2022) captured every day, in what MacKenzie and Munster (2019) refer to as ‘platform seeing’. Another familiar application of this exists in the context of surveillance technologies, where neon-green rectangles (bounding boxes) identify, extract, label, and categorise moving bodies or features. This is a political process. Bodies can be mislabelled or misidentified due to biases in the training datasets (Kronman, 2023), and this has racialised implications in many contexts (Amaro, 2022).

Latent Logic employ this type of machine learning in their efforts to develop ‘smart actors’ or ‘sims’ through the *conversion* of behaviour models into the simulation model constructed by OmniCAV partners. Road users are distinguished into three discrete categories: as either a vehicle, cyclist, or pedestrian. An additional computational technique is required to perform a task called ‘Video to Behaviour’ (or ‘ViBe’). This was developed by the company in order to calibrate traffic camera footage for the purpose of image detection to identify relevant objects, and track object trajectories through space and time, and record the resulting trajectories of road ‘actors’ (Behbahani et al., 2019).

A spokesperson for Latent Logic described how ‘smart actors’ are developed:

> “essentially, they [unsupervised machine learning algorithms] learn from looking at hours and hours and hours of data at what *normal* human behaviour looks like and by behaviour we mean as in motion through traffic situations. So that's things like, y'know, if the road is empty and you want to turn right, how do people turn right? Some people cut the corner a bit, others kind of wait quite long and then slam the brakes and then take a sharp

> corner. *And so, by looking at enough data, we kind of learn how do humans on average do it, but also what's the distribution of human behaviours?* And then there's also interacting with other humans so going around the right-hand corner, you're just interacting with your environment, but in traffic obviously people are always interacting with other people. And so, they've also learned what do these interactions look like? How do people- who waits for whom? Who gives priority to whom? How much distance do you leave behind someone? How do pedestrians and cars interact? How do pedestrians and cyclists interact? And all of that is just learned by kind of watching *enough* data" (Interview, July 2019, my emphasis)

In this quote, the Latent Logic spokesperson refers to 'normal' behaviour learnt from machine learning. The Latent Logic spokesperson explains machine learning methods of analysing traffic data detects patterns of movement from groupings of road users and understands this as a form of 'behaviour'. This is an overwhelmingly empiricist interpretation of movement that equates the idea of gathering 'enough' data as the benchmark or metric to validate computational understandings of how humans move (Tennant and Stilgoe, 2021).

Figure 7.5 shows four stills from a promotional video on Latent Logic's YouTube channel taken from 2019 that seeks to explain in visual terms the process of creating 'human behaviour models' via machine learning. In the top two images there is an animation of a road traffic scenario shown from a high-angle view (assumedly the angle of the mounted CCTV camera) with vehicles and pedestrians crossing the intersection. Illuminated by a ghostly white frame, the top-left image shows how various road users are 'detected' in the video footage. This is the process of object *recognition* and feature *extraction.* At this stage, objects (or bodies) are automatically categorised and labelled as part of the CNN approach towards image detection and

segmentation. Then, in the top-right image, and as the video continues, it appears the movement or trajectory of these actors is *tracked* through space indicated by the colourful lines streaming behind vehicles and pedestrians as they navigate this intersection. Here, the significant feature is mapping the *trajectory* of each actor according to its relation to the roadscape in the image.

Faded over the scene in the bottom-left image is an animation representing the process of *extraction* of behaviours based on movement patterns evident in the footage. The background text in the screenshot is particularly illuminating as behaviours are coded with terms characterising each type of actor (e.g., vehicle, pedestrian, cyclist), profiling characteristics of the driving (e.g., 'law-abiding' or 'aggressive') alongside the roadscape driven on (e.g., intersection, highway merge). The bottom-right image shows the *conversion* of this data into a *sim*-like version of a road user that can be used to test ADS in agent-based simulations of roads.



Figure 7.5: "AI that Creates Human Behaviour Models for Driving Simulation" (2018). Reproduced from: Latent Logic YouTube video, Screenshots.

The video affords a specific visual representation of machine learning methods of analysis used by Latent Logic in the OmniCAV project. The video demonstrates the process of effectively *recognising* road users from other image features and *extracting* movement trajectories as behaviour. This is represented here by the steady 'flow' of moving traffic. There are some particularly interesting questions here on ways machine learning methods of analysis 'see' or 'recognise' objects in space, which has significant implications for understandings of visuality and seeing (MacKenzie and Munster, 2019) and its political implications (Amoore, 2020). Here, however, I am interested in the complex socio-technical imaginaries playing out in this video that shows how assemblages of infrastructure, hardware, software, people, and algorithms produce simulated citizens.

Decisions on the training datasets used by Latent Logic to carry out this analysis determines the capabilities of its algorithms to render features in images, in what Amoore (2020) terms 'regimes of recognition'. Training datasets have important implications on what is made perceptible and how digital images are processed, analysed, or actioned. According to Latent Logic, the training dataset has limited traffic recognition capabilities meaning it is only able to detect objects of interest in its CCTV data, namely cars, buses, trucks, humans, or bicycles. The training dataset therefore excludes many other bodies or objects from the training dataset, including other human and non-human users of road spaces. This has significant implications on who is recognisable and subsequently the safety and reliability of simulation as a method for ADS verification. Afterall, as Hind (2022) illustrates, the capabilities of algorithms to perceive objects (or not) has serious implications, as was evident in the death of Elaine Herzberg in Tempe, Arizona.

In this section, I further elaborated the socio-technical processes of *recognition*, *tracking*, *extraction*, and *conversion* associated with machine learning methods of analysing images like CCTV data. In turn, this process creates s*im citizens* as digital imitations of road actors (vehicles, pedestrians, cyclists) deployed in the simulation test environment to validate ADS. Like in the 'real' world, then, I argue *sims citizens* have citizenship responsibilities to socialise ADS with virtual figurants of the actors they represent.

7.6. Outputs: humans and vehicles as *sim* citizens

Throughout this thesis I have used a socio-technical ecology framework to explore multiple citizenships that are produced from overlapping relations of discourses, practices, and materialities that emerge in a UK smart city (Chilvers et al., 2018; Chilvers and Kearnes, 2016a; Pallett et al., 2019). This chapter traced the complex socio-technical arrangements projected by OmniCAV partners in their description of simulation testing in digital twins. I showed that Latent Logic constructed their machine learning methods of analysing human behaviour as a process capable of generating 'realistic' sims for ADS testing in a digital twin. I explained this through the following processes: data *acquisition*, image *tracking* and *extraction*, behavioural model *conversion*, and *object* outputs. This is not a purely technical process, but is instead generated from a far more complex ecology of relations between software, hardware, people, and other non-human actors (Amoore, 2020; Pereira, 2022). The object recognition and scene analysis methods I described Latent Logic using were capable of identifying and tracing specific features (i.e., vehicles, pedestrians, and cyclists) and modelling their behaviours for the digital twin. Patterns of road actor behaviours were then deployed in the form of digital *sims* to enact scenario testing and validation exercises on ADS.

I further argue that *sim* citizens are both human and non-human in digital twins. Sims are the output of this complex socio-technical ecology of arrangements where the perceptive capabilities of machine learning algorithms recognise objects like

vehicles to be as important as humans in simulating traffic. Humans and vehicles are *sim* citizens who arguably enact forms of participatory, beneficiary, and expert forms of citizenship in the digitally-mediated twin of Oxfordshire. By this I mean: sim citizens *participate* through computational forms of feedback (i.e., identifying where ADS fail); sim citizens are *beneficiaries* of ADS through their enrolment in the virtual living lab of the digital twin; and sim citizens are *experts* who are optimally trained through behaviour models that calibrate their involvement in ADS testing.

Roads are increasingly populated by even more diverse types of moving objects than accounted for by Latent Logic, such as e-scooters or delivery robots. The Automated Driving Systems that form the machinic sensemaking of CAVs (Hind, 2022) will therefore need training with both human and non-human road users, whether in the digital twin or 'real-world'. The implication of this then is that not all citizens are or will continue to be human in digitally-mediated smart cities (Rose, 2017), especially given this renewed pursuit of vehicle automation.

Chapter 8

Conclusion

8.1. Introduction

Through this thesis, I have contributed an empirically rich assessment of the diverse ways in which smart citizenship is enacted in a UK smart city. I developed a 'socio-technical ecology' framework as a conceptually rigorous approach of analysing the varied and emergent forms of citizenship I encountered. This approach set aside a set of entrenched debates in the literature that explicitly focusses on assessing the extent to which smart cities are being delivered in 'top-down' or 'bottom-up' ways or citizenships enacted as either 'passive' or 'active' (Ratti and Townsend, 2011). My analysis recognised many other forms of citizenship beyond participatory versions favoured by scholars who challenge government or corporate power and advocate 'democratic' decision-making (Cardullo and Kitchin, 2018). Instead, I proposed a relational approach of uncovering far broader typologies of overlapping, interrelated, and interconnecting citizenships emerging from variegated efforts to implement smart in the local context of Oxfordshire.

In doing this work, I elaborated four citizenships: the ***participatory***, ***beneficiary***, ***expert***, and ***sim*** citizenships. The research therefore responds to sustained calls of critical geographers for more nuanced qualitative engagements with the 'actually

existing' ways in which smart cities and citizenships are enacted (Burns and Welker, 2022; Kitchin, 2015a; Shelton and Lodato, 2019), both discursively and materially. I showed that multiple citizenships were enacted in the smart city and materialised through a much wider range of discourses, practices, and objects. The original, substantial empirical contribution I have made through this thesis furthers our understanding of emerging relations between humans and technologies in digitally-mediated cities (Rose, 2017).

In this concluding chapter, I provide a cross-cutting summary of the main contributions and findings of this research. I start by revisiting the research questions and outlining precisely how I answered those questions in this thesis. I then evaluate the implications of its findings and end by formulating a series of recommendations for future geographical research on smart cities and citizenship.

8.2. Revisiting the research questions

The central aim of this thesis was to provide an empirically nuanced examination of 'actually existing' ways in which citizenship is enacted in smart city projects in the UK county of Oxfordshire. It sought to examine diverse discourses, practices, and materialities of citizenship in response to current literatures and narrow focusses on participatory forms of engagement. I posed the following three research questions:

RQ1. What different enactments of citizenship emerge from smart city projects in the UK county of Oxfordshire?

RQ2. What forms of discourse, practice, and material devices underpin the way citizenships are being articulated within smart city projects in Oxfordshire?

RQ3. What implications do these enactments and logics have for different forms of democratic citizenship?

I addressed **RQ1** and **RQ2** in Chapters 4 to 7 by identifying a typology of citizenships emerging from a wide variety of smart city projects in Oxfordshire, UK. I developed a broad conceptual framework I described as a **socio-technical ecology approach** to analyse the empirical variety of citizenships I encountered. I applied the ecology metaphor in three ways. First, the term ecology shifted analytical attention from individual cases or events of participation towards the "dynamics of **diverse** interrelating collectives" (Chilvers et al., 2018, p. 200). I was interested in not only exploring the **dominant** ways citizenships were constructed, but also the **diverse** and **decentred** relations that emerge from smart city engagement. My approach thus challenged assumptions in the literature that focus on **participation** as central to expressions of citizenship (Cardullo and Kitchin, 2019; Granier and Kudo, 2016; van der Graaf, 2014) and antithetical to corporate or state power. Second, I deployed the term ecology as a methodological heuristic of identifying the connections or dis-connections between these citizenship discourses. In Chapters 4 and 5, for instance, I showed that there were differential or ambiguous deployments of 'participation' or 'co-creation' terms in similar smart city contexts (i.e., iHUB innovation projects; OxLEP imaginaries of living labs). Hence, there were not always direct relations

between the dominant ways in which smart city citizenship was imagined or practiced between each context. Third, the ecology approach of citizenship in this thesis facilitated a systematic analysis of meanings and actions that constitute varied forms of smart city engagement (Chilvers and Kearnes, 2016a).

In Chapter 4 I described ***participatory*** citizenships fostered by smart projects with the Oxfordshire County Council iHUB. I explained the discursive significance placed on citizen participation in smart projects like Cities-4-People, that I saw articulating fairly conventional ideals and practices of 'active' deliberative engagement. I identified a number of different ways participatory citizenships were enacted in innovation projects, including practices materialised through post-it notes (C4P), smartphones (C4P, CIE), bicycles (CIE), or pull-up posters (DRIVEN). I highlighted several citizenship frameworks and vocabularies such as co-creation, which shaped the specific engagement practices being mobilised in such projects. Evidently, I have shown the notion of participation remains a significantly important way in which citizenship is understood by Oxfordshire partners and enacted in smart projects I considered in Oxfordshire, as echoed by its significance in existing literatures.

In Chapter 5 I explored a type of ***beneficiary*** citizenship. Beneficiaries was primarily a discursive position constructed by OxLEP partners from plans to engage citizens with 'living laboratories' in Oxfordshire. I demonstrated that living lab discourses were underpinned by the ideal of citizens accruing benefits by testing prototype

services or emanate technologies, such as MaaS apps or CAVs. Imaginaries centred on expanding existing testbed capacities or capabilities in Oxfordshire assumed the acceptance and enrolment of citizens in tests and demonstrations for the purposes of technical validation or verification. The figure of the beneficiary was henceforth mobilised to justify technological investments aligned with UK government agendas at the time, and framed as responses to a set of anticipated crises and challenges.

In Chapter 6 I analysed practices of ***expert*** citizenships enacted at smart events, like at innovation conferences or roundtable meeting. I illustrated how participatory and beneficiary citizenships were constituted in spaces like Mobility Labs, where project partners constructed participatory methods or tools as an expert knowledge domain (Kelty, 2019a). I also showed how Smart Oxford partners framed 'local' knowledge as a condition of expert citizenship too. I detailed discursive practices like networking or pitching as a specific form of smart city expertise that was enacted at such events.

Finally, in Chapter 7 I discussed the socio-technical imaginary of OmniCAV partners of ***sim*** citizens in computational simulation models of Oxfordshire. Project partners envisioned 3D computer models as 'virtual testing environments' populated by sims enacting the 'realistic' behaviours of their real-world counterparts. I explained a set of human, infrastructural, and algorithmic agencies justifying Latent Logic's claims that they can 'replicate' human behaviour computationally. I suggested the way that machine learning methods of analysis categorised humans as objects suggested

humans and vehicles were identifiable as sims in much the same way. Future geographical research on AVs could further consider how smart city citizenships are produced through machine learning and forms of automation in the city (Batty, 2018b; Cugurullo, 2020; Luusua et al., 2022).

I similarly answered **RQ3** through my empirical chapters uncovering this ecology of emerging and interrelated discourses, practices, and material devices associated with smart city citizenships (Chilvers et al., 2018; Chilvers and Kearnes, 2016b). I showed that there were varied implications of citizenship discourses on practices that emerged in actually-existing smart projects. For instance, I discussed uses of the term 'co-creation' in relation to the Cities-4-People project and the implications this had on the participatory practices of engagement with Barton residents. As I previously argued, the co-creation models I considered enacted instrumentalised forms of participation to facilitate established ideals of deliberative engagement. This demands a significant amount of time and labour from people. In the case of C4P, the residents who were engaged with the project were already disadvantaged by age, dis/ability, and class. I thereby challenge scholars and practitioners to be attentive to who participants are and how their experiences *of* participation (Kelty, 2019a) are differentiated, as this may influence the practices or materials used to 'democratically' engage people. In other ways, I highlighted highly gendered and classed imaginaries of beneficiary citizens in the chapter on living lab experiments. Visions of Oxford city and Oxfordshire in 2030 and 2050 respectively removed any

bodily or identifiable features, but future journeys visaulised by emerging forms of mobility exclusively followed the lifestyles of office-workers, who were assumedly able-bodied, who could afford anticipated costs of adopting multi-modal transport (Marsden and Reardon, 2018; Pangbourne et al., 2018; Singh, 2020). That future urban transport systems are imagined as mediated by smartphone apps is a vision centred entirely on highly connected, highly mobile citizens as the main beneficiary of such technologies. Attributes of expertise were not universally-distributed in the smart city either, especially as expert citizens were constituted by their involvement in a rather closed 'community' by Smart Oxford and discursive practices of engaging with innovation networks. Finally, I raised some provocative reflections on the sim citizenships produced by the OmniCAV project as part of digital twin testing. Here, I theorised that smart citizenship is both human and non-human as socio-technical imaginaries of machine learning capabilities frame subjects as objects analysed in much the same way. The implication of the empirical typology and ecology of the citizenships I have uncovered is to encourage a far more capacious approach of understanding what constitutes democratic forms of engagement in smart cities.

8.3. Implications of this research

In this section I thematically group the original contributions this research makes to critical studies of both smart cities and citizenship. I also identify opportunities to further apply the socio-technical ecology framework in future research on digitally-mediated cities.

8.3.1. Contribution to critical studies of smart cities

I have contributed a detailed and nuanced study of an 'actually-existing' smart city which addresses its emergence and manifestation in its varied organisational and institutional forms (see Chapter 3). This represented a shift from seeking to define precisely what constitutes *the* smart city. I was able to identify a wider typology of interrelated and interconnected organisations, project partnerships, people, and activities, thus demonstrating the analytical value of adopting such a capacious 'ecological' approach (Chilvers et al., 2018; Pallett et al., 2019).

My systematic mapping of smart activities in Oxfordshire highlighted the dominant governance model of experimentation which generated a number of innovation-led projects or activities, with dynamics typical of 'projectification' (Karvonen et al., 2020; Karvonen and van Heur, 2014; Torrens and von Wirth, 2021). The Oxfordshire County Council iHUB followed this model with its teams and policy officers sourcing and scraping external project funding (e.g., provided by Innovate UK, CCAV, or Horizon 2020), to address its strategic agendas or technological interests. I found that experimental projects were generally organised as short-term, multi-sectoral partnerships where specific outcomes or deliverables were designed early in the competitive stage (Cowley and Joss, 2020). For example, DRIVEN had developed a roadmap of when predetermined goals or milestones would be reached. This had specific implications on ways citizens were engaged with projects; the majority of

decisions were already established or oriented towards the project scope or funding requirements.

Much of the smart cities literature centres 'the urban' as the scale in which activities are enacted. I found forms of what I consider to be *rural* experimentation in parts of Oxfordshire, contradicting this focus (Lovell et al., 2018). Discursively, this involved projects like OmniCAV articulating the value of testing AV technologies in 'rural' or 'peri-urban' areas (Chapter 7) or OxLEP visualisations of living lab experimentation for Culham village (Chapter 5). I challenge geographers to consider at what other spatial scales, typologies, geometries, or geographies forms of smartness is enacted.

Building on Eveqvist and Karvonen (2021), I evidenced in Chapter 3 the strategic function of academic partners in Cities-4-People to 'protect' or 'guard' the project and its publishable outputs from external attention or collaboration. Lead partners from the WAAG Society and UCL acted in their role to safeguard C4P by blocking my involvement through my gatekeeper at the Oxfordshire County Council iHUB (see Appendix D). Future research should consider other strategic functions that project partners perform in shaping and driving engagement with innovation processes.

In my examination of Oxfordshire, I repeatedly challenged dichotomous assessments evident in the literature of smart cities as top-down or bottom-up and citizenships as active or passive. The ecology I uncovered has highlighted why such

tropes are not necessarily analytically robust. For instance, the UK state does not exercise forms of state power in a linear way and this is reflected in the patchwork of smart projects and "bundles of experimental local practices" (Cowley and Caprotti, 2018, p. 1) I identified being enacted in Oxfordshire. Unlike in studies of state or corporate smart cities, the forms of smart city power I identified manifested in diffuse and distributed ways across a complex network of people, organisations, groupings, and actors who represented a wide range of sectors. Further research, for instance, may consider theorising the role of interstitial actors in shaping how smart cities are envisioned, implemented, or contested (Burns and Welker, 2022, p. 2). I am interested in developing research based on this given emerging technologies like e-scooters or unmanned aerial vehicles (UAVs) require convening entirely new groupings of organisations or citizenships in need of scholarly attention.

Overall, this thesis has made a significant empirical contribution to the study of 'actually existing' smart cities in the UK (Shelton et al., 2015). It has done so by mapping the networks of organisations, institutional groupings, and people who facilitate or govern 'smart' in Oxfordshire. It evidenced models of experimental governance within Oxfordshire County Council that inform who, how, and when citizens are engaged in innovation processes (Cowley and Caprotti, 2018). Largely temporary pockets of citizen engagement with iHUB projects involved leveraging established conventions of citizen or 'public' engagement (Chilvers et al., 2018). My findings therefore inform critical debates by demonstrating that power is dispersed

or distributed amongst a far more complex ecology of stakeholders, processes, and relations in smart cities.

8.4.2. Contribution to literatures on citizenship and participation

There were multiple forms of citizen engagement emerging across Oxfordshire County Council iHUB projects. I responded to this by arguing that conceptualising smart citizenship as participation provides a limited heuristic to evaluate the smart city as being democratic or not; more participation does not necessarily equate to outcomes that make smart cities more democratic, more equitable or more politically accountable (Chilvers and Kearnes, 2016b). As I argued in this thesis, the current emphasis of the smart cities literature on citizenship as participation limits analyses to procedural, discursive forms of political voice (Chilvers and Kearnes, 2016b). Participation in these accounts takes place in discrete cases or events that lead critical scholars to raise questions of inclusion/exclusion (Shelton and Lodato, 2019) or the role of individuals as smart city citizens (Datta, 2019a). Though Chapter 4 addressed the significance of participation in ways that partners understood smart citizenship, the empirical chapters altogether evidence there is a far broader ecology of citizenships that emerged in Oxfordshire. My analysis thus makes three original contributions to studies of citizenship and participation.

First, I evidenced how citizenship terms like co-creation were interpreted differently amongst smart projects with varied implications. In Chapters 4 and 6, I described

co-creation as part of a methodological framing of participation that emerged from first the Cities-4-People project and second OxLEP proposals. In the first, the co-creation term was used by partners (i.e., Waag, Copenhagen Business School) to rhetorically construct the project as unfolding in an inclusive, empowering, or representative manner. It was a participatory framing that was mobilised to gain innovation funding from EU sources and signal their highly participatory approach to smart city making. In Chapter 5, I showed how co-creation was deployed slightly differently by OxLEP partners to refer to processes of socialising new or emerging technologies with citizens in the form of experimental living laboratory trials. Here, the idea of co-creating the smart city meant citizens providing the conditions to validate or verify technologies in testbed trials or demonstrations. Thus, I have evidenced that smart cities can produce differentiated meanings of citizenship terminologies that construct projects or ideas as being 'citizen-centric'.

Second, Chapter 4 demonstrated different participatory expectations placed on citizens who were engaged with smart projects associated with the Oxfordshire County Council iHUB. Participation in Cities-4-People was practiced through a set of time-consuming activities with citizens in Mobility Labs conducted in Barton, east Oxford. Citizens, recruited from two of the most deprived neighbourhoods in the city, were required to engage with a series of participatory exercises or activities to test project and its POTM approach. Comparatively, the Go Ultra Low project engaged citizens through the TRO consultation process and trial feedback from EV

charge point users. While both projects relied on discursive forms of participation, the trial element of the Go Ultra Low project was a far more familiar form of public address. The Cities-4-People project mediated citizen participation mainly through a series of Mobility Labs that were experimental by design testing POTM approaches with marginalised residents.

As I explained in Chapter 3, I was unable to directly recruit or interview citizens who participated in iHUB smart projects, like those in Cities-4-People workshops or data generators in the Cycling Infrastructure Evaluation project. Issues of access meant I was restricted from interviewing people who were considered to be participants. As I explained in Chapter 3, the purpose of this would have been to discuss how citizens understood their participation and experiences of engagement (Kelty, 2019a). Other studies like Datta (2020) and Zandbergen and Uitermark's (2019) highlight the ways citizens articulate their engagements with smart projects through technologies like safety apps or sensors, which differ from the discursive emphases often placed on rational ideals of deliberative decision-making or collective action.

In Chapter 7 I began to consider the non-human agencies of *vehicles* as subjects of advanced algorithmic analysis (i.e., machine learning) performed on CCTV data to develop behaviour models of 'smart actor' sims for digital twins. I elaborated the complex socio-technical processes of *acquisition*, *extraction*, *tracking*, and *conversion* that systematically categorised and constituted human and vehicle actors and their

behaviours. Creating the ‘realistic’ scenario testing necessary for ADS testing in the digital twin required sim citizens to reproduce road behaviours virtually. Given the growing interest in 'digital twins' as a tool of urban planning or management (Batty, 2018a; Kitchin et al., 2021), this finding is important in thinking through processes of socialising ADS with citizens and spatial interrelations of ADS testing in digital and ‘real-world’ contexts.

8.5. Evaluating the conceptual use of ‘citizenship’

‘Citizenship’ is the primary framework I have used in this thesis to conceptualise forms of agency enacted in smart city projects or activities in Oxfordshire. Due to the way existing debates frame relations of power, the literature on smart cities has been oriented towards notions of citizenship in its examination of political discourses and practices of smart city rights, democracy, and engagement (Kitchin, 2022b; Shaw and Graham, 2017; Wylie, 2018). I recognise there are inevitably issues with such an approach. Many interpret citizenship as a formal framework indelibly linked with state power and formal institutions in which rights, responsibilities, and entitlements are formally enshrined (Isin and Nielsen, 2008). In the early stages of this research, I reviewed literatures on Henri Lefebvre’s concept of ‘the right to the city’ to consider whether this could be reframed or reworked to smart city contexts, which some geographers have started doing (Cardullo et al., 2019; Oyedemi, 2015; Rosol and Blue, 2022). I did not find this literature particularly insightful given its fairly rigid, dichotomous theorising of power and its lack of clarity of what such a

'right' entails (Attoh, 2011). Instead, I set aside the more traditional associations of 'formal' citizenships (e.g., legal status, membership, rights) towards 'substantive' citizenships (e.g., practices, claims-making) discussed in citizenship literatures (Isin and Ruppert, 2015). I acknowledge the tension between these different approaches.

Other UK studies further show that some cities do not even use nor refer to the term 'smart citizens', instead emphasising other groupings like 'the wider community' or 'key stakeholders' (Rose, 2020), as evident in this thesis. The citizenship framework I adopted largely centred on practices of individual citizens involved in democratic processes (Kelty, 2019a), thus limiting the social groupings or relations I unpacked in each chapter (Burns and Welker, 2022). Future research should further explore other ways in which smart cities constitute different forms of sociality beyond the fixed notions of citizenship I have worked with in this thesis.

There are many other ways of conceptualising how humans and non-humans are engaged in and with smart cities beyond the 'citizenship' framing I have used in this thesis. Within STS the term 'publics' is more widely used in literatures concerned with deliberative democracy, societal engagement, and socio-technical transitions (Chilvers and Kearnes, 2016b; Melanie Loehwing and Jeff Motter, 2009), for example. STS scholars such as Warner (2002) draw an important distinction between '*the* public' as a normative referent category and '*publics*' which come into being through discursive acts of address. Publics reflect "an ongoing space of encounter

for discourse" (Warner, 2002, p. 62) which can be disaggregated from state power, formal frameworks of citizenship, or pre-existing institutions. How 'the public' is constituted through discourse reflects how its social existence is then imagined, practiced, or materialised, and how publics relate to one another (Taylor, 2004, p. 106). In Chapter 6, for instance, I could alternatively conceptualise the 'local' tech CEOs, CTOs, and directors as the *public* addressed through the Smart Oxford board and gathered by its social imaginary of what the 'wider community' constitutes. I find my early engagement with the concept of publics complimentary to the wider aims of this thesis of exploring multiple ways *publics* are *discursively* enacted, and how this informs its practices and materials.

In sum, I acknowledge and recognise there are other frameworks for conceptualising forms of agency that depart from the 'citizenship' framework I have deployed in this thesis. I suggest the STS term 'publics' may provide a promising alternative given its relative distinction from literatures on 'smart citizenship.' That said, the dominant ideologized tradition of both 'the public' as well as 'citizens' is linked with rational-critical dialogue, which is something I have heavily critiqued throughout this thesis. I therefore need to consider how I further utilise and engage 'publics' in any future research.

8.5. Implications towards reflexive engagement with innovation

Through this thesis, I have engaged a diverse range of organisations in Oxfordshire who shape and participate in innovation processes and socio-technical transitions towards the development of emerging technologies and smart cities more widely. I have examined, for instance, how local authorities like Oxfordshire County Council constitute forms of 'smart citizenship' and how it was differently enacted. I further recognised in Chapters 3 and 4 that project-based forms of urban experimentation I observed in the field – as the main strategy of funding innovation in the UK – might act as barriers to institutional forms of learning (Cowley and Caprotti, 2018; Torrens and von Wirth, 2021). In response, this section first outlines what any future agenda for action which builds on the findings of this study should involve, and second how I plan to communicate such an agenda with organisations I engaged in this research.

#1: Review how citizenship terminologies are interpreted across iHUB teams.

In light of my findings, I would first recommend that Oxfordshire County Council reflects on ways citizens are engaged with different iHUB projects and technologies across its strategic priorities and teams. I consider this important given I observed significant variations in what was meant by terms such as 'participation', 'public engagement', or the 'wider community' (see Chapters 4 and 6). Using polysemantic or undifferentiated terminologies can generate confusion or ambiguity within and between key institutions (Elsdon-Baker, 2015), and this could constrain the critical function of local authorities to safeguard or protect public values of democratic

accountability within innovation processes (Eneqvist and Karvonen, 2021). Hence, it is important to disaggregate how different iHUB teams interpret vocabularies of citizenship engagement as well as its practical implications.

By analysing smart citizenship through the term 'ecology' I identified the dominant form of participation in iHUB projects, which centred on eliciting public opinions or views. This generally included consultations (GoUltraLow) or deliberative processes (Cities-4-People). I problematised forms of engagement such as public dissemination (DRIVEN) given this followed a deficit-model of 'informing' citizens. I also highlighted collective forms of engagement with interested or affected publics to crowdsource cycling infrastructure data (CIE project). Future agendas for action from Oxfordshire County Council should therefore compare ways citizens engage with innovation projects, perhaps to diversify the approaches proposed for future innovation bids or funding applications.

#2: Consider what participatory expectations, responsibilities and demands are placed on citizens, and whether those participatory responsibilities are equitably distributed.

Throughout this thesis, I have repeatedly returned to the EU Horizon 2020 project 'Cities-4-People' and its frameworks for engaging citizens through the concepts of 'co-creation' and 'co-design' (see Table 4.4). I contended that Citizen Mobility Labs that were implemented in Barton, east Oxford required already socio-economically

marginalised residents to repeatedly participate in deliberative conversations and to detail their transport and mobility challenges. It is important to recognise that any form of participation can be intensely affective, meaningful, burdensome, time-consuming, incomplete, or emotionally taxing (Kelty, 2019a). I do not doubt that the Citizen Mobility Labs were well-intentioned, and I have faith consortium partners were sensitive to those factors. However, the systemic approach I took that mapped participation across iHUB projects showed that responsibility for co-creating smart city solutions was adopted in Cities-4-People as an experiment and that most other innovation projects were not grounded in similar frameworks of engagement.

For this reason, any future agenda for Oxfordshire County Council iHUB projects should consider what participatory responsibilities or expectations are placed on citizens to be able to engage with innovation projects. Does a co-creation or co-design framework over-burden those participating in a project? In what ways can citizens accrue benefits from their participation beyond the immediate scope of a temporarily-funded smart project? Are there existing networks or forms of social infrastructure to facilitate other forms of engagement over regularly burdening individuals as participants? These are key considerations I would account for in reflexively designing citizen engagement with innovation processes.

#3: Involve multi-disciplinary social science perspectives in the development of smart city plans or activities.

Any future agenda of action from Oxfordshire partners involved in developing smart city plans or emerging technologies should involve the early engagement of multi- or transdisciplinary social science perspectives. Innovation processes tend to be skewed towards or centre STEMM practitioners during the initial stages of funding, developing, researching, or advocating for technologies. The deficit of 'upstream' or early social sciences perspectives in such processes means there is often a lack of adequate critical engagement with fundamental societal considerations, such as trustworthiness, or the possibility of differentiated impacts of technologies across diverse social identities or groupings. The gatekeepers I discussed in this research recognised this need; I accessed several stakeholders events by bringing '*the* social science viewpoint' to debates. It is therefore fundamental there are multiple social science perspectives involved in innovation processes to shift attention from purely technological issues to the societal challenges incumbent of any socio-technical transition.

AV researchers note the constructive role social sciences *could* play in working with government researchers, policy makers, analysts, academic/commercial engineers, or original equipment manufacturers (OEMs), to expand the scope of societal considerations discussed or debated in relation to autonomy, or to provide valuable policy or decision-making insights (Bissell et al., 2020; Cohen et al., 2020). Hence, I

also encourage social scientists to develop future agendas for action that takes a far more collaborative or engaging role with developers of emerging technologies.

To take forward these recommendations I will design a dissemination pamphlet that I will share with interview participants in the concluding stages of this research. The pamphlet will summate in lay terms key empirical findings and explain the agenda for action I detailed in this section. I acknowledge the PhD thesis is not necessarily the best forum to share action agendas with non-academic audiences and those I engaged in this research, which is why I feel a summative pamphlet is appropriate.

8.5. Future Avenues for Research

In this concluding section, I provide brief recommendations and reflections on the possible avenues for future research on smart cities and citizenship.

Future research could further analyse the institutional arrangements of smart city making that I uncovered in Chapter 3 and its implications on citizenships. In this research, I was not able to follow a smart project from its inception to completion, which could affect the forms of citizenship engagement I observed. Amongst the exemplars I identified, there were a wide set of terms used to describe activities like living labs, testbeds, trials, or pilots that broadly related to the 'projectification' of urban experimentation (Cowley and Caprotti, 2018; Torrens and von Wirth, 2021). Given the institutional form of smart closely associated with its funding source and

condition, it is highly probable that the iHUB continues to organise projects this way. However, I would be interested to explore the possible forms of institutional learning that happens in government organisations like Oxfordshire County Council between different projects, strategic priorities, and the technologies it is invested in.

Future research could also examine the ongoing implications and fallout of the COVID-19 pandemic (see Calzada, 2022; Datta et al., 2020; Milan, 2020; Mullick and Patnaik, 2022). This may include reflections on varied governmental responses to the crisis, the implications of digital technologies and apps introduced to track and monitor the spread of the virus (e.g., contact-tracing apps), or the ways smart technologies were redeployed to collate Covid data. This research was conducted prior to the start of the pandemic, but I suspect almost all of the citizenships I have detailed in this thesis will have been affected by it. Social distancing rules introduced by the UK government to prevent or curtail successive waves of viral transmission had distinct implications on cities and citizens. Most in-person forms of social interaction were temporarily upended, curtailed, or disrupted. Participatory practices of citizenship, then, may have been transferred to online video conferencing platforms like Zoom or Microsoft Teams. Likewise, national lockdowns may have completely altered the behavioural data that sim citizens were trained on to validate ADS in digital twins. There is therefore an urgent need for geographical research to investigate precisely how the COVID-19 pandemic has amplified or

reconfigured smart citizen dynamics due to the unanticipated and transformative conditions of the pandemic.

Finally, I consider the more recent convergence between literatures on smart and platform urbanism pertinent to future geographical research or analyses of urban citizenships (see Barns, 2020; Caprotti et al., 2022; Hodson et al., 2021; Rose et al., 2020a; van der Graaf and Ballon, 2019). Literatures that combine smart and platform urbanism address many other forms of digital mediation enabled by a growing and complex ecosystem of platform services. As I demonstrated in this thesis, platforms are "powerful intermediaries" (Barns, 2020) of various forms of citizenship in smart cities. For example, I showed the mediating role of smartphone apps core to concepts like MaaS which continue to guide future mobility imaginaries of UK government stakeholders like those I detailed in Chapter 5. Further research could address the Oxfordshire County Council partnership with Waze and how this type of arrangement interacts with the consortium form I decided to focus on. More generally, the ongoing convergence of smart and platform urbanism suggest that question of democratic citizenship in digitally-mediated cities will remain critical to the future of cities.

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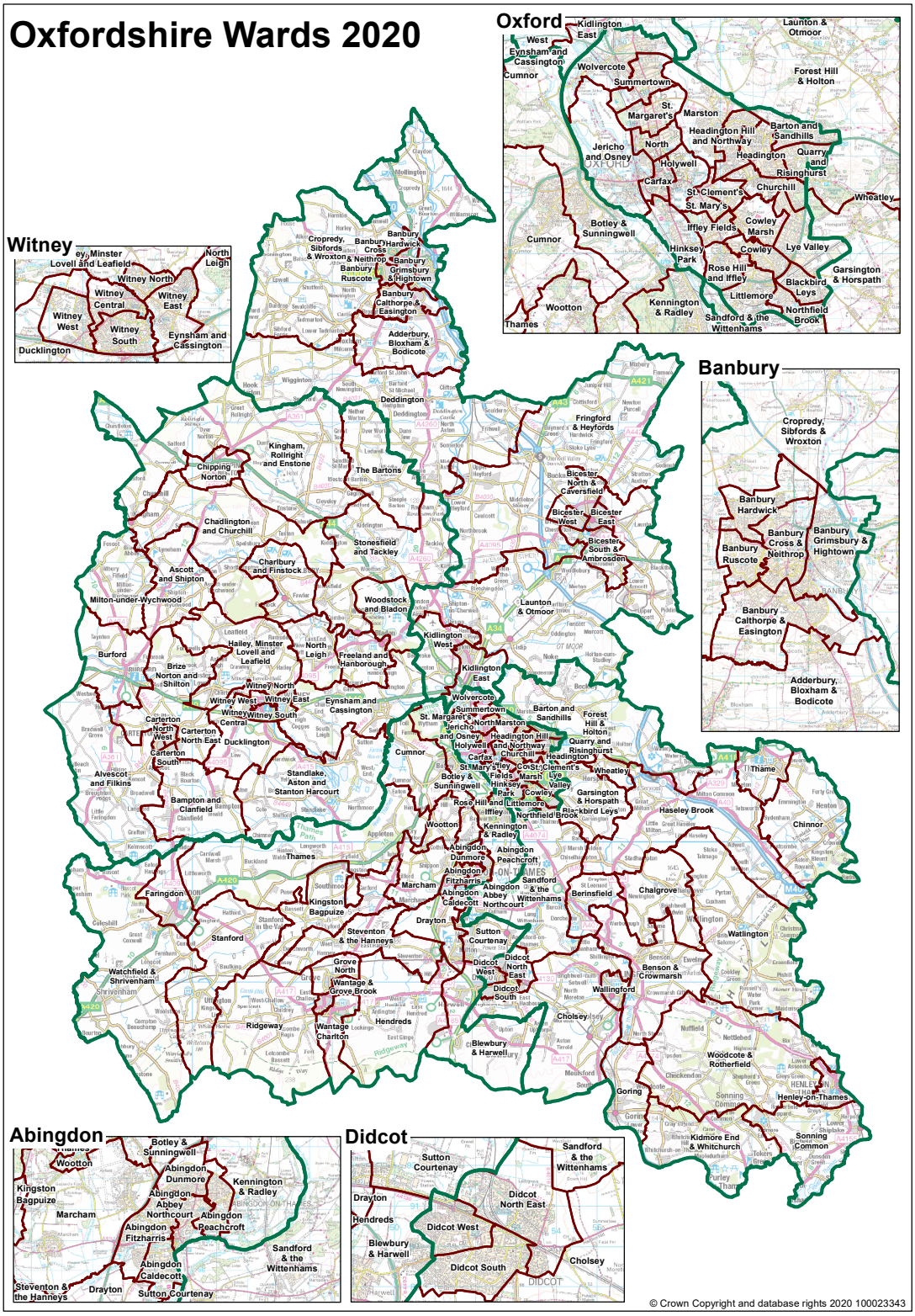
Appendix A

Administrative boundaries in Oxfordshire, reproduced from Oxfordshire Insight (2021a). Permission to reproduce administrative map has been granted by Oxford City Council.



Appendix B

List of 55 interviews conducted with Oxfordshire participants.

	Participant	Date	Location
1	Head of the iHUB, Oxfordshire County Council	Sep-18	Oxfordshire County Council Offices
2	Head of the iHUB, Oxfordshire County Council	July-19	Oxford Brookes University
3	Group Manager, iHUB, Oxfordshire County Council	Aug-19	Oxfordshire County Council Offices
4	Group Manager, iHUB, Oxfordshire County Council	Aug-19	Oxfordshire County Council Offices
5	Automated Transport Team Leader, iHUB, Oxfordshire County Council	Jun-19	Oxfordshire County Council Offices
6	Electric Vehicle Integration Team Leader, iHUB, Oxfordshire County Council	Jul-19	Oxfordshire County Council Offices
7	Health and Care Innovation Team Leader, iHUB, Oxfordshire County Council	Jul-19	Oxfordshire County Council Offices
8	Head of the Smart Oxford Board, Oxford City Council	Jul-19	Oxford city
9	Principle Bid Management Officer, iHUB, Oxfordshire County Council	Nov-18	Oxford city
10	Principle Bid Management Officer, iHUB, Oxfordshire County Council	Oct-19	Oxford city
11	Lead Technologist, Automated Transport, iHUB, Oxfordshire County Council	Jul-19	Oxfordshire County Council Offices
12	Integrated Data Analyst, iHUB, Oxfordshire County Council	Jul-19	Oxfordshire County Council Offices
13	Lead Technologist, EV Integration, iHUB, Oxfordshire County Council	Jul-19	Oxfordshire County Council Offices

14	Community Engagement Officer 1, iHUB, Oxfordshire County Council	Jul-19	Oxford city
15	Community Engagement Officer 2, iHUB, Oxfordshire County Council	Oct-19	Oxfordshire County Council Offices
16	Health and Care Project Support Officer, iHUB, Oxfordshire County Council	Aug-19	Oxfordshire County Council Offices
17	Research Assistant, iHUB, Oxfordshire County Council	Aug-19	Oxfordshire County Council Offices
18	Strategic Highways Development Appraisal Officer, iHUB, Oxfordshire County Council	Aug-19	Oxfordshire County Council Offices
19	Researcher, MaaS/Quantum Technologies, iHUB, Oxfordshire County Council	Aug-19	Oxfordshire County Council Offices
20	Senior Data Scientist, iHUB, Oxfordshire County Council	Aug-19	Oxfordshire County Council Offices
21	Spokesperson, Latent Logic	May-19	Oxford city
22	Spokesperson, XPI Simulation	Jul-19	Telephone Interview
23	Spokesperson, Ordnance Survey	Jul-19	Telephone Interview
24	Spokesperson, Admiral Group	Jul-19	Telephone Interview
25	Spokesperson, Mobility Oxford (MoBox)	Mar-19	Oxford city
26	Spokesperson, Mobility Oxford (MoBox)	Jul-19	Oxford city
27	Spokesperson, Low Carbon Hub	Mar-19	Telephone Interview
28	Spokesperson, Low Carbon Hub	Apr-19	Oxford city
29	Director of Strategy and Programmes, Oxfordshire Local Enterprise Partnership	May-19	OxLEP Offices
30	Project Development Assistant, Oxfordshire Local Enterprise Partnership	May-19	Oxford city

31	Researcher, University of Oxford	Jul-19	Oxford University College
32	Spokesperson, South Oxfordshire and the Vale District Council	May-19	South Oxfordshire District Council Offices
33	Spokesperson, Siemens	Jun-19	Telephone Interview
34	Spokesperson, Culham Science Centre, UKAEA	Jul-19	Culham Science Centre
35	Spokesperson, Remote Applications in Challenging Environments Facility, UKAEA	Jul-18	Culham Science Centre
36	Spokesperson, Remote Applications in Challenging Environments Facility, UKAEA	Jul-19	Culham Science Centre
37	Head of Innovation and Inward Investment, Oxfordshire Local Enterprise Partnership	Jun-19	Oxford city
38	Spokesperson 1, Knowledge Exchange and Impact Team, University of Oxford	Jul-19	Oxford University Offices
39	Spokesperson 2, Knowledge Exchange and Impact Team, University of Oxford	Jul-19	Oxford University Offices
40	Spokesperson 3, Knowledge Exchange and Impact Team, University of Oxford	Jul-19	Oxford University Offices
41	Spokesperson, Lucy Zodion	Aug-19	Lucy Zodion Offices
42	Spokesperson, Oxfordshire Local Enterprise Partnership	Jul-19	Oxford city
43	Knowledge Exchange Spokesperson, Oxford Brookes University	Sep-19	Oxford Brookes University
44	Researcher, Oxford Brookes University	Jul-19	Oxford Brookes University
45	Oxford University board member, Smart Oxford	Jul-19	Oxford city
46	Spokesperson, Nominet	Oct-18	Oxford city
47	Spokesperson, Oxford Flood Network	Sep-18	Oxford city

48	Spokesperson, Oxford Flood Network	Sep-18	Oxford city
49	Spokesperson, Oxford Civic Society	Aug-18	Oxford city
50	Former Board Member, Smart Oxford Board	Aug-18	Oxford city
51	Former Board Member, Smart Oxford Board	Sep-18	Oxford city
52	Spokesperson, Star Light, Star Bright	Aug-18	Bristol, UK
53	Spokesperson, Playable City Commission	Sep-18	London, UK
54	Spokesperson, Regeneration & Economic Services, Oxford City Council	Jul-19	County Hall, Oxford City Council
55	Spokesperson, Oxfordshire Growth Board and Ox-Cam Arc Board	Aug-19	Oxford city

Appendix C

Key events attended during the fieldwork period (June 2018 – September 2019)

	Event and Organisers	Date/Time	Location	Brief Description
1	Board meeting, the Smart Oxford board	25th July 2018	Oxfordshire County Library, Oxford city	Quarterly meeting of the Smart Oxford board, closed-door and invite-only
2	'Lord of the Ring Roads: Making Oxford a Smart City?', Oxford Technology and Media Network (OTMN) and the Smart Oxford board	6pm – 9pm, 24th September 2018	Modern Art Oxford Gallery, Oxford city	Networking event organised by OTMN/Smart Oxford with speakers involved in innovation and smart cities
3	'BartOn the Move', Cities-4-People project	6pm – 8pm, 1st October 2018	Barton Neighbourhood Centre, Oxford	One of several 'Citizen Mobility Labs' where citizen participation and engagement took place
4	'Partnering with supermarkets to Provide Transport', Cities-4-People project	6pm – 8pm, 14th November 2018	Barton Neighbourhood Centre, Oxford	Working group meeting set up to discuss one of several pilots for the Cities-4-People project with local partners
5	'Concessionary Pass Pilot', Cities-4-People project	2:30pm – 4:30pm, 15th November 2018	Oxfordshire County Council Offices, Oxford city	Working group meeting set up to discuss one of several pilots for the Cities-4-People project with local partners
6	'Cyber Security Challenges in Future Mobility', Cyber Security Oxford	2pm – 3pm, 15th March 2019	Robert Hooke Building, University of Oxford, Oxford	Cyber security seminar with two speakers from the Oxfordshire County Council iHUB automated transport team
7	'Living Lab Roundtable Prep', Mobility Oxford (MobOx)	9:30am – 11am, 3rd April 2019	Speedwell House, Oxford city	Private meeting between two representatives from MobOx and Smart Oxford to brainstorm, design, and structure the roundtable event
8	'Establishing the Oxfordshire Living Laboratory Framework', Mobility Oxford (MobOx) and the Oxfordshire Local Enterprise Partnership (OxLEP)	4pm – 6:45pm, 8th April 2019	The Jam Factory, Oxford city	Roundtable meetings convening a host of stakeholders interested in developing Oxfordshire as a living laboratory
9	'Project LEO (Local Energy Oxfordshire)',	5pm – 6:30pm, 7th May 2019	School of Geography and the	Seminar-style event and Q&A with an Oxford

	Oxford Energy Network, University of Oxford		Environment, University of Oxford	University professor involved in leading Project LEO in Oxford
10	'Living Lab Governance CIC', Mobility Oxford (MobOx) and Smart Oxford	2pm – 5pm, 12th June 2019	MobOx Office, Osney Mead	Private meeting with two representatives from MobOx and Smart Oxford to discuss bringing forward living laboratory ideas
11	'Living Lab – Business Model', Mobility Oxford (MobOx) and Smart Oxford	2pm – 4pm, 4th July 2019	MobOx Office, Osney Mead	Private meeting with two representatives from MobOx and Smart Oxford to discuss CICs and other business models
12	'Harwell EnergyTec and HealthTec Connect', Harwell Campus	12pm – 1:30pm, 18th July 2019	Harwell, Didcot, Oxfordshire	A networking event for members of two clusters based at Harwell campus
13	'VentureFest Oxford', Fusion Events	9am – 7pm, 11th September 2019	Oxford Brookes University, Oxford	Annual network and conferencing event for people working in research and innovation, including 'angel' investors, entrepreneurs, and tech businesses
14	'OxLEP Annual Event', the Oxfordshire Local Enterprise Partnership (OxLEP)	8:15am – 10:30am, 4th September 2019	Blavatnik School of Government, University of Oxford, Oxford	This event involved the official launch of the Oxfordshire Local Industrial Strategy (LIS) by the OxLEP
15	'DRIVEN – Autonomous Vehicle Project', Mobility Oxford (MobOx)	1pm – 4pm, 19th November 2019	Oxfordshire County Library, Oxford city	Promoted as an open event for anyone interested in the future of transport, this event disseminated findings from the DRIVEN project with speakers from its consortium.

Appendix D

Letter from the Copenhagen Business School on behalf of the Cities-4-People project consortium, December 2018.

Adam Packer,
St John's College,
Oxford University,
St Giles,
Oxford.

CBS
COPENHAGEN
BUSINESS SCHOOL
HANDELSHØJSKOLEN

5 December 2018

Copenhagen Business School
Department of Management,
Society and Communication
Dalgas Have 15
Room V2.083
2000 Frederiksberg
Phone Office: +45 3815 2561

Dear Adam,

I am writing to you because it has been brought to my attention that you are doing research on the Cities-4-People project as part of your PhD. As coordinator, I am afraid that I must insist that you do not pursue any research while the project is ongoing, since this will interfere with and jeopardise the work the consortium is conducting. Unfortunately, this also means that we will not be able to share any data, as this is strictly confidential material. We will, of course, be more than happy to share with you our published work when it is ready, and you are welcome to reference this in your PhD.

Kind regards
Julie Jo Nygaard

JULIE JO NYGAARD
PROJECT MANAGER CITIES-4-PEOPLE
TEAM OF SUSTAINABLE URBANISATION
DEPARTMENT OF MANAGEMENT, SOCIETY AND COMMUNICATION

CITIES 4PEOPLE
PEOPLE ORIENTED TRANSPORT & MOBILITY

Appendix E

Participant Information Sheet

School of Geography and the Environment
Oxford University Centre for the Environment
University of Oxford
South Parks Road
Oxford, OX1 3QY

Mr Adam Michael Packer
adam.packer@ouce.ox.ac.uk

School of Geography and the Environment
enquiries@geog.ox.ac.uk 01865 285070

Smart Cities, Smart Citizens: Exploring emerging forms of 'smart citizenship' across Oxford(shire)'s projects, partners and people

PARTICIPANT INFORMATION SHEET
Reference: SOGE 18A-168

You are being invited to take part in the *Smart Cities, Smart Citizens* research project. Before you decide whether to take part or not, it is important for you to understand why the research is being done and what it will involve. Please consider the following information carefully – and please do ask if you require any more information.

What is the purpose of this research?
Many cities across the UK are developing 'smart city' programmes that propose a number of changes aimed at enhancing economic growth, sustainability and organisation of the city and its services. This can often involve a range of technologies, sensors or data. However, there is little known about the idea of 'smart citizenship' in actually existing cases. This study will engage with several projects, partners and people in Oxfordshire developing technologies or projects in order to generate a better understanding of the ideas and values underpinning this work. It also explores how citizens are enacting citizenship practices evidenced through several projects in the county.

What will the study do?
The study involves:

1. Seeking informed opinion from stakeholders involved in several projects across Oxfordshire in the form of semi-structured interviews;
2. Following the histories and development of projects at key intervals by updating a research diary and conducting follow-up interviews;
3. Interviewing members of the public involved in smart projects to understand what being a citizen is like in Oxford in relation to smart city projects

Why have I been invited to take part?
The study seeks a range of key stakeholders including policy makers, practitioners and members of the public to develop a better understanding of smart activities in Oxfordshire.

Do I have to take part?
No, it is not compulsory for you to take part. However, we believe that you have something important to contribute to the study. You can ask questions about the research before deciding whether or not to participate. If you do agree to participate, you may withdraw yourself from the study at any time, without giving a reason, by advising the researchers of this decision.

What will happen to me if I take part in the research?
If you are happy to take part in the research, you will be asked to be **interviewed about the project you are a part of or have participated in**. Upon arrival, I will talk you through the study procedures and give you a chance to ask any questions. If you are still happy to take part, you will then be asked to sign a consent form. This interview should take approximately an hour. If possible, you will then be asked to be interviewed **two more times** during the course of the research. This will enable us to discuss different aspects of the project or initiative you represent, and it will give me an insight into how the projects you discuss develop over the duration of the fieldwork. This may also take approximately an hour.

Are there any potential risks in taking part?
We hope that the experience of taking part will be enjoyable and that there are limited to no risks taking part in the study. If there are any concerns, please inform the principle researcher who can respond to this.

Are there any benefits in taking part?
Benefits include being able to feed into a better understanding of the thinking behind smart city projects and the place of citizenship within this. You may also find working with social scientists to be interesting or mutually informative.

What happens to the data provided?
The information you provide as part of the study is the **research data**. The **research data** will be handled responsibly: interviews will be recorded via a Dictaphone and the audio file stored on an off-site, external hard drive for the duration of the study. The audio file will be transcribed into an interview script. This is also stored on the external hard drive. Both the audio file and interview transcript will be saved using a unique identifier code and the original file on the Dictaphone destroyed.

Personal data is any research data from which you can be identified (e.g. your name, position or the audio recording). We will minimise the use of personal data as much as possible in the study. However, it may not be possible to fully anonymise your responses in the final research output and we will ask you how you would like to be referred. We would like your permission to use direct quotes. Consent forms will be stored in an off-site folder and destroyed shortly after the completion of the research. The primary researcher and supervisors will have access to personal and research data.

All research data and records will be stored for at least 3 years after publication or public release of the work of the research. We may retain and store your personal data for an additional period of time as necessary for the purposes of the study, and for further research. For more details of the data management strategy, please speak to the relevant researcher or their supervisor.

Will the research be published?
All those who take part in the research can request a summary of the research findings. The research findings are likely to be published in journal articles or books. The research will also be written up as a thesis. On successful submission of the thesis, it will be deposited both in print and online in the University archives, as part of the Oxford University Research Archive (ORA), to facilitate its use in future research.

The University of Oxford is committed to the dissemination of its research for the benefit of society and the economy and, in support of this commitment, has established an online archive of research materials. This archive includes digital copies of student theses successfully submitted as part of a University of Oxford postgraduate degree programme. Holding the archive online gives easy access for researchers to the full text of freely available theses, thereby increasing the likely impact and use of that research.

Who is organising and funding the research?
The research is funded by the UK's Economic and Social Research Council (ESRC) and St. John's College, Oxford. Based at the School of Geography and the Environment, the research is part of Mr Adam M Packer's doctoral research. This is supervised by Professor Gillian Rose and Dr Alex Vasudevan.

Who has reviewed this study?
This study has been reviewed by, and received ethics clearance through, the University of Oxford Central University Research Ethics Committee (CUREC). The reference number is: SOGE 18A-168

Who do I contact if I have a concern about the study or I wish to complain?
If you have a concern about any aspect of this study, please speak to the relevant researcher or their supervisor who will do their best to answer your query. The researcher should acknowledge your concern within 10 working days and give you an indication of how they intend to deal with it. If you remain unhappy or wish to make a formal complaint, please contact the relevant chair of the Research Ethics Committee at the University of Oxford who will seek to resolve the matter in a reasonably expeditious manner:

Chair, Social Sciences & Humanities Inter-Divisional Research Ethics Committee
Research Services, University of Oxford
Wellington Square,
Oxford, OX1 2JD
ethics@socsci.ox.ac.uk

Data Protection
The University of Oxford is the data controller with respect to your personal data, and as such will determine how your personal data is used in the study. The University will process your personal data for the purpose of the research outlined above. Research is a task that we perform in the public interest. Further information about your rights with respect to your personal data is available from http://www.admin.ox.ac.uk/councilsec/compliance/gdpr/individualrights/.

Further Information and Contact Details
If you would like to discuss the research with someone beforehand (or if you have questions afterwards), please contact:

Professor Gillian Rose. gillian.rose@ouce.ox.ac.uk
Dr Alex Vasudevan alex.vasudevan.ouce.ox.ac.uk

THANK YOU FOR READING THIS INFORMATION SHEET

Appendix F

Participant Consent Form

School of Geography and the Environment
Oxford University Centre for the Environment
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South Parks Road
Oxford, OX1 3QY



Adam Michael Packer
adam.packer@ouce.ox.ac.uk | 07999788267
D.Phil. Geography and the Environment

PARTICIPANT CONSENT FORM

Reference Number: SOGE 18A-168

Smart Cities, Smart Citizens

EXPLORING EMERGING DISCOURSES OF 'SMART CITIZENSHIP' ACROSS SEVERAL PROJECTS, PARTNERS AND PEOPLE IN OXFORDSHIRE

		Please initial each box
1	I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐
2	I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without any adverse consequences or academic penalty.	☐
3	I understand that research data collected during the study may be looked at by designated individuals from the University of Oxford where it is relevant to my taking part in this study. I give permission for these individuals to access my data.	☐
4	I understand that this project has been reviewed by, and received ethics clearance through, the University of Oxford Central University Research Ethics Committee (CUREC).	☐
5	I understand who will have access to personal data provided, how the data will be stored and what will happen to the data at the end of the project.	☐
6	I understand how this research will be written up and published.	☐
7	I understand how to raise a concern or make a complaint.	☐
8	I consent to being audio recorded.	☐
10	I understand how audio recordings will be used in research outputs.	☐
11	I give permission to be quoted directly in the research publication against my name.	☐
13	I agree to take part in the study.	☐
14	I agree for my personal data to be kept in a secure database.	☐

Name of Participant	Date	Signature

Name of Person Recording Consent	Date	Signature

THANK YOU FOR TAKING PART IN THIS STUDY

Appendix G

Sample Interview Guide

Adam Michael Packer
adam.packer@ouce.ox.ac.uk

School of Geography and the Environment
University of Oxford

Interview Guide

Focus Area	Example Questions	Time
	Information sheet and consent form.	
Introduction to the Research	It may not be possible to guarantee complete anonymity.	5 mins
	Is it okay for me to record the interview? And to take notes during the interview?	
May I continue?		
Introductory Questions	Can you tell me a bit about yourself? When did you move to Oxfordshire?	5 mins
	What is your position? What does this involve?	
	Describe to me your background before working here.	
Background of the Proposal	Could you describe the project/proposal to me? What is the background of this?	15 mins
	Who do you think are the key stakeholders involved in this?	
	What would you say is the purpose of this work?	
Organisational Dynamics	Could you describe the everyday practicalities of this project and the work you're doing?	10 mins
	How are tasks divided between team members or consortium partners across these groups?	
	How do you communicate between different partners, including non-experts?	
Living Laboratories and Experimentation	Let's talk about some of the technologies themselves. Could you describe what ____ does?	15 mins
	Where is this being used or tested? How is this technology being tested in Oxfordshire? How would you describe these activities?	
	What forms of experimentation do these activities and projects involve?	
	What data collections methods are being used throughout the project?	
	How does this compare to other parts of the Local Industrial Strategy or other projects in the region?	
	What is the process of evaluation for the project?	
Citizenship and Participation	How have people or citizens been a part of this project so far? Which citizens *in particular* are involved and in what ways?	15 mins
	What do you mean when you say ____?	
	How has this project been received by members of the public? How do you think citizens would respond to this project?	
	Could you explain what the outcomes of this project are for citizens in Oxfordshire?	
	How can members of the public get information or access to the data gathered by this project?	
	What do you think it means to be a 'smart citizen'?	
	How do you think this technology will impact citizens?	

Adam Michael Packer
adam.packer@ouce.ox.ac.uk

School of Geography and the Environment
University of Oxford

		10 mins
Oxford as a Smart City	Could you describe how you see this project affecting Oxfordshire's growth or 'smart' future?	
	Would you say this technology could be transformative for Oxford? If yes/no, then why?	
	Who do you think this project is for?	
Closing Interview	Reminder of the right to withdraw from research	
	Concluding remarks	