Instrumentalization in the Public Smart Bikeshare Sector

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Declaration

I declare that the work described in this dissertation is, except where otherwise stated, entirely my own work, and has not been submitted as an exercise for a degree at this or any other university. I further declare that this research has been carried out in full compliance with the ethical research requirements of Maynooth University.

Signed: _____

Robert Bradshaw August 2018

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Abstract

This thesis is concerned with understanding how smart technologies are conceived, created and implemented, and explores the ways these processes are shaped by historical, geo-political, economic and technical contexts. At its core the thesis is concerned with understanding how technical citizenship and democracy can be preserved within the design process against a backdrop of increasing neoliberalism and technocracy. This is investigated by means of a comparative study of smart public bikeshare schemes in Dublin, Ireland and Hamilton, Canada. These schemes are configured and systemized using a variety of technical and ideological rationales and express the imaginaries of place in significantly different ways. Utilising a conceptual framework derived from Andrew Feenberg's critical theory of technology, the thesis unpacks and problematizes the innovation process in order to understand how the outcomes of these schemes support the way of life of one or another influential social group. The philosophical orientation of the study is critical constructivism which combines a form of constructivism with more systematic and socially critical views of technology. The axis of comparison between the schemes is democratization and the manner in which the rationalizations and embedded cultural assumptions characterizing particular places operate to support or resist more egalitarian forms of participation. Methodologically, Feenberg's critical framework is supported both by theory-driven thematic coding and critical hermeneutics which is an interpretative process that compliments the theoretical framework and positions issues of power and ideology within a wider, macro-level context. Data sources supporting the research comprise interviews, a variety of documentary sources and the architectures and technical specifications of both smart bikeshare systems. The findings from the research illustrate that despite the pervasiveness of a neoliberal orthodoxy conditioning technology production, citizen-centric design is still possible within a climate of consensus building and cooperation. As such, the thesis adds to the body of knowledge on philosophy of technology, critical urbanism, smart city development, democratic engagement and collaborative infrastructuring. In addition, the conceptual framework, developed in response to the empirical cases, represents an elaboration of Feenberg's work and so the thesis also makes an important contribution to the analytic and methodological potential of critical theory of technology.

Chapter 1 - Introduction

Introduction

Through the use of data-driven systems and networked infrastructures, smart cities and the policy initiatives supporting them, are positioned as enabling cities achieve greater efficiency and control, sustainability, innovation and economic performance. In addition, and given technology's capacity for transformation, technology led approaches to urban development also offer the potential of social innovation through improved citizen engagement and integrative forms of governmental practices and processes (Townsend 2013; Kitchin 2014).

Seen in this light, smart cities promise not only instrumental and financial rewards through improved service management, competitive advantage and net job creation, but also the empowering of citizens by enabling the co-production of infrastructure, public services and strategic development. In this formulation, the city is framed as a platform which empowers participatory and cooperative processes. Connecting data, people and knowledge, the city is envisioned as a dynamic and productive hub for the construction of the city by its citizens. Implicit in this narrative is the assumption that smart technologies are inherently value-free and benign, and used for progressive and egalitarian ends.

While information and communications technologies may offer the potential to foster greater democratization, it has been argued that urban regimes have placed comparatively little emphasis on engaging with design and implementation strategies which might support meaningful citizen participation. Rather, urban administration is more generally characterized by prioritising instrumental features such as information dissemination and service delivery which emphasise efficiency and cost saving (Freeman & Quirke, 2013; Wiig, 2015; Kitchin et al., 2017). Furthermore, critical scholarship has also noted that the design of smart technologies operates in hegemonic ways by translating the interests of powerful capitalist and bureaucratic actors into specifications which create modes of citizenship characterized by passivity, obedience and consumerism (Feenberg, 2010; Hacklay, 2013; Hannig, 2016; Cardullo & Kitchin, 2017).

As such, smart technologies are being increasingly implicated in processes of splintered urbanism (Graham & Marvin, 2002) with the implementation of networked, digital infrastructures being characterized by socio-economic and spatial bias. From

this perspective, narratives proposing 'technological neutrality' can be seen as a strategic attempt by vested interests to depoliticize design and position it beyond the scope of political action (Hacklay, 2013). Therefore, considerations of democracy and citizen participation have been largely rhetorical and mobilized to add legitimacy to technical praxis concerned with supporting private interests and entrepreneurial modes of governance (Cardullo & Kitchin, 2017; Perng, 2017). Such action has tended to produce technologies which are functional in nature, but which are resistant to social influence and the interests, concerns and needs of people and communities (Holland, 2008; Feenberg, 2010; 2017). It is the position of this thesis that, despite the pervasiveness of structural and ideological constraints conditioning technology production, citizen-centric design may still prevail when supported by rationalizations and reflexive practices concerned with the reintegration of functionality with progressive social values. This thesis explores such potential through an investigation of one smart technology – public smart bikeshare.

Contemporary or 'smart' bikeshare is a form of mobility in which bikes are made available from a network of strategically positioned stations distributed throughout the urban environment. Modern designs, which are generally supported by sophisticated information and communication technologies, deliver automation, ease of use, improved management and operations processes and reduced cost. As a result, smart bikeshare has spread exponentially in recent years and, as of 2015, there were more than 900 public schemes operating globally (DeMaio & Meddin, 2015). In addition to its potential in delivering cities instrumental value by reducing congestion and $C0_2$ emissions, improving health and extending the reach of public transportation for example, smart bikeshare is also being positioned by city administrations as integral to making cities smarter, more sustainable and more connected (Cuddy et al., 2014; Rani & Vyas, 2017). Furthermore, and against a backdrop of increasingly critical commentary on the ideological nature of the smart city concept, smart bikeshare is being promoted by urban regimes as a means of delivering greater equity to disadvantaged communities by mitigating social, economic and transport disadvantage (Buck, 2012; Clark & Curl, 2015; Hannig, 2016)

Despite this however, a number of scholars have begun to question the motivations at the heart of the smart bikeshare industry (Fishman et al., 2013; Duarte & Firmino, 2017). In a manner reflective of broader smart city concerns, smart bikeshare is emerging as a technology appropriated by elite interests leading to its

implication in social polarization and gentrification. This is evident in patterns of implementation bias characterized by economic and spatial disparity and in configurations which operate to preferentially exclude already marginalized groups (Hannig, 2016; Duarte & Firmino, 2017). The design of smart bikeshare systems therefore, has become intimately linked with issues of neoliberalism, democracy and social justice. As such, smart bikeshare represents an important socio-technical innovation through which these issues may be explored

The philosophical orientation of this research is critical constructivism which understands design as a contested terrain where competing value systems seek expression through the configuration of technical devices. This positions the work within a tradition which deeply implicates the form and content of technology with the worlds and identities it creates. This contrasts with other positions common within the philosophy of technology, which, in the interest of clarifying key terms and concepts for the unfamiliar reader, require some exposition.

1.1 Positioning the research with the Philosophy of Technology Tradition:

Feenberg (1999) has identified four main schools of thought which have characterized scholarship within the tradition of philosophy of technology; instrumentalism, determinism, substantivism and critical theory (see Table 1). These positions differ with respect to the role of human actors and the neutrality of technical means.

Table 1.1: Technology and Society: Main Schools of Thought

Technology is:	**Autonomous**	**Humanly Controlled**
Neutral	Determinism (e.g. Traditional Marxism)	Instrumentalism (Liberal Faith in Progress)
Value-Laden	Substantivism (means and ends linked in systems – Ellul, Heidegger)	Critical Theory (Choice of alternative means-ends systems).

Source: (Feenberg, 1999: 9)

Technological determinism is predicated on the assumption that technology and its development follow its own autonomous functional logic, which is independent of social contexts. From this perspective technology is seen as social only through the purpose it serves (MacKenzie & Wajcman, 1996). Therefore, it is perceived to be analogous to science and mathematics by its intrinsic independence to the social world. According to technological determinism, technical progress follows an inexorable path from lower to higher forms of sophistication with each stage of its development following a single trajectory of necessary and dependant steps. As such, technology is framed as a decontextualized and self-generating entity with its own immutable imperatives to which society must adapt and conform. Implicit in this view is the notion that all attempts to develop democratic controls of technology, and its associated impacts, are inherently futile (Bijker, 1995).

Instrumentalism sees technology as a universal resource which humans can appropriate for the betterment of society. It overlaps with determinism in that it also views technology as not encapsulating values per se but differs in that it allows for the influence of human control in its developmental trajectory. Implicit in this position is faith in progress through technological development (Feenberg, 2010). This view is dominant within institutional settings where digital technologies are accepted as delivering quality of life improvements for society in general (Hacklay, 2013)

Substantivist or essentialist views of technology propose that design is not neutral but incorporates the interests and agendas of powerful actors and is therefore value-laden and ideological. Best exemplified by work of Martin Heidegger (1977) and Jacque Ellul (1964), substantivism sees technology in largely dystopian terms.

> *"According to substantivism, modernity is an epistemological event that discloses the hidden secret of the essence of technology. And what is hidden? Rationality itself, the pure drive for efficiency, for increasing control and calculability…Substantivist critique has affinities with determinism. For both, technological advance has an automatic and unilinear character. What makes substantivism so very gloomy is the additional assumption that technology is inherently biased toward domination.* (Feenberg, 1999: 3)

Again, this position inevitably precludes democratic control of technology given its one and immutable 'essence'.

On the other hand, Feenberg's critical approach to technology acknowledges the tendency in modern societies towards efficiency and control but retains the

possibility that design may also incorporate socially specific values and so develop in ways which can incorporate multiple epistemologies. It emerges broadly from critiques by Herbert Marcuse (1964), Michel Foucault (1980) and from scholars in the constructivist tradition such as sociologist Bruno Latour (1987) who problematized the primacy of scientific rationality and argued that design was a social construction amenable to human intervention. As such, society has the capacity to choose alternate means-ends systems. Feenberg has synthesized insights from both essentialist philosophy and social constructivism to produce his own unique theoretical framework for interpreting the technology production process. The position stands at the intersection of two historic traditions then, neither one of which by themselves, can address the primary issue of political possibility. As will be discussed in Chapter 2 for example, common criticisms of constructivist theories of technology highlight their focus on contingency, fluidity and moral neutrality which ignores structure and thereby depoliticizes technical activity production no less than those perspectives from the essentialist tradition.

Feenberg's response to this dilemma - instrumentalization theory - provides the analytic and normative tools supporting the research and proposes that design must be considered at two analytically distinct levels which he terms primary and secondary instrumentalization. These instrumentalizations broadly correlate with substantivist and constructivist notions of technology. Primary instrumentalization is concerned with our functional relation to reality.

> *"At the first level, we seek and find affordances that can be mobilized in devices and systems by decontextualizing the objects of experience and reducing them to their useful properties. This involves a process of de-worlding in which objects are torn out of their original contexts and exposed to analysis and manipulation while subjects are positioned for distanced control."* (Feenberg, 2005: 2)

In the secondary instrumentalization technologies are integrated with existing devices and systems and with ethical and normative principles. While primary instrumentalization simplifies a device, this secondary phase offers the potential to imbue technology with qualities and characteristics which can cause a 'disclosing' or a 'revealing' of a world.

> *"Disclosing involves a complementary process of realization which qualifies the original functionalization by orienting it toward a new world involving those same objects and subjects*." (Feenberg, 2005: 3)

Within the context of this research, instrumentalization theory acts as a powerful framework for analysing the dialectical process by which smart bikeshare systems are produced, as multiple actors and interests compete for dominance. Where primary instrumentalization (functionalization) holds sway in the design process, systems tend to be simplified, separated from their social contexts and operate largely in support of goal-oriented action or to preserve the autonomy of powerful interests. Conversely, where secondary instrumentalization is informed by ethical and aesthetic considerations, there exists the potential to recontextualize and adapt these systems for greater social value. While analysis at the primary level is informed by substantivist critiques of technology, analysis at the secondary level is inspired by the potential of technology revealed through empirical studies in the constructivist tradition. Chapter 2 provides an elaboration of instrumentalization theory, justifies it use within the context of this research, and reflects upon its relationship to other theoretical positions within science, technology and society studies. In particular it contrasts Feenberg's critical perspective with poststructural approaches such as assemblage theory, social construction of technology (SCOT) and actor network theory (ANT) which, while useful methodologically and as a counterpoint to essentialism, fail to adequately address the key issue of power as an influence configuring the production of technology.

1.2 Research Question and Contribution to Research

While scholarship on smart bikeshare has begun to map its relationship with inequality and exclusion, much of the research to-date has tended to view systems as technically homogenous and adopted an instrumental perspective which quantitatively assesses smart bikeshare in different geographic locations using statistical and other quantitative methods to understand its impact on categories such as modal share, safety, the environment and so on (DeMaio, 2009; Midgley, 2009; Shaheen et al., 2013). Thus far, there have been no detailed empirical studies which either critically evaluate design as a form of urban technopolitics or explore the potential of smart bikeshare systems to enrol citizens in collaborative practices such as participatory design, knowledge sharing, and devolved forms of decision-making.

This project addresses this gap by investigating the instrumentalizations underpinning smart bikeshare and, by extension, interrogates the dominant narratives of progress within which the smart city has become corralled. It proceeds through a comparative study of two schemes – Dublinbikes (Dublin, Ireland) and SobiHamilton (Hamilton, Canada). These schemes are paradigmatic from a critical perspective in that their respective designs, and the processes by which they were realized, articulate fundamentally different notions of 'success' and the common good. While Dublinbikes is symptomatic of the technocracy and instrumentalism broadly characterizing the sector (and smart technology production more generally), SobiHamilton's design, which is adaptive, inclusive and open, demonstrates that these processes need not be ubiquitous. As such, the cases represent a productive way of examining the interplay between primary and secondary instrumentalizations and the effects that the values and cultural assumptions sedimented in both sites of production have on decision-making, strategic planning and urban development.
The research question which this thesis answers is:

How may the design and implementation of smart bikeshare systems preserve notions of equality, democratization and citizenship?

In answering this question, the project makes the following original contributions to research. Through hermeneutically tracing the attributes and functional properties of smart bikeshare systems back to the instrumentalizations acting upon them, it demonstrates that the architectural and ideological content of systems is not technically determined but is a product of the socio-cultural milieu within which the design and implementation process occurs. As part of this process, it empirically reveals how an orthodoxy of neoliberalism and bureaucracy operates in a real world setting to corporatize one instantiation of this technology, while also illustrating the potential of reflexive design to reconfigure smart bikeshare as a platform for innovation, dialogue, participatory modes of governance and systemic social change. In this sense it leverages, and operationalizes, both essentialist and constructivist perspectives in demonstrating the pervasive role of structure in patterning design while also articulating a view of agency as capable of conditioning these processes. The research also maps the interdependencies between these processes and the smart city narratives operating in both locations. As such, and in

addition to providing academics and practitioners with a set of integrative principles to guide the design of smart bikeshare schemes, it adds to the body of knowledge on critical urbanism, smart city development, democratic engagement, collaborative infrastructuring and technical citizenship. The thesis also makes an important theoretical contribution to the critical canon by demonstrating the utility of Feenberg's framework in a new, and still emerging, empirical setting. Through the research process, this framework was adapted to address limitations in its formulation by incorporating the conceptual means to more effectively map technology's response over time to the influence of environmental factors such as socio-political change, experiential learning and technical innovation. Modifying the model to embrace this aspect of technology emphasises the ongoing and emergent nature of design and enhances the framework's capacity to be usefully applied across multiple settings.

1.3 Thesis Structure

The argument and empirical research are set out in seven chapters. Chapter 2 provides a critical examination of the smart city construct, which in large part reflects the background cultural values and assumptions shaping smart technology production. The chapter problematizes the rhetoric which positions the smart city as inherently depoliticized and benign by mapping its implication in processes of entrepreneurial governance, control and social polarization. Through this lens, the design of technology emerges as operating hegemonically to perpetuate the interests of powerful stakeholders and, in the process, produce urban citizenship characterized by compliance and consumerism. The chapter also engages with conceptual positions which propose that technology may resist such processes to produce systems which retain diversity and incorporate a multitude of goals and aspirations. As previously noted, these notions of contestation and reflexive design are central to the work of philosopher of technology Andrew Feenberg. Accordingly, the chapter provides a discussion of his work, contrasts it with other conceptual positions within the sociology of technology tradition, and justifies its use in this project. A discussion of the recontextualization strategies which may be employed to support instrumentalization theory's emancipatory agenda is also provided.

Chapter 3 reviews the history and technical evolution of bikeshare, maps its potential instrumental, cultural and environmental value to cities and explores the ways

in which the configuration of contemporary schemes has become increasingly aligned with the underlying logics of the smart city. Through bias inscribed at the level of design and implementation, smart bikeshare systems are shown to operate primarily in the support of sectoral interests. The chapter also explores previous scholarship which focuses on strategies and practices which might reorient smart bikeshare both as an equitable mode of transport and as a political platform. The chapter also describes how democratic interventions might be used tactically to build networks of influence across multiple domains and in the process effect systemic social transformation. The chapter concludes with an examination of the potential of creative design both to mitigate many structural, economic and procedural barriers to equity and to foster knowledge sharing and decision-making practices which might (re)position riders as co-creators of the schemes they appropriate.

Chapter 4 provides a discussion of the methodological choices made in support of the research. The chapter is structured using a conceptual framework developed by Sanders et al. (2007) which describes the successive layers the research must pass through as a coherent methodology is formulated. Accordingly, the chapter begins with a discussion of the ontological and epistemological assumptions inherent in critical theory and describes the implications of these assumptions for the methodologies being used. The chapter continues with a discussion of the reasoning used to interpret the project's research findings, construct explanations and draw conclusions. In this instance, Feenberg's instrumentalization theory was used primarily abductively, however the process retained both deductive and inductive elements. The reasons for this hybrid approach are explained and justified in the chapter, as is the choice of case study as an appropriate strategy through which to develop the research. The chapter also provides a discussion of the factors influencing the choice of research sites and the tools used to collect and analyse data. This focuses on critical hermeneutics' use as an interpretative tool to compliment and extend thematic coding as a means of understanding both the macro and micro level forces shaping design.

Chapter 5 presents the findings from the projects' first case study – Dublinbikes. It provides a detailed chronological account of the schemes' development and maps the relationship between its configuration and the contexts from which it emerged. Two factors proved especially influential in this regard; firstly, the increasing neoliberalism which had come to define governance at both urban and national scales,

and secondly, Dublin's historic failure to adequately manage the spread of unauthorized outdoor advertising infrastructure. Together these contexts would produce the alliances and strategies shaping the systems' trajectory. Contrary to the rhetoric positioning DublinBike's as promoting citizenship and social equity, the scheme emerges as a technology used primarily to protect the structure and authority of Dublin City Council. This is manifest in patterns of service distribution which is linked back to the nature of the public private partnership used to implement the scheme and the managerialist and autocratic modes of governance which operated to exclude public and political representation from the democratic process. The chapter also provides an exploration of the commonalities and interdependencies between Dublinbikes and a series of other smart initiatives unfolding within the city. This reveals the systemic failure of local governance to support participatory and consensus building processes. As such, the scheme emerges as symptomatic of a broader culture of institutional inertia.

The findings from the projects' second case study – SobiHamilton - are presented in Chapter 6. It adopts a structurally similar approach to Chapter 5, beginning with an account of the challenges created by the city's geo-political configuration and continuing with a detailed empirical account of the way the project was guided through its various developmental phases. It pays particular attention to the dependencies and interconnections between the systems' configuration and the rationales and beliefs operating in the broader decision-making environment. The findings reveal SobiHamilton to be reflective of a new and inclusive politics emerging within the city. The scheme embodies notions of democracy and technical citizenry, with institutional and lay epistemologies combining to create a technology with a diverse set of interests and goals. In practice, design emerges as a distributed function involving universities, civic organisations, bureaucrats, technologists, environmental groups, community advocates and citizens. In contrast to DublinBike's technocratic and functionalist orientation, which acts to preserve the status quo, SobiHamilton's configuration explicitly addresses the structural and cultural barriers to equity currently characterizing the industry and actively fosters increased dialogue between decision makers and citizens. This positions the scheme as a platform for enabling new forms of innovation and engagement which have already begun to influence technology production across other areas of the city.

Chapter 7 interprets the findings from both case studies through Feenberg's critical lens. It mobilizes the analytic and ethical tools provided by instrumentalization theory to develop and enrich the empirical accounts from the preceding chapters and position them within a broader conceptual and explanatory framework. Given the nature of the findings, the analysis critiques the modes of power through which bias has shaped the technical horizon in Dublin and examines the rationalizations and practices by which Hamilton has managed to preserve enlightened notions of democracy. Accordingly, the chapter begins with a separate analysis of each case which explores the relationships between processes of instrumentalization and technology production. Here, the culture of corporate and institutional governance in Dublin emerges as strategic and autocratic; with consequential effects on the system and the forms citizenship it produced. SobiHamilton, by comparison, reflects a more vocational and collaborative ethos with the technology designed to integrate with the city's technical, social and cultural environments. The chapter continues with a second-level analysis which compares and contrasts the cases and explores not only the proximate or local factors formative to their respective schemes but also the provincial, national and supra national contexts which coalesced to produce fundamentally different conceptualizations of success.

Finally, Chapter 8 leverages the findings from the study to develop a set of design principles which, despite the variability and contingency of place, may be reasonably applied to encourage more equitable system production across multiple settings. The chapter also proposes a series of strategic policy initiatives, which, based on the empirical findings, are likely to provide the governmental, technical cultural contexts to support such efforts. These include enhanced co-ordination between state actors, greater integration of smart bikeshare with public transportation, the provision of multi-player ecosystems and the creation and sharing of fine-grained data. The chapter also provides a reflection on the implications of the research for theory which emphasises the importance of critical perspectives for an understanding of the structural forces constraining democracy. It also calls for closer scrutiny of positions within the science technology and society tradition which avoid engaging with issues of power and which, inadvertently or otherwise, act to promote technology as neutral. The chapter concludes with a series of recommendations for future research conceived to compliment the findings from this project and address some of the limitations inherent in its design.

Chapter 2 - Theoretical Perspectives

Introduction

Smart technologies have been typically positioned by their advocates as inherently transformative and progressive, with the potential to create cities which are coherent, agile and responsive (Hollands, 2008; Greenfield, 2013; IBM, 2017). In this positive framing, digital, networked technologies (transportation systems, smart grids, sensor networks, urban surveillance systems, mobile/locative media and so on) produce data which support the integration, management and control of urban infrastructure and services (Kitchin, 2016). Implicit in this framing is the assumption that technology is depoliticized and neutral; operating in a largely benign way to promote efficiency and productivity and reduce uncertainty in the management of places (Hacklay, 2015).

Increasingly however, this narrative is being challenged in the critical literature (Holland, 2008; Wiig, 2015; Coletta et al., 2017) which emphasises the hidden or black boxed ideologies embedded within the design and management strategies producing technological infrastructure. These practices have a hegemonic effect by "*being a representation of specific abstractions and thinking about the way cities and societies function*" (Hacklay, 2015: 2). Essentially, technology can be mobilized to preserve and perpetuate the philosophies, aspirations and ways-of-life of dominant actors (Feenberg, 1999; Dusek, 2006). In particular, attention has been focused on the technocratic, functionalist orientation of smart technologies, which, it is claimed, tends to support both neoliberal and autocratic forms of governance and perpetuates citizens as compliant and passive consumers of products and services (Kitchin 2014; Datta 2015; Sadowski & Pasquale 2015; Luque-Ayala & Marvin 2016; Kitchin et al., 2017). This prioritization of corporate and state interests (and values) leads to the exclusion of more pluralist epistemologies, which reflect the experience, knowledge claims and identities of society more generally (Bijker, 2013).

In response to these criticisms, proponents of the smart city have sought to emphasize that technology innovation is being motivated - at least in part - by the desire to promote social equity and more participatory forms of governance. IBM's product portfolio for example is being increasingly positioned as enabling new forms of crowdsourcing, engagement and citizenry (Abbas, 2016) and at a European level the 'European Innovation Partnership for Smart Cities and Communities' (EIPCSS) states that an essential element of the successful smart city is the "*co-creation, co-*

design and co-production of solutions by citizens" (Smart cities.eu, 2017). Similar narratives are appearing at a city level. Smart Dublin, the organisation for the management and development of the city's smart initiatives, is now marketing its activities under the banner "*Open, Engaged, and Connected*" which valorises collaborative frameworks, open innovation and transparent governance (DCC, n.d.). The promise, therefore, is that technology can be used as a channel to improve access to, and engagement with, decision makers and more generally that the smart city paradigm brings with it a normative shift that sees the city produced through more collaborative forms of negotiation and planning.

Despite this rhetoric of new horizons, criticisms of the logics and ambitions of the smart city have persisted. Sceptics have argued that this current iteration of the city is merely a phase in the evolution of entrepreneurial urbanism (Coletta et al., 2017; Wiig, 2015) which tends to coalesce around strategies for economic development, territorial competitiveness and attracting both capital and expertise to cities (Shelton et al., 2014; Coletta et al., 2017). As such, the technologies it produces remain deeply implicated in promoting and maintaining neoliberal forms and practices (Hacklay, 2013; Gabrys, 2014; Shelton et al., 2014; Wiig, 2015).

This chapter explores these issues in order to separate the rhetoric of smart technologies from the reality of their current formulations. A theoretical framework is then developed which provides a means through which the politics of technology and its implication for citizenry might be explored and problematized.

2.1 The Politics of the Smart City Imaginary

Though lacking a precise definition, the term 'smart city' has come to mean something inherently positive. Its proponents claim that networked, data driven technologies, can operate both instrumentally and normatively to reconfigure the nature of urban life and deliver technical, social and political improvements. Amongst the primary benefits claimed by such proponents is that smart technologies can deliver: a smart economy, through innovation and competitiveness; smart governance by supporting transparent and evidenced-based decision making; smart mobility, through integrated intelligent transport systems; and smart environments, by providing environmentally sustainable ways of producing and conserving energy; and significantly, smart citizens by

fostering a citizen-centric model of development which prioritizes social justice, participation and democracy (Hollands, 2008; Townsend, 2013; Kitchin, 2016).

Implicit in this imaginary is the assumption that cities are universal, ahistorical and aspatial (Kitchin, 2016) with the technology serving them framed as value-free; a neutral servant, with largely benign and benevolent impacts (Feenberg, 2010). It is an assumption that stems from a liberal faith in 'progress' and assumes that technology only acquires a valuative dimension or a social meaning through the ways in which it is applied (Hacklay, 2013). Increasingly however, this position is being challenged by critical scholars who have questioned the role which contemporary technologies play in specific social and political contexts (Holland, 2008; Shelton et al., 2014; Wiig, 2015; Cardullo & Kitchin, 2017). They have demonstrated that the assemblage of actors, ideologies and technologies associated with real-world smart city implementations operate in ideologically partisan ways. The emerging consensus suggests that the production, design and use of various technologies is not only the product of social variables (Bijker et al., 1987) but is actively implicated in the perpetuation of the power geometries which they serve (Feenberg, 1999; Dusek, 2006; Shelton, et al., 2014; Kitchin et al., 2015).

Hacklay (2013) for example notes that claims to neutrality essentially act as a mechanism to depoliticize technology given that the instrumental or technocratic rationality underpinning its production commands near universal assent. As a consequence, so called normative rationality - which incorporates beliefs, values and meanings - becomes marginalized with consequential outcomes for democracy (Feenberg, 2017; Perng, 2017). If political or normative issues can be reduced to a set of technical-scientific problems, then a solutionist mentality can prevail as there would remain little need for political discourse (Feenberg, 2011; Perng, 2017). Technologists are positioned as already knowing the optimal way to do things in their domain hence citizen input is redundant. The position also leverages the deterministic notion that innovation leads inevitably and incrementally to more sophisticated (and positive) technical outcomes, which again operates to obviate the need for engagement and contestation (Bijker, 2013). Therefore, those who persist in challenging solutions developed by technocratic regimes can more conveniently be framed as irrational and ignored. Accordingly, there is a growing concern that smart technologies produced by assemblages of corporate and state actors act hegemonically to conserve and

perpetuate historically constituted hierarchies of knowledge and power (Hollands, 2008; Kitchin et al., 2017).

While the literature notes that the particular forms of power and control invested in, and performed by, smart city technologies are the product of situated and context-dependant variables, there remains nonetheless a pattern of enacting and reproducing neoliberal forms of governance which disguises growing social polarization (Graham & Marvin, 2001; Hollands, 2008). Such polarization belies the emphasis on human capital and participatory democracy found in much of the promotional literature and reflects the less than altruistic motivations energising the smart city concept (Peck & Tickell, 2002; Greenfield, 2013; Wiig, 2015).

2.2 Neoliberalism, Governance and Technology

Kitchin et al. (2017) note that, while the genesis of the 'smart city' can be traced to the drive by technology corporations in the late 2000s to cultivate new business opportunities, the concept is only the most recent phase of a process that has been developing steadily for decades. Cocchia (2015) identifies previous iterations as including the knowledge city (Ergazakis et al., 2004), digital city, (Couclelis, 2004), intelligent city (Komninos, 2006), wired city (Hollands, 2008) and ubiquitous city (Anthopoulos & Fitsilis, 2010). Despite the absence of a universal definition and the often unplanned and emergent character of the smart city (Dourish, 2016; Coletta & Kitchin, 2017), the themes that unify the phenomenon are the promotion of a 'utopian urbanism' by tech companies, property developers, governments and other sectoral interests (Datta, 2015) and the increased tendency towards the marketization and privatization of key urban infrastructure and services (Holland, 2008). Watson (2015) also notes that the constantly shifting labels and marketing associated with the city is part of an entrepreneurial model which makes apprehension and critique more difficult. Furthermore, it leads to a blurring of the distinction between the city and the private sector which enables the legitimization of neoliberal and algorithmic forms of governance (Cardullo & Kitchin, 2017). The result is the diminution of participatory decision making and technical citizenship.

Recent research on the nature of such citizenship reveals that innovation is frequently characterized by paternalism, stewardship and the promotion of passive consumption, with technology production and design bearing the hallmark of top down

autocracy (Holland, 2008; Clark & Shelton, 2016). Cardullo and Kitchin (2017) note that citizen participation within the smart city paradigm typically ranges from non-existent to tokenistic with individuals essentially positioned as 'users' reduced to experiencing algorithmically-mediated services. While algorithms are typically positioned as value free instruments of efficiency, Kitchin and Dodge, (2011) and Hacklay (2013) note that embedded within their operation are certain ideologies and rationales about how society should be managed. In practice, algorithms operate in tandem with institutions, administration, laws and social norms to exercise a form of disciplinary power designed to instil particular habits, dispositions, expectations and self-disciplining (Kitchin et al., 2017). Therefore, distributed and automated software-mediated technologies act to modify behaviour in accordance with neoliberal or bureaucratic ideologies. Feenberg (1999), leveraging Weber's concepts of rationalization (1964), proposes that it is 'operational autonomy' and self-perpetuation which dictates the style of technological design as powerful actors strive to maintain functional and ideological control of their domains through technocratic means.

Researchers from the Programmable City project at Maynooth University, who undertook extensive research on 'Smart Dublin', cite numerous instances where these forms of technocracy are evident. Based on their analysis of traffic management systems, for example, they note that behind the veil of social and political neutrality these technologies, and the data they generate, are often implicated in networks of surveillance, policing and other forms of security and governmentalities (Kitchin et al., 2017). Drawing on the work of Monahan (2007), they also argue that such systems perpetuate forms of neoliberal development by emphasizing;

> "…*'pipes' over places, maximizing the flow of privately owned vehicles through those pipes' and privileging the support for certain mobilities over others (private over public transportation, driving over walking or bicycling. "* (Kitchin et al., 2017: 16)

Similar themes emerged in their analysis of city dashboards. These systems are generally proffered as offering factual, comprehensive and accurate representations of various aspects of urban life. They essentially claim to translate the contingency and complexity of cities into rational and decontextualized forms of knowledge (Mattern, 2014).

> *"As such, they provide a powerful realist epistemology for monitoring and understanding cities, underpinned by an instrumental rationality in which 'hard facts' trump other kinds of knowledge and provide the basis for formulating solutions to urban issues... and they expand the capacity to govern by extending forms of power/knowledge*." (Kitchin et al., 2017: 7)

Smart meters, intelligent transport systems and smart lighting, amongst others, were also shown to operate to instrumental and technocratic rationales which act to conserve institutional hierarchies and encourage particular (self) regulatory outcomes (Kitchin et al., 2017). Even with projects designed to promote collaboration and devolved forms of decision making such as citizen sensing and environmental monitoring, citizens are often little more than data producers with no agency to act upon this data subsequently. Again, this form of participation is instrumental rather than substantive (Hacklay, 2013). Gabrys (2014) also notes that diverting citizens into modes of environmentality can have the effect of leaving neoliberal power unexamined. In the process, the logic of efficiency and economic optimization shapes development whereas previously it may have been understood through social or noneconomic modalities.

Similarly, attempts intended to connect citizens to decision makers through ICT have tended to be both restrictive and utilitarian. Government agencies can be resistant to cultural and operational change and the extent to which they can scale their organisations, skills and expertise to accommodate engagement can be limited. Also, bureaucracies develop proficiencies at routine tasks which can cause technical specialization and path-dependency. This rarely lends itself to the kinds of flexibility required to engage constructively with the public (Perng, 2017). Consequently, engagement initiatives generally favour information dissemination and are supported by sterile, highly bound technical systems (Freeman & Quirke, 2013). Furthermore, they have tended to limit the notion of 'technical citizenship' to providing feedback on proposals developed by elites in the absence of consultation or democratic oversight (Dutil et al., 2008; Perng, 2017). In this way organisational identity is preserved. This also mirrors much activity in the private sector. In the case of hackathons for instance - where citizens with the appropriate technical expertise are invited to participate in collaborative design initiatives – events are typically owned and run by corporate sponsors who encourage innovation towards the creation of marketable products. In this way hackathons can be said to perpetuate business-led development and neoliberal urban governance (Perng et al., 2017).

Another aspect of the smart city is the repositioning of the public as consumers, with citizens restricted to selecting between products and services from a marketplace of providers. These products and services range from free-to-use private apps to core utilities increasingly delivered by private corporations or public private partnerships (Cardullo & Kitchin, 2017). The rhetoric promoting (and legitimizing) this shift from depoliticized to neoliberal forms of governance exploits arguments which focus on the perceived inability of traditional public sector administrations to competently deliver and/or manage technology based services, thereby promoting the need for various forms of privatization (Graham & Marvin 2001; Greenfield 2013; Kitchin 2014; Vanolo, 2014). Therefore, problems often associated with public administrations such as a lack of economic resources, poor internal integration, a deficit of knowledge and skills, cultural inertia and so on, become the basis not for systematic organisational reform leading to improved standards of governance but for increased co-operation with the private sector. Consequently, regimes comprising a variety of technocrats, bureaucrats, policy experts and vested interests tend to coalesce around self-serving epistemologies which understand the smart city, and its people, as best served by hybrid or 'beyond the state' configurations (Swyngedouw, 2005). Such configurations frequently operate from positions of monopoly and are unlikely to prioritize normative or ethical changes which might compromise their own autonomy (Feenberg, 2010). As such, democratic interventions become additionally challenging (Agyeman & McLaren, 2015; Perng, 2017). Collaborations between state and corporate entities can also result in infrastructure being assembled piecemeal, with systems poorly integrated with legacy technologies, the built environment and urban governance (Shelton et al, 2014). Such infrastructure may also be resisted by city departments which have limited scope to incorporate new business and information handling practices into business-as-usual activities (Kitchin et al., 2016; Perng, 2017). This tends to produce urban infrastructure which is managed with limited input from either city governance or citizens. Cardullo and Kitchin (2017) note also that chief executives of local authorities may have the capacity to action such projects without obtaining sanction from elected representatives and so democratic oversight is entirely absent. Furthermore, the democratization of large-scale projects in particular can be complicated by funding requirements (Cope, 2017). The planning of such projects is typically complex and challenging and so is often conducted in the absence of citizens as adequate resources are rarely made available to accommodate their participation. Once funding has been

secured then projects must meet contractually pre-defined deliverables and milestones thereby further reducing the potential influence of citizen advocacy.

Consumerism in a smart city context is also a catalyst for social stratification and inequalities through bias in the distribution of infrastructure and services. For example, those who can afford it are invited to buy into a smart lifestyle by living in smart buildings and districts (Cardullo & Kitchin, 2017). These spaces are supported by technologies and systems designed to enhance convenience, security, mobility, service efficiency and so on. Through this process of 'neo-liberal urbanism' (Peck & Tickell, 2002) the smart city is increasingly marketed to educated, mobile professionals with social and political capital. As a result, the implementation and distribution of urban infrastructure is often modulated by patterns of socio-economic prejudice (Graham & Marvin, 2001; Feenberg, 2010; Mattern, 2016) which runs contrary to the rhetoric of smart communities embodying sustainability, diversity and inclusion (Holland, 2008; Shelton et al., 2014). In the case of Dublin for example, Heaphy and Pétercsák (2016) have reported that a special development zone comprising a mix of high-end offices blocks and residential apartments (and home to head offices of Facebook, Google and LinkedIn) has been designated a 'smart district' and will benefit from the associated investment in infrastructure, services and innovation.

> *"…the area is to become a testbed for new smart technologies and act as a means to attract additional inward investment (especially from urban Internet of Things companies). Much of the space created is privately owned and managed rather than being public space, with such developments operating for the benefit of their owners and counter to that of an urban common."* (Cardullo & Kitchin, 2017: 11)

This kind of differential investment in infrastructure, which caters to powerful places and people, leads inevitably to unequal economic growth and a 'splintered urbanism' characterized by an abandonment of the ideals of justice and equity (Graham & Marvin, 2001).

All in all, the design, implementation and use of technology within the smart city paradigm is typically orchestrated to maintain the ideologies, ambitions and ways-of-life of powerful bureaucratic and corporate actors. Democracy, contrary to its portrayal in the marketing literature, is framed within a concept of neoliberal

citizenship which simultaneously emphasises the privatization of services and infrastructures and the framing of people as passive subjects and consumers.

> "*…it [citizenship] is most often framed within an instrumental rather than normative or political frame. In other words, citizens are encouraged to help provide solutions to practical issues – such as producing an app, or feeding back on a development plan, or to perform certain roles/responsibilities – but not to challenge or replace the fundamental political rationalities shaping an issue or plan."* (Cardullo & Kitchin, 2017: 18)

Despite this quite pessimistic analysis however, there remains optimism in the literature that interventions are possible which might reorient such decontextualized notions of democratization towards one which embraces pluralism, participation, equitable access to resources and so on (Feenberg, 1999; 2017). Cities are historically, politically, economically and culturally contingent places and as such the technologies they produce can embody this diversity. Despite the technological trends characterising the smart city, the potential still exists for technology to resist processes of right-wing colonization and incorporate the interests and goals of a broader range of political and normative perspectives (Dusek, 2006; Shelton et al., 2014). As political and discursive agency within society shifts, then so also does the possibility of translating this momentum into technical changes which meet socially relevant goals.

This tension between conservation of hierarchy on the one hand and more democratic forms of technological transformations on the other is fundamental to the work of critical theorist Andrew Feenberg. His 'critical theory of technology' (1999; 2010) challenges the primacy of technocracy while also theorizing on the nature of technology production and the means by which it might retain alternate interests and values. A discussion of his work, which forms the philosophical and theoretical framework supporting this research, will comprise the remainder of this chapter.

2.3 Mapping Critical Theory of Technology:

Feenberg's theoretical position is essentially a synthesis of insights and critiques on modernity developed by theorists such as Weber (1964), the Frankfurt School (Adorno & Horkheimer, 1972) and Lukács (1971), and principles which emerged subsequently from sociological studies of technology (e.g. Bijker et al., 1987; Latour, 1987; Bijker, 1997) which emphasized the contingent and relational nature of technological development. While these studies proved useful in developing a critique of

technological determinism by illustrating that the trajectory of innovation was a product of social variables, their general reluctance to engage with issues of politics and power limited their scope to highlight social injustice and how technology might affect societal change. By contrast, Feenberg's work explicitly addresses these limitations by enabling a hermeneutic reading of technology through an analysis of how design and implementation practices are embedded within broader sets of values, processes and taken-for-granted assumptions. Furthermore, through his concept of 'instrumentalization theory', he elaborates a position where the translation of public demands into technically rational systems is possible. As such, it adopts an ontological position which is mindful of both substantivist and poststructural traditions and supports a reading of design praxis which leverages their respective strengths.

STS and Critical Perspectives: A Synthesis

STS (science, technology and society) studies emerged from critiques of determinism which understood technology as a decontextualized and self-generating entity with its own immutable imperatives to which society must adapt and conform (Bijker, 1997: 281). A counter argument to this thesis emerged in the early 1980s with the advent of a constructivist sociology of technology which demonstrated the socially contingent nature of technological development and attempted to problematize design and innovation. It was developed primarily from a synthesis of four broad academic traditions – the sociology of scientific knowledge (SSK), the sociology of industrial organisations, technology policy studies and certain approaches within the economics of technological change (Williams & Edge, 1996).

This interpretative approach both examines the content of technology and offers an exploration of the particular processes and contexts that frame its development. The approach proposes a *constitutive entanglement* between the social and technical realms leading to their co-production (Latour, 1983; Kling, 1980; Orlikowski & Scott, 2008). Methodologically, STS involves studying technical innovation and noting points of "interpretative flexibility" or "branch points", which had the potential to launch multiple technical designs on their own developmental path. The task is then to understand why one interpretation, rather than another, succeeded. A core principle of this approach is the notion that the workings of science (the end product, be it an artefact, theory or knowledge) be seen as the *explanandum* and not

the *explanans*. In other words, to avoid teleology, all technologies should be treated symmetrically which might then reveal their contingent and constructed nature (Bloor, 1973; 1976). A consequence of this has meant that, for the most part, constructivist studies have adopted ontologies which lack a normative core and fail to situate technopolitics within broader political and cultural processes.

Klein and Kleinman (2002) note that constructivist studies assume implicitly that all groups are equal and that all relevant social groups are present during in the innovation process. These assumptions fail to adequately account for the wider socio-cultural and political milieu in which artefact development takes place. Some groups, women for example, may be entirely excluded from design and implementation processes, while others may not be groups at all but may be a diverse collection of subgroups for whom one actor claims to speak (Russell, 1986; Wajcman, 1991). Also, the assumption that the result of inter-group activity is usually consensus, leading to the stabilization of particular technologies (Bijker, 1997), is somewhat optimistic and overlooks both systematic asymmetries of power and how these asymmetries are rooted in the structural features of political and institutional life (Klein & Kleinman, 2002).

> *"The background conditions of group interactions, such as their relations to each other, the rules ordering their interactions, and factors contributing to differences in their power, remain largely invisible.....social construction of technology ignores the question of how existing groups were able to come into being, whether some individuals sharing common meanings were unable to unite into a group, and how groups entered the set of groups with access to the design process"* (Klein & Kleinman, 2002: 3)

A prominent conceptual model within this tradition - Actor Network Theory (Latour, 2005) – is equally problematic. ANT's proposes that entities have no inherent qualities: they acquire their form and functionality only through their relations with other entities in the network. It also proposes an 'ontological symmetry' among human and non-human 'actants', essentially arguing against any *a-priori* distinction between what is technical and what is not (Bloomfield & Vurdubakis, 1997). Non-human actants can include for example science, technology, economics and politics (Callon, 1986). A 'network' of relations is formed through the enrolment of actants by means of negotiations. This process is explicated by the 'sociology of translation' which aims

to describe, rather than explain, the transitions and negations that take place as the network is configured or translated (Callon, 1986).

While it has proven useful in describing the scope, diversity, and complexity of factors impacting the design and use of technology, its value-free relativism and the attendant lack of critical and ideological substance has tended to produce descriptive rather than explanatory insights. Sandra Harding (2008), for example, has criticized ANT for dismissing such basic social categories as race, class, and postcolonialism, concerns echoed by Casper and Clarke, (1998) and Star (1991). These concerns also resonate with explicitly feminist critiques of constructivist studies by Wajcman (1991; 2000), Quinlan (2012) and Lagesen (2012).

Kleinman (1998) suggests that an emphasis on agency has led ANT researchers to ignore or undervalue the restrictions placed on human actors in their efforts to act. Latour (1987), for example, suggests that the researcher should be attentive to actors and begin the analysis by following them through the networks they inhabit. Kleinman however notes that:

> *"At a methodological level, restricting analysis to the world as seen by actors may lead us to ignore distributions of resources that are of no concern to the actor being followed. We may, furthermore, overlook institutional constraints to which actors are not particularly attentive."* (Kleinman, 1998: 4)

These concerns have been re-iterated within debates on contemporary urbanism. Brenner et al. (2011), proponents of a political economy approach to understanding and problematizing processes of neoliberal development, have highlighted that while assemblage theory (an approach modelled on actor network theory) may have methodological value in exploring previously neglected aspects of capitalist urbanization, at an ontological level it:

> "*…displaces the investigation of capitalist urban development and the core concerns of urban political economy (e.g. the commodification of urban space, inequality and power relations, state intervention, polarization, uneven spatial development). In explicitly rejecting concepts of structure in favor of a 'naïve objectivism', it deprives itself of a key explanatory tool for understanding the sociospatial 'context of contexts' in which urban spaces and locally embedded social forces are positioned."* (Brenner et al., 2011: 7)

This essentially paraphrases Feenberg's position in relation to technology development. His '*context of contexts*' resonates with the formulations and critiques

of the smart city paradigm previously outlined and is derived from historical insights on the alienating influence of capitalist economics (Marx, 1906) and the associated spread of bureaucratization and technocratic rationalization (Weber, 1964). The cumulative effect of these processes has resulted in a decontextualization of society where the dominant orthodoxy of calculation, optimization and control has replaced traditional values and ethics (Adorno & Horkheimer, 1972; Marcuse 1964; Lukács, 1971). This reified rationality, and the technologies it produces, exploit the implied autonomy of science and technical progress and threatens the potential of agency to mobilize counter arguments and resistance. Insights derived from STS however – partial though they may be – suggest the potential of a reflexive or democratic rationalization.

> "*While technology studies may lose part of the truth when it emphasises only the social complexity and embeddedness of technology and minimizes the distinctive emphasis on top-down control that accompanies technical rationalization it nevertheless allows any concrete thing to be grasped as a manipulable variable, and this includes human beings themselves."* (Feenberg, 2003: 1)

Critical theory of technology therefore incorporates the contingency and underdetermination of technical development demonstrated empirically through STS case studies into a framework which assumes apriori that dominant groups will actively seek to achieve self-interest through resisting particular designs and promoting others. The resulting decision rules or 'technical codes' which translate discursive and technical demands into a technology are the hegemonic realization of particular interests (for the most part institutional and bureaucratic) in a design solution where multiple alternate solutions are possible or desirable. The choice between these solutions appears to be made on the basis of technical efficiency, while in reality highly rationalized systems are as prone to bias as the minds which conceive them.

> *"Substantive bias is based on factually questionable beliefs, but efficient operations are often unfair even where bias in this ordinary sense is avoided. I have introduced the concept of "formal bias" to describe prejudicial social arrangements of this type. Formal bias prevails wherever the structure or context of rationalized systems or institutions favors a particular social group…critical theory of technology analyzes formal bias in technological design which, like the market, combines rational principles (calculation and optimization) with social determinants." (Feenberg, 2008: 7)*

This formal bias is comprised primarily of 'constitutive' and 'implementation' variants. Constitutive bias is evidenced in the values embodied in a theoretical system and is independent of context. Here, the technology systematically favours a particular social group irrespective of its social or geographic setting. Surveillance technologies, with some exceptions, operate to enhance the power of a minority with political power at the expense of the surveilled. It is not substantively biased because its primary intention is not to discriminate per se; it is merely acting in the service of enhanced efficiency and control. Implementation bias on the other hand is realised subsequently through contextualizations in the real world. Transportation systems which disenfranchise poor communities for example exhibit implementation bias.

In this way, the interests and autonomy of powerful groups can be preserved and propagated behind the myth of neutrality. Despite these structural constraints, the possibility of radical transformation through political action exists. This potential is articulated through a concept of dialectical technological rationality which Feenberg's terms instrumentalization theory.

Instrumentalization Theory

Instrumentalization theory is Feenberg's conceptualization of the technology development process. He frames the dialectic between technocratic and democratic rationalizations in terms of two analytically distinct processes he terms primary and secondary instrumentalization, both of which have implications for the subjects (humans) and objects (technologies) of technical action.

> *"The emphasis on purpose obscures another aspect of functional objects that I call "meaning." The duality of function and meaning underlies the "double aspects" of the instrumentalization theory."* (Feenberg, 2010: 176)

Primary instrumentalization involves processes of decontextualization and reduction, in which the instrumental or quantifiable aspects of technology are seen in isolation of its environments and simplified in order to make them manipulable by technical reason. Though largely neutral at this stage, such artefacts are vulnerable to capitalist and managerial projects of control which results in technology designs that reinforce Weberian notions of societal rationalization (Kirkpatrick, 2013). Through the hierarchical structure of modern organisations, the subjects of technical action are protected from the consequences of their actions. This encourages both an attitude of

strategic positioning and the differentiation or separation of the technical and social spheres.

> *"One cannot "operate" workers or consumers as one would a machine, but one can position oneself strategically with respect to them so as to influence them to fulfill pre-existing programs they would not otherwise have chosen.*" (Feenberg, 2000: 307)

Primary instrumentalization therefore, embodies the technocratic orientation of many smart technologies and associated forms of governance. Unlike essentialist critics of technology, however, such as Heidegger (1977) and Borgmann (1984) who ontologize such characteristics, Feenberg proposes a secondary phase in the production of technology which offers the potential of counteracting the reifying effects of primary instrumentalization.

Secondary instrumentalization is the process of recontextualizing a new technical arrangement to fit with its natural, technical and social environments. When supported by the appropriate normative and ethical orientation, this process of integration or 'systemization' provides an opportunity to insert meanings and values into the design and implementation process. This envisions a technical praxis where;

> "*Power would devolve to the members of technical networks rather than concentrating at the top of administrative hierarchies. As more actors gained access to the design process, a wider range of valuative considerations would inform technical choices. These formal changes would result in new technical designs and new ways of achieving the efficiencies that characterize modern technological activity."* (Feenberg, 2010: 77)

Through the vocation and tactical initiative of historically subordinated actors, reflexive rationalization can reveal the basic norms and values underpinning either technology itself and the prevailing organisational and institutional logics. Through remediating strategies or democratic interventions such logics can be destabilised and reconfigured to perform in ways that are sympathetic to social values.

> "*Secondary instrumentalizations support the reintegration of object with context, primary with secondary qualities, subject with object, and leadership with group through a reflexive meta-technical practice that treats technical objects and the technical relation itself as raw material for more complex forms of technical action."* (Feenberg, 2000: 16)

Reflexive secondary instrumentalization is exemplified by design approaches which merge multiple functions and technical attributes into an artefact or system thereby conserving a wide range of influences and contexts in a single technology. In this way, its functionalization can be accommodated to the requirements of its environment leading to innovation that is both technically and normatively progressive. Simondon (1958) describes this process as 'concretization' while Feenberg uses the metaphor of the palimpsest (a parchment comprising diverse layers) to capture the heterogeneity of the actors and inputs shaping the design process.

2.4 Democratic Interventions and Recontextualization Strategies

To support secondary instrumentalization, Feenberg articulates forms of democratic intervention which differ both quantitatively and qualitatively from traditional political representation. Technical politics arises from 'participant interests'; issues of concern unifying particular individuals in relation to particular technical assemblages. Such interests comprise the diversity of impacts which shape quality of life issues for families, communities, workers and so on. For labour it may involve the manner in which technology acts to deskill or disempower; for families and communities concerns may focus on environmental damage, pervasive surveillance, health and safety concerns, or perhaps equitable access to infrastructure and services. Once motivated to coalesce around a technical issue and affect change then agency can be enacted through a variety of approaches which Feenberg co-opts from the field of science, technology and society. The result is a synthesis comprised of three primary strategies; innovative dialogue and participatory design, creative appropriations and forms of micropolitics.

Innovative Dialogue and Participatory Design

Innovative dialogue and participatory design embody the emergence of post-technocratic political activity and offers the potential of both creative and inclusive solutions to the conflict between lay and professional actors. The participatory design community uses the concept of 'agonistic' engagements between a variety of stakeholders to capture the notion of disparate and sometimes conflictual interests, coming together to democratize innovation and produce technologies which

incorporates the goals and values of multiple interests (Bjögvinsson et al., 2012; Le Dantec & DiSalvo, 2013; Perng, 2017).

The approach originated in Scandinavia in the 1970s with much of the early work being concerned with fostering democracy in the work-place by empowering employees to contribute to the design of technologies which were increasingly defining their lives. At this time few worker representatives had meaningful knowledge of computer technologies and so had been forced to either accept technologies which disempowered and/or deskilled or simply reject them (Spinuzzi, 2005). Participatory design represented a third way that would allow workers retain a degree of control over of the nature and quality of their work. An early example was the much-studied UTOPIA project in Sweden which brought software engineers together with newspaper workers to develop innovative ways of computerizing the printing process (Feenberg, 1999). The concept of participatory design subsequently developed a commercial aspect when companies developed collaborative processes with lead or expert users to design new product and services (Von Hippel, 2005).

In recent years the principles and practices of participatory design have been repurposed for innovation serving social rather than purely organisational needs. In addition to technical artefacts and systems, this process may also deliver a principle, an idea, a social movement or an intervention (Bjögvinsson et al., 2012). Participatory design typically comprises structured processes of engagement through which lay actors, civil institutions, and networks of scientific and technical expertise become involved in various forums (scenario workshops, experimentation, round table and consensus conferences, citizen panels and so on) in order to create solutions, guide policy makers and encourage public debate (Joss & Belluci, 2002). Bijker (2013) proposes such arrangements can lead to 'pluriform' or hybridized forms of governance which act to align social and institutional practices and goals, while Böschen (2013) refers to the process as creating *meta-expertise* – combining technocratic and instrumental reason with lay epistemologies to produce layered, creative solutions**.** He emphasises the notion of collective experimentation to problem solving which he describes as a social process of trial and error in which not only solutions for specific or bounded problems are found but also new settings of perceptions and forms of knowledge are created, and new social forms of co-operation and conflict resolution are being developed (Böschen, 2013).

From the perspective of supporting civic and governmental actors, these processes meet two important political objectives. Firstly, they strengthen civil society by encouraging citizens to participate in the resolution of issues impacting their lives. Secondly, they enable a reconfiguration of governance which promotes openness, transparency and adaptability.

> *"A government does not stay as a coherent entity that includes or excludes particular values or partnerships with organisations. Instead, by articulating and enacting wider societal values associated with the experimentation in practical ways, a government is reshaped by the explorations of establishing alliances, adjustments and arrangements involving certain parts of a government with the hopes and accompanying challenges of affecting others"* (Perng, 2017: 3)

To avoid the risk of such practices being reduced to a consultative process for the legitimation or endorsement of policy initiatives and development plans, engagement needs to take place in an environment of trust, willingness and mutual respect (Bianco, 2016; Peng, 2017). Participatory design and innovative dialogue have been used effectively in the development of transportation systems (Cascetta & Pagliara, 2012), roads infrastructure (Roushan, 2004), municipal art projects (Perng, 2017), health informatics systems (Pileman & Timpka, 2008), community housing and safe food initiatives (Manzini, 2013) and community informatics projects (Carroll & Rosson, 2007) amongst many others. Feenberg also notes that technologies produced iteratively through ongoing forms of engagement are likely to be inherently more sustainable, as constant revision and improvement through dialogue will inevitably incorporate a more democratic vision.

Creative Appropriation

Creative appropriation is a form of innovation where individuals participating in a technical network can reinvent an artefact or system by appropriating it to new purposes and investing it with new meanings (Feenberg, 2010). Hacklay (2013) describes this practice as a form of hacking and proposes that it operates at multiple levels of sophistication depending on the technical skills of the user.

'Meaning hacking', for example, occurs when the participants do not make material changes to the operation of a technology but may use it or the data it produces, in a new context. Hacklay cites the example of 'Map Action' the humanitarian

organisation which supports aid agencies and governments by creating maps of disaster areas which act to support a shared operational picture and improve decision making. Map Action volunteers will frequently augment their efforts with a variety of maps or geotagged photos of the affected areas which have been uploaded to the web, typically for unrelated reasons. In a similar vein, Becker et al. (2013) describes the example of the 'EveryAware' project which encourages citizens to use low cost sensing tools to assess the state of the environment and exploit the power of social media to spread data, information and knowledge in real-time as a form of political activism. In one instance, communities adjoining Heathrow were provided with a smartphone app – WideNoise - which monitored noise levels at the airport but also allowed the data to be annotated. Participants used this functionality to register their emotional responses to the noise being generated. This combination of quantitative (noise samples) and qualitative (feelings, opinions) data produced both meaningful and actionable results. The output from the initiative served as evidence to a governmental committee reviewing development plans for the airport. Again, this level of hacking requires no reconfiguration to the way the technology performs; its value coming from its potential to promote community interests and to use data to challenge dominant orthodoxies.

Deeper hacking can be seen in the exploitation of Web 2.0 technologies to produce customized content such as mash ups (web integrations using APIs and web services, etc.), community or collaborative maps or a variety of user generated content such virtual communities or citizen journalism (Stillman & Johanson, 2007).

More sophisticated forms of appropriation, however, may require considerable technical skills to fundamentally reconfigure existing systems or create new ones. In the 1980s, for example, the French telecommunication company Postes, Télégraphes et Téléphone implemented one of the first end-user videotext information systems – Minitel - which operated over telephones lines and was designed to support access to a centrally controlled menu of online information services. Users quickly discovered, however, that the system could be modified to support speech functionality and within months the service was being re-appropriated for online chat, companionship and sex.

> *"Here we have a dramatic illustration of the "interpretative flexibility" of technology. A concatenation of devices configured by its designers as the solution to one problem—the distribution of information—was perceived by its users as the solution to quite another problem—human communication. The*

> *new interpretation of the technology was soon incorporated into its structure through design changes and, ultimately, through a change in its very definition."* (Feenberg, 1999: 145)

The internet, which superseded the Minitel, is also a technology originally conceived to support institutional goals, but subsequently reworked through the innovative efforts of skilled users to become a communications platform serving a multiplicity of needs and interests.

Activism and Advocacy

In addition to participatory design and creative appropriations, recontextualizing strategies may also incorporate others forms of micropolitics, such as advocacy, activism and resistance (Feenberg, 2017). The power of social movements, for example, can play a prominent role in challenging orthodoxy leading to more responsive and conciliatory cultures. Ecological actors have been successful in effecting social and political reform leading to new laws, regulations and technical codes (Feenberg, 1999). These codes have translated social concern for the environment into new technical solutions which include renewable energy generation (wind energy, solar power, bioenergy, etc.), green computing (server virtualization, hardware optimization and high-density storage technologies), sustainable transportation (hybrid vehicles, smart bikeshare and carbon-neutral fuels), and so on (Watson et al., 2010). It has also led to emerging fields such as 'Green Information Systems' which explore the potential of integrating social, environmental and business interests in design solutions which make entire networks more sustainable (Brooks, et al., 2010; Dedrick, 2010). These environmental values are no longer seen as externalities which compromise efficiency and profit. They are now understood as imperatives around which financial and other interests much operate. This is a clear example of technical codes changing organically in response to societal pressure and demonstrates the capacity of social movements to effect change at a global scale.

The power of agency to shape innovation is also evidenced in the retail sector. In recognition of the power of customers, deliberative, web-based platforms are now an integral feature of commercial portals and offer customer communities the opportunity to provide feedback not only on product design and service provision but also to shape strategy at an institutional level across a range of areas including sustainable practices, ethical procurement, data protection and so on (Boddy et al.,

2008). Collaborative technologies are also enabling citizens as an important source of external innovation. This can be seen in the software sector, for example, where glitches and bugs are routinely identified and resolved by expert users and solutions then disseminated both within the user communities and to professional developers. As in the case of participatory design, this frames users as active collaborators in the innovation process, co-producing knowledge, insights and expertise (Laino & Laine, 2012).

Significantly, forms of agency can also operate within and across institutional settings when vocationally motivated actors wish to guide technical innovation in enlightened ways. Organisational leaders may champion particular initiatives or subordinates may operate in concert to subvert autocratic or conservative regimes by using guile, tact and situational awareness to create new socio-technical networks which deliver on more ethical agendas. An example of this is the development of online education technologies. Early instances of ICT mediated distance learning were developed under a technical code which emphasised service efficiency and cost saving (Feenberg, 2002). Accordingly, university administrators, in collaboration with computer companies, produced automated systems which oriented the field toward the delivery of unsupported, pre-packaged content over the Internet. However, after concerted resistance from the teaching profession, systems evolved to incorporate both human communication and information delivery (Noble, 1998). Today, technologies such as Blackboard and Moodle provide integrated and collaborative virtual environments which support sound pedagogical goals (Stone & Chaney, 2011).

Similarly, we see many institutional technologists, despite operating in hierarchical, rule-bound structures, drawing on ethical, political and philosophical principles to question the foundational assumptions of their own professions. Karwat et al. (2015), discussing the emergence of the 'activist engineer' note that:

> *"Activist engineers understand how the notions of apoliticism and ahistoricity result in the current engineering practice of offering only technological progress as a solution to any future problem…Employing praxis, activist engineers transform contemporary engineering practice as they are empowered to act on the political and value claims of their work. They thus reframe problems such as climate change and sustainability as socio-ecological problems that cannot be exclusively addressed as technological problems."* (Karwat, et al., 2015: 4)

This can lead to a more a reflexive design culture which shifts the priority from profit and liability to long term resilience. In the transportation sector for example, this is evident in the efforts of engineers and urban planners who use their strategic positions in technical networks to advocate for more sustainable development such as pedestrianized streets, cycle infrastructure, public bikeshare, more integrated public transit systems and so on. Again, this demonstrates how governmental structures may be adapted from within to form new socio-political arrangements in the pursuit of progressive infrastructuring (Marres, 2012; Perng, 2017).

These various forms of agency offer cities the potential to enrich and contextualize instrumental reasoning and the partial, realist epistemologies which support it. By encouraging a more nuanced and relational understanding of cities as places of diversity and complexity, democratic interventions can lead to technologies which are more social, inclusive and emancipatory. However, the extent to which secondary instrumentalization can mobilize these strategies will be dependent on the particularities of place and the capacity of individual cities to overcome cultural, economic and socio-political obstacles in the pursuit of new forms of technical politics (Zukin, 1995).

> *"…no two cities hold the same qualities, having different histories, populations, cultures, economies, politics, legacy infrastructures and systems, political and administrative geographies, modes of governance, sense of place, hinterlands, interconnections and interdependencies with other places, and so on…. Little is known, as yet, as to the specificities of these differences and their effects, and yet smart city technologies are still being developed and marketed as universal solutions to urban issues".* (Kitchin, 2016: 8)

Accordingly, smart cities call for a set of comparative studies which examine how smart technologies are formulated in different places under the influence of such local contingencies. This research addresses this call by empirically investigating one such technology – pubic smart bikeshare systems - and uses the tools provided by instrumentalization theory as a conceptual and analytic framework. Smart bikeshare schemes are sociotechnical assemblages comprising a variety of technologies, institutions, stakeholders and processes which in turn operate within a diversity of social-cultural and political milieus conditioned to a greater or lesser degree by broader smart city narratives. Instrumentalization theory operates hermeneutically by tracing the configuration of concretized designs back to the assumptions, decision-making

practices and logics producing them. In the process, the nature of the smart city landscape, as it emerges in different cities, can be unpacked and the conditions required for more productive and egalitarian forms of technopolitics identified.

In sum then, by explicitly positioning design processes as inherently political and providing the conceptual means to analyse the interplay of structure and agency, instrumentalization theory preserves a conception of technical democracy lacking in either dystopian accounts from the substantivist tradition or in the largely descriptive and value neutral accounts of design provided by much of the STS canon. For this reason, it has been chosen as the lens through which the systems will be analysed. In the interest of clarity, instrumentalization theory is summarized as follows:

1. Instrumentalization theory is a critique of rationality loosely based on the work of Marx, Weber and the Frankfurt school.

2. The theory proposes the formal bias of highly rationalized systems and artefacts.

3. A hermeneutic reading of technology should reveal the analytically distinguishable primary and secondary instrumentalizations.

4. Instrumental rationality, concerned with efficiency and functionality, appears at the level of the primary instrumentalization. This instrumentality has minimal social constraints.

5. Secondary instrumentalization is the process of embedding artefacts and systems in a real-world context where their realization will favour one or another powerful group.

6. Technical codes form the decision rules which stabilize the design of technical artefacts and systems.

7. Conflict between design and its habitat give rise to demands that may be expressed in new codes and designs.

The next chapter provides a discussion of smart bikeshare and its relationship with the smart city construct.

Chapter 3 - Smart Bikeshare

Introduction

Smart bikeshare programmes are a form of transportation sharing in which bikes are made available for use, typically on a short-term basis, from a network of strategically positioned stations, distributed throughout the urban environment. Typically, schemes are engineered to support point-to-point-based trips. Though the concept originated in the 1960's, its proliferation is generally associated with the emergence of viable technical formats in the late 1990s which supported its use and maintenance, and which mitigated the limitations and constraints of earlier approaches. Contemporary designs, which are generally augmented by sophisticated telecommunications systems, smart access technologies and e-payment options, deliver high levels of automation, improved management and operations processes and reduced cost. Consequently, the concept has proliferated in recent years and smart bikeshare is now a pervasive urban transportation infrastructure, with municipal systems operating throughout the world (Fishman, et al., 2013; Meddin & DeMaio, 2015). This growth has been underpinned by significant policy interest. From a city management perspective, smart bikeshare can reduce greenhouse gases and other emissions from the transportation sector by curbing the volume of motorized vehicles on the road (Midgley, 2011). It can also be used as a strategy for managing congestion, improving public health, reducing infrastructure costs, and extending the reach of the public transit network through integrations with other modes (Murphy & Usher, 2015). Despite pre-dating the smart city, smart bikeshare is increasingly positioned as an important policy intervention for making cities 'smarter' and more connected (Cuddy et al., 2014; Rani & Vyas, 2017).

Smart bikeshare has also been proposed as a way of promoting social equity and inclusion (Buck, 2012). In recent years there has been significant research interest in the subject of transport disadvantage which has revealed the economic, social and educational constraints experienced by those unable to fulfil their mobility needs (Clark & Curl, 2015). By distributing smart bikeshare services as an equitable means of mobilizing individuals and communities, such disadvantage may be mitigated (Fishman, 2016; Hannig, 2016). This emancipatory aspect of smart bikeshare positions it as an object of political discourse and associates it more generally with the renaissance in cycling which can be understood, at least in part, as a form of oppositional culture challenging the orthodoxy of private transportation (Horton,

2016). Smart bikeshare is also aligned ideologically with new and emerging models of collective urban consumption which are less commercial, more collaborative and underpinned by notions of urban citizenship and rights to the city (Agyeman & McLaren, 2015).

Therefore, and in addition to its technical or instrumental capabilities, smart bikeshare has become emblematic of both environmental and social justice and its adoption is increasingly seen as a rite of passage for cities wishing to position themselves as ethically informed, citizen-centric and progressive (Fishman et al., 2013; Agyeman & McLaren, 2015; Wayne, 2016). However, despite smart bikeshare's exponential growth and the rhetoric of equity and inclusion supporting it, several studies have begun to question the politics underpinning the configuration and implementation of many systems (Fishman et al., 2013; Hannig, 2016). In a manner characteristic of the smart city, smart bikeshare is emerging as a technology appropriated by powerful interests leading to its implication in processes of capital accumulation and gentrification. This is manifest in patterns of implementation bias characterized by socio-economic and spatial inequality and in forms of constitutive bias embedded at the level of technical design which act to operationalize various forms of social sorting (Hannig, 2016; Duarte & Firmino, 2017).

This chapter reviews the history and evolution of bikeshare, maps its relationship with the city and explores the way that the design and implementation of contemporary systems participates in the ongoing corporatization of city management and technocratic governance. It also examines the ways in which technical politics and agency of various kinds may be used to reconfigure smart bikeshare as a platform for social and technical innovation.

3.1 Bike Sharing: An Overview

History and Evolution

Bikeshare initiatives have developed significantly since their introduction in Europe in the 1960's and are generally regarded as having gone through four generations of implementation and design in the interim. The 1st generation, deployed in Amsterdam in 1965, was characterised by the use of general-purpose bikes, custom painted for identification, and available to the public to borrow from, and return to, any location. The system was unmanaged and depended heavily on the integrity of users to

appropriate the bikes responsibly. The scheme failed quickly however, as the majority of the fleet was vandalised or stolen. In addition, the poor quality of the bikes, coupled with the lack of incentives to treat them with care, meant that bikes proved less than durable (Midgley, 2009).

The 2nd generation of systems, pioneered by Bycyken or 9city bikes of Copenhagen in 1995, were designed to address these shortcomings and proved somewhat more successful (DeMaio, 2009). The construction of the bikes was more robust and the introduction of a coin deposit system as a way of accessing the bikes meant that a degree of control had been introduced. The Copenhagen model led to a series of European bike sharing programs including Bycykler in Sandnes, Norway (1996), City Bikes in Helsinki, Finland (2000), and Bycykel in Arhus, Denmark (2005). Though bikesharing's history in North America is somewhat shorter, multiple coin operated schemes had emerged there by the late 90s also. Programs included Olympia Bike Library in Olympia, Washington (1996); Yellow Bike in Austin, Texas (1997); Red Bikes in Madison, Wisconsin (launched as a free bikesharing system in 1995 and evolved into a coin-deposit model a few years later); Freewheels in Princeton, New Jersey (1998); and Decatur Yellow Bike in Decatur, Georgia (2002) (Shaheen et al., 2010).

Though somewhat more manageable, experience with these schemes demonstrated that second generation designs were prohibitively expensive to operate (Midgley, 2011). Non-profit groups were frequently created to administer the bikesharing programs and, in many cases, local governments provided bikesharing organizations with funding (Shaheen et al., 2010). Theft however remained a problem due primarily to the anonymity of the users. In addition, time usage was not limited, and so bikes were frequently kept for extended periods of time making fleet management extremely difficult (Shaheen et al., 2010). Although bikesharing began as a way to reduce motor vehicle use, Bonnette (2009) notes that:

> "*…both the first and second generation bikesharing schemes provided welcome opportunities to cycle but did not provide adequate enough support nor reliable service to alter motorized transportation choices and influence people to make significant changes*". (Bonnette, 2009: 22)

These limitations persisted until the emergence of viable technical formats in the late 1990s which effectively exploited the capacity of information and

communications technologies to automate systems and address the shortcomings of previous designs. Launched in Rennes in France in 1998, the Vélo à la Carte system is generally recognised as the first implementation of 3rd generation or "smart bike" systems. These architectures, which represent the vast majority of current bikeshare schemes, typically use networked docking stations capable of automatically checking-out and returning bikes. Users, who can avail of annual subscriptions or short-term passes, typically pay for services using credit card-based e-payment systems and can then access the bikes through a variety of technologies include smart cards, fobs, mobile phone applications or even SMS (Buttner et al., 2011). Day-to-day fleet management and operations is supported through tracking technologies which relay information on usage patterns and fleet location via the docking stations to central information systems. These improvements have made 3rd generation schemes much more feasible in larger urban environments with many fleets now running into the thousands (Shaheen et al, 2012).

Though introduced in 1998, the adoption of 3rd generation systems was somewhat limited until 2005 when Lyon launched its scheme with a fleet of 1500 bikes. Given its scale and subsequent success, this system is generally viewed as the primary catalyst for the accelerated adoption of smart bikesharing within Europe (Bührmann, 2008). The introduction in 2010 of an innovative scheme (Bixi) by Montreal – is credited with having had a similar impact on diffusion in North America (Shaheen et al, 2013). The design pioneered a number of innovations such as the use of mobile, solar powered docking stations which meant that infrastructure could be moved with relative ease making the network effectively demand responsive.

The Bixi scheme was also noted by Shaheen et al. (2013) as being the catalyst for the emergence of a 4th generation of systems which they categorized as including all the main components seen in 3rd generation systems but with the additional goal of seamless integration with public transportation and other modes. This involves integrated ticketing and high levels of physical and digital alignment between smart bikeshare infrastructure, parking facilities and public transit services. Other innovations associated with 4th generation designs are the use of dockless architectures which allows bikes to be distributed freely within the urban landscape and tracked using GPS technology, the use of electric-hybrid vehicles, incentives to encourage sustainable fleet distribution and the incorporation of collaborative digital platforms

and Web 2.0 technologies to enhance performance and improved communication with riders (Bradshaw & Donnellan, 2012; Shaheen et al., 2013).

As of 2015, the number of smart bikeshare programmes is estimated to be 900, operating in more than 50 countries and 5 continents, with a global fleet in excess of one million bicycles (Meddin & DeMaio, 2015). By comparison, there were 213 smart bikesharing schemes operating in 14 countries using 73,500 bicycles in 2008 (Midgley, 2011). China, a relative latecomer to bikeshare, has already the largest number of schemes at 237, with Italy and Spain representing the largest European markets at 114 and 113 respectively. The USA, which has historically lagged Europe by 3 to 5 years, operated schemes in 54 cities as of 2015 (Meddin & DeMaio, 2015).

Provisioning Models

The success of modern IT-based schemes has increased the variety of vendors and implementation models operating in the smart bikeshare sector (Buhrmann, 2008). While providers may include national governments, local authorities, transit agencies, for-profit and not-for-profit organisations, the most popular source of bikesharing services to-date, particularly in Europe, has been through the outdoor advertising model (Fishman, 2016). With this approach, advertising companies such as JCDecaux and Clear Channel, run the service on behalf of the city, typically in exchange for the right to use public space to display revenue generating advertisements (Midgely, 2011). Examples include Dublin, Paris, Lyon, Brussels, Seville, Brisbane, Toyama, Milan and Stockholm (cyclocity.com, 2017). While this approach may represent a convenient way for cities to implement transportation infrastructure, some researchers have raised the issue of moral hazard (Bonnette, 2009; DeMaio, 2009; Duarte & Firmino, 2017). As the advertising companies generally do not benefit directly from revenues generated by the system (typically these go to the jurisdiction) there may be little incentive for operators to maintain high levels of service quality or to fund ongoing innovation and system development (DeMaio, 2009; Buttner et al., 2011). Furthermore, while the service may appear to have little or no cost to the taxpayer there is still a cost to the municipality in the form of forgone advertising revenues (Gris Orange, 2009; Midgley, 2011). These partnerships also carry inherent additional risks, i.e. path dependency (Kitchin, 2015), hidden costs (Bonnette, 2007) and lack of alignment between public and private interests (Holland, 2009).

These concerns, in addition to public unease at the notion of auctioning public spaces to secure bikeshare services, have motivated some countries to re-evaluate the wisdom of using the advertising model. Increasingly, European cities have begun to negotiate new relationships with vendors which operate on the basis of service contracts. These arrangements offer cities the potential of exploiting external experience and expertise while maintaining higher levels of strategic control (DeMaio, 2009; Shaheen, et al., 2013). This is especially the case when services are provided in conjunction with transportation authorities. In a review of implementation strategies, DeMaio (2009) proposed that this model may offer the greatest benefits to the city in terms of effective integration with other transit modes as smart bikeshare is likely to become a natural extension of the city's other mobility offerings.

In North America, the advertising model which characterized the European experience did not prove popular, which in part accounts for the fact that European schemes have historically been somewhat larger (Fishman, 2016). SmartBike DC, a system supplied and operated by Clear Channel in Washington DC between 2008 and 2010, was a notable exception. Having performed poorly, however, it was subsequently replaced by Capital Bikeshare, a city owned scheme run through a public private partnership with the bikeshare vendor 'Motivate'. For the most part, schemes in the US and Canada tend to use either this publicly owned/contractor run model - Boston, Ottawa, San Francisco and Chicago are examples - or implement through not-for-profit organisations created specifically to deliver these services. Examples of the latter approach include Kansas, Montreal, Boulder, Denver and Houston (Shaheen, et al., 2014).

Historically, the for-profit model has found little traction (Fishman, 2016). Nextbike, a German based operator, and Citi Bike, which currently provides services to New York City, are two early examples of privately owned and run systems. However, this situation is rapidly changing. Griffith (2017) has noted the dramatic impact that Chinese start-up companies have had on the industry since their recent arrival. Using a 4th generation dockless design, these companies can distribute bikes without the need for capital-intensive fixed infrastructure or government subsidies. All that is required is venture capital. Mobike for example, the largest of these start-ups, launched in Washington, DC in September of 2017, with Ofo, its nearest rival, launching in Seattle just a few weeks previously. US companies have responded accordingly. San Francisco based LimeBike, another dockless operator which was

started in 2017, has already raised $70 million through venture capital and operates in 20 US markets including Seattle and Dallas (Dickey, 2018).

> *"The market is getting crowded. Five bike-share companies are operating in Washington, DC—Mobike, LimeBike, Ofo, Spin, and JumpDC. It's reminiscent of the early days of ride-hailing, when it felt possible that Hailo, TaxiMagic, Gett, Juno, or Whisk might take significant market share."* (Griffith, 2017: n.p.)

The public smart bikeshare sector is also heavily reliant on corporate participation. Research has shown that while capital expenditure has traditionally been absorbed by state agencies (local authorities, governments, transportation authorities and so on), a combination of advertising sales and private sponsorship deals is currently funding an average of 70% of operating costs globally (Shaheen, et al., 2013; Fishman, 2016).

The capital and annual operating costs of schemes vary significantly depending on technical architecture (station based or dockless for example), population density, service area, and fleet size (Cohen et al., 2013). Capital expenditure will include the fabrication and installation of hardware (bikes, and stations if applicable), licences or the purchase of back-end systems used to run the equipment, access technologies (cards, fobs, keys and so on) and the purchase or rental of distribution vehicles (DeMaio, 2009). Capital costs are often expressed as a 'cost per bike', defined as the total cost of the system divided the number of bikes in that system. Operating costs include maintenance, bike distribution (also known as system rebalancing), staff, insurance, office space, storage facilities, website hosting and maintenance, and electricity (if necessary) (DeMaio, 2009). Midgley (2011) estimated the average capital and operating cost of 3rd generation schemes at $4,000 and $2,000 respectively. The cost of emergent models such as those using dockless architectures is estimated to be approximately 25% of their 3rd generation equivalent (Bradshaw & Donnellan, 2012).

Instrumental and Social Value to Cities

The policy interest in smart bikeshare, and cycling more generally, has been spurred to a large degree by the growing recognition of the negative environmental and health impacts of car usage and climate change (Fishman & Brennan, 2010). Smart bikeshare is positioned as a way of mitigating many of these impacts while simultaneously

enhancing public health and environmental awareness (Shaheen et al, 2013). From a transportation perspective smart bikeshare can complement and enhance public transit by overcoming the so-called last mile connectivity problem. When station distribution is configured to connect effectively with buses and trains, cities can expect an increase in usage of these modes as people opt to use smart bikeshare as part of multimodal trips. This has been demonstrated in schemes in Europe (Murphy & Usher, 2015; Goodman & Cheshire, 2014), Asia (Mateo-Babiano et al., 2016), Australia (Fishman, 2016) and North America (Shaheen et al., 2013). Environmental benefits are magnified by the modal shift away from cars which leads to reductions in fuel consumption and the associated production of atmospheric pollutants. Analysis conducted by Shaheen et al. (2013) for example concluded that, while results varied significantly across cities based on different assumptions about user behaviour, trip distribution and trip substitution, smart bikeshare still yielded an average CO_2 saving of 1.5 kg per trip. Though research on smart bikeshare's impact on public health is limited given its recent adoption, the health benefits of cycling are well established (Andersen et al., 2000; Cavill & Davis 2007; Shepard, 2008). Bullock et al. (2017) also note that:

> *"Many instances of heart disease, type-2 diabetes, breast cancer and colon cancer could be avoided by maintaining a moderate level of activity for 30 min per day….Although it is notoriously difficult to attribute overall health benefits to any one activity, PBS [Public Bike share] provides a distinct contribution in this respect as it allows for exercise in association with work or other trips as distinct from cycling for leisure or dedicated fitness activities."* (Bullock, et al., 2017: 2)

From an economic perspective, shopping patterns have been shown to migrate towards areas serviced by station infrastructure, with benefits derived for both businesses and riders. Businesses experience increase customer traffic and sales while riders benefit from reduced transport costs (Buehler & Hamre, 2014). Smart bikeshare is also understood as a mechanism for improving work force mobility leading to benefits in urban economies. Having analysed data from Dublin's scheme – *Dublinbikes* - researchers concluded that the integrative and time saving capabilities of smart bikesharing have led to the city being more efficient and productive (Bullock et al., 2017). Other economic benefits noted in the literature include increased tourism, reduced expenditure on public health care and savings on infrastructure such as public transit and car parking (DeMaio, 2009; Buttner, 2011; Shaheen et al., 2013).

In addition to its capacity to support transportation efficiencies and economic optimization, smart bikeshare may also be understood through social, political and cultural modalities. Some researchers, for example, have speculated that its proliferation is related to what has been called the 'bike renaissance' (Pucher, et al., 2011). This renaissance is characterized by the spread of dedicated infrastructure (cycle lanes, bikes paths, dedicated traffic lights, parking facilities and so on), the incorporation of the bicycle as part of multimodal networks (bike racks on buses, bike-friendly transit systems), new legal and regulatory frameworks protecting the interests of cyclists (speed limits, overtaking restrictions, driver penalties), and urban design practices informed by more progressive and democratic notions of liveability and community (Buck & Buehler, 2012; Ehrgott et al., 2012; Caulfield, 2014). This aligns smart bikeshare with cycling as a form of social and ecological counter culture.

In a similar vein, Clark and Curl (2015) have noted that a growing understanding of the interdependencies between urban form and modal choice has revealed the economic, educational and social disadvantages suffered by those unable to fulfil their mobility needs. The dominance of the car has had an organic effect on land use patterns with the result that urban activity has become increasingly freed from the constraints of public transport routes. The resulting polarization between those owning and those lacking private transport fosters disadvantage such as exclusion from employment, learning, healthcare, social and cultural networks and so on (Hine & Mitchell, 2003; Muller, 2004). This problem has been exacerbated by historic and ongoing failures in public transportation policy.

> "*By and large, transport projects are assessed in terms of reducing transport costs, improving efficiency, and promoting economic growth. The contribution of transport operations to poverty alleviation [has been] seen, in general, as indirect and stemming from broadly based economic development".* (Gannon & Liu, 1997: 3)

The resulting inequality in the distribution of transport and mobility infrastructure, especially in developed countries, is well documented in the literature (Hook & Howe 2005; Markovich & Lucas, 2011; Starkey & Hine, 2014). It is also acknowledged by international agencies such as the World Bank (Jennings, 2014), the World Health Organisation (WHO, 2016) and the International Transport Forum (Lewis, 2011). The literal and metaphorical disconnect which follows operates to amplify social and economic isolation (Gannon & Liu, 1997; Gwilliam, 2003)

> *"Today, the life of the low-income urban resident, living on the periphery, largely remains one of long wait and travel times, multiple transfers, long travel distances, and a significant percentage of income spent on declining and poor-quality transport options".* (Jennings, 2014: 6)

Part of the promise of smart bikeshare is its potential for mitigating this disadvantage by providing communities with an affordable and accessible form of mobility (Shaheen et al., 2013; O'Brien et al., 2014). In addition to creating more employment opportunities and alleviating poverty, it has the potential to enhance social participation and social cohesion (Jennings, 2014; Joshi et al., 2015). When used to support marginalized groups, smart bikeshare offers the potential '*of pulling the various facets of everyday life back into close physical proximity'* (Horton, 2006: 10).

Smart bikeshare has also been aligned with models of collaborative consumption and co-production which are less profit driven and underpinned by ideals of urban justice and inclusivity (Agyeman & McLaren, 2015). After a historical decline in the culture of 'sharing' associated with the development of consumer capitalism and the pervasive privatization of urban spaces and resources, a significant resurgence of interest in a shared public realm has emerged in recent years (Ivanova, 2011). Initiatives such as transportation sharing (car and bike share), tool sharing, community-use centres, multi-purpose streets, land sharing in the form of community gardens and mixed-use development and sharing through digital platforms such as E-bay and Gumtree, all operate to reconfigure the city as a place of engagement, exchange and co-operation (Sustaintrust.org, 2017). As such, sharing offers cities a sustainable foundation for urban justice and a transformative approach to urban futures. It also offers the potential to build greater empathy and solidarity between socially, culturally and economically divided communities (Agyeman & McLaren, 2015). This re-emphasises smart bikeshare's role in a broader political discourse concerned with democracy, social and environmental cohesion and rights to the city (Horton, 2006).

3.2 Smart Bike Share and Smart City Narratives

Ongoing technical innovation, combined with its socio-political and normative connotations, has positioned smart bikeshare at the nexus of a number of smart city narratives and objectives (Fishman, 2014; Duarte & Firmino, 2017). From a purely

technical perspective, innovations such as advanced tracking technologies, low-power sensors, real-time information and transit apps, mobile infrastructure and physical and digital integration with other modes and systems are leading to increased sophistication in the configuration of contemporary systems and positioning smart bikeshare as an important component of the 'sustainable', 'intelligent' and 'connected' city (Rani & Vyas, 2017). Cuddy et al., (2015) for example have proposed that smart bikeshare is both an emerging node on the Internet of Things (IoT) and a form of 'mobility-as-a-service' (MAAS) and as such, part of an ecosystem of technologies such as public transportation, traffic management systems, integrated ticketing, smart parking, smart carsharing and so on, which function in interconnected and complimentary ways to deliver enhanced mobility and improved performance and efficiencies for cities. This is also reflected in developments at an industry level. In 2015, ThingWorx, a leading IoT platform provider, partnered with Smoove, a French developer of smart bikeshare systems, to power its service in cities throughout the world (PTC.com, 2015) while in 2017, Mobike and Ofo both announced similar IoT partnerships with AT&T/Qualcomm Technologies and Chinese Telecoms/Huawei respectively (Att.com, 2017; huawei.com, 2017). In a related manner, Smart bikeshare is also increasingly seen as an important source of 'big data' (Romanillos et al., 2016) with the availability of granular, GPS-based spatio-temporal data likely to lead to improved service provision, business intelligence and city planning. Under the right circumstances it may also see smart bikeshare function as an environmental sensing platform.

> *"With the right attachments a bike is a weather monitor, an air quality detector, noise detector and a vibration monitor, telling the city in real time exactly what is happening at street level…This more intensive data capture is facilitated by bikes that have regular access to a power supply – which means especially bikeshare bikes."* (Wayne, 2017: n.p.)

From a political or discursive perspective, many cities have also strategically mobilized the symbolic value of smart bikeshare as a way of demonstrating their commitment to progressive modes of development and as a means of counteracting many of the negatives that have become synonymous with the smart city project, i.e. techno-fetishism, neoliberal governance, splintered urbanism and so on (Agyeman et al., 2013; Hannig, 2015; Fishman, 2016; Duarte & Firmino, 2017). Smart city programmes around the world routinely link their schemes to addressing issues of

social disadvantage. ‘Smart City Cleveland’ for example explicitly associates its scheme with improving opportunities for low-income communities, the disabled, senior citizens and students (Smart City Cleveland, 2016). ‘Smart Dublin’ has marketed its system using similar rhetoric. It frames Dublinbikes as an integral part of its efforts to create a more open, connected and engaged society (Smart Dublin, 2017). This discourse of inclusion and equality has now become commonplace with the adoption of smart bikeshare increasingly seen as a litmus test for cities wishing to promote themselves as egalitarian and progressive (Fishman et al., 2013; Duarte & Firmino, 2017).

> *“Besides the relatively technical aspects, it is also noteworthy to see mayors, governors, and even presidents and prime ministers riding bicycles. And they do so not as bicycle users, but as bicycle promoters. In the political arena, bicycles, and in particular bike-sharing systems, became a sign of social equity.”* (Duarte & Firmino, 2017: 50)

This is also reflected in smart bikeshare’s growing profile at smart city expos, workshops, and summits and in funding initiatives such as smart city challenges, which typically position it within narratives of innovation, environmental sustainability and social responsibility (futurecities.skift.com; smartcitiesworld.net, 2017; smart-city-expo-Barcelona, 2017).

Despite this however, several critical researchers have begun to problematize the political and economic interests producing the smart bikeshare phenomenon (Buck, 2012; Hannig, 2016; Fishman et al., 2013). Contrary to the prevailing discourse, their analysis is revealing smart bikeshare as complicit in processes of capital accumulation and neoliberal governance, leading in many instances, to the systematic segregation and marginalization of particular people and places. Through values embedded at the level of design and implementation, smart bikeshare is emerging as increasingly aligned, both practically and ideologically, with the broader smart city paradigm and the corporatized notions of citizenship which inform it (Agyeman & McClaren, 2015; Hannig, 2016)

3.3 Smart Bikeshare and Social Justice

Despite bikeshare’s proliferation, a number of research studies have begun to detail patterns of socio-economic and spatial disparity in the distribution of smart bikeshare services across cities around the world. For the most part, smart bikeshare represents

a predominantly young, white, male, middle-class, well-educated demographic (Fishman et al., 2013; LDA Consulting, 2014; McNeil et al., 2017). Furthermore, these characteristics tend to be consistent across geographies, cultures and political inclinations (Buck & Buehler, 2013). Research in North America for example has demonstrated that schemes in San Francisco, Washington, New York, Philadelphia, Montreal, Toronto, and Minneapolis and St Paul (The Twin Cities) all show a significant under representation of minorities and low-income communities (Shaheen et al., 2012; Hoe & Kaloustian 2014; LDA Consulting, 2014), while many programmes in Europe, Asia and South America exhibit similar bias. In London, for example, nearly 90% of respondents to a transportation survey identified as being white, with the majority disproportionately wealthy relative to the general population (Transport for London, 2014; Goodman & Cheshire, 2014). In Dublin, the findings from a similar survey suggest that marginalized groups were significantly underrepresented in the city's scheme, with the unemployed and low paid accounting for only 4% of the 2250 respondents. The majority of participants - nearly 80% - were found to be in the ABC1 social grouping - the demographic most associated with wealth and privilege (Delve Research, 2011). Analysis also revealed that only 22% of Dublin's membership is female (Murphy & Usher, 2015). Similar patterns of exclusion and inequality were found in Melbourne and Brisbane (Fishman, 2016), Rio de Janeiro (Duarte & Firmino, 2017), Buenos Aires (Hannig, 2016) and Mexico City (Grabar, 2013; Jaffe, 2014).

Kodransky and Lewenstein (2014) propose that barriers to equitable access fall into three broad categories: structural, financial and cultural. Structural barriers include 'procedural and operational' obstacles such as the requirement to have a credit card, bank account or drivers' licence to secure membership. In relation to credit cards, Ethan Cohen-Cole (2011) has highlighted the spatial correlation between ethnicity and banks cards noting that minorities will tend to be poorer and have lower credit quality. Having a requirement for these technologies to access smart bikesharing services essentially acts to disproportionately eliminate low-income citizens (Hannig, 2016). Financial barriers typically relate to the cost of using schemes - which can at times be prohibitive - and the common practice of requiring significant security deposits from new members. Citing Kodransky and Lewenstein's research, Hannig (2016) notes that:

> *"Informational barriers (e.g. lack of information, understanding and language translation) prevent potential low incomes users from understanding the*

> *benefits of bikeshare or even how to use it. Cultural barriers include distrust of authority, discomfort with shared mobility systems or a preference for more culturally acceptable modes of transportation such as cars."* (Hannig, 2016: 206)

Of the impediments to equity noted in this research, the most pressing is the issue of basic access to the service. While the relationship between station distribution and population density may explain the tendency to situate schemes in populous city centre locations (Buttner, 2011; Toole Design Group, 2012), in many instances network design is being patterned by other socio-spatial factors. Buck (2012), for example, notes that wealth and social class are key variables impacting the distribution of service infrastructure. Typically, low-income, medium density areas are served more poorly than their affluent but equally populous counterparts (Clark & Curl, 2015; Fishman, 2016; Hannig, 2016). Duarte and Firmino (2017), highlight the case of Rio de Janeiro, a city characterized by socio-economic divisions. The city recently implemented a bikesharing scheme with most of the infrastructure being located along the seashore and adjacent higher income neighbourhoods. Significantly, Rio's outdoor advertising regulations are quite prohibitive and the use of billboards and panels in much of these areas is forbidden. The main sponsor of the system is Itaú, one of the country's leading banks. It uses the bike system as a mobile platform to carry its logos and colours and thereby strategically circumvent regulations which are spatially static. It also allows Itaú to target affluent consumers while associating its brand with environmentally and socially responsible projects. These relationships have become widespread throughout the industry (López-Pumarejo, 2011; Shaheen et al., 2012; Griffith, 2017). In London, the title sponsor is Santander; in New York, Citibank; in Barcelona, Vodafone; in Portland, Nike; in Dublin, Coca Cola, and so on. This essentially corporatizes the provision of public smart bikeshare services, leading to the promotion of privilege rather than inclusion.

> "W*hen one sees flagship cities delaying or stalling their bike-sharing systems expansion to more peripheral and/or poor neighborhoods, one must consider the reasons behind it. By locating docking stations in more upmarket neighborhoods, bike-sharing systems operators are not only targeting richer (credit-card holders serve as a proxy) potential users, but also richer consumers who do not need to ride bicycles, and who welcome the bike-sharing systems as a sign of an environmentally friendly and modern lifestyle."* (Duarte & Firmino, 2017: 57)

The reliance on credit cards and other e-payment systems may also have implications for privacy. Electronic IDs, smart cards, e-keys, mobile phone apps and other electronic access technologies routinely gather detailed personal data about riders as they interact with systems. Once integrated with tracking technologies such as GPS, it provides system operators with fine-grained information on how particular riders navigate particular regions of the city. Such data may become additionally valuable if combined with credit card information. An agreement between bikeshare vendors and credit companies for example may link two critical market data, enhancing their value significantly in the process - especially to marketers (Duarte & Firmino, 2017). This aspect of smart bikeshare resonates with well-established and critical discourses on the smart city relating to pervasive and extensive forms of state and corporate surveillance.

> *"The everyday practices we enact, and the places in which we live, are now deeply augmented, monitored and regulated by dense assemblages of data-enabled infrastructures and technologies on behalf of a small number of entities. The age of big data means a deluge of continuous (real-time), varied, exhaustive, fine-grained and often indexical, relational, flexible and extensional data. We are no longer simply lost in the crowd; we can be spotted, tracked and traced."* (Kitchin, 2016b: 6)

The European Cyclist federation (2017), cognisant of the risks, have recommended that private smart bikeshare data should only be used in accordance with EU data security and privacy legislation, including the storage of such data within the European regulatory space and not remotely, where best practice standards may not apply. The threats posed serve to highlight the need for rigor, transparency and accountability as state actors negotiate and implement partnerships with the vendors, system operators and sponsors (Cuddy et al., 2014).

3.4 Equity and Community Focused Solutions

In response to issues of social justice, several cities have attempted to systematically remove barriers and improve the reach of smart bikesharing for underserved populations. Buck (2012) reports on the findings from a number of North American cities which developed equity programmes and deployed strategies to reverse industry trends. These strategies included locating station infrastructure in vulnerable areas (Minneapolis), subsidizing membership fees or offering tiered pricing (Boston,

Minnesota, Arlington and Maryland Counties), experimenting with cashless payment options (Arlington) and partnering with non-profits to recruit members (Denver and Montreal). Despite modest success, however, vulnerable groups still tend to be underrepresented (Buck, 2012). Hannig (2016) proposes that while mitigating barriers has merit, the measures deployed are often based on limited or broad data and developed in isolation, without the participation and engagement of communities. Accordingly, there is a risk of the personal values of planners and operators prevailing over the needs and wishes of citizens (Hannig, 2015). Accordingly, there is an emerging consensus that the most equitable programmes are those which invest time and effort in developing partnerships between decision makers, community partners and communities (NACTO, 2015). These partnerships foster camaraderie, collegiality and mutual respect;

> *"When communities are included in the decision-making process, the possible ideas and solutions are virtually endless. Many practitioners may feel that opening the public would result in infeasible, unusable feedback that would interfere with developing consensus. However progressive guidance and case studies indicate that fostering meaningful involvement with communities as a partner in developing solutions can impart a sense of ownership and overcome cynicism and mistrust."* (Hannig, 2016: 209)

The potential of smart bikeshare to act as a catalyst of systemic social change is also noted in the literature. Smart bikeshare implementation can be leveraged as form of tactical urbanism in that it can be used in the development of social capital between citizens and the building of organizational capacity between public-private institutions, non-profits, and their constituents (Lydon et al., 2011; Wesley et al., 2016). Given that smart bikeshare is naturally aligned with a range of issues related to progressive urbanism (cycling infrastructure, active transportation, open streets, health, and sustainable practices, etc.) the possibility exists to use its implementation as a catalyst for building networks of influence which extend far beyond its boundaries. Used purposefully, smart bikeshare can become a part of a hybrid forum where conflicting interests can create *knowledge controversies* that can be resolved through various forms of democratic interventions - dialogue, experimentation, tactical resistance, collaborative design and so on (Callon et al., 2009). These processes, which may enrol a multiplicity of actors (urban planners, the public, traffic engineers, political representatives and other communities of interest), offer the potential of

producing technical (and social) infrastructure which strengthens civil society (Wesley et al., 2015). Davidson (2013) emphasises the technical aspect of this process. He describes it as '*a play on the physical and political landscape, manifested as a design intervention*'. Agyeman et al. (2013) reiterate the relationship between technology design and the politics of equality:

> *"Crucially, equity needs to be considered in the design of sharing programs – ideally with the participation of likely users. Currently it is all too often an afterthought in formal sharing schemes such as bike and car sharing programs where technologies effectively exclude those on low incomes. However, those on lower incomes are typically more generous, charitable, trusting and helpful when compared to those on higher incomes, exhibiting greater compassion and commitment to egalitarian values.* (Agyeman et al., 2013: 18)

Design and Democratization

The ongoing technical innovations which are energising 4th generation or demand responsive smart bikeshare models offer the promise not only of functional and technical improvements but also the potential to engage with riders in new and more socially progressive ways.

The use of GPS has precipitated the development of stationless or dockless systems which make the need for networks of hardwired infrastructure redundant. In turn, this has significantly reduced cost which lowers economic barriers to more equitable service distribution. Stationless approaches also afford riders higher levels of flexibility and trip customization (Parkes et al., 2013). In addition, while the use of GPS may improve planning and management processes, it may also serve to enhance democracy by supporting communities to advocate more effectively for access to bikeshare and related infrastructure. Being able to use openly available GeoJSON data files to demonstrate bias or partiality in the way schemes are configured, for example, provides important opportunities for agency and makes this data a catalyst for greater political participation and social activism (Outram et al., 2010; Fishman, 2016). GPS may also be deployed to keep bikes within prescribed geographic areas by alerting bikesharing operators when bicycles leave permitted zones. This might be coupled with dynamic pricing models which reward riders who return bikes to depleted zones

and act to naturally rebalance the scheme. SobiHamilton, a scheme implemented in Hamilton, Canada has operationalized this feature.

The growth of smart bikeshare has also coincided with a similarly rapid growth in e-bike performance, affordability and usage (Fishman, 2016). This innovation is becoming increasingly popular in Europe (Electric Bike Report, 2017), and Asia in particular (Munkácsy & Monzón, 2017). This technology overcomes what researchers in MIT's SENSEable City Lab identified as some of the primary obstacles to cycling in an urban environment – longer trip distances and challenging topography (Outram et al., 2010). Mitigating these factors offers the potential of making smart bikeshare accessible to more user groups. In particular, it may encourage older rides or people with mobility issues to participate more constructively in their own lives (Outram et al., 2010). In addition, many schemes have reported a correlation between topography and re-balancing requirements. Unsurprisingly, bikes tend to collect at the bottom of hills and the financial and environmental cost of bike distribution (typically this requires fleets of diesel-powered trucks) can be considerable (Jurdak, 2013). Hybrid bikes may be instrumental in reducing such costs and play an important role in the improved reach and penetration of schemes. Improving physical and digital integration with other modes enhances reach and usability and acts to legitimize smart bikeshare as a bona fide form of public transportation by embedding it in the technical and cultural fabric of the city. Consequently, it may be that smart bikeshare benefits from the levels of subvention typically seen in other areas of the transit network. This would encourage higher levels of state control and sustainable development rather than growth dependent on profit accumulation (Bradshaw & Donnellan, 2011). Boston represents a case in point:

> *"Boston has a multimodal public transport system, including commuter rail, subway, BRT and bus; the bike-sharing system covers four municipalities...the main sponsors of the bike-sharing system are public authorities, including city councils, some planning and transport metropolitan authorities; and advertising is forbidden in areas of the system, such as Cambridge…Thirty-one of the 131 subway stations have a bikesharing stations within a 100m radius of a subway, and all but one of the most used subway stations has an adjacent bike-sharing station."* (Duarte & Firmino, 2017: 54)

Philadelphia's scheme is also noteworthy in this regard. The city owns the scheme and runs it through Indego, a private company. However, they employ an access manager to operate within Indego's offices to ensure that key aspects of the service contract

(equity issues, data compliance and service quality, etc.), are honoured as part of day to day operations (Kinny, 2016).

The incorporation of social media platforms as a deliberative or interactive component of schemes may offer the potential of strengthening the co-production of services by integrating riders in knowledge sharing and decision-making practices. Combined with GIS tools, these platforms may be used to enable riders contribute environmental and technical information which might be used to adjust infrastructure or contribute to other service quality improvements. 'Social Bicycles' (SoBi) is an example of a service provider providing such functionality. Using technology this way to promote engagement and dialogue could (re)position riders as active participants in the creation of the systems they appropriate (Outram et al., 2010). It would also introduce enhanced levels of transparency and accountability into the service provisioning process and provide the city with an important source of secondary data with which to support urban planning activities (Bradshaw & Donnellan, 2013).

3.5 Conclusion

Smart bikeshare schemes are extensive socio-technical networks comprising hardware, software, communications technologies, data and business processes, funding models and implementation strategies. They may differ significantly in how they function, the affordances they offer, the goals they are intended to serve, the manner in which they are integrated into their respective environments, and the ways they are operationalized and supported. These differences have a material impact on the degree to which they meet the needs of civil society and position schemes, and the intentions underpinning their design and implementation, as socially relevant.

Though the current literature has begun to map the relationship between social justice and smart bikeshare, to-date, no detailed case studies have been undertaken which specifically examine the situated and context dependent practices which produce system configurations in different cities. Despite the pervasive neoliberalisation of the smart bikeshare sector, the process has not been universal. While some city administrations have been complicit in the prioritization of business interests to the detriment of communities already stigmatized by disadvantage, others have managed to engage authentically with smart bikeshare's normative and political potential by creating technologies which espouse genuinely egalitarian values.

Understanding how forces in given locations coalesce to legitimize the adoption of particular designs addresses knowledge gaps in the critical technology, smart city and smart bikeshare literatures. By providing detailed empirical and theoretical accounts of the processes by which cities produce, what is ostensibly, the same technical proposition, this thesis explores the ways in which cities are engaging with notions of democracy and technical citizenry and, the degree to which these notions are being shaped by broader smart city discourses.

Chapter 4 - Methodology

Introduction

The purpose of this chapter is to provide a description of, and a justification for, the methodological choices made in support of the research. The discussion is informed by a conceptual framework known as the 'research onion' developed by Saunders et al., (2007) which describes the successive layers which must be negotiated as effective research is developed (see figure 4.1 below). The framework understands this process as beginning with the researcher's philosophical orientation and progressing logically through a series of interdependent and increasingly granular layers leading ultimately to the collection and analysis of data and the production of useful insights.

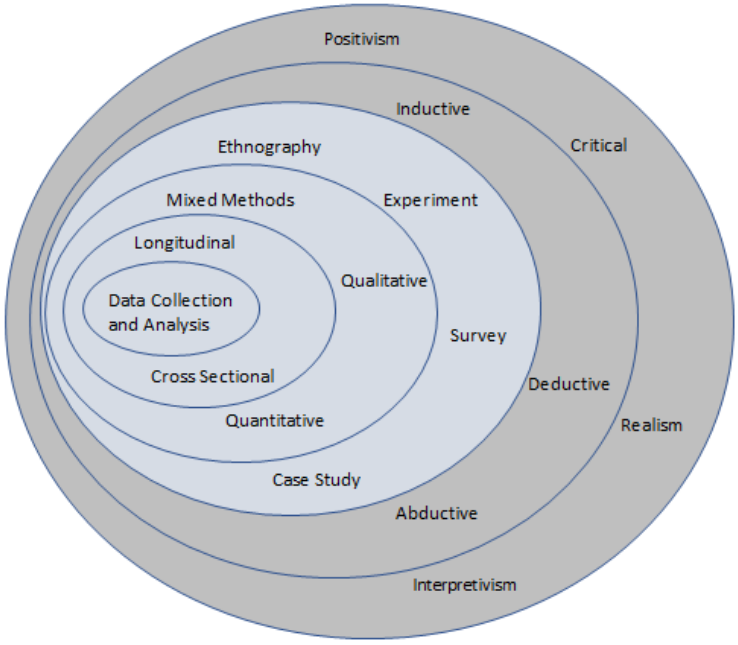
Accordingly, the chapter begins with a discussion of critical philosophy through explaining the ontological and epistemological assumptions of the project and outlines how these assumptions fit with the methodology being used. Stemming directly from the work's philosophical and theoretical orientation is the method of reasoning guiding the research. While abduction, the approach most commonly associated with critical research, was adopted to support this study, the investigation also retained both deductive and inductive elements. The chapter explains why the application of this mixed approach was both necessary and appropriate.

A comparative case study, which included smart bikeshare schemes in Dublin, Ireland and Hamilton, Canada, was the strategy adopted for the research. The appropriateness of the case study approach is discussed here, as is the process of identifying these particular schemes as likely to provide explanatory insights into how different cities create technologies with fundamentally different outcomes for citizens. Given the constraints of the research, and in keeping with the case study strategy, the investigation was cross-sectional rather than longitudinal in nature, with data sources primarily comprising interview and documentary evidence. These aspects of the research are explained and critically reflected upon in the chapter.

To ensure methodological rigor, the data analysis used thematic or analytic coding, a process informed by the constructs developed from Feenberg's critical theory. It also drew on critical hermeneutics as a method of integrating the multiple data sources to produce a holistic understanding of the cases. In particular, the interpretation drew on the work of Paul Ricoeur (1977). Ricoeur's approach to the interpretation of texts and text analogues (processes, institutional arrangements and

technologies, for example) aligned with the project's conceptual orientation and a discussion of critical hermeneutics, and its application in this context, is provided.

Figure 4.1: Research Onion



Source: Adapted from Saunders et al. (2009: 108)

4.1 The Critical Paradigm

The purpose of this research is to investigate the ways in which technology is actualized in different geographic locations under the influence of local and supra-local forces. As discussed in Chapter 2, there is an assumption that technical infrastructure has politics and that powerful stakeholders, typically neoliberal and bureaucratic institutions, will use their influence to configure design specifications and implementation strategies to protect and perpetuate their own interests, often to the detriment of other social groups. The research is concerned with the ways in which agency, in the form of democratic interventions, can be mobilized to challenge institutional control leading to technologies which are ethically progressive. This aligns the research with the broad ideological and political aims of the critical tradition making its adoption as a philosophical position from which to investigate the case study environments both appropriate and logical. In particular, the work is aligned with Feenberg's theoretical position which specifically identifies technology as another

form of domination and calls for its democratization as part of a broader program of social transformation.

While the contexts of application define particular variants of critical research such as Marxism, feminism, race theory (and critical theory of technology), the approach has inherent a set of ontological and epistemological assumptions which broadly define it and which, given their methodological implications, warrant discussion and clarification.

Assumptions underpinning Critical Research

Critical research is typically concerned with power dynamics and the liberation of disenfranchised sections of society from the "false consciousness" created by the dominant orthodoxy. Therefore, research in this tradition is essentially committed to an emancipatory agenda which creates change that benefits these groups (Lincoln et al., 2011). Ontologically, the critical position posits that reality is both historically constituted and apprehendable, and the causes for its present incarnation can be understood through an investigative process which acknowledges the social, cultural, economic and political forces which act to subjugate and control (Guba & Lincoln, 1994). Hence, critical research proceeds through the subjective experiences of people (phenomenology) which uncover the mechanisms and processes which act to (re)produce networks of power. In this regard it acts to:

> "*...establish a dialectical stance with respect to the researcher-participant relationship that serves to empower the participants and stimulate transformation of oppressive conditions to more equitable one."* (Ponterotto et al., 2013: 44)

Critical scholarship therefore seeks to overcome taken-for-granted beliefs, ideologies and structures by developing self-awareness through critical reflection and by encouraging an *emancipatory consciousness* in research participants and society more generally (Denzin, 1994). This pre-existing normative orientation, which prioritizes certain political and ethical goals, is therefore informed by a value-laden axiology which transparently links the production of knowledge, at least in part, to the historicity of the researcher. Therefore, critical research problematizes the subjective-objective dualism found, for example, in positivist research and instead understands epistemology and the production of 'truth' or knowledge to be intersubjective. In this

sense, it also fundamentally challenges traditional distinctions between ontology and epistemology in that what *can* be known is inevitably influenced by the interaction between a *particular* investigator and a *particular* object or group. Here, critical research is similar to social constructionism, however, unlike constructionism critical research proposes that as knowledge claims are always embedded in regimes of truth, consideration should be given to asymmetries in power which act to exclude or marginalize (Ceci et al., 2002). For this reason, critical philosophy can be said to be anti-foundational. Reality is alterable by human action and the transformative power of knowledge is embraced (Scotland, 2012).

Methodologically, and in keeping with these fundamental assumptions, critical research generally adopts a transactional, dialogic and dialectic approach intended to foster conversation and critical reflection. The transactional nature of the engagement between the researcher and the researched necessitates a recursive, iterative dialogue in order to provide a holistic understanding of the motivations, ideologies and rationales underpinning the phenomena under investigation. It is dialectical in the sense that it is ultimately intended to produce insights which may liberate people from ideologically static notions of structure and agency.

These assumptions – ontological, epistemological and methodological - shaped the manner in which the research process unfolded. In particular, they influenced the choice of methods used to collect data and the analytic framework used to subsequently interpret it. These aspects of the research are discussed in some detail later in the chapter.

The research proceeded using a largely abductive approach. Unlike deductive and inductive reasoning which focus on theory testing and theory building respectively, abductive reasoning relies more heavily on intuition and logical inference, and ultimately on the overall coherence and plausibility of the narratives and explanations developed during the research process (Shuster, 2012; Asvoll, 2014; Cardullo & Kitchin, 2017). From the perspective of this research, the abductive approach involved deploying Feenberg's critical framework as a set of sensitizing concepts through which the case study environments might be translated and analysed. While this was not designed to prove or disprove critical theory of technology per se, the process nevertheless retained both deductive and inductive modes, as the theory (as a starting hypothesis) was continually subject to evaluation and the possibility of elaboration and development. This produced a hybrid methodology characterized by

an ongoing dialogue between constructs and research sites which acted to refine the application of the theory and strengthen the interpretative process.

4.2 Case Study as a Research Strategy

The case study strategy is generally acknowledged to be an appropriate means of generating in-depth and multi-faceted understandings of complex phenomena operating within their natural context (Yin, 2009). While it can be used within a variety of disciplines and paradigms (Yin, 2009), it is commonly associated with the social sciences and interpretative research (Flyvbjerg, 2006). In contrast, for example, to experimental or positivist approaches where the researcher may often attempt to exert direct control over variables, the case study approach is viewed as promoting a naturalistic understanding of the issues (Crowe et al., 2011).

While case studies can be exploratory or purely descriptive, Yin (2009) proposes that the case study strategy is especially suited to explanatory research which is concerned with answering 'how' and 'why' type questions and which attempts to reveal the motives, rationales, and processes which lead to certain phenomena or outcomes. As such, the case study approach is aligned with the aims of the research. Citing Schramm (1971), for example, Yin (2009: 17) notes that;

> *"The essence of the case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions; why were they taken, how were they implemented, and with what result.*

As opposed to purely historical research, the case study strategy is also well suited to the investigation of contemporary events. Historical in this sense refers to scenarios where no relevant persons are alive to report, even retrospectively, what occurred. Historical influences in the more traditional sense are routinely included in case study investigations as part of a holistic understanding of the phenomena (Yin, 2009). Yin also notes that the case study inquiry typically relies on multiple sources of data which need to converge in a triangulatory fashion, and as such, benefits from the prior development of a theoretical or conceptual framework which acts to guide the collection and interpretation of data (Yin, 2009). From the perspective of this research, the use of Feenberg's theoretical constructs enhanced the internal validity of the findings by supporting the identification of casual rather than purely spurious relationships.

Stake (1995), in an effort to define the case study in relation to scientific enquiry, has characterized three main types of case study; intrinsic, instrumental and collective. Intrinsic is generally adopted when investigating a unique phenomenon, while instrumental is used in a particular case to develop a broader appreciation of a given issue. Collective or multiple cases are generally undertaken, either simultaneously or sequentially, to develop deeper insights and understandings. This resonates with Miles and Huberman (1994), who note that by virtue of cross case analysis, multiple case studies tend to be more comprehensive and explanatory and have the added potential of producing findings which may be generalizable i.e. these findings have enhanced external reliability.

Yin (2009) also distinguishes between two primary multiple case study designs; holistic and embedded. A holistic approach is one that treats the environments being investigated as whole or integrated entities where a single phenomenon or *unit of analysis* is being explored. A unit of analysis might be an individual, a group, a process, an organisational entity and so on. Embedded studies on the other hand occur where there are multiple and disparate sub units of analysis. This research involved understanding the manner in which the constitution and configuration of particular smart bikeshare schemes under investigation were mediated and shaped by a diversity of context specific forces and, as such, are the primary focus of the investigation. Accordingly, the case studies are holistic in nature. As noted by MacQuarrie, (2012):

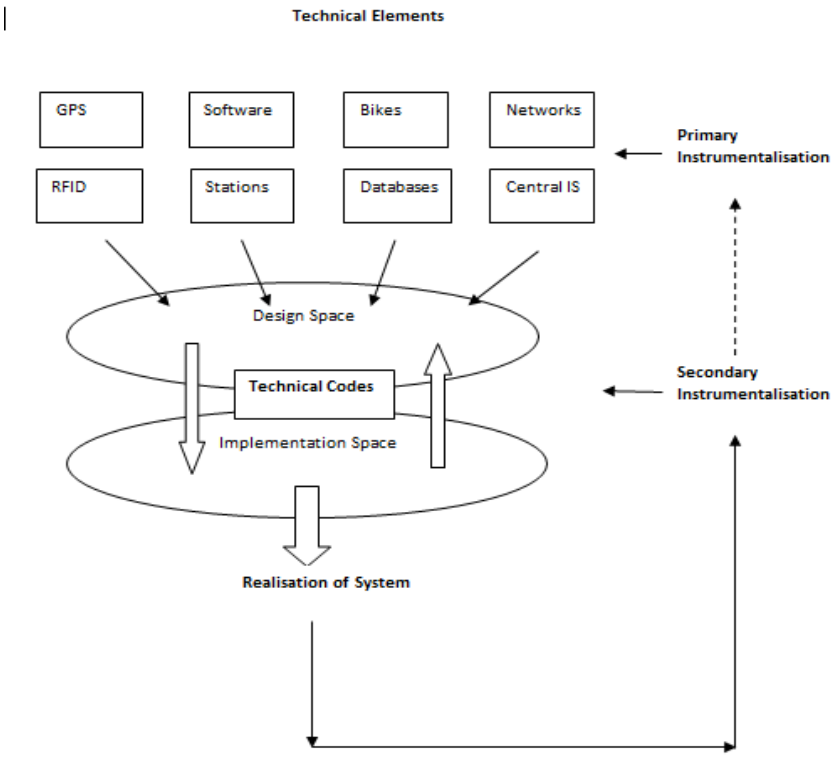
> *"The design, implementation, and analysis [of holistic cases] should facilitate a synergistic combination of various aspects or elements of the case study. Thus, a holistic case study is composed of various components, and the challenge for the researcher is to create a credible synthesis of these elements of knowledge."* (MacQuarrie, 2012: 2))

4.3 Conceptual Framework Supporting the Case Studies

A conceptual framework (see Figure 4.2) developed from Feng and Feenberg (2008) was used to guide the research and explore key concepts and ideas. The framework understands schemes to be the product of technical codes or cultural horizons which act to shape design and implementation processes. Technical elements and functional attributes (primary instrumentalization), which tend to have relatively little bias and form the basic ingredients of technical practice, are actualized in the city though an assemblage of forces effected largely by institutional actors, policies and processes

(secondary instrumentalization). It is here that schemes become integrated into specific practices, are connected to other devices, and are ascribed specific meanings and use. The feedback loop connecting the actualized systems with processes of secondary instrumentalization is an adaptation to the original framework as developed by Feng and Feenberg (2008) and allows for the impact of environmental contexts on the ongoing development of the systems. The broken line including primary instrumentalization in this process acknowledges that even the choice of basic technical elements can have a valuative and/or political aspect, however minimal.

Figure 4.2: Conceptual Framework



Source: Adapted from Feng & Feenberg (2008)

The particular constructs which comprise both instrumentalizations and which contributed both theoretically and methodically to the coding and interpretation of data collected are described below.

Primary Instrumentalization: Functionalization

This instrumentalization consists of four moments of technical practice. The first two relate to characteristics of the object and approximate to Heidegger's notion of a

decontextualized ‘revealing’, while the latter two define the subject and are sympathetic to Habermas’ concept of Communicative Action i.e. they suggest the intrusion of a functionalist or technocratic rationality into the ‘life world’.

Decontextualization - Reduction

Decontextualization and reduction are interrelated steps which capture the processes by which objects are essentially separated from their natural environment for the purposes of utilitarian, technocratic evaluation. Together, they operate to negate those attributes and qualities which might otherwise meet socially relevant goals.

> *“Inventions such as the knife or the wheel take qualities such as the sharpness or roundness of some natural thing, such as a rock or tree trunk, and release them as technical properties from the role they play in nature. Technology is constructed from such fragments of nature that, after being abstracted from all specific contexts, appear in a technically useful form.”* (Feenberg, 1999: 203)

In effect, these processes of objectivication simplify artefacts in order that may be integrated into technical networks and systems. Feenberg calls what remains ‘primary qualities’; primary that is from the standpoint of the technical subject for whom they are a power base.

> *“The tree trunk, reduced to its primary quality of roundness in becoming a wheel, loses its secondary qualities as a habitat, a source of shade, and a living, growing member of its species. To the extent that all of reality comes under the sign of technique, the real is progressively reduced to such primary qualities.”* (Feenberg, 1999: 203)

Primary qualities may include anything about objects that makes them amenable to control, formalization and quantification (weight, size, shape and so on). In this sense decontextualization and reduction resonate with Heideggerian substantivism; the contraction of all of technology’s potential to the most abstract and instrumental capacities and, in the process, the sacrificing of those secondary qualities which have social and ethical value.

Autonomization - Positioning

These concepts are the antithesis of reciprocity and involve a separation of technical subject from the object of control making redundant the natural feedback loop that typically mediates and conditions such a relationship.

> *"The subject is largely unaffected by the object on which it acts, thus forming an apparent exception to Newton's law...Administrative action too, as a technical relationship between human beings, presupposes the autonomization of the manager as subject, who must neither fear nor pity the laid-off worker. Their relationship must be functional."* (Feenberg, 1999: 203)

The technical subject situates or positions itself strategically to navigate among its objects and control them. This positioning is highly characteristic of the technocratic control one sees in modern, hierarchical organisations and is marked by an indifference to the social and environmental consequences of the pursuit of optimization and/or self-perpetuation. Feenberg proposes the design of artefacts is complicit in this process by inducing workers and consumers to fulfil pre-existing programs that may otherwise have not chosen. This reaffirms technology's positional character.

Secondary Instrumentalization: Realization

Secondary instrumentalization is also defined by four moments. While primary instrumentalization defines the basic technical orientation of the object and subject, a process of secondary instrumentalization is required to integrate a device or system into a real-world context. Though highly constrained under a technical rationality, this recontextualization process offers an opportunity to embed the technology in a multitude of technical and social networks through mediations that are cognisant of normative and aesthetic considerations. In this sense it offers the potential to compensate for the reifying effects of primary instrumentalization. Therefore, each moment of the secondary instrumentalization can be seen to as a foil or counterpoint to those outlined above. Again, the first two concepts relate to the object and the latter two to the subject.

Systematization - Mediation

Systematization and mediation are processes through which the artefact can be recontextualized and designed with multiple contexts and use cases in mind. In the vernacular of ANT, they represent the "enrolment" of an object in a network (Latour, 1992) where the artefact or system assumes a multitude of technical and cultural identities and meanings. The technically underdetermined way this is accomplished

allows for the intervention of socially relevant interests and values and the moral and ethical imperatives of a broader spectrum of user groups. When supported by the appropriate valuative mediations, systematization can harness the inherent capacities or 'secondary qualities' of technology to inset it seamlessly into a new social context. Characterized by commodification under a neoliberal orthodoxy, these processes retain the capacity to give the concretized or realized object an additional dimension and redefine not only its 'function' but its 'meaning'. Feenberg's examples of online education platforms and the Minitel system, which demonstrate the capacity of goal-oriented systems to assimilate the concerns and interests of affected communities, are illustrative in this regard.

Vocation – Initiative

These processes speak directly to the democratic interventions described in Chapter 2. It is through the modalities of vocation and initiative that such interventions can mediate and reconfigure the effects of autonomy characteristic of primary instrumentalization. In so doing, the technical subject is no longer isolated from objects of control but is reshaped by their relation to them. This reciprocity accounts for the co-constitution of subject and object.

> "*Vocation" is the best term we have for this reverse impact on users of their involvement with the tools of their trade. The idea of vocation or "way" is an essential dimension of even the most humble technical practices...but tends to be artificially reserved for professions such as medicine in most industrial societies*." (Feenberg, 1999: 206)

When motivated by a sense of vocation, tactical actors (implicated publics and institutional subordinates for example) can mobilize initiative to circumvent the strategic power of executive, instrumentally-oriented decision-makers. As previously described, such agency may take many forms such as resistance, advocacy, collaborative design, and collegiality.

> "*Collegiality is an alternative to bureaucratic control in modern societies with widespread if imperfect applications in the organization of professionals such as teachers and doctors. Reformed and generalized, it has the potential for reducing alienation through substituting self-organization for control from above.*" (Feenberg, 1999: 203)

It is through such interventions that the tension between conservation of hierarchy and democratic rationalization can be productively resolved. Table 4.1 below illustrates these concepts and the relations between them.

Table 4.1: Instrumentalization and associated concepts

	Functionalization	**Realization**
Objectivication (Technology)	Decontextualization Reduction	Systematization Mediation
Subjectivication (Human)	Autonomization Positioning	Vocation/identity Initiative

Source: (Feenberg, 1999: 208)

In keeping with the critical paradigm, the concepts defined above were not applied prescriptively, but instead used as a means to support a critical reflection of the substantive issues impacting the relationships between society and technology.

4.4 Choosing the Case Studies

Stake (1995) proposes a case to be a "*specific, complex, functioning thing*" with the primary factor influencing selection being the case's capacity "*to maximize what we can learn*" (1995: 4). Creswell (2007) adds that, despite not knowing in advance which cases may prove exemplary in addressing a set of research questions, purposeful sampling enables the researcher to include cases which have the potential for greater probative value in unpacking the phenomena under investigating. Accordingly, the bikeshare schemes comprising the study were selected using an information-oriented technique, rather than a random or stratified sampling logic.

The choice of Dublinbikes and SobiHamilton as appropriate case studies was influenced primarily by prior knowledge developed through previous study. In 2011 and in pursuance of a master's degree in information systems, I undertook a research

project which aimed to understand the degree to which the design of bikeshare schemes could be optimized from the perspective of environmental sustainability using an informatics-based framework. Both Dublinbikes and Social Bicycles were included as subjects of this research. While the work was largely instrumental in nature, focusing on the capacity of technical architectures to reduce cost and enhance usage through information exchange between riders and system operators, the process uncovered a diversity of schemes (systems in Copenhagen, Denmark and Baltimore, USA were also included in the study) whose design characteristics were technically underdetermined and mediated, to a greater or lesser degree, by geographic, political, economic and cultural contexts. Due to the limitations of the research, these issues remained largely unexamined but given their significance as factors influencing design praxis, and given the themes motivating this thesis, the cases represented an important opportunity for deeper critical analysis.

Prior to the final selection of the cases, additional research was conducted to understand the current status of the systems. This comprised of preliminary conversations with stakeholders from both cities in order to develop a better understanding of the contexts impacting system design and identify any technical adaptations or innovations which might have occurred in the interim. These discussions proved especially fruitful in the case of SobiHamilton as the scheme has not been implemented at the time my MSc was undertaken and so prior research had been limited primarily to exploring SoBi's architecture as a design concept with a set of technical and social potentials. SoBi's CEO provided invaluable detail and insight into key issues relating the schemes development and implementation which, in addition to informing the case selection process, also informed much of the field work when data gathering began.

This preparatory phase of case selection was also supplemented by a review of historic and contemporary media accounts of both schemes (websites, blogs, newspaper articles and social media platforms for example) and a review of the literature dealing specifically with smart bikeshare and equity. The latter aided in framing and interpreting technical activity in both cases though a socio-political lens.

What this exploratory stage of the thesis established then was that the systems were conceived in contextually disparate environments and each articulated fundamentally different notions of democracy, citizenship and innovation. Dublinbikes, a traditional 3rd generation scheme implemented through a public private

partnership (PPP) with French outdoor advertising firm JCDecaux, was controversial from its inception, with the manner of its planning, implementation and subsequent operation drawing criticism from a variety of political and social commentators. In particular, concern centred on the nature and quality of decision making within city management and the effect this had on the rationales and motivations shaping the scheme's design and performance. Despite articulating a progressive smart city narrative which ostensibly promotes creativity, openness, and inclusivity, Dublin's scheme had experienced little technical or social innovation since its deployment and had been configured largely to serve areas of economic and social prosperity. By contrast, SobiHamilton represented the industry's first large scale, 4th generation implementation and was widely recognised as an important contribution to solving many of the technical and normative issues characterising the industry (Shaheen et al., 2010; Bradshaw & Donnellan, 2013; Fishman, 2016). The implementation, which needed to negotiate considerable historic, geo-political and economic barriers, represented a diversity of interests and stakeholders. Significantly, this was achieved in the absence of an explicit or overarching 'smart city' agenda.

Given their paradigmatic nature, Dublinbikes and SobiHamilton represented critical cases through which issues and themes relevant to the research could be investigated. As previously mentioned, detailed critical case study research involves critical reflection on current practices, questions taken-for-granted assumptions, and attempts to critique the status quo and the role of dominant actors in the shaping of social relations. In particular, the studies were chosen to serve the following research question:

How may the design and implementation of smart bikeshare systems preserve notions of equality, democratization and citizenship?

4.5 Data Collection

Data sources to support the research comprised interviews and documentary evidence. To support a holistic understanding of system creation, implementation and use, interviewees comprised stakeholders from the following groups: system designers and operators (Hamilton), system members or users, advocacy groups, civil servants, politicians, journalists, and industry experts. The number and category of participants is outlined in Table 4.2 below.

Participants became involved by being formally approached due to their situated knowledge of the bikeshare scheme and/or the processes leading to their creation. Contact was made initially via email, with follow up phone calls made to discuss in some detail the purpose and aims of the research. Subsequent participants were mainly recruited through snowball sampling, based on recommendations and introductions made by these primary contacts. System users in the Hamilton case were recruited primarily through engaging with the city's network of residents and community organisations located in the schemes service area.

Representatives from JCDecaux - system designers and operators for Dublinbikes - refused to participate in the research. Likewise, their counterparts in Dublin City Council with responsibility for the commissioning and implementation the system also refused an invitation to participate in the interview process. While a junior manager representing Dublinbikes agreed to a meeting to discuss issues relating the system, he declined to sign a consent form, making the information gathered essentially unusable. This was compensated for by enrolling key informants (identified through newspaper articles, planning documents and snowball sampling, etc.) who had particular historical knowledge of the project and so could provide testimony relating to critical development and implementation processes influencing the system's creation.

As Dublin does not have the dense network of community and residents' groups characteristic of Hamilton, system users (scheme members) were recruited by invitation using a number of social media platforms i.e. Facebook, Twitter, LinkedIn and Boards.ie (a public forum). Significantly, more men responded to this process than women which is consistent with the gender imbalance of the scheme noted in Chapter 3.

Interviews

Interviews can be structured, semi-structured or in-depth. Semi-structured interviews were chosen as the most appropriate instruments for this investigation. Structured interviews are analogous to surveys and are standardised and quantitative in nature. They do not support an open dialogue and cannot be modified as contexts change. In-depth or unstructured interviews tend to be conversational, without scripted agendas or pre-set themes. They are sometimes called 'non-directive' as the interviewer makes

no attempt to direct the interviewee. Semi-structured interviews combine elements of both the other approaches. The researcher can develop a set of themes and questions to be covered while allowing the flexibility to modify the questions as contexts change. Questions may be omitted, and the order of questions may be changed given the nature of the circumstances (Sanders, 2009). The process supports an open, interactive dialogue, while at the same time ensuring the focus remains on the key constructs under investigation. For these reasons a semi-structured interview format was adopted across both participating cases. 53 discrete interviews (comprising 20 female and 33 male participants) were conducted, with some stakeholders occupying more than one category. For example, a number of system users in both cities were also community advocates, civil servants or academics etc.

It should be noted at this juncture that the concept of equity informing the research, and the interview process, was understood primarily through the lens of social disadvantage. The design of the systems, the distribution of network infrastructure and the willingness or otherwise of either city to engage in consensus building practices were largely shaped by socio-economic factors. While cycling and smart bikeshare does demonstrate a gender imbalance, research conducted in Dublin by Brereton (2016) and Dennehy (2016) attributed this, at least in part, to additional responsibilities that women tend to have in relation to shopping or to the transportation of children which make them more likely to choose other modes of transport. This research also noted the impact of issues such as poor traffic management and the inadequate provision of appropriate cycling infrastructure (segregated cycle lanes for example) which tend to differentially increase the perception of risk in women and undermine their sense of self-efficacy. As these issues are beyond the scope of the thesis, they were not explored in the research, although the capacity of bikeshare to energize cycling related agendas is discussed in the Hamilton case. Also, where stakeholders were cognisant of the needs of racial and ethnic minorities – also a feature of SobiHamilton - this is duly noted in the findings.

Table 4.2: Category and Distribution of Interview Participants

Type	Dublin	Hamilton
System Members/Users	9	6
Journalists	1	2
Activists - Advocates	5	6
Civil Servants	4	4
System Operators	0	2
System Designers	0	2
Academics	1	2
Politicians	3	1
Industry Experts *	9	9

**The information developed through industry experts was applied to the evaluation of both cases. These experts include system developers (3), transportation and data analytic scholars (4), systems software developers (1), and Industry officials (1).*

While interviews, were primarily based on one-time contact, additional short or supplementary interviews were conducted to develop additional insights or to clarify issues and points of interest as they arose during the data collection process.

In accordance with recommended ethical procedures, interviewees were offered complete anonymity and informed consent was received from each participant (see Appendices 4 & 5). Additional information sheets and consent forms were supplied where interviewees may have required permission from their respective organisations to participate in the process. Where applicable, participants had it made clear to them that the organisations they represented would be identified in the research.

In addition, interviewees had explained to them the precise nature and purpose of the research study, the reasons for their selection, the procedures to be undertaken and any risks that might be involved. They were offered the opportunity to ask any questions and have such questions fully answered both before and after interviews. Interviewees were also advised that they could withdraw from the process at any time without prejudice. The researchers contact detail were supplied to allow interviewees clarify any aspect of the process or to withdraw their contributions if they so wished.

All interviewees, with the exception of a representative of Dublin City Council, waived anonymity and were willing to be identified in the study.

Documentary Sources

Documentary sources supporting the research varied depending on availability. It included company and government reports, strategy and policy documentation, organisational websites, letters, emails, procurement and contract documents, patents, physical artefacts (the systems themselves), formal studies, academic papers and newspaper and website articles. Together these provided important historical, political, and technical accounts which supplemented the interview process and provided additional contextual material to which critical analysis was applied.

Yin (2009) notes, for example, that documentary evidence is stable (can be reviewed repeatedly), unobtrusive (not created as a result of the case study), exact (contains exact names, references and details of events) and provides broad coverage (may cover a long time-span and include many events and settings). In addition, while documentary evidence may not present a literal recording of events, when used judiciously it may act to corroborate or contradict interview testimonies. As such it offers the potential of considerable probative value.

Documents were sourced both prior to and during field work. Prior to field work a systematic internet search revealed important issues relating to the schemes. In the case of Dublin for example, newspaper articles and advocacy websites provided important historical accounts of controversies and disputations which proved pivotal to an understanding of the formative phases of the project. Once field work commenced, these issues informed both the interview process and the types of additional documentation necessary to develop a more coherent picture of how and why these issues arose and how they were managed. A number of these documents had initially not been released to the public domain and had to be secured subsequently by a national newspaper using freedom of information (FOI) legislation. In particular, these included tending/request for proposal (RFP) documentation, the initial concession contract (2006) and the contract defining the schemes' subsequent expansion (2013). While this documentation provided valuable information on the nature of the structural and financial relationships between DCC and JCDecaux and supported a critical an analysis of the formative phase of the scheme, they failed to

confirm the participation of other vendors in the tendering process. Information relating to other bidders had been specifically requested but none was provided. Given the obfuscation and expedience which would characterize much of the decision-making relating to the project, this omission may imply that negotiations were bilateral and uncompetitive from the outset. This aspect of the project is noted in the empirical findings.

In the case of Hamilton, a combination of business planning and public engagement documentation, also secured prior to field work through the city's office of active transportation, provided a detailed chronology of the events leading to the implementation of the scheme and systematically identified key stakeholders based on their participation at various developmental phases of the project. Again, this information identified issues and points of interest which were developed through the interview process. As with the Dublin case, additional institutional documents such as contracts, independent reports and strategic planning documents were secured once field work commenced and proved especially useful in corroborating (and in some cases challenging) data developed through other sources.

Formal bikeshare studies and academic articles, developed primarily from the literature review, provided grounding in the technical and political issues confronting the industry and so aided in the development of problem definitions and interview design. Patent documents and video material supported an understanding of the performance characteristics of the systems and the implications of these characteristic for the various stakeholder groups associated with them. Furthermore, video material made available on social media platforms which documented key pre-implementation debates in the council chambers of both cities also helped to clarify the political and cultural environments shaping design processes.

4.6 Data Analysis

Critical Hermeneutics

Prior to and in conjunction with the process of thematic coding, which involved applying Feenberg's theoretical construct to the data, the case studies were read and re-read using a critical hermeneutic lens to allow the multiple accounts and testimonies from across both case studies to be evaluated as a holistic whole rather than be biased by individual or partial accounts.

Hermeneutics was originally developed as an approach to the interpretation of ancient and biblical texts but has, over time, become an increasingly popular methodological tool within the social sciences in particular (Kinsella, 2006). Myers (2016), for example, has proposed that all qualitative research, concerned as it is with meaning making and the understanding of human experience (phenomenology) involves a hermeneutic component, as testimonies (text or their analogues) are interpreted by necessity as part of the analytic process (Myers, 2016). Kinsella (2006) adds that:

> *"Qualitative research is by its very nature informed by hermeneutic thought. Given that the emphasis in qualitative research is on understanding and interpretation as opposed to explanation and verification…the connection between qualitative research and hermeneutic thought becomes self-evident."* (Kinsella, 2006: 2)

While a number of hermeneutic approaches exist, for example those of Gadamer, Heidegger and Husserl – it is the critical potential inherent the work of Paul Ricoeur (1971) that offered the best opportunity for congruence between the critical philosophy underpinning this research and the methodological processes actualizing findings (Geanellos, 1999). Though critical theory and critical hermeneutics are not necessarily synonymous given that Ricoeur's work does not decide apriori which dialectics and oppositions will be most significant, it is widely accepted that much critical enquiry today is informed by the critical hermeneutic process (Rorty, 1991; Wallace, 2000; Kinsella, 2006; Myers, 2016). Kögler (1996) for example has proposed that many contemporary critical scholars draw on Ricoeur's framework as a methodological tool to support deconstruction and interpretation. In addition, Feenberg has identified Ricoeur's work in particular as an important contribution to the development of a hermeneutics of technology (the analysis of the artefact) and a natural methodological choice in the application of his work (Feenberg, 1992). While hermeneutic phenomenology focuses on the conscious constructions and interpretive activities employed by actors as they encounter phenomena, critical hermeneutics offers an additional layer which addresses issues of power and ideology and situates the interpretative process in a wider social, cultural, economic and historical setting. It assumes apriori that the constructions that individuals make operate not only in a sense making or interpretative way but to reproduce (or resist) the underlying ideological assumptions inherent in a given context. Its epistemic orientation also acknowledges

that no observation or description is free from the effects of the observer's experiences, pre-suppositions, and projections of his or her own personal values and expectations (Ricoeur, 1981).

Critical hermeneutics' alignment with critical theory therefore distinguishes it from pure hermeneutics which proposes that the text (or analogue) is in some sense 'out there' as a disembodied object that is amenable to objective analysis in the positivist tradition (Bleicher, 1982). It differs also from a purely poststructuralist approach which suggests that there is no such thing as an objective or true meaning of a text (Madison, 1990 as cited in Myers, 2004). Critical hermeneutics recognizes that the interpretive act is one that can never be closed as there is always a possible alternative interpretation. Using this approach, the interpreter constructs the context as another form of text, which can then itself be critically analyzed. In this sense the interpreter is recursively creating a text upon a text, and the process whereby the textual interpretation occurs is self-critically reflected upon (Ricoeur, 1977). As with critical theory, an essential concept in this approach is the interpreter's recognition of their own historicality. Therefore, the dialectic between text and interpreter leads to an iterative and reflexive series of interpretations which synthesizes an approximation the 'truth'. In this way, the approach acknowledges the interrelationship between epistemology (interpretation) and ontology (interpreter) and provides researchers with a method of developing intersubjective knowledge.

Methodologically and conceptually, Ricoeur proposes that interpretation proceeds from naive understanding, where the interpreter has a superficial grasp of the whole of the text, to a deeper understanding, where the meaning of individual texts and the 'whole' are mutually constitutive and emerge through an ongoing dialogue with one another (Ghasemi et al., 2011). This process is known as the hermeneutic circle. Significantly, the interpretative processes associated with the hermeneutic circle are guided by anticipated explanations (Gadamer, 1976). For the purpose of this research, these anticipated explanations are conditioned by the underlying theoretical framework derived from critical theory of technology. The critical hermeneutic process also encompasses not only an interpretive - dialectic reading of interviews and documentary sources, but also understands text analogues such as socio-political and cultural contexts, organisational structures and behaviours, the performance of projects, and importantly, the nature of the technological artefact itself to be significant and subject to interpretation (Myers, 1994).

This situates the analysis of written texts within a broader or global process which attempts to bring clarity and coherence to an object of study which may appear confused, incomplete or contradictory in one way or another (Taylor, 1976). This process requires that the researcher does not necessarily merely accept the self-understanding or accounts of participants, but seeks to critically engage with the totality of understandings in a given situation (Myers, 1994). Within the context of this research, critical hermeneutics added substance and direction to the application of Feenberg's constructs and provided a 'recta-theory' or framework for the iterative analysis and integration of a diversity of sources.

Thematic Coding

In a manner consistent with the hermeneutic tradition, an important aspect of Feenberg's critical theory of technology is the interrelationships between local or situated decision making and the broader socio-political and economic milieu within which these processes occur. Consequently, the research process was designed both to develop an understanding of the pre-existing contextual landscapes in both case study environments and then map, in chronological order, the developmental processes which led to the design, implementation and ongoing management of the schemes. MAXQDA was used to assist in the analysis of the data and the following broad categories were created to structure the data logically and sequentially.

Contexts (Historic, political, economic, cultural and geographic) – Pre-implementation – System Design and Configuration – Management and Operations - Ongoing Innovation.

Each developmental phase was then subdivided into the construct categories or dimensions derived from Feenberg's work i.e. Positioning – Initiative, Autonimization – Vocation, Reduction – Mediation, Decontextualization – Systematization.

The data was then structured further into factors illuminating these dimensions both descriptively and analytically. For example, in the Hamilton case, many variables impacting the degree to which the system was designed and implemented to integrate into the physical, cultural and technical environments (decontextualization – systematization) were identified. For illustrative purposes a sample are shown below in figures 4.3 and 4.4.

The following extract from an interview with a system developer at SobiHamilton demonstrates the impact of Google on systematization and innovation. The extract deals with processes of developing open standards for smart bikeshare data being pioneered by the scheme.

> *"I was in Chicago recently at a conference and of course they have bikeshare there, quite a large system but we were trying to get around the city and Google maps doesn't tell me where the bikeshare stations are so I have Google maps running on my phone because that's how I'm navigating but to get a bike I have to go to their site, open their app and try to locate where I am in on that map by referencing my position on Google maps. So, I have two maps...so Google doesn't have the bikes because there was no open standard. So now if we can agree on a standard, companies like Google need to only design one key to access the data from multiple systems and they'll take the time to do that properly. I mean with the transit data there was a standard and any city that wanted their transit information on Google had to present the data in that format or Google just wouldn't engage with it.*

This passage was also coded as relevant to the role of 'technical design', 'data' and 'connection to other systems' in patterning the systematization and configuration of the scheme. Additionally, it speaks to the willingness within the SobiHamilton organisation to respond to the broader systems landscape with technical experimentation and innovation. Many other examples developed in the case study corroborate this attitude of openness and enterprise and are discussed in detail in the findings chapter.

The role of 'cycling safety', 'traffic infrastructure', and 'advocacy' on systemization is demonstrated in this passage from an interview with a local cycling campaigner.

> *"So, I think that one of the really interesting things for me and my role in "Yes We Cannon" (advocacy organization) is that we actually used the fact that Bike Share was coming as an impetus for the installation of the Cannon Street Bike Lane. We highlighted to Council that 'you know, you guys already approved this, we know the money is coming. These systems work best where there are proper networks of infrastructure so if you want it to be successful you need to be able to provide people, especially in the lower city, with a decent East – West route because there wasn't one until Cannon Street'."*

Figure 4.3: Sample of Coding for Hamilton

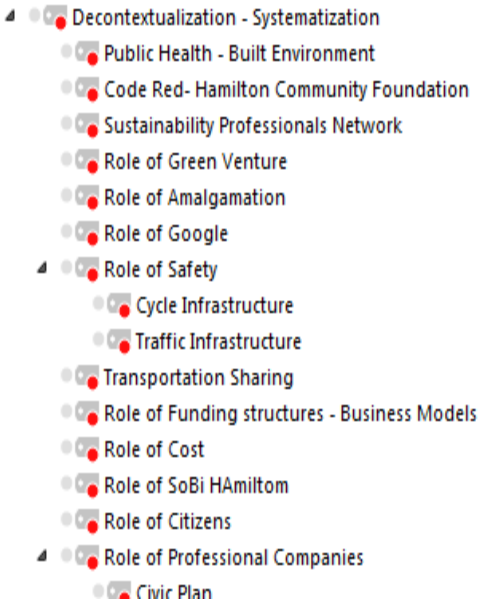
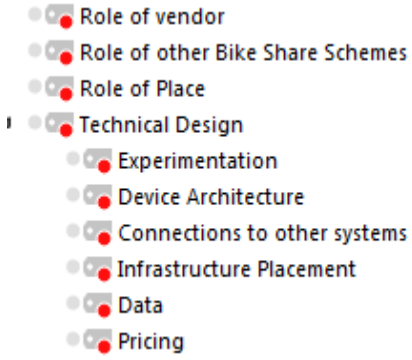


Figure 4.4: Sample of Coding for Hamilton



The importance of 'initiative' and 'vocation' also proved pivotal to the character of Hamilton's scheme and led to the categories illustrated in figure 4.5. The following quote from a local activist for example describing the efforts of the city's transportation demand manager to mobilize support for the project was coded under 'leadership', 'hacking – tactical' and 'citizen engagement'.

> *"Somebody had to take the leadership role, somebody had to organize, and to capture all of that civic engagement and put it together. Somebody had to tie all that together and present it as a package and it simply wouldn't have happened without him. He took a big political risk as a staffer. This is not a city that rewards innovation and progressive thinking.....no good deed goes unpunished in this town (laughs). I mean as a staffer he has to lead on this but also to stay out of the limelight and not be seen to be antagonistic to his own organization and so he's doing an enormous amount of work that can be all but invisible to a lot of people."*

The quote also suggests some of the political conservatism that had to be negotiated in order for the project to materialize.

Figure 4.5: Sample of Coding Structure for Hamilton

In the case of Dublin - which emerged as the product of a fundamentally different set of rationales and ideologies – this segment from an interview with a community activist involved in appealing key planning decisions taken by Dublin City Council captures the frustration felt at the manner in which the democratic process - and environmental legislation - were circumvented for the sake of expedience.

> *"Well as group we felt that the steps that were taken were reversed. There was a contract, then public representatives were informed and then a more general notification to the public that Dublin Bikes were on their way and they were going to be a wonderful thing…I would say that the Aarhus convention particularly points out that for anything that has an impact on the environment, and has a significant impact on the quality of life for people within cities, the first thing that happens is proper public consultation. We made that point of course but nobody listened."*

The segment was categorized as a 'pre-implementation' activity and coded as examples of autonomization and strategic positioning within city governance.

It should be noted that coding was initially provisional and went through a number of iterative phases as the dynamics both within and across cases unfolded and judgements guiding the analytic process became incrementally more refined and discriminating. This was the value of the hermeneutic process which continued after the coding process completed until a satisfactory approximation of the 'truth' was reached.

> *"In intensive, case study research, the movement of understanding is constantly from the whole to the part and back to the whole; in other words, the more interviews we conduct and the more information we gather, the more we understand the case study as a whole and its constituent parts. This*

> *hermeneutic process continues until the apparent absurdities, contradictions, and oppositions…no longer appear strange, but make sense."* (Myers, 1995: 56)

4.7 Lessons Learned

Through undertaking the research process a number of issues emerged which should be noted in the interest of informing future researchers. Firstly, the length of time required to transcribe interviews was significantly under-estimated. It was assumed at the out-set that one hour of dialogue would take 2 - 3 hours of transcription, however, this proved somewhat optimistic. In addition, the semi-structured nature of the process encouraged interviewees to be expansive in their responses. While this contributed positively to understanding the contextual dimensions of the cases and improved the findings considerably, it also meant that some interviews took significantly longer than expected, with the inevitable impact on the duration of both transcription and analysis.

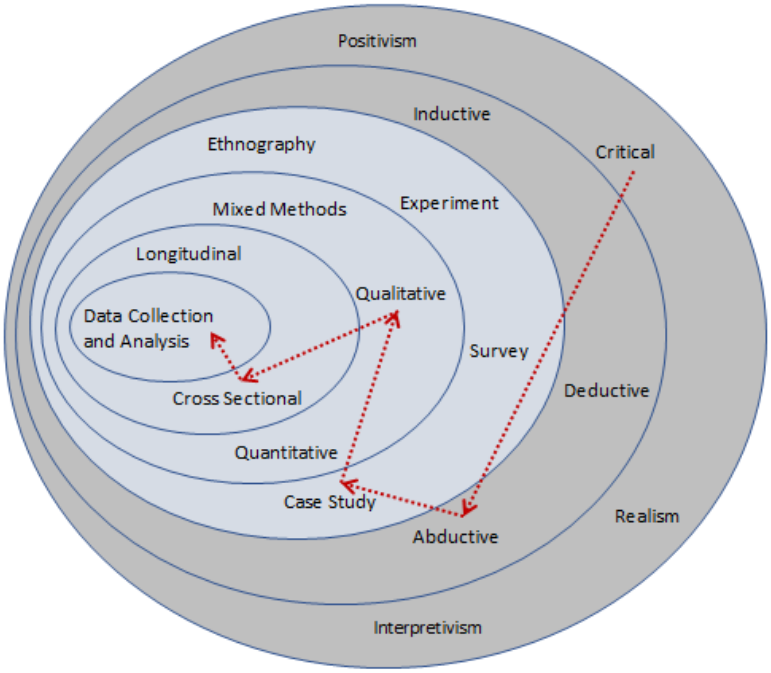
Secondly, it should not be assumed that all elements of the interview strategy will be implemented precisely as intended. As noted previously, key stakeholders within both JCDecaux and Dublin City Council with direct responsibility for developing and running the scheme refused repeated invitations to participate in the study – significant, given the overall findings. The effect was mitigated, however, by the inclusion of additional stakeholders who provided valuable insights and critical reflection which strengthened the study.

Finally, it should not be assumed that all the interview participants short listed at the outset will be available as and when required by the research. All interviewees for this project were initially contacted in the early part of 2016, a number of months prior to the commencement of the data gathering process. They were advised as to the nature of the research and were invited informally to participate. They were then contacted intermittently in the intervening period both to advise them of progress and to maintain the profile of the project. In parallel with this, and to mitigate the risk of unavailability, an alternate list of interviewees representing other potential schemes was developed which could have been used should circumstances have required it.

4.8 Summary

As originally described, the research process was informed by the layers of Sanders' research onion. The initial schematic has been updated to illustrate the path that was chosen through these various layers to best support the investigation (see figure 4.6).

Figure 4.6: Path through Research Onion



Source: Based on Saunders et al. (2009: 108)

An abductive comparative study was at the heart of the research process. It used primarily qualitative data comprising interview and documentary evidence to which both critical hermeneutics and thematic coding were applied in order to complete analysis process. Due to the time constraints that applied, the research was conducted using a cross-sectional approach.

Chapter 5 - Dublinbikes

Introduction

Dublinbikes represents something of a paradox. Implemented in 2009 through a public private partnership (PPP), the scheme is currently promoted by municipal actors as an exemplar of creative urban design which has revolutionized the transportation landscape, improved the quality of life in the natural and built environments and consolidated Dublin's core as culturally and socially integrated (Dublin City Council, 2011). As such the scheme is positioned as creating a more connected, sustainable and healthier city and one which embodies progressive notions of equity and innovation. This is made explicit in Dublin City Council's stated commitments to the scheme which include: ensuring that Dublinbikes contributes to the evolution of socially integrated economic and residential communities; maximizing access to the service by developing a robust network of stations which facilitates sustainable, city-wide movement for all citizens; and, ensuring that the design and construction of the Dublinbikes system is of the highest quality and is appropriate to the scale and context of its environmental surroundings (Dublin City Council, 2011).

Taken at face value then, this positions Dublinbikes as an archetype – a planning and implementation blueprint – for addressing the structural, cultural and technical barriers to equity discussed in Chapter 3. Certainly, when judged purely from the perspective of usage, Dublinbikes is comparable with many of the more positively cited international systems, e.g. Paris, Barcelona, New York, Lyon and Mexico City (Cohen et al., 2013). Perhaps unsurprisingly, Dublin City Council has been eager to emphasize this aspect of its performance through discourses which conflate high levels of demand with overall success. This rhetoric has also been effective in conditioning public opinion, with much of the recent media coverage of the scheme being celebratory in tone (Pope, 2016; White, 2017). However, when the manner of Dublinbikes' planning, implementation and management is subjected to a normative or ethical analysis this veneer of success begins to dissipate and a much more problematic picture of emerges. Contrary to the narratives of social inclusion, Dublinbikes, from its inception, has been characterized by corporatization and neoliberal governance and has operated explicitly in the interests of 'special people and places'. In the process it has fragmented the experience of the city's most

disadvantaged citizens and contributed to ongoing processes of economic and spatial segregation.

This chapter explores these issues through a detailed empirical examination of the project from pre-implementation contingencies through to DublinBike's current status, paying particular attention to the rationales, motivations and behaviours formative to the concretized design. As such, it provides a thick description of the interconnectedness of technology production and the modes of governance characterizing the city. Two contexts in particular emerged as crucial to the development of the scheme. Firstly, the emergence of entrepreneurial forms of governance at both a national and municipal level, and secondly, local governments' need to resolve an historic problem relating to the spread of unauthorized outdoor advertising infrastructure. These factors would coalesce to produce many of the decision rules and taken-for-granted assumptions shaping the scheme's technical and normative core.

5.1 Entrepreneurial Governance as a Prelude to Dublinbikes

For the two decades prior to the inception of Dublin's bikesharing scheme in 2009, urban governance in Ireland had become increasingly oriented towards entrepreneurialism, a trend characterized by the promotion of local economic development through partnerships with private capital and away from historical modes of administration which were viewed as largely "passive" or depoliticised. Studies such as those conducted by MacLaran et al. (2007) attributed this transformation in Dublin in particular to central-government urban renewal policies in the 1990s designed to enhance the role of the private sector which precipitated a philosophy of neoliberalism within the culture of the city's local governance structures.

The shift in the Irish context was not an isolated one. Urban governance in Dublin was part of a pattern which had its genesis in the economic stagnation of the 1970s. Exemplified in the UK by the conservative party, entrepreneurial governance – in conjunction with financial liberalization and deregulation - was seen as fundamental to revitalizing the economy. In practice, this involved privatizing many national industries, and stressing the importance of risk taking, investing and wealth accumulation (Hall & Hubbard, 1996). By the 1990s this turn towards an

entrepreneurial form of governance had become the received wisdom for many western English-speaking cities, including Dublin (MacLaran et al., 2007).

Opponents of this trend countered that it was the state control of key public assets that provided co-ordinated integration of infrastructure, continuity of service and equitable access for users (Herne, 2009). Despite this, and considering the ideological changes occurring abroad, Ireland became more vulnerable to the notion that the adoption of a neoliberal ethos and increased engagement with the private sector would enhance governance and prove more beneficial to the country's economic and social fortunes (Herne, 2009). An integral component of the process was the increased use of public private partnerships (PPPs) as a mechanism for procuring new services and infrastructure. After a tentative beginning, the extent to which successive Irish Governments engaged with the PPP model led to Deloitte in 2006 describing Ireland as having one of the most mature PPP markets (Reeves, 2013a). Used initially on a pilot basis in 1999, PPPs were subsequently used to provide roads infrastructure, civic buildings, light rail, schools infrastructure, social housing, water and waste treatment, and waste and environmental services (Reeves, 2013b).

This process of enhanced collaboration with private capital was (and continues to be) predicated on two primary assumptions: value for money and improved outcomes for citizens. These assumptions seemed almost axiomatic given the private sector's reputation for speed, efficiency, cost effectiveness and innovation. However, despite the subsequent scale and penetration of the PPP model in Ireland, such claims have been challenged by a number of studies conducted by independent researchers.

It has been noted for example that while entrepreneurial governance brought a fluidity and a re-distribution of roles and responsibilities within the urban planning process, with greater executive power divested to city officials to work with stakeholders in the interest of local communities, the politics and practice of local government all too often ceded power to the private sector or to quasi-government organisations. This trend tended to lead to the marginalization of citizens and advocacy groups. Essentially, due to significant power differentials between citizen's groups and other stakeholders, social, cultural and environmental objectives were either ignored or deprioritized (MacLaran et al., 2007). This pattern, found countrywide, was especially applicable to the Dublin context given the level of development activity taking place.

Research undertaken by Reeves (2013a), which reviewed the performance of PPPs since their inception also highlighted the contradiction of key government actors positioned as advocates of PPP policy whilst simultaneously acting as guardians of the public purse. Reflecting on the implications for transparency and accountability he notes that:

> "*The Irish PPP experience to date has been characterised by a distinct scarcity of information that is made available to Irish citizens (including academics and other independent researchers). This scarcity also extends to statutory bodies charged with duties of oversight in the public interest. This has obvious implications for making decision makers accountable for their actions."* (Reeves, 2013a: 13)

His research also challenges many of the assumptions regarding PPP's superior economic performance. He notes, for example, that when one considers the increased transaction costs associated with the PPP model (typically legal, technical and financial advisory costs) combined with the higher cost of borrowing for the private sector then the case for PPPs being cost effective becomes more difficult to make (Reeves, 2013b). This is in addition to the tendency of the private sector to minimize its exposure to risk, leading to greater liability for the state and the tax payer.

In relation to the planning environment, studies conducted by Fox-Rogers et al. (2011) and Grist (2008; 2013) have demonstrated that the considerable change to the form, and interpretation of planning regulations since 2000 has been explicitly intended to promote private sector interests. Such changes include curtailing the circumstances under which infrastructural projects can be appealed, shifting the role of the planning appeals board from one of decision maker to one of facilitator of strategic infrastructure, and removing a number of controls which had previously offered the most vulnerable communities a degree of protection and security. The 'pre-planning' meeting is a case in point. It provides a forum for discussions between corporate interests, local-authority planners and senior management leading Fox and Murphy (2014) to propose that a *shadow planning system* exists adjacent to the 'official' planning system, which can be accessed only by powerful economic interests'. These forums would prove especially problematic when used to expedite infrastructure associated with the Dublin bikeshare project.

In summary then, the mode of governance which was actively shaping the economic, political and cultural life of Dublin during the implementation of the

bikeshare scheme was increasingly neoliberal, in both theory and practice, and characterized by strategies, policies and practices intended to encourage and support the objectives of private capital. These trends would define the broader decision-making landscape within which the design and development of Dublinbikes would take place

5.2 Pre-implementation: From Outdoor Advertising to Bikeshare

While entrepreneurial governance, and the use of Public Private Partnerships, would influence a number of the structural decisions relating to the scheme's implementation, at a micro level it was Dublinbikes' relationship with another network of urban infrastructure that would ultimately shape many aspects of its design and valuative content.

For many decades Dublin had had a significant problem with the spread of unmanaged and unauthorized outdoor advertising infrastructure. Prior to the planning and development act of 1963, outdoor advertising had essentially been managed independently by local authorities using a permit-based system. Though the new act attempted to regulate the advertising industry by requiring that subsequent infrastructure would comply with the terms and conditions of a formal, standardized planning process, in practice it did little to address the problems associated with historic advertising. A Built Environment & Heritage Officer with An Taisce, an independent charity that operates to preserve and protect Ireland's natural and built heritage, explained:

> *"It was like a general absolution that was granted in 1963 and legacy advertising structures were given legal status as of that date, but importantly, any new development or alternation to these structures would require additional permissions. And of course what happened, due largely to poor enforcement, was that all of the advertising companies effectively behaved like cowboy operators and did as they pleased and so the problem just got worse despite the changes to the legislation."* (Heritage Officer, An Taisce, 2016)

This was compounded by the fact that under current planning law, once a seven-year period has elapsed without enforcement proceedings being initiated, Dublin City Council is prohibited from taking any further action. For all intents and purposes this represents a statute of limitations after which the advertising in question becomes legal in perpetuity (Dept. of the Environment, 2012). The result was that many companies

were emboldened to exploit this loop hole and allow structures to stand without applying for new permissions for their extended use.

The cumulative effect of these practices had become so problematic by the late 1990s that An Taisce had begun commissioning their own studies to quantify the extent of the problem. In a report published in 1999 (An Taisce, 1999), they noted that while there was a large number of smaller advertising companies complicit in the maintenance of unauthorized structures, the three major companies - which together had formed the Outdoor Media Association (OMA) - were David Allen & Sons, More O 'Ferrall, and TDI. Of these, David Allen & Sons Ltd was by far the largest single operator (see Appendix 1). The report noted that the majority of the company's structures were either erected without permission or had been allowed to stand after their period of authorization had expired. It also revealed that Dublin City Council and the OMA had been in extensive negotiations for the preceding 18 months with the terms of the discussions between them based on the principle of the OMA offering the removal of an agreed number of hoardings from particular areas in return for permission being granted for new, strategically located, infrastructures to be erected. The report's main conclusions were as follows:

1. The major proportion of outdoor advertising structures in Dublin was unauthorized and operated by Dave Allen & and Sons.
2. The extent of maintenance of unauthorized use of advertising structures seriously compromised the credibility and integrity of the Planning and Development Acts and the planning system.
3. The extent of unauthorized advertising hoarding development in Dublin called into question Local Government's administrative and managerial competence as a planning authority.
4. The internalized discussions between the OMA and Dublin City Council were potentially prejudicial to Dublin City Council's determination of ensuing planning applications in excluding prescribed bodies and third parties.

In 1999, and concurrent with these internal discussions taking place with Dublin City Council, Dave Allen & Sons was purchased by the French advertising multinational JCDecaux. The company had originated in Lyon, France, in the early 1960s and specialized in the provision of bus stop advertising systems and street

furniture. In the years that followed, it expanded aggressively, partly through the acquisition of smaller companies, and by the early 1990s it had developed a major international presence. The regime change, however, did little to alter the culture of non-compliance in Dublin. On the contrary, "*the pattern of systemic illegality and contempt for the planning laws that had characterized the previous administration became even more pervasive"* (Heritage Officer, An Taisce, 2016).

In October of 2005, and in an attempt to address this problem, DCC invited proposals for a citywide project which, in addition to the requirement to rationalize advertising infrastructure, invited bidders to provide for the public realm with a range of amenities *"such as way finding systems, information and communications systems or bike rental services"* (DCC, 2005*).*

The inclusion of bike rental services might appear somewhat arbitrary until one considers that in 2003 JCDecaux had purchased the Vienna based media company Gewista, which had pioneered the smart bikeshare movement in Austria that same year by implementing a scheme in the city (JCDecaux, 2003). JCDecaux, aware of the increasing importance of both smart technologies and environmental sustainability for urban policy makers, had subsequently developed the concept through a newly created subsidiary, Cyclocity, and strategically used the offer of smart bikeshare services as part of their negotiations with city authorities throughout Europe. By the time the procurement process for the Dublin project was concluding, this "bikes-for-billboards" model as it became known, had been successful in securing the company access to lucrative, publicly owned space in Angers, Lyon, Toulouse, Marseille, Seville and Paris, amongst others (Meddin & DeMaio, 2015; Cyclocity, 2017).

In 2007, DCC announced that the procurement process, which had been conducted in the absence of either public consultation or democratic oversight, had been completed and JCDecaux had been chosen as the successful bidder.

> *"The signing of the deal was framed as an executive decision, not a reserve decision for elected representatives, so basically management felt they didn't require it to be ratified by the council. We [councillors] had no visibility of the deal at all until the negotiations were done. Even after that, information was very limited."* (Dublin City Councillor, 2016)

Due to 'commercial sensitivity' DCC refused to make public the details of this process and the identities of the other tendering parties have never been made known. What was revealed, however, was that in exchange for the decommissioning of 100

historic advertising hoardings and the provision of a number of public amenities - to include a bikeshare scheme, a public information system (civic messaging) and a way finding network - DCC would entertain planning applications from JCDecaux for 120 new structures to be erected on publicly owned property.

The deal was immediately criticized in the media and elsewhere on the basis that it was ill conceived, lacked transparency and would inevitably have a detrimental impact on the aesthetics, culture and liveability of the city (Coyle, 2008; MacEoin, 2008; McDonald, 2008; Murphy, 2008). Watchdog and advocacy groups questioned the probity and impartiality of the planning process given that DCC had essentially entered into a quid pro quo deal which appeared to guarantee apriori planning permission to JCDecaux (Coyle, 2008). They also argued that the provision of a bikeshare scheme under such circumstances was little more than a cynical attempt to mitigate the overall effects of JCDecaux's business practices in the city.

> *"It was a stitch-up between Dublin City Council officials and the Advertising Company JCDecaux. The amazing thing is that many of the signs they're removing never had planning permission in the first place, and they haven't even made public the list of what is being removed. JCDecaux know their way around Dublin, and I've no doubt that they've picked the highest value sites for their urban clutter… Oh, they're throwing in a few free bikes as a sop to the Council, but as far as I'm concerned the whole idea should have been killed at birth."* (Ciaran Cuffe, City Councillor and former minister for planning, BlogSpot, July 15th, 2008)

Furthermore, political and social commentators suggested that to partner with JCDecaux in the first place, given their documented history of disreputable behaviour seriously compromised the credibility and integrity of governance in the city.

> *"We considered it a scandal that JCDecaux, a company with such a rotten record of illegality here was awarded that contract…and there were well publicized allegations of corruption abroad as well. Even a cursory browse on the net will attest to that.* (Heritage Officer, An Taisce, 2016)

It is certainly the case that in the years prior to the awarding of the contract, JCDecaux had developed an international reputation for predatory business practices which had led to a number of high-profile convictions for bribery, fraud and corruption.

In 1992, Jean-Claude Decaux, then owner and Chairman of the JCDecaux organisation, was convicted of unlawfully contributing money to the re-election expenses of the major of Liege, Belgium. He received a one-year prison sentence,

which was subsequently suspended (the times.co.uk, 2016). In 1996, French politician Jacques Valade, was indicted on charges of favouritism in awarding a public contract to JCDecaux for the installation of electronic notice-boards in more than 160 high schools and, also in 1996, the Belgian manager of JCDecaux was convicted in Antwerp for his part in the provision of fraudulent invoices to finance political parties (Mecklin & Cothran, 1998). In 1998, the French department for fraud control, having investigated JCDecaux, issued a report recommending that the company be fined 14.3 million French francs for two practices in particular: the length of its street furniture contracts with local authorities (typically 15 years) and additional clauses in the contracts which often permitted Decaux to extend these contracts indefinitely without going through a competitive bid (The Independent (London), April 25, 1998 as cited by Mecklin & Cothran 1998). In 2000 Jean-Claude Decaux was again convicted of corruption, this time in France. He was fined 100,000 French francs and given a six-month suspended jail sentence for collusion after being improperly awarded a public contract. The court found that the pre-contractual negotiations that the parties had entered into had contravened the rules of public works contract code and constituted a breach of procurement law (Marketingweek.com, 2000). In 2000 and 2001 JCDecaux funnelled illegal political contributions to the Mayor of Philadelphia in an effort to expand their portfolio of advertising contracts at the city's airport. An agent acting on the company's behalf was convicted of conspiracy and fraud and sentenced to a lengthy term of imprisonment (Hinkelman, 2007). And in June 2005, JCDecaux was fined €10m by the French Competition Council for failure to comply with injunctions relating to street furniture contracts dating back to 1998 (Campaignlive.co.uk, 2006).

All of these cases were in the public domain while DCC was purportedly carrying out due diligence to establish the appropriateness of entering into a long term (15 year) partnership with JCDecaux. The fact that negotiations continued regardless of the company's history led to speculation that the outcome of the process was essentially a fait accompli.

> *"Well realistically how could DCC deal with any other operator? It was farcical to suggest that the tendering process was open and competitive when the only way to resolve this historic problem was to ensure that JCDecaux were part of the solution. They could, and should, have taken the legal route of course but chose not to. It was easier to do what they did."* (Heritage Officer, An Taisce, 2016)

Coupling the provision of a bikeshare scheme with an attempt to resolve issues related advertising also caused concern:

> "*The bike scheme was simply a mechanism for regaining control of advertising within the city and I would argue that there was already a system of control for advertising within the city and that was the planning process. The bike scheme should have been implemented using an entirely separate, independent process. Instead it became implicated in this business and we see the result of that today.*" (Community activist, 2016)

5.3 Implementation: Strategic Manipulation and Failed Contestation

Criticisms of city governance only intensified once the project transitioned to the implementation phase and the logics and imperatives giving it momentum became more transparent. The manner in which the planning process in particular was manipulated to exempt both sets of infrastructures – advertising and bikeshare - from legal and democratic safeguards was especially controversial.

When JCDecaux applied for planning permission for its new structures, the company used a tactic known as 'project splitting' to navigate – or circumnavigate - the application process. Project splitting refers to the practice of strategically splitting a larger project into its constituent elements in order to minimize its apparent size and impact and so absent it from certain controls and regulations which would otherwise apply (European Commission, 2015). In this instance, it was used to exempt the infrastructure from an Environmental Impact Assessment which would have evaluated it in terms of its inter-related socio-economic, cultural and human-health impacts. A lecturer in urban planning at a third level institute in the city explained that:

> "*It was a clear example of project splitting which has been a huge problem for these kinds of projects. Basically, you make the project so cumbersome and so expensive to challenge that it gets through on its own momentum. Plus, you're unlikely to see the wider effects of what the project will bring because at any one time you're dealing with only parts rather than the whole. This could only have been done with the co-operation of DCC."* (Lecturer in Urban Planning, 2016)

Perhaps unsurprisingly, DCC would go on to approve all 120 applications made to it, in spite of formal objections from An Taisce, environmental and advocacy groups, the Dublin business community, and a number of private citizens. Subsequent appeals to An Bord Pleanála were rejected, despite the recommendations of their own

investigators who had found that the proposals adversely impacted on the public realm, endangered public safety, and detracted from the character of the city (An Bord Pleanála, Inspector's Report, 2007).

In time however, a number of applications were abandoned. Some were withdrawn voluntarily by JCDecaux because of highly critical commentary in the press, while others were discontinued after concerted pressure was brought to bear on DCC by activists and elected representatives. The final number of sites was reduced to 72. Consequently, the number of historic advertising units that JCDecaux were obligated to decommission was adjusted accordingly by DCC from 100 to 50. This raised another issue. Under the particulars of the planning permission granted, the deal could not progress if 100 units were not decommissioned. Therefore, the decision by DCC to bilaterally renegotiate the terms of the agreement outside of the planning framework was interpreted by An Taisce to be unlawful. In March of 2008, they duly wrote to the National Bureau of Criminal Investigations, citing Part 8 of the Planning Act 2000, which makes clear that to knowingly proceed with development in the absence of appropriate permission was a criminal offence. Specifically, they claimed that the renegotiation between JCDecaux and DCC represented:

> *"…a conspiracy, to breach the Planning Acts with the full knowledge of both parties, with millions being at stake, and the environment of the city being at issue.*" (Heritage Officer, An Taisce, 2008)

The letter received no acknowledgement from the National Bureau of Criminal Investigation. A subsequent application to DCC under the Freedom of Information Act (FOI) seeking to clarify this issue was similarly ignored (An Taisce, 2016).

Furthermore, and in a move that would prove especially contentious, JCDecaux were given carte blanche by DCC to select the sites they wished to decommission. *Plan magazine*, a bi-monthly architecture and design publication based in Dublin which carried out inspections of all identifiable locations provided by JCDecaux, revealed that the addresses consisted primarily of: obsolete units on sites which had been redeveloped; sites where development consent had already been granted or sites newly obscured by recent development. In other cases, the addresses provided did not actually exist at all.

> *"In one case JCDecaux provided an address that has not stood for decades, at 30 Lower Gardiner Street; separately 64 Richmond Road is also listed although again it is not known when any billboard was ever there. 43 Ravensdale Road in Crumlin is also listed yet* Plan *can find no such address. 533 North Circular Road is listed – a house on the corner of Russell Street that was demolished last January. From here, three billboards are claimed to have been removed."* (Journalist, Plan Magazine, 2016)

The roll out of bike stations, when it occurred more than a year later, was no less problematic. Again, the project was split into its contributive elements (40 stations), but this time the intent was to circumvent the planning process entirely. Part 8 of the planning and development regulations 2001–2013 (DCC, 2017) which define requirements in respect of development being conducted by local authorities, obligates such authorities to be subject to the normal provisions of planning law when the value of the work being undertaken exceeds €126,000. This is to ensure that work of an operational or functional nature, such as maintenance to sewers, water pipes and other infrastructure, can be expedited as a matter of routine, whereas more significant developments should be subject to democratic oversight. In such instances, the regulations specifically require the local authority to provide the public with information on the nature and extent of the proposed development which might then be used as a basis for meaningful public participation. Once the stations were assessed as standalone structures, however, their individual value fell short of the €126,000 threshold and so DCC claimed them to be exempt from any permissions process. A representative of the cycling advocacy organisation 'The Dublin Cycling Campaign', noted:

> "*To be honest I didn't know anything about it, nobody did as far as I'm aware, and I was involved with the Strategic Policy Committee for Transportation at the time and had been for a number of years. I mean as a cycling advocate, yes of course, I would have been supportive of it, but nobody had a chance to object. It seemed to just take place in the background. It was a funny sort of a background deal*." (Dublin Cycling Campaign, 2016)

Strategic Policy Committees (SPCs) are local authority committees charged with the task of formulating, developing and reviewing policy across particular domains (housing.gov.ie, 2017). They are intended to give councillors and relevant sectoral interests (social, cultural, economic, environmental, etc.) an opportunity for full participation in the policy making process from the earliest stages. That proposals for a major piece of transportation infrastructure had not been made visible at this level of

governance should have been cause for concern, but for some senior politicians it came as no surprise. Eamon Ryan, T.D., Leader of Ireland's Green Party and former Government Minister, observed that:

> "*Yes, there's an element of contempt there for the political system [within DCC], a disregard for both the general public and for elected representatives. It was especially obvious for me when it came to rezoning land for development purposes. They would mow down any bit of green land to get a development done…it's a kind of macho, chauvinist, 'can do' attitude that glorifies being able to overcome all adversaries and all odds. So, no, there are no surprises here at all."* (Eamon Ryan, TD, 2016)

There were those too who felt that the manner of the scheme's implementation violated the Aarhus convention. The convention – from the United Nations Economic Commission for Europe - grants the public rights regarding access to information, public participation in decision-making, and access to justice. It focuses primarily on interactions between the public and public authorities. The Convention is legally binding on States that have become parties to it. Ireland signed the Aarhus Convention on 25 June 1998 (citizensinformation.ie, 2017).

> *"Well, as group we felt that the steps that were taken were reversed. There was a contract, then public representatives were informed and then a more general notification to the public that Dublinbikes were on their way and they were going to be a wonderful thing. I would say that the Aarhus convention particularly points out that for anything that has an impact on the environment and has a significant impact on the quality of life for people within cities, the first thing that happens is proper public consultation. We made that point of course, but nobody listened."* (Community Activist, 2016)

DCC management would face resistance from councillors, but with contracts already signed many felt that continued resistance would have negligible impact.

> *"Some of the councillors didn't like the way the deal was handled, and they put down a motion of no confidence in it. Legally perhaps it might have complicated things for management had it been passed. It certainly wouldn't have looked good, but technically they could still have proceeded because the contract had been signed at that stage and that contract would have superseded any decision by the councillors.*" (Dublin City Councillor, 2016)

A local activist however felt relations between the parties had become fractious at this point with outcomes being shaped, at least in part, by intimidation and coercion.

> "*John Tierney [who was the City Manager at the time] was a particularly autocratic leader and he would often present councillors with no realistic options whatsoever. And, in fact, at one particularly heated council meeting that I attended during this period in 2007 he made it very clear that councillors could be held personally liable for any breach of that contract, which I thought was a very 'interesting' position to adopt*." (Local Activist, 2016)

Details of this contract would remain confidential for almost two more years. In 2008, Colin Coyle, a journalist with the *Irish Times* newspaper, made an FOI request for a copy of all records related to the 'bikes - for - billboards' scheme. When DCC refused the application due to privacy commitments to JCDecaux, Coyle appealed the decision to the Office of the Information Commissioner, whose function it is to independently review decisions made by public bodies in relation to FOI requests.

In a ruling issued in June of 2009, the Commissioner stated that in its dealings with her office, DCC had not acted in accordance with the provisions of the FOI Act, had persistently withheld information and documents relevant to her adjudication of the case, and had behaved in a manner so secretive that it carried with it scope for abuse (Office of the Information Commissioner, 2009). She went on to conclude that the advantages in terms of openness and accountability of disclosing the details of the agreement outweighed any possible harm to either DCC or JCDecaux. Accordingly, she annulled the original decision of the Council and directed the release of a number of key records, including the tendering and contracts documents. In addition to their failure to identify (or confirm the existence of) other participants in the bidding process, these documents would raise a number of other concerns.

Firstly, they confirmed the suspicion that the signing of the contract in the absence of democratic oversight had violated due process. A number of commentators had argued forcefully that under the terms of the 2001 Local Government Act the disposal of public land (for bikeshare or advertising infrastructure) was a reserved function to be performed only by elected representatives (MacEoin, 2008). Page four of DCC's tendering document, "Revised Invitation to Bid", explicitly acknowledges this requirement:

> "*It should be noted that, insofar as there is a disposal of interest in land pursuant to the contract, the consent of the council under section 183 (1) of the Local Government Act 2001 will be required*." (Revised Invitation to Bid, DCC, 2005: 4)

Section 183 (1) also obligates that the local authority to make available to council all details pertaining to such a disposal or re-appropriation in order that consent be informed. For DCC to arbitrarily absent itself from the provisions of this Act and exclude councillors from exercising their political authority is highly problematic and confirms the role of bureaucratic rather than democratic power in expediting the project.

Secondly, the documents demonstrate the failure by DCC to properly define requirements in relation to a bikesharing scheme. The substance of the documents is almost entirely concerned with the issue of advertising rationalization and they make only occasional and cursory references to "public amenities" as a postscript to the projects' primary deliverable. Therefore, factors critical to a successful scheme, such as service assurance, bike distribution, system interoperability, innovation and development, and data ownership, amongst others - are entirely absent. That DCC would have no articulable vision for bikeshare at the contractual phase of the project supports the narrative that, at a conceptual level, it was little more than a contrivance designed primarily to progress an unrelated set of objectives. The expediency seen here would go on to characterize much of the scheme's subsequent implementation and management.

5.4 Distribution Bias and Socio-Economic Inequalities

Infrastructure Distribution

Once the two networks of infrastructure materialized in the city, a number of disparities and inequalities became apparent. While the preponderance of the advertising infrastructure was sited in heavily trafficked, less affluent suburban areas, the bike stations, by comparison, were located in well heeled, business centric locations in the south and south east of the inner-city centre and clearly intended to mobilize a largely middle class, professional clientele. The led to the charge that the communities most impacted by the advertising billboards received none of the benefit of the bikeshare services by way of exchange. See figure 5.1 below.

DCC would counter that the decision to implement the first phase of the scheme in a city centre environment was merely following industry best practice, as understood at the time. They also attempted to align Dublinbikes with a broader "Smart Travel Policy" which was formulated explicitly to increase active and sustainable

modes of transportation. However, the "National Cycle Policy Framework", the instrument through which smarter travel was to be delivered, would prove unashamedly biased in its orientation. For example, a key component of this framework, the "Cycle to Work Scheme" introduced in 2009, provides tax incentives to employees who purchase new bicycles though their employers. This form of subsidization has never made available to other sectors of society i.e. the unemployed, the elderly, students or indeed volunteers with social organisations, and so one can reasonably infer that the policy structures organising cycling (and bikeshare) within the city were inherently preferential and discriminatory.

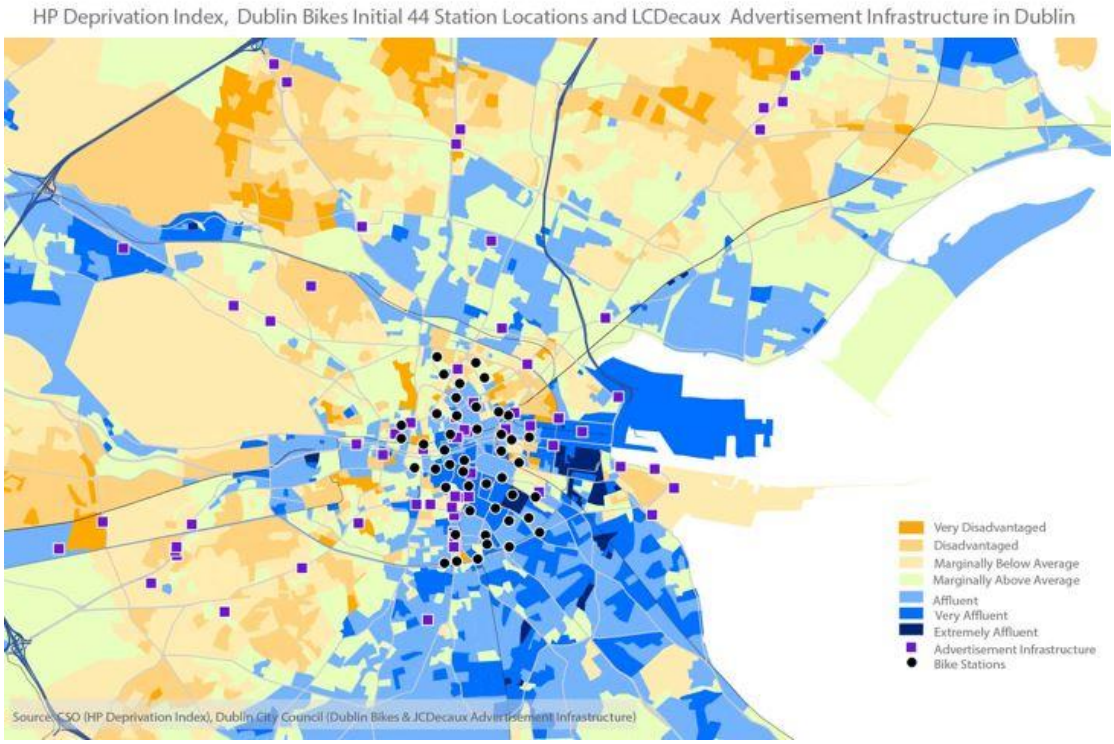
In relation to the advertising infrastructure, they claimed that the placement of the hoardings was consistent with its outdoor advertising policy as agreed with councillors and as encapsulated in a map entitled 'Zones of Advertising Control' which essentially describes the city in terms of geographic areas to which different advertising policies would apply. This map, however, leaked in early 2008 to the online Irish Architecture and Planning Magazine *Archiseek*, proved contentious:

> *"Most notable is the absence of an official City Council stamp, or for that matter a date. So, the question must be asked: who drew up the map? And by what authority it is now being acted upon as if it were already adopted policy?"* (Archiseek, May 2008)

No elected representatives interviewed for this research had any participation in, or prior knowledge of, such a map or the policy decisions which informed it. The philosophy behind it though was transparent nonetheless:

> "*I suspect that the planning protection afforded to protected structures and architectural conservation areas meant that certain more affluent areas, particularly in the south east inner city, weren't seen as appropriate places for the billboards. So in effect, the more run down the area, the more likely you were to see these hoardings. So yes, it's a vicious circle really of run down area, poor public realm, 'ah sure just bung in the ads there and we'll be fine'!"* (Lecturer in Planning, Dublin, 2016)

Figure 5.1: Distribution of Advertising and Bikeshare Networks Against Deprivation Index



By contrast, and despite the mixed demographic of the bike scheme's service area, the spatial distribution of the network managed to avoid many densely-populated areas generally acknowledged to be economically and socially deprived. A cycling advocate and journalist with a leading online cycling magazine felt that the placement of stations raised fundamental issues about governance in the city and, for the most part, reaffirmed the widely-held perception of DCC as insular and indifferent to consensus building.

> "*There's isn't that public faced discussion at the micro level that you see in other cities. I mean it's understandable that they'd implement initially in the city centre, you've a high concentration of people there and a poor public transportation network, but the particular placement of stations in this case is problematic. And querying them about it – or about anything controversial for that matter - invariably meets with the same stonewalling. The responses are very controlled, very slow and very bureaucratic.*" (Cycling Advocate and Journalist, 2016)

5.5 Value Proposition and Capital Distribution

Value for money calculations are based on prices as indicated on JCDecaux's rating card which, in 2009, were made available on their website. Current rates are no longer in the public domain.

The company's new infrastructure consisted of 50 "metropole" (large format) and 22 "metropanel" (smaller, so called "6 sheet" format) hoardings. The majority of the structures are dual aspect i.e. they display advertising on both panels of the billboard. Depending on the location and the orientation of the hoardings, it may be that some panels offer less penetration than others and so custom rates may apply. Each panel can display 4 scrolling sheets or advertisements, resulting in 8 in total per billboard which are rented on a fortnightly cycle. The rates for the metropoles and metropanels in 2009 were €1250 and €425 respectively. A journalist with *Plan magazine,* who carried out site inspections of the hoardings and investigated the financial implications of the deal in 2009, estimated the value of the infrastructure at €170 million (MacEoin, 2009). This is in broad agreement with an assessment by the former CEO of a leading Irish advertising company operating in the sector at the time.

> *"We modelled it at the time and estimated the value at over €150 million. And those figures weren't plucked out the air; this was our business, so we made sure they stood up to close scrutiny. In fact, we were one of the first groups to object to this project and the value of the deal to the city was an important argument against it."* (Advertising Industry Expert, 2017)

There is a significant disparity between these estimates and those outlined in Schedule 2 of the concession contract, agreed in 2006. Predicated on the assumption that all 120 installations would receive planning permission, JCDecaux projected net revenue of €109 million based on modest annual growth rates of 4%. Once adjusted to reflect the actual network of 72 structures which materialized, this figure is nearer €70 million. Given the refusal of DCC managers party to the agreement to participate in the research, no opportunity has been provided to reconcile the difference between the evaluations from independent commentators and those of JCDecaux.

By way of mitigation, one must allow that in the intervening period Ireland experienced an economic recession which adversely impacted the advertising sector. A report issued in 2012 on behalf of the Association of Advertisers in Ireland (AAI) notes a steady decline in gross outdoor advertising spending for the years 2008 – 2011.

In addition, *The Irish Times* reported in 2018 that JCDecaux has experienced operating losses for much of the preceding decade (Woods, 2018). Despite this, the value of the infrastructure is still likely to significantly exceed the value of the amenities provided to the city, which DCC estimated at €54 million.

This figure comprises €27 million for the bikeshare scheme, €4 million for a 'finger point' wayfinding system intended to assist people navigate to various amenities within the city, and €23 million for a civic communication system (DCC, Report on Revenue Options to Facilitate Expansion, 2016). These figures refer to the lifetime of the 15-year contract. The civic communication system, which allows DCC to run public information campaigns, utilizes JCDecaux's advertising network, and is comprised of access to 38 panels (21 faces on the metropole hoardings and 17 on the metropanel) charged at commercial rates. This essentially means that, at a time of fluctuating fortunes in the industry, the city is one of JCDecaux's most profitable and stable customers.

5.6 System Expansion: Technological Lock-in and Continued Exclusion

In 2010, the scheme experienced a mini expansion with the addition of 4 new stations. The expansion was primarily funded through the provision of 6 additional advertising concessions which were made subject to the provisions of Part 8 of the Planning and Development Regulations – the same regulations which are reserved exclusively for the control of Local Government development. In effect, DCC applied to its own planning department on behalf of JCDecaux, using a process which excluded any right of appeal to an independent authority.

> *"I would say is it is striking that having had very vigorous public objections using the existing planning laws, you then use a process that is reserved for local authority development which is effectively certain to succeed.*" (Community Activist, 2016)

In 2013, and in response to calls from the public for improved access to the service, the scheme underwent a major expansion, more than doubling in size to encompass 101 stations and 1550 bikes. In a report (DCC Report No 178/2013) DCC outlined that it had considered two primary options for managing the expansion:

1. Engage in direct negotiations with JCDecaux.
2. Go out to public tender.

The 2nd option came with the caveat that to pursue it would potentially result in a scheme that was incompatible with the existing network. JCDecaux, as part of their negotiations with DCC, had made clear that they would not entertain integrating their network with that of another service provider. This was confirmed by the Secretary of the Department of Transport in response to issues raised by the Public Accounts Committee which had expressed concern that the procurement process for the expansion appeared to be uncompetitive (see Appendix 2). The Department explained that, as the original contract had made no provision for system interoperability and given that the scheme's hardware and supporting software systems were proprietary, JCDecaux were under no legal or contractual obligation to co-operate with any third-party technology (Department of Transport, 2013). In effect, JCDecaux has achieved technological 'lock-in'. Lock-in is a form of path dependence whereby a technology is chosen not because of its superior performance or cost effectiveness but because of its dominant position in the market (Kitchin, 2015).

Accordingly, and once the appropriate permissions to negotiate directly with JCDecaux were received from the European Commission, DCC signed a new 10-year contract. Given the deep-seated hostility towards the bikes-for-billboards model, the decision was taken to develop the scheme using a service level contract. Under the terms of the deal, JCDecaux would be paid an annual fee of almost €2 million to cover the costs associated with running the expanded part of the network - 950 bikes and 57 stations. This equates to a cost of €2,100 per bike. Analysis conducted by Urban Mobility Consultant and industry expert Peter Midgley in 2011 found that the operational costs for JCDecaux's schemes in Paris and Velov ran at just €1,050 and €1,200 per bike respectively, with capital costs for both projects amounting to approximately €3,150 per bike. DCC would pay JCDecaux capital costs of almost €5 million which equates to €5,300 per bike. The expenditure included stations, docking points, bikes, maintenance vans and so on. Despite the sums paid, JCDecaux retains complete ownership of the network.

> "*Well, JCDecaux have patented that equipment, it's their intellectual property, and so owning it would have been of no benefit to us. They'd still own all the control systems, all the back-end systems, so we wouldn't be able to engage with anyone but them anyway. The truth is we didn't want to own that equipment*." (Senior DCC Manager, 2016)

This begs the question, why would DCC feel compelled to compensate JCDecaux quite so generously for it? Either JCDecaux are paid on a service contract basis, in which case the city owns the infrastructure and incurs only the associated running costs, or alternatively, JCDecaux retains ownership of the network and then assumes the burden of liabilities and risks associated with this such as depreciation, damage, theft and so on. To incur all capital and operational expenditure without ensuring either ownership or control of the assets is problematic and reflects DCC's severely compromised position at the negotiating table.

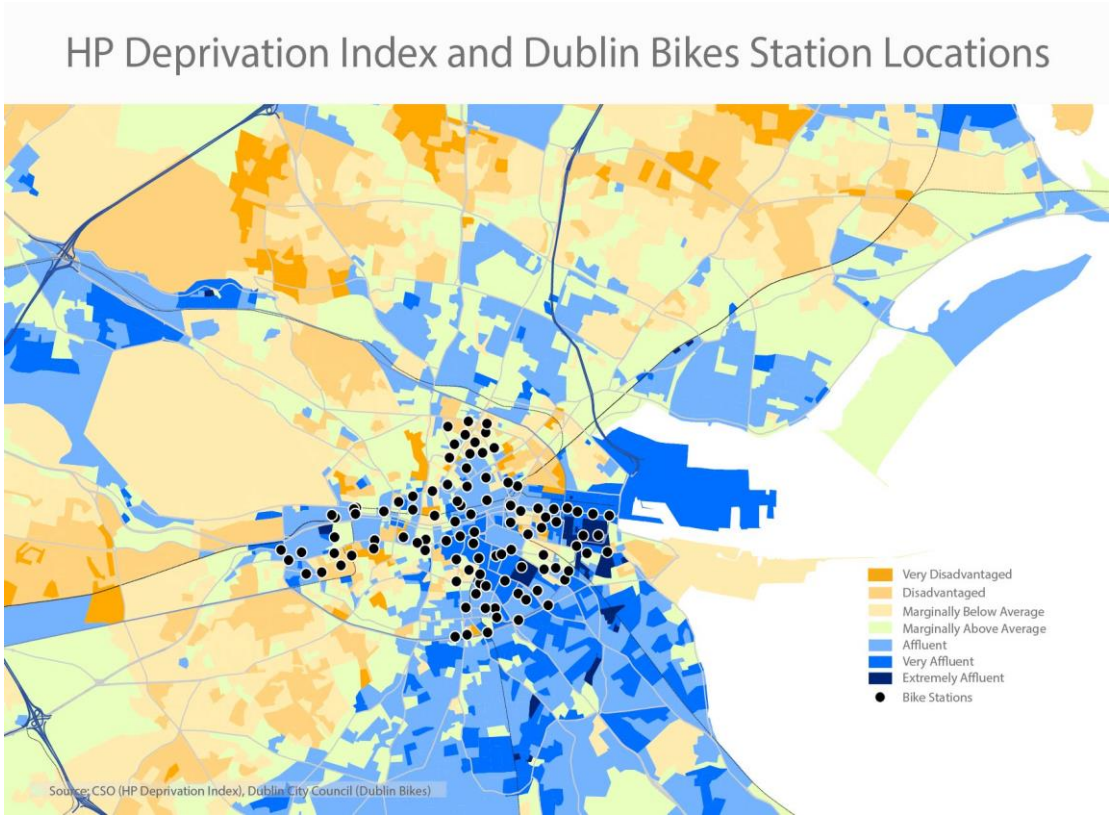
DCC would defray some of the operational costs associated the expansion by enrolling Coca Cola as a commercial partner in 2014. In June of that year the scheme was renamed Coca-Cola Zero Dublinbikes and the company's branding was added to the hardware, website, digital interfaces, advertising material and so on. It was a development that many members found perplexing.

> *"Is it just me or is this completely counter intuitive? We have a growing health issue here and increasingly there's the recognition that exercise should be an important part of our lives. And here's a system that's being touted as an important part of what the city is doing to address these issues and they allow Coca Cola to come in and essentially take over. Are the values of Coca Cola in some way sympathetic to the values of a bikeshare scheme?"* (Scheme Member, No 1, 2016)

Planning activities associated with the new infrastructure were again conducted in the absence of public or political consultation and while the scheme increased in both size and density, the configuration of the network continued to show the same patterns of socio-economic bias. Large swathes of the North West and South West inner city have continued to be excluded from the service area (see figure 5.2). An urban planner, and DublinBike's member, captured the sentiments of many interview participants;

> *"There's just this implicit assumption that people of a certain socio-economic background will abuse the service or damage the bikes or claim off the scheme for injuries and so on. Look at Amien Street, Buckingham Street, Railways street, Sherriff Street [socially deprived, city centre areas]. Why aren't the stations here? They're in the core of the city centre? I mean there are thousands of people moving through these places every day but there's also a lot of social housing there too and I wonder if that's the reason."* (Urban Planner and Scheme Member, No 2, 2016)

Figure 5.2: Post Expansion Distribution of Bikeshare Network against Deprivation Index



The findings from a survey conducted by Delve Research in 2011 on behalf of DCC into the perceptions and experiences of the service broadly reflect these concerns around disparity, access and exclusion. Results suggest that marginalized groups were found to be significantly underrepresented in the scheme's membership with the unemployed accounting for only 4% of the 2250 respondents. The majority of members - nearly 80% - were found to be in the ABC1 social grouping - the demographic most associated with wealth and privilege (Delve Research, 2011).

5.7 System Configuration, Innovation and Social Value

The system provided by JCDecaux is a design utilising the first iteration of smart bikeshare technology developed in the mid-2000s and comprises a configuration of networked, automated stations controlled by a central information system. While bikesharing is an inherently sustainable form of mobility, the high levels of fixed infrastructure required by this configuration make it labour intensive, expensive and

impactful on the natural environment – especially when compared to more creative, contemporary approaches (see Appendix 3).

Functionally, the scheme is reliant on RFID (Radio Frequency Identification) tags, which are fitted to each bike and read by docking point technology at the beginning and end of each trip. Essentially, they create a sensor network that monitors usage and generates system updates which are then made available to cyclists via kiosk interfaces or through web-based applications. The information also enables management and operational activities such as bike distribution and fleet management.

RFID, as used in this arrangement, is a binary technology limited to recognising the availability of bikes and docking stands on a station by station basis. Unlike GPS, which generates real time spatial and temporal data, RFID does not support active tracking and so has limited capacity to mitigate the effects of vandalism and theft. The choice of this technology also limits the design's capacity to inform planning or to foster the development of reciprocal relationships between cyclists and decision makers. Used generatively, fine grained GPS data can be a catalyst for collaboration across a range of practices and knowledge sharing activities including system design, transportation modelling and policy formation. Given that Dublinbikes has a minimal digital footprint, this form of design inspired co-operation is not possible. In addition, the data that Dublin's scheme does generate was proprietary until 2013, when access to it was secured as part of the negotiations to expand the scheme. Prior to this, system information was protected by JCDecaux with no access being afforded to third parties, including the city.

> *"There was a number of private apps that attempted to get off the ground after the scheme started but JCDecaux wouldn't co-operate with them and they were shut down. In fact, they were threatened with legal action."* (Dublin City Councillor, 2016)

Furthermore, the scheme does not import any external data sets and so is not animated by a range of information streams (real time transit schedules, weather forecast data, etc.) which have the potential to enhance usability, nurture behavioural change and extend the scope and penetration of the scheme through purposeful integrations with other systems. In this sense the scheme has become somewhat anachronistic given the increasing importance of data driven, networked infrastructures to the development of smart cities and smart citizens.

> "*Increasingly bikeshare data is becoming an important asset to cities. If you want to understand how cyclists appropriate the city, then the technology needs to be smart enough to tell you what's going on. Likewise, if you want bikeshare to co-operate with other technologies then there needs to be seamless information exchange with other systems. You need to reduce friction between systems, they need to be open.*" (Christine Outram, MIT, 2016)

Outram had been a project Manager with MIT's SENSEable City Lab in 2010 and had overseen the development of the 'Copenhagen Wheel', a high-profile research project which created an electric-hybrid bicycle that also acted as a mobile environmental sensing unit capable of monitoring air pollution levels, traffic congestion and road conditions. The concept, which functioned by harnessing the power of smart technologies and crowdsourcing, pioneered many of the technological and social innovations now appearing in contemporary 4th generation bikeshare schemes i.e. the use GPS, electric motors, integrated digital interfaces (telemetry), creative engagement with riders through social media platforms and so on (Outram et al., 2010)

In 2014, an assistant professor at Trinity College Dublin (TCD), who had previously worked as an analyst on the Copenhagen Wheel project, brought research proposals to the city which involved instrumenting the Dublinbikes fleet with the same tracking and environmental technologies that had been used at the SENSEable City Lab. The research was a proof-of-concept intended to establish the viability of using distributed, mobile, low cost sensing technology as a means of supporting environmental management systems. The research also included a participatory sensing component, with riders to be invited to use the functionality of their smartphones (GPS, microphones, cameras, and other applications) to augment any data collected. The researcher hoped the findings would challenge the perception that 'cheap' sensors could only produce 'cheap' (poor quality) data:

> "*If you have a high-end monitoring stations that cost €10,000 you might be able to afford 5 or 6 but with the same amount of money you can lose perhaps a little accuracy but you gain enormously in terms of spatial resolution with sensors on perhaps hundreds of bikes So, yes, we felt the research was important, important technically but also important socially because it incorporated notions of 'collective production' and 'eco-collaboration' which are so important now. It was also an opportunity for JCDecaux to develop the scheme. The research findings would obviously have been shared with them."* (Assistant Professor, TCD, 2016)

JCDecaux, however, refused to participate in the research and instead, the project was implemented by the 'Hubway' bikeshare scheme in Boston, Massachusetts when the researcher transferred there as part of a Fulbright scholarship in 2015. The experience caused him to reflect on the way Dublin had chosen to manage the system:

> *"It is often the case that new technologies can be viewed quite negatively or suspiciously by city administrations who may have to re-learn or re-train or re-structure in order to exploit them effectively. If the culture is not supportive of that, then it becomes easy to see why there may be little interest in innovation or even active resistance to it. It also explains of course why these kinds of systems get outsourced. Perhaps there are implicit assumptions that 'troublesome' developments are not likely to happen and even if they do, they become something for a third party to worry about. I don't know. I certainly don't believe that DCC have ever been proactive in looking for any kind of improvements, have they?"* (Assistant Professor, TCD, 2016)

This observation resonates with the experiences of a senior manager within the DCC organisation who asked to remain anonymous.

> *"I think the public sector as a whole is full of challenges in terms of the types of people and the structures that they have in place. You have a very administrative side of the house and then you have the professional roles which are engineers, planners, legal, finance. You don't have roles dealing with data analysis or spatial analytics. And we haven't had recruitment for years so from a smart city or a smart tech perspective procurement has become a problem because people simply aren't up to speed on the latest innovations and technology and quite apart from the skills deficit, DCC is a very siloed organisation, structurally and culturally, so it's a major challenge to develop data handling processes that span multiple areas."* (Senior Manager, DCC, 2016)

This may help explain, at least in part, the disparity between much of the rhetoric found in DCC's strategy and policy documents and the relative sterility of Dublinbikes technical and ideological fabric.

Dublin's Digital Master Plan, for example – a document written in 2013 as negotiations to expand Dublinbikes were on-going – provides a macro level blueprint for the development of 'Digital Dublin' (Digital Dublin, 2013). It explicitly embraces technology innovation as the key to a smarter city and commits to improving Dublin's technological capability through open and creative engagement with cross sectoral stakeholders. Accordingly, the plan provides a set of core guiding principles intended to inform and underpin all digital activities. These principles include:

- Developing Dublin as an innovation ecosystem and incentivising innovation;
- Making the adoption of new technologies the key to realising innovation;
- Promoting intersectional innovation by using Dublin City as a testbed;
- Through open innovation, embracing a governance model which shares ideas, information and data between sectors, organisations, citizens and with other collaborating cities;
- Embracing digital governance and technologies to increase democratic participation;
- Future proofing the technical infrastructure to attractive to inward investment;
- Celebrating and promoting innovators and entrepreneurs as heroes.

The reality of Dublin's 'smart city' project, however, is quite different from the one envisioned here. Behind the policy initiatives and the associated narratives of coherence and co-ordination lie processes and practices that are, for the most part, ad-hoc and reactive. Research conducted by the Programmable City team (Coletta et al, 2017) aimed at mapping and understanding the smart city concept from a Dublin perspective identified a number of key issues which were holding the city back from realising its goals. These included:

- A piecemeal approach and a lack of a guiding strategy with associated mission and goals;
- An absence of joined-up thinking and a preponderance of siloed-systems;
- Weak governance structures and an absence of directed leadership;
- A lack of a formalised process of engagement between stakeholders and others;
- Under-resourcing of investment and weak staffing and skills capacity;
- Inflexibility in the working practices and a staid cultural mindset with respect to procurement, experimentation, and operations.

Coletta et al. (2017) go on to contend that:

> "*Dublin as a smart city is being articulated as 'open, engaged, connected', but how this plays out on-the-ground is somewhat different to that hoped for. Rather than the smart city being 'open as in open data', 'engaged as in engaged citizens', and 'connected as in a connected city', it is 'open as in open ended or open market', 'engaged as in otherwise engaged', and 'connected as in loosely coupled'*."

The absence of integrated thinking can be seen in a number of projects developed in conjunction with multinational technology corporations which were ostensibly framed as promoting improved access to governance and decision making. The city's open data platform 'Dublinked', for example, which is represented as supporting citizens, developers, researchers and government through *"sharing data, sharing ideas, and connecting the Dublin Region*", was developed primarily as a vehicle for enabling the city to make its data available to IBM.

> *"Dublinked was only set up because DCC wanted to share data with IBM, but they couldn't do that without making it available to the public as well, there would have been legal issues stopping them for releasing it to IBM only. So Dublinked was actually part of an attempt by DCC to get IBM to increase their presence in Dublin, provide more jobs, etc. That was its primary purpose. The platform hasn't been handled with any great care since and has lost its way a bit."* (Senior DCC Manager, 2016)

'City Watch' is another project where the goals are supposedly socially oriented. The initiative, which was a partnership between the city and the Intel Corporation, was framed as a participatory sensing platform which explored how data generated by citizens, in combination with data from utilities and municipalities, could be used to make cities sustainable and connected.

> *"In reality, the data collected was simply dumped in a database and none of it got fed back into the organisation, none of it became operationalized. It was probably done to accommodate Intel develop a concept or product offering. That would have been typical. What is the point of something like this if it's just to satisfy the needs of an industry partner? It has no social value, no value to the city. The cumulative effect of this kind of thinking of course is that we have a ton of sensors in the city, but nobody is doing anything with them."* (Senior DCC Manager, 2016)

We see disparities and inconsistencies at a project level also. The Dublinbikes Strategic Planning Framework (DCC, 2011), which articulates a future vision for the scheme, describes it as a vital and integrated component of the city's smart public transportation infrastructure which will continue to benefit from ongoing investment and customization. The reality, however, is somewhat less sanguine. With the exception of an integration with Dublin's public transport ticketing system in 2016, the Dublinbikes design has seen neither incremental nor disruptive change, despite the dynamic technical and social landscape within which it operates.

It has been suggested that JCDecaux's architecture was developed with standardization and replicability as its key design parameters, and as such, is not easily configurable to local needs. The experience of other European cities, however, suggests otherwise.

A member of the Dublinbikes scheme, currently working in Brussels, has had the opportunity to compare JCDecaux's systems in both cities. He noted a number of key differences between their respective designs and the information and business processes supporting them. In addition to the use of contactless cards which allow users direct access to bikes, Brussels is also progressive in its use of social media.

> *"Bikeshare schemes are basically distributed information systems and when run properly there should be feedback loops from users which regulate how the systems function. I mean that's the whole idea of 'smart' isn't it? So, in Brussels they use twitter to do this. You can report issues, make suggestions and so on and of course it's visible to everyone, which increases information distribution but also transparency. Dublin has no presence at all on social media. The channels of communication are kept to a bare minimum, in fact getting through to them is so difficult that the tendency is to avoid it altogether, which is probably what they intended in the first place. You know, the idea of designing attrition into how it operates to deter people for engaging properly. It's indicative of a much bigger issue though. There's just this pathological aversion to dealing with the public."* (System Member, No 3, 2016)

The scheme also closes operations at night, which distinguishes it not only from Brussels but from the rest of the international community.

> *"As far as I'm aware, Dublin is the only place worldwide that places that kind of restriction on travel. We're told it's about "health and safety" which is perhaps the most abused term in the Irish public service and used continually to stymie or remove any issues from the agenda. I don't believe that it's acceptable. It's simply using the language of bureaucracy to justify an unjustifiable position."* (System Member, No 3, 2016)

Other facets of the design also operate to constrain usage. Dublinbikes, for example, has no cash-based subscription options to accommodate people without bank accounts or credit cards and using the scheme requires a €150 deposit. This operates to reinforce the ideological statement made when the implementation of the network studiously avoided disadvantaged areas. It also blurs the distinction between the scheme as public transport infrastructure and commercial platform.

> *"How difficult would it be to come up with a solution that says, yes, equity is important to us as a city? But you see this kind of indifference in the pricing structure too. I mean it is €20 a year for membership with the first 30 minutes of every trip free, right? Think about that for a second. How is that sustainable? What sense does that make with so many communities excluded from the service area because of a lack of funding? And it's additionally problematic when you consider that the membership is almost entirely comprised of people who could afford to pay reasonable charges. It tells me that DCC didn't have the confidence to price it properly in the first place and now they can't change it."* (System Member, No 3, 2016)

Perhaps the most significant operational issue impacting the user experience is the chronic shortage of bikes at key locations and at key times. The problem, which is caused by inadequate bike distribution or system 'balancing', has dogged the scheme since its inception and was referenced repeatedly by riders as a major obstacle to service quality in Delve's research report (2011). It has also been the subject of numerous official complaints to both JCDecaux and DCC (Gittens, 2015). For a number of commuters, the lack of service predictability has essentially rendered the scheme unusable.

> *"As of last week, I've decided not to use the scheme any more. I got myself a banged up looking bike which I leave at Heuston [Dublin's primary railway station linking the city to much of the rest of the country]. The Dublinbikes service was just so unreliable that I couldn't keep on using it. It was just causing too much stress, so, I had to stop. I have a couple of friends who make exactly the same commute and their experience is the same also. They just couldn't use the scheme."* (Former Dublinbikes member, 2016)

The contract defining the expansion in 2013 is enlightening in this regard. Firstly, the document confirms that, for the first five years of the schemes' operation, DCC had neglected to secure any commitments to service levels from the vendor, which effectively meant that no mechanism had existed whereby service or service quality could be quantified and monitored (Dublinbikes Expansion Contract, 2013). The city had effectively ceded full discretionary power to JCDecaux to deliver the scheme based on its own corporate notions of social responsibility.

Secondly, the Service Level Agreement (SLA) developed between the parties in 2013, which supposedly sought to address this problem, is exceptional for its brevity and lack of detail. Effective SLAs are typically robust documents which comprehensively articulate the objectives that a vendor must achieve in order for service performance to meet agreed standards. They should also provide a detailed and

coherent set of evaluation criteria by which service delivery may be judged and meaningful penalties applied when required. The Dublinbikes' Service Level Agreement, in its entirety, is less than a third of a page in length and its sole reference to system balancing is as follows:

> "*For average rentals of up to 15,000 per day we will regulate on average 600 bikes a day Monday to Friday (calculated on an annual basis)*". (McCann Fitzgerald, 2013)

That the city would regard a performance specification as vague and poorly defined as this as adequate is troublesome. What are the service assurance implications of regulating 600 bikes in 15,000 rentals per day, i.e. what commitment does this level of regulation make to bike availability in a highly dynamic system with spatial and time dependant demand? Can this metric, such as it is, be independently tracked or is DCC reliant on the vendor to report instances where contract breaches occur? It should perhaps come as no surprise that DCC has applied no service level related penalties since the implementation of this agreement (DCC Manager, 2016). The problem of system balancing is aggravated by the National Transport Authority's repeated refusal to allow JCDecaux's fleet distribution trucks access to the city's network of bus lanes which in turn significantly impacts their capacity to navigate the city at peak times.

> "*Dublinbikes is not pure public transport is it, not in the sense that buses and trains are for example. It's a blended mode, a hybrid really. It provides a public service, but it's privately owned, so getting those bikes around the city is JCDecaux's problem, it's not my problem.*" (NTA, 2016)

It should be noted that, in addition to public buses, this infrastructure is currently made available to private buses and taxis. This failure by state transport authorities to support the integration of Dublinbikes into the broader public transit landscape has contributed not only to poor service quality but also to the perpetuation of the system as partial and proprietary. The lack of meaningful co-operation between the NTA and DCC on this issue may also suggest tensions arising from the NTA's effective exclusion from the original planning and development process.

5.8 Summary

Contrary to the current narratives of inclusion, connectedness and innovation, Dublinbikes is an isolated and technically static platform which operates in the service

of corporate and bureaucratic interests with service distribution reflecting well established patterns of geographic and economic bias. This is exacerbated by the barriers to equity noted previously by Kodransky and Lewenstein (2014), such as poor communication, the requirement to pay a significant deposit or to have a credit card or bank account in order to access the system. These constraints essentially act as mechanisms which preferentially excludes vulnerable groups and contributes to marginalization through transportation disadvantage and related forms of deprivation (Clark & Curl, 2015; Hannig, 2016). As such, it perpetuates the notion of bikeshare as a form of middle class consumption.

The result is an ideologically confused system which is neither public transportation nor purely private enterprise and so it bound by the imperatives of neither. Had Dublinbikes been conceived as a purely commercial enterprise, and operated in a competitive ecosystem, then the scheme may have developed organically in response to innovation, economic opportunities and a variety of social demands. Instead, the monopoly that the platform represents has led to technical stagnation, inferior service quality and negligible capital investment.

Furthermore, the absence of design attributes and information processes which might support collaboration and dialogue acts to objectify riders and position them primarily as decontextualized service recipients. This belies the schemes' enrolment in smart city narratives of reciprocity and egalitarianism. In this sense, the scheme is paradigmatic of the kinds of atomization characteristic of neoliberal development as identified previously in the critical technology and smart bikeshare literatures (Wiig, 2015; Cardullo & Kitchin, 2017; Duarte & Firmino, 2017).

The design and implementation of Dublinbikes can be understood as emerging as a function of both macro and micro level forces. At a macro level, the shift towards entrepreneurial governance and the increased use of public private partnerships for the provision of urban infrastructure were important factors shaping the culture of executive decision making in the city. At a micro level, an unrelated problem with advertising infrastructure, in combination with DCC's particular modes of governance, had consequential effects on how these processes were enacted in practice. At the pre-implementation stage, their bilateral negotiations with JCDecaux effectively created what Fox and Murphy (2014) described as a shadow planning system which acted primarily to preserve special interests and restrict the participation of either the public or public representatives. This set the ideological tone for the remainder of the project.

The deployment of Dublinbikes would subsequently be characterized by managerialism, negligent procurement and contract management, project splitting, and the manipulation of planning and environmental regulations in order to expedite the project without proper oversight. This has had two significant effects: firstly, it has inhibited the schemes capacity to participate meaningfully in the building of capital between the municipal government and citizens; and secondly, it has constrained Dublinbikes as a mode through which related political agendas might be developed.

In addition, the performance of the public private partnership created to implement the system echoes many of the criticisms noted previously in the literature, i.e. there has been a marked absence of transparency and accountability from both partners; the partnership has operated to privatize profit and socialize risk; and Dublinbikes represents a dubious value for money proposition (Reeves. 2013a; 2013b). It also reaffirms the claim by MacLaran et al. (2007) that power differentials between citizens and powerful stakeholders tend to lead to a deprioritization of social, cultural and environmental considerations. The lack of synergy between private and public interests in this context has resulted in a project characterized by a marked indifference to social imperatives, and a technical system which is obsolete, insular and path dependant. In this sense the scheme resonates with the concerns of Hollands (2009) and Kitchin (2015) as noted previously in Chapter 3. However, the scheme has been particularly effective in protecting and perpetuating historically constituted hierarchies of knowledge and power, and in this sense is an affirmation of the role of structural constraints on the ethical and instrumental character of the technology production process.

By contrast, the following chapter reports the findings from a scheme which understands and articulates fundamentally different notions of citizenship and participation. SobiHamilton, the scheme implemented by the city of Hamilton, Canada, illustrates the potential of vocation and initiative to materially pattern the form and function of technology. It also offers an important exploration of the ways in which institutional expertise and lay experience can combine in creative ways to produce solutions which embody a diverse but complimentary set of goals and ideologies.

Chapter 6 - SobiHamilton

Introduction

This chapter presents the findings from a case which represents an important counterpoint to the instrumentality and autocracy characterizing Dublin. As part of its development, SobiHamilton, the city of Hamilton's smart bikeshare scheme, negotiated significant geographic and socio-political obstacles to its implementation, primarily through the vocational efforts of key stakeholders who worked collaboratively to progress the project as part of a broader movement of systemic urban transformation. In the process, this assemblage – comprising governmental, institutional, community and private actors – used a variety of democratic interventions to produce a platform which meets multiple needs and goals.

In keeping with the structural format from the previous case, the discussion explores SobiHamilton's development chronologically; beginning with an account of the challenges created by the city's particular geopolitical configuration and continuing with a detailed description of the manner in which the project was guided through its lifecycle phases, i.e. design, implementation and management. Throughout, this account pays particular attention to the ways agency and citizens engagement were mobilized to build consensus, overcome institutional and cultural inertia and advance progressive notions of social justice and innovation. The chapter also demonstrates the capacity of smart bikeshare to incorporate democratic ideals without loss of functionality and sustainability. On the contrary, SobiHamilton embodies the notion of technological concretization i.e. the successful incorporation of a diversity interests and values into a single artefact through reflective design processes.

6.1 Contexts and Challenges

Hamilton, with a population of just over 700,000, is a Canadian port city in the province of Ontario, which is situated approximately 30 miles south west of Toronto. Geographically, the city is part an area known as the 'Golden Horseshoe', a particularly densely populated and industrialized region which sits within the Greater Toronto and Hamilton Area (GTHA) (Weaver, 2012).

Historically, the economic engine of the city was the steel industry with 'Stelco' and 'Dofasco' providing employment to over 50,000 people at its peak in the 1970s. Due to the impact of various free trade agreements - in particular NAFTA - the

industry's fortunes have suffered in recent decades and the effects on the city have been significant.

> *"Canada has lost an enormous amount of industrial capacity in the last 25 years....and most of that has gone to the Southern US and to Mexico and under the world trade organisation a lot of the work has migrated to places in China and Indochina to cheaper cost bases."* (Ryan McGreal, Journalist, Activist, System Member, 2016)

The result was a major economic decline in the early 1990s, especially in the areas most reliant on the industry i.e. the east end of the city which located the mills and the adjacent downtown core. During this period, social deprivation increased sharply – with high unemployment, poverty, a reliance on social housing and a collapse of property prices – as tens of thousands of jobs were lost.

> *"The real fear during that period was that it might just collapse completely, and we'd become another Detroit or Buffalo."* (Ryan McGreal, Journalist, Activist, System Member, 2016)

In the last decade, however, Hamilton has experienced a renaissance. As the steel manufacturing sector all but collapsed, the city migrated slowly and organically to a more knowledge-based economy. The primary catalysts for this have been Hamilton's Universities, McMaster and Mohawk.

> *"I would say 15 years ago politicians had literally written this area off, much of the downtown was written off. It was a very suburban attitude. What happened though is you started to get concurrently, with the depressing economic times and the diverse location, a new generation demographically and people were coming to school, beginning to start their own businesses. I would say that started in the 2000s but didn't reach critical mass, until maybe five or six years ago."* (Civic Plan, Community Planning Organisation, 2016)

Essentially, graduates from the local universities, equipped with enthusiasm and creativity, began exploiting depressed property prices to set up enterprises which are now slowing redefining the city, both culturally and geographically:

> *"…the people running and hiring these businesses are of a generation where they are also interested in urban topologies; density, architecture, mixed use space, issues around liveability and community and so on. The other thing that happened was the orientation of the economy in Hamilton was largely towards the East end where you had the industrial cluster at the start...things have now shifted towards the west where McMaster is. So, there are almost corridors of*

employment where you have businesses located downtown here, they might do some business towards here and the west end." (Civic Plan, Community Planning Organisation, 2016)

So, the city centre, once in free fall, is slowly emerging as a centre of creativity and innovation and the result is a mixed demographic where commercial and cultural interests in the form of art galleries, craft shops and design centres co-exist with residential and social housing. This movement towards a progressive urbanism, however, is not without its obstacles. City governance, historically conservative, has not kept pace with the ideological changes characterising the transformation in its core. This is partly due to the natural risk aversion and conservatism that tends to characterize bureaucratic city politics, and partly a product of the city's cultural and social history.

"The city has a huge inferiority complex, I think, which probably stems from our working-class roots and being seen historically as Toronto's poor cousin. At the risk of applying pop psychology to how a city develops we have 'this is good enough for the likes of you' mentality in Hamilton and it means that anything that can be taken as liberal or urbanist is going is going to be much more difficult." (Ryan McGreal, Journalist, Activist, System Member, 2016)

This is especially evident in Hamilton's attitude to public transportation. Frequently framed (especially in suburban quarters) as a necessary evil for people who cannot afford cars, transportation policy continues to prioritize investment in roads infrastructure in order to support the movement of goods.

"They still haven't made that leap to it being a piece of modern infrastructure that links knowledge-based industries. The new economy is about brains and ideas and that is people moving not goods, so you want to move people from the hubs of knowledge - universities, downtown and parts in between - to their homes and for that you want cycling, walking and certain kinds of transit." (Civic Plan, Community Planning Organisation, 2016)

The genesis of this ideological schism has a historical dimension. Under the direction of the provincial government, the City of Hamilton merged with the adjacent regional municipalities in 2001 (Weaver, 2012). Essentially, the old city was amalgamated with a number of outlying districts which had previously been administratively distinct. This has had a significant impact on the politics and culture of the city. Hamilton is divided into 15 wards, each represented by a city councillor. While the suburban wards are less densely populated, a condition negotiated as part of

the amalgamation process ensured that all councillors had equal voting rights in municipal decision making.

> *"Nobody wanted the amalgamation to take place. The city didn't want it because there was a perception that turned out to be correct that, because of the way the wards were allocated, you'd have a ward in the city which has 3 times as many residents as suburban wards and you have equal voting rights so there's an extreme imbalance because in practice 1/3 of the population essentially has a veto over 2/3 of the population."* (Ryan McGreal, Journalist, Activist, System Member, 2016)

The result is that many progressive initiatives intended to enhance the liveability and quality of life of the core of the city have been vetoed by suburban councillors who perceive them either as irrelevant or counterproductive to the interests of their voters. Cycling infrastructure has been a casualty of this tension. A legacy of the steel industry is a network of multi-lane, one-way streets that traverse the city and which were provided to accommodate the many thousands of cars that travelled daily to and from the mills when the industry was at its peak. This infrastructure now has surplus capacity, some of which could be repurposed for cycling. Initiatives such as these, however, have typically been viewed negatively by many suburbanites whose priority is navigating the city quickly and efficiently. The result is that, despite a comprehensive cycling master plan (City of Hamilton, 2009), the city's cycling network is politicized and disintegrated with much of it appearing and disappearing at ward boundaries.

> *"I think about the ward my parents are in and there are chunks of the system (cycling network) that are missing up there because Tom [local councillor] gets a couple of complaints from constituents and he blocks implementation. So that kind of thing happens too, despite the master plan you still get councillors able to block it and there is a funny approach at City Hall. Often, when one councillor wants something for their ward, others will respect that because they in turn want the same support when they come to the rest of the council. So that happens a lot."* (Director, Environment Hamilton, Advocacy Organisation, 2016)

Citizens haven't remained passive in the face of these kinds of obstacles, however. On the contrary, the frustration felt by many people at the lack of coherent leadership has been the catalyst for a bottom up, grassroots movement by citizens and advocacy groups, intent on effecting real political and social change. This momentum, part of the broader economic and cultural revival taking place in the city, is capitalizing

on a network of politically engaged residents and community associations which began in the 1960s and 1970s in response to the kinds of destructive urban renewal policies which saw the city demolish many of its historic buildings in favour of concrete high rises. Initially, the groups were formed in key locations by affluent residents who had both social and political capital, but based on their successes, the principles of directed community co-operation migrated to more working-class neighbourhoods. Even though these groups had gone into a kind of stasis in the intervening period of economic depression, their connective tissue remained.

> "*Somebody was always there to carry the torch but in the last 10 years or so they've become a lot more active I think as people have become more conscious of neighbourhood issues*." (Ryan McGreal, Journalist, Activist, System Member, 2016)

This history is also evidenced in the areas' political demography. In 2017, the provincial leader of Canada's left wing New Democratic Party (NDP) was a former city-centre Hamilton councillor, as was the city's federal representative. This is in sharp contrast to the political constitution of the rest of the city.

> "*People living in the suburbs tend to be passive, people in the core tend to be quite vocal, so I think there's a bit of a culture difference that way. The non-vocal camp might show up and vote at the council elections every 4 years, but as long as the city doesn't burn down they're fairly content. And then there's that other group which tends to roll over their councillors a lot more. They tend to change more frequently with the issues."* (Community Activist, Professor Mohawk University, 2016)

It was into this landscape that the bikeshare scheme would be introduced. The project undoubtedly had to negotiate a particular set of historical, political and cultural challenges, but there was also a momentum at work in the city centre which gave cause for optimism.

6.2 From Advocacy to Bikeshare

The genesis of the bikeshare programme can be traced back to an initiate that stemmed from McMaster University's Office of Sustainability in 2009. The office was originally created to foster sustainability within the confines of the campus and focused initially on routine operational issues such as waste management, carbon inventories, and so on. Over time, however, and largely through the stewardship of its director, the

office grew in scope, finally creating its own internship programme which gave students from diverse disciplines an opportunity to collaborate on various environmental initiatives while receiving academic recognition and support.

> *"So, we said let's connect with the academics who were giving course credits for experiential learning in various capacities. For engineering this might be a design component or maybe project management, but for sociology, it might need to encompass an element of social critique or demographic work. Once we found out what these faculties needed to achieve with their students, then it was up to me to work with them to provide these petri dishes, these campus of living labs for students to get involved with these projects; and part of that was making connections pan campus."* (Director, McMaster Office Sustainability, System Member, 2016)

In practice, the scope of many of the projects which emerged ran naturally beyond the confines of the campus – community gardens, food security initiatives, etc. - and so the programme began developing connections not only across the university but also with organisations within the broader community. This dovetailed with the university's agenda of enhanced collaboration with local partners which was intended to help refine its research and support programmes. The concept of a bikeshare system was therefore ideal in that it satisfied the university's micro and macro level strategies.

The project was conceived by two students who initially envisioned it as a solely on-campus implementation. This changed quickly however once they analysed the results of their feasibility study.

> *"Well, first off they found that the older 1st and 2nd generation systems were highly manual and no longer appropriate, so they recommended a 4th generation scheme. They also found that the population density of the downtown area would be sufficient to support a scheme. The whole city was too large a geographic area to consider for the project because the cost would be enormous. These were the primary learnings for that phase of the project."* (Director, McMaster Office Sustainability, System Member, 2016)

At this point McMaster recognised its potential value to the city and connected with Hamilton's Transportation Demand Manager (TDM), Pete Topalovic. In addition to being responsible for developing sustainable mobility initiatives, Topalovic is also professionally and personally invested in a number of related agendas – community engagement, health initiatives, civil rights, and so on. He currently lectures in sustainability in McMaster and is actively involved in a variety of groups and

organisations which are a committed to social equality and progressive urban development.

As a Hamiltonian, he intuitively understood the challenges to implementing a bikeshare scheme in a city with Hamilton's fractious political landscape and in an area that still retained a largely blue-collar demographic. Despite this, a recent shift in the province's transportation policies suggested that, if handled tactfully, realizing a scheme might be possible. In 2008, the Metrolinx board of directors voted to adopt a regional transportation plan, named 'The Big Move' (Metrolinx, 2008a), which was designed to deliver a common vision for transportation in the greater Toronto and Hamilton area (GTHA). This initiative in turn had been driven by 'The Places to Grow Act' of 2005 (Province of Ontario, 2005) which was intended assist the Ontario government plan for growth in a coordinated and strategic way. Its objectives were to identify and plan for areas of growth, prevent sprawl, increase density, and protect natural resources. The Big Move was essentially the transportation component of this initiative. Phase one of The Big Move became known as 'quick wins' (Metrolinx 2008 b).

> *"So, The Big Move came to be in 2007 and right away they asked the cities for some projects that they could fund right now that fit with The Big Move and they called that quick wins and the only conditions were that they be capital projects and be innovative and transit related."* (Peter Topalovic, TDM Hamilton, 2016)

In 2009, Metrolinx awarded Hamilton thirty million dollars for the purpose of making improvements to its public transportation network – namely to its main bus corridors. By 2011, due to planning delays, a significant portion of that money has remained unspent and had accrued interest of almost two million dollars. Based on the provisional study carried out at McMaster, this amount would be sufficient to meet the capital costs of implementing a bikeshare scheme in the city centre and, given that it could framed, at least in part, as *free money,* it would go some way in allaying the concerns of city hall which might otherwise be tempted to block the idea at the outset. To strengthen the legitimacy of the project, Topalovic leveraged many networks of expertise in the planning process.

Mohawk University's Department of Transportation, Engineering and Technology was asked to consolidate the initial feasibility study by conducting a station location demographic analysis and provisionally identify the service area

boundaries. The analysis it produced became the main deliverable for a full credit capstone course created by Mohawk to support the graduate student undertaking the research. At the same time, mid-2011, a not-for-profit environmental organisation called 'Green Venture' was invited by Topalovic to collaborate with Mohawk to develop a business case. Green Venture had started in 1994 and been designed as an umbrella group to connect with, and co-ordinate, smaller environmental organizations of the day. Over time however, it became the region's lead agency to promote sustainable living ideas. Topalovic had worked with the organisation previously on various initiatives such as sustainable school transportation projects, climate change workshops, and sustainable business initiatives. Once this phase had been completed and approval for the use of quick wins money had been secured from Metrolinx, 'Civic Plan', a community planning and research organisation, conducted some final statistical analysis which refined the service area and ensured the system being envisaged was consistent with best practice, as identified across a number of other US and Canadian schemes.

The final report (City of Hamilton, 2013) which was submitted to City Hall in April 2013 emphasised that, while capital costs would be met by the city, no additional funding would be sought to support the running of the scheme, and in addition, the vendor - yet to be chosen - would run the scheme through a not-for-profit organisation for a period of five years during which they would be liable for any short fall between revenue generated and operating costs. It was also careful to emphasize bikeshare as transit rather than cycling.

> *"The last thing we wanted to do was frame bikeshare as niche or aspirational or hipsterish. That kind of framing brings its own baggage. The demographic in the core may be changing, but it is still working-class or certainly mixed and what they want is to get around. That's why we placed many of the hubs adjacent to bus stops, car parks and even carshare terminals. We needed to emphasise utility and for this to be part of the transit network for the city."* (Peter Topalovic, TDM Hamilton, 2016)

Reassured that the city had been exposed to limited liability and satisfied that the project met the stated objectives for 'quick wins' as set out by Metrolinx, the council agreed that the project could proceed to tender. In December 2013, after and open and transparent selection process, Social Bicycles (SoBi) were announced as the winning bidders.

6.3 Social Bicycles (SoBi): Designing for Equity

Social Bicycles was developed in 2007 by Ryan Rzepecki, a long-time cycling advocate, who had previously worked as a project manager at New York's Department of Transportation bike program with responsibility for siting bike racks, editing cycling maps, and conducting field research on bike facilities. He had been interested in the concept of bikeshare since its emergence in Europe a few years previously and felt that the 3rd generation designs that the industry had become reliant on were restrictive and prohibitively expensive. With sustainability, elegance and equitable access as his design parameters, Rzepecki produced a system that innovated in a number of key respects. The SoBi model is based on an architecture which exploits 4th generation technologies such as GPS tracking, mobile communications and a custom-built digital locking mechanism thereby obviating the need for hardwired, digital kiosks (see Appendix 3). However, it weds this design to a network of simple bike rack hubs which offers riders a greater degree of service predictability and helps to mitigate the anxieties of conservative local authorities. Initially conceived as a dockless architecture, this innovation was developed in response to expectations on the part of cities based on what other vendors had done historically.

> *"So, I would say that the RFPs we worked on for the first two years effectively described the 3rd generation approaches that had developed traction in the market up to that point and we had to adapt our design and write some clever responses which explained how a very different architecture could meet those same requirements. And then it took us two years to basically reshape the market so that RFPs were written in an agnostic way that would allow for our type of system."* (Ryan Rzepecki, CEO, SoBi)

The result is a system that is a fraction of the cost and significantly less impactful on the environment than its predecessors. GPS tracking also produces rich data sets which have the potential to feed into municipal planning activates.

> *"What's important is that the core data can be very transformative for a city. If you know where people want to cycle you're going to be able to identify where they may want to place bike infrastructure and if you know where people want to park you can decide where best to place your bike racks. So, when you designate a docking station (legacy 3rd generation approach) you're doing that planning work up front …it's prescriptive, it's not reactive. You're not able to modify the system according to actual demand. So, we have unencumbered data which can allow us to shape the system."* (Ryan Rzepecki, CEO, SoBi)

In addition to supporting cities plan infrastructure distribution, SoBi's data can also be used to encourage reciprocity with riders.

> *"The system can also display any of the routes taken by a user through data visualisation that we developed. So, you have the opportunity to name the route that you take and add some secondary data like what kind of trip it was; errand, work related, recreational, and so on. You can also annotate those routes with other information, like the conditions of the trip, was it safe, where are the problems or issues and so on. And this information can be shared with other riders both within the system or exported to various social media platforms like Facebook or Google+. And again, at some point in the future this may be useful in transportation modelling or to bike planning professionals, urban planners, etc. For that to happen of course we need cities to want it."* (Ryan Rzepecki, CEO, SoBi)

By designing a demand responsive, low cost, scalable solution that fostered collaborative relationships between riders, operators and municipalities, Rzepecki was trying to overcome some of the technical and social barriers that constrained the spread of what he saw as the first truly disruptive transportation technology since bus rapid transit. However, despite the advantages to the system, SoBi discovered early in its development how risk adverse cities could be.

> *"Cities tend to be incredibly conservative and driven towards reliability and proven track record which makes it very difficult to enter a market. We were only able to do so in Hamilton because of the failure of the biggest vendor and because the industry is relatively new and cites were just a little more flexible in how they engaged with it."* (Ryan Rzepecki, CEO, SoBi)

The vendor Rzepecki was referring to was Bixi. Bixi was a not-for-profit public bikesharing scheme developed and implemented in Montreal, Canada in 2008 which subsequently expanded to a number of cities in North America. In January 2014, the company filed for bankruptcy citing $46 million in debt (Goodyear, 2014). The primary cause of the company's collapse stemmed from a legal dispute with their software supplier – 8D technologies - which led to significant delays in high profile implementations in New York, Chicago and San Francisco (Fried, 2014). The company did not survive the controversies that ensued. Hamilton's Request for Proposal (RFP) process was conducted during this period and though Bixi responded to the tender, an administrative error in their response automatically disqualified them from the process. With hindsight, it is arguable that Bixi may have chosen to constructively eliminate itself from consideration at this time given its downward

trajectory. Deliberate or not, their difficulties gave SoBi the opportunity it had been waiting for.

> *"So, yeah, we had implemented in a few smaller places at this point in Tampa and Santa Monica, but Hamilton was our first implementation of real size and a great opportunity to show what we and the technology could do. If you get a 40 or a 100-bike project off the ground it's easy for that to be dismissed so we needed a large-scale case - a proof of concept if you will - and yes, things went our way and we got Hamilton."* (Ryan Rzepecki, CEO SoBi)

For SoBi then, the Hamilton project represented an important point on their developmental path. It essentially provided them with a test-bed to demonstrate the merits of many of their design ideas while also giving them the opportunity to adapt and refine the model in response to challenges in a large scale, complex, operating environment. From Hamilton's perspective, this was an opportunity to work with a fledgling company whose collaborative ethos would complement the spirit that had characterized the project since its inception.

As per the business case, the scheme would be implemented and run through a not-for profit organisation, to be named SobiHamilton. Though the planning process had defined a provisional network at this point, Topalovic in particular understood that successfully embedding the scheme in the fabric of the city would be dependent on the support and engagement of its citizens.

> "*Based on my own experience I think the truly successful projects are the ones that engage with the grass roots, but also ones that are top down. I mean you need professional expertise so, yes, there's a top down element to it, but you also need to leverage the expertise and experience on the ground, so that's citizens and advocates right.* (Peter Topalovic, TDM, Hamilton, 2016)

Consequently, collaborating with SobiHamilton to design a public engagement programme was the first item on Topalovic's to-do list when the project transitioned to the design and implementation phase.

6.4 Remediating Strategies and Democratic Interventions

Central to the design and implementation of the system was the public participation campaign which was run during the early part of 2013 and which was notable for the variety of tools, techniques, communications platforms and groups mobilized to ensure its effectiveness. A summary is provided here to illustrate the extent of the campaign.

Social Cyclist

This digital engagement-based platform was developed by Social Bicycles to aid in launching their various bikeshare programs and was a keystone of their digital public engagement strategy. The platform gave users the opportunity to vote in support of the provisional hub locations being proposed or, conversely, to comment negatively if so they wished. In addition to allowing respondents make recommendations of their own, it also provided a forum for discussion and debate. This dialogical aspect of the platform supported both a quantitative and quantitative analysis of the locations and system design (see figures 6.1 and 6.2)

Social Media

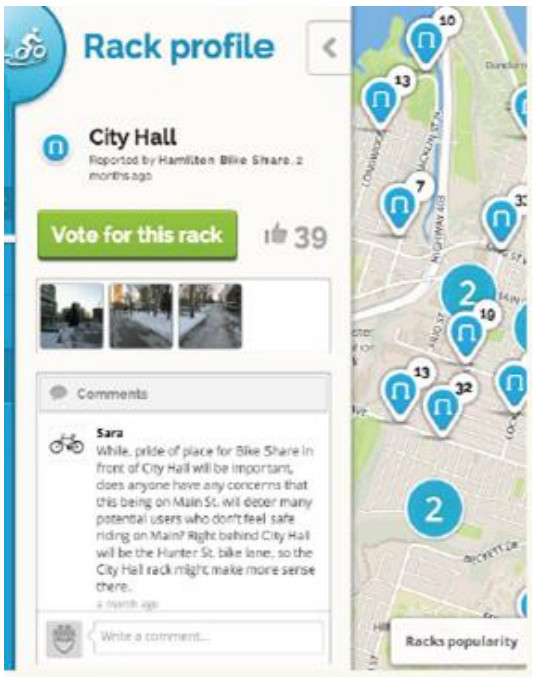
Messages from several influential accounts in the region each coordinated re-tweets that socialized the project and broadened the audience (see figures 6.3 and 6.4). During the engagement period, thousands of users were reached with up-to-date information about the program while also being given an opportunity to participate through the platform. The project was also posted directly to four Facebook pages: Hamilton Bike Share (a page run by a local cycling advocate), Social Bicycles, Smart Commute Hamilton and Open Streets Hamilton. Open Streets is an initiative where streets, temporarily closed to motorized traffic, become "*paved parks*" where people of all ages, abilities, and social, economic, and ethnic backgrounds can come out and improve their health. These branded web pages carried information to networks of people likely to be sympathetic to goals of the project.

Against this backdrop, several local media outlets, such as The Hamilton Spectator, CBC Hamilton, and Raise the Hammer - a local website founded by Ryan McGreal and committed to progressive urbanism - also socialized the project, built anticipation and disseminated newly released information through wide-reaching articles.

Printed Maps

Physical maps with attached sticker sheets prompted the public to vote for locations or suggest new locations for hubs. Figure 6.5 represents the map that was printed and placed at strategic locations around the city.

Figure 6.1: Commenting on Social Cyclist



Source: City of Hamilton, 2014

Figure 6.2: Voting using this platform

Source: City of Hamilton, 2014

Figure 6.3: Mobilizing support through Twitter

Source: City of Hamilton, 2014

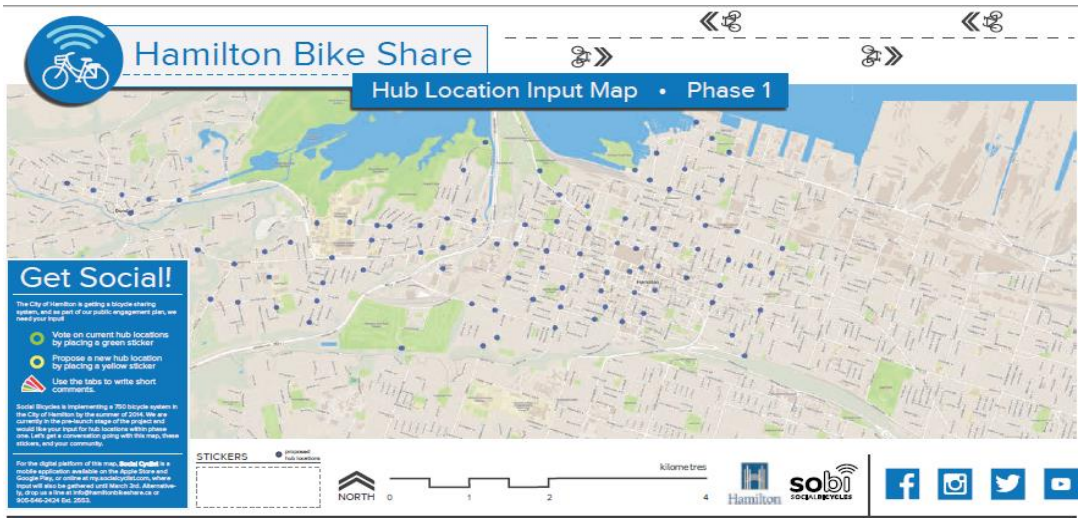
Figure 6.4: An Example of Collaborative Network Design

Source: City of Hamilton, 2014

It was also used as a method of direct engagement. Maps were brought to community centres and any public meetings or events where they were likely to find large groups of people.

> "*The use of these physical maps became a launching point for conversation in the communities. Several locations requested a map as a way of providing us with feedback and also to show support for the projec*t." (City of Hamilton, 2014)

Figure 6.5: Distribution of SobiHamilton Infrastructure



Source: City of Hamilton, 2014

Committees and Advocacy

A Hamilton Bikeshare Committee loosely comprising of thirty people associated with cycling, transit, sustainability, health and related interests in the city had been formed during the tendering process to support the project and they met regularly through the engagement phase to discuss key issues including logistics, the engagement strategy and how best to manage feedback. The process gave the campaign direction and developed valuable insights which ultimately acted as a catalyst for engagement in related areas. The Sustainability Professionals Network (SPN), for example, is an advocacy group formed during 2013 by Topalovic and representatives from both McMaster and Mohawk universities, all of whom were active on the bikeshare committee. It is essentially a network of professionals, scholars and environmental-civic groups that operates through workshops, presentations, campaigns and social

events to raise the profile of sustainable practices. A key component of what they do is 'Community Based Leadership in Sustainability' (CLS) (Sustainability Professionals Network, 2015) – an education initiative managed by McMaster's Office of Sustainability.

> *"So, I wanted to do a programme that would have more reach, and more impact, so I proposed the development of CLS which was around education and civic engagement. So, there were events organized where people could choose topics they wanted to know more about and what they got really animated about was 'safe streets' and improved pedestrian and cycling infrastructure. That was really important and so we worked with that."* (McMaster Office of Sustainability, System Member, 2016)

What is significant from the bikeshare project's perspective is that the CLS programme was running concurrently with the scheme's citizen engagement campaign and with many of the same residents and community groups. The programme therefore had the effect of developing awareness in these communities of the importance of the bikeshare scheme and its potential role in delivering on agendas that concerned them. This reciprocity is a characteristic of the city's DNA and was in evidence throughout the lifecycle of the project.

> *"I would say it's like interconnected clusters. SPN is a cluster and there are ones that we make sure to work with like cycling, the built environment, urbanism generally. They're all clusters here too and you'll see many of us working in more than one group, in more than one cluster. It's the Goldie Locks paradigm right. The city isn't too big, so you can know all the activists and issues intimately but it's big enough to generate enough capacity to be effective, to lobby and advocate effectively."* (Director, McMaster Office of Sustainability, System Member, 2016)

Another example of this kind of synergy involves the Hamilton Cycling Committee which is comprised of approximately a dozen advocates (many of whom participated in the bikeshare steering group) who meet monthly in city hall under the guidance of Topalovic to discuss all things cycling related, coordinate activities and exchanges ideas. It was this forum that produced perhaps the most successful piece of grassroots advocacy that the city had seen in many years – the 'Yes We Cannon' campaign – which delivered the province of Ontario's first separated, 2-way protected bike lane on Cannon street, downtown Hamilton. Orchestrated by a local cycling advocate, the campaign was careful to exploit the bikeshare project.

> *"I think that one of the really interesting things for me and my role in Yes We Cannon is that we actually used the fact that bikeshare was coming as an impetus for the installation of the Cannon Street Bike Lane. We highlighted to Council that you know, you guys already approved this. We know the money is coming, these systems work best where there are proper networks of infrastructure, so if you want it to be successful you need to be able to provide people, especially in the lower city, with a decent East – West route."* (Cycling Advocate & System Member, 2016)

The tactic employed in the campaign is called 'engagement organizing' a targeted, face to face interaction with resident groups, community associations and citizens which focused on divesting responsibility for urban transformation to local people rather than professional organizations.

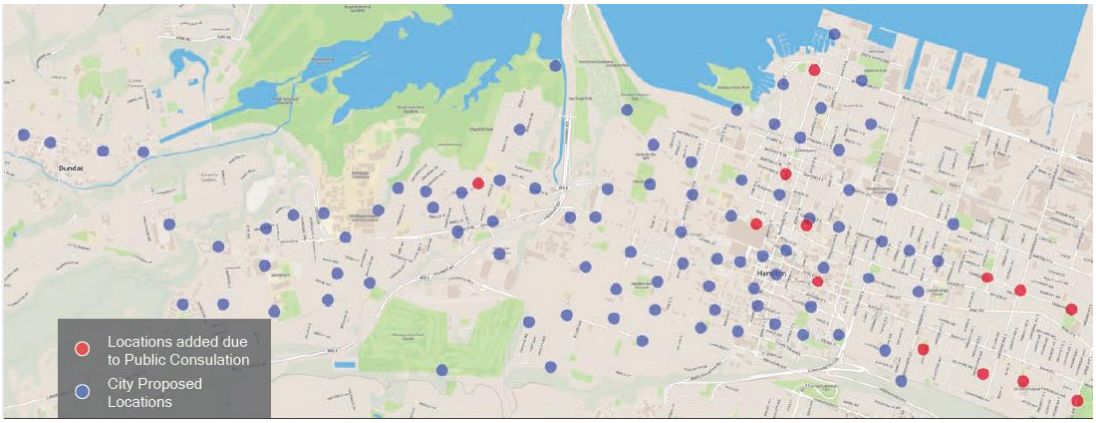
> *"If you look at engagement organising you're going right to the door to door level. You get your people banging on doors and helping constituents to understand the position their councillor has taken on an issue and how that position may impact on them. And you get them to write letters, send emails or pick up the phone so it's essentially political campaigning. In fact it's the method that the Obama campaign used the first time around. They call it the snowflake model."* (Director, Environment Hamilton, Advocacy Organisation, 2016)

Again, this helped to create a sense of agency and leadership within these communities which was subsequently leveraged by Topalovic and SobiHamilton. In the end, their campaign generated responses from more than 3,000 people. The red icons in Figure 6.6 below show the new hubs which resulted directly from this process and which account for over 10% of the total. It is important to note also that many of the original hubs were agreed with the public who voted and submitted supportive comments.

The collaboration with the public continued post-implementation. Once deployed, the flexibility of the architecture was exploited to allow unrestricted, organic traffic patterns to emerge as a way of optimizing the design.

> *"We had what we called desire lines. It's like you let people walk on the grass before you put the path in. So, we removed the controls and let people park the bikes wherever they wanted within the service area for 3 months without any financial penalty and based on how the bikes were distributed – those desire lines - the network was adapted again*." (Peter Topalovic, TDM, Hamilton, 2016)

Figure 6.6: SobiHamilton Hub locations – red indicates sites proposed directly by the public



Source: City of Hamilton, 2014

Expertise developed through Topalovic's own intercity professional networks also played an important role in the design process – especially those with neighbouring Toronto and Minneapolis whose own systems were well established at this time. Minneapolis, though not Canadian, is another great lake city with a similar climate and a similar sized implementation.

> "*We met with them numerous times and learned all we could about operations, hub density, the attributes of station sites, what kinds of public reaction we should expect and so on. What was Toronto's interaction with its own bureaucracy in terms of placing stations? I mean that was an important one that we'd never have anticipated but we'd been prepared for by talking with other schemes. I mean we had internal city staff saying, 'well it's not our problem' and we had residents saying, 'don't you dare put a station there'. I had calls coming in to me saying 'I just want you to know that this is a really stupid idea', click!*" (Peter Topalovic, TDM, Hamilton, 2016)

The final network - the product of local planning and design expertise, networks of advocacy, citizen engagement and the experiential learning from other cities - comprised 800 bikes and 101 hubs distributed across four wards of the city centre. In terms of size and density this is comparable with Dublin's current scheme (and significantly larger than Dublin's initial implementation) however, in terms of equity and inclusion, the distribution pattern of the infrastructure reflects the demographic it serves.

> *"Yeah, that's what we set out to do. I recently tallied all of our hubs and referenced them against the neighbourhoods they're in and 40% are in areas that are technically deprived - so called neighbourhood action strategy areas."* (Community Manager, SobiHamilton, 2016)

Equitable access is also the rationale behind much of the design innovation taking place in other areas of the scheme. In addition to tiered pricing with reduced fees for students and the low paid, the scheme also introduced initiatives such as 'Everyone Rides' (Topalovic & Johnson, 2017) which essentially makes 250 yearly memberships available to the most disadvantaged groups through various social organisations. Many of these go to the city's growing immigrant population.

> *"If you look at Hamilton we're predominantly a white city, but that's changing. So, we need to develop strategies for supporting these people too. What we want to do is work with religious organisations like churches, temples, and Mosques. Environment Hamilton has done something called 'Greening Sacred Spaces' which focused on working with these communities to raise aware of sustainability and that's the approach that we want to follow too."* (Peter Topalovic, TDM, Hamilton, 2016)

SobiHamilton's Community manager also runs regular cycling classes for new members designed to familiarize them with using the system and with navigating the city safely.

6.5 Iterative Innovation and Concretization

Technical innovation, largely in the form of new data products, digital tools and system integrations, has also been an emergent property of the relationships underpinning the project and one with both macro and micro dimensions.

At an industry level, perhaps the most significant development has been the creation of the North American Bike Share Association (NABSA). The organisation was formed in the aftermath of Bixi's bankruptcy when relationships had been damaged and the industry was left somewhat in disarray. It was the municipalities in the form of NACTO – The National Association of City Transportation Officials – who intervened and brought the key vendors together in an effort to restore trust and foster co-operation. It was at one of these meetings that the idea for NABSA was developed.

> *"I suppose people were ready to talk by then, a lot of changes had happened, certain people had left, new people had arrived. Up to that there was a huge focus on secrecy. Whether it had to do with future developments with technology or how people were going to respond to RFP processes, there was just a big focus on making everything proprietary and getting cities locked in to contracts. So, you bought a system, you bought hardware, software and bikes from the same supplier. Cities recognised that this was not going to lead to a fruitful future for the industry."* (Project Manager, NABSA, 2016)

With the legitimacy of the concept at stake, the industry recognised that the benefits of cooperation outweighed any short term commercial and competitive considerations. Leveraging the NABSA platform to build trust, the vendors have since begun collaborating on a broad range of issues such as funding opportunities, operational issues, procurement challenges, integration with public transportation and system interoperability. Perhaps the most significant initiative to emerge from this process has been the 'General Bike Share Feed Specification' (GBFS) (Github.com, 2017). The standard was designed to make bikeshare data feeds freely available via a uniform format so that map and transportation-based apps such as Google Maps and Transit App could conveniently incorporate the data into their platforms. Available GBFS data includes station locations, bike and dock availability and information on pricing. The idea for the GBFS came from a similar initiative in the public transit domain called the 'General Transit Feed Specification', or GTFS (GTFS.org, 2018), which defines a common format for schedules and associated geographic data. Social Bicycles was a founding member of NABSA and the primary architect of the bikeshare feed standard.

> "*Well, the structure [of the standard] was a group decision involving all the main industry vendors, but because SoBi had an API already, modifying it was relatively quick and easy and that's what happened. So basically, the GBFS is SoBi's original API tweaked to accommodate what were pretty modest changes. And of course, the whole idea of the standard was to get Google to take the data and use it on their maps. That's the big fish."* (Operations Manager, SobiHamilton, 2016)

Significantly, and due to opportune timing, the site of the standards' first implementation was Hamilton, which aligned with SoBi's interest in framing the scheme as an exemplar of 4th generation design. SoBi also used the standard as part of a recent integration with Transit app which, in addition to providing commuters with real-time bike and transit information, allows them to manage the entire booking and

payment process without having to interface with the vendors' website. Rzepecki sees these kinds of third-party collaborations with specialist expertise as being an important part of their, and the industry's, development.

> **"***So, it's so hard just trying to do one thing really well, let alone trying to solve every issue in the eco-system. So, mapping and location-based technologies are important areas of development right now and I think we're going to build some capabilities into our software and then partner out for richer solutions."* Ryan Rzepecki, CEO, Social Bicycles)

Against this backdrop of transformation at an industry level, technical innovations are also emerging from within the SobiHamilton organisation. The systems' operations manager is another of the principles associated with the project with a background in advocacy and has campaigned extensively on issues including cycling and related infrastructure, road safety, public transportation, architectural preservation and so on. After graduating with a degree in computer science from McMaster in the early 2000s, he decided to *follow a calling* and set up a bike co-op in the city which has committed itself primarily to reconditioning old bikes and making them available to the community through schools, charities and other social organisations. He feels that the foresight shown by Topalovic at the contract negotiation stage of the project has contributed significantly to the level of engagement they have had with the vendor ever since.

> *"They [SoBi] have a lot more responsibility here than they would in most places because when they signed the RFP back then they agreed to ensure that the system operated for 5 years. So, they took the legal responsibility for making sure that the bikes get moved around and repaired, and then they moved the responsibilities for that contract on to us. I mean I found them pretty receptive anyway, but the very close integration with this particular system helps. Plus, I'm quite vocal about this stuff, so if there's something that their system doesn't do I tell them about it, I'm not afraid to do that."* (Operations Manager, SobiHamilton, 2016)

The result of their collaboration has been a series of adaptations and system enhancements, many of which are likely to migrate to the vendor's other implementations. One such innovation involved developing a script which operates on the data collected through the systems' API to configure a custom map of the network that supports maintenance and operations.

> *"So, this script goes out and gets standard real-time data from the system but then displays the bikes at the various hubs in a much easier to use fashion. It shows for instance how many bikes need to be moved or redistributed at each hub based on pre-set targets, it shows which bikes are faulty, what the fault code is; maybe it's a battery failure or loss of connection to the network or whatever. This information was there but SoBi hadn't developed it, and it's important because it makes the techs' life a lot easier and in turn improves service quality for riders. This was something we developed here in SobiHamilton."* (Operations manager, SobiHamilton, 2016)

In the longer term SobiHamilton is hoping to work with expertise in McMaster to come up with a problem definition for predictive rebalancing. Essentially, this requires an algorithm which can determine the minimum and maximum number of bikes required on a hub by hub basis based on a complex set of variables.

> *"Ideally, what would happen is as time goes on and people use the bikes, we gather better data on how many people are taking them, how many people are returning them, what's the weather like, what day of the week and time of the day it is, holidays events, etc. Over time there should be an algorithmic determination of optimal distribution levels. So, for instance the system would start to understand that the train comes in a 3:45 and 6 people take bikes on one day and 8 the next and 4 the next, so if that hub is full at 3:40 we don't want to go taking bikes away because x amount of those bikes are going to be needed in a few minutes. That, to me, is a mathematical problem that should be quite solvable, but not with only our own resources."* (Operations Manager, SobiHamilton, 2016)

Other innovations have focused on improving the user experience, such as enabling a single member book multiple bikes per transaction - not possible in Dublin and important for families or tourists - or incorporating a digital interface to the bike's control panel to prompt riders through the booking process. These ideas were developed by SoBi's backend software team but were tested and implemented in cooperation with SobiHamilton. Perhaps the most significant development to-date however, has been the use of geo-fencing as a technique to encourage the natural rebalancing of the system. A geo-fence exploits the characteristics of GPS to create a virtual boundary or perimeter around an actual geographic location. In Hamilton the technique is used to define a space of approximately 10-15 meters around each of the hubs within which a bike can be returned should docking spaces be unavailable. The system is designed to apply a penalty of one dollar if bikes are docked outside these areas; however, returning a bike to a geo-fenced zone yields a credit of 66 cents, a reward that can be claimed by any member.

> "*If you're a member and walking down the street and see a bike out of hub, or if you happen to see it on the app you can just sign it out and bring it back to a hub and get that credit. So, I'm sitting on quite a bit of credit right now because for a while every time I saw a bike out of hub I'd bring it back. No, it's not a lot of money but it offers a nudge and helps people to feel involved. It also gets bikes around which is the important thing."* (Ryan McGreal, Journalist, Activist, System Member, 2016)

The concept, which addresses perhaps the most persistent and costly operational issue in the industry, was devised by SobiHamilton and is already working in SoBi's systems in Boise and Santa Monica.

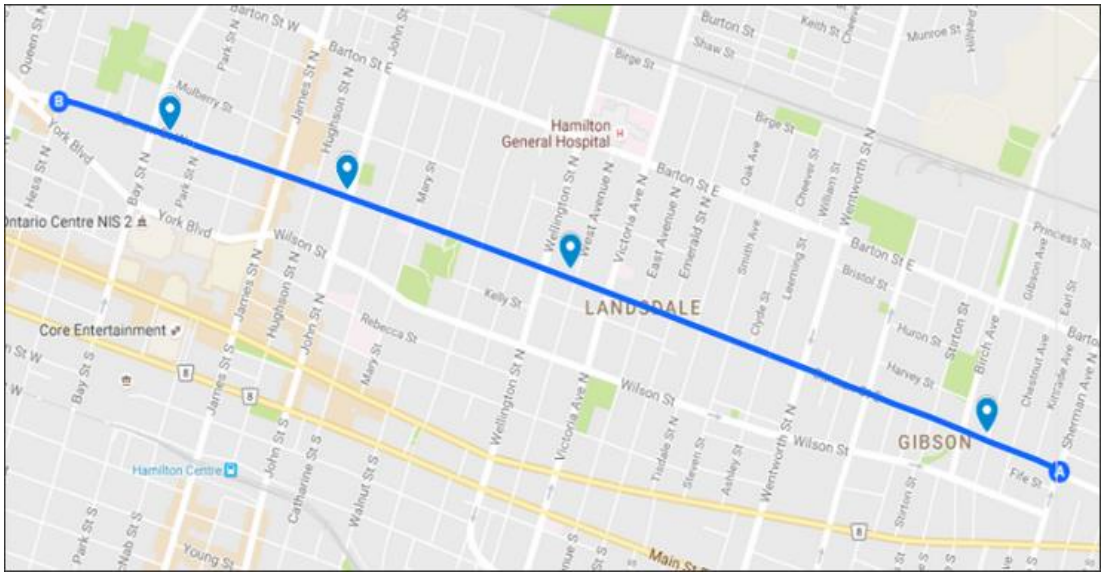
System data has also been an important catalyst for activity across a range of related social and technical areas. Topalovic, for example, has collaborated with the public health department to understand how the GPS trace data might improve health.

> "*So, when I looked at the SoBi data with Pete, the average ride is around 10 or 12 minutes. So, if you're doing that twice a day that's 20 to 24 minutes or, based on the Canadian activity guidelines, your physical activity for the day. So, if you use active transportation – cycling or walking - then you're building it into part of your day, so you don't have to worry about going to the gym or whatever. We're planning a research project around this once the data can give us a fuller picture."* (Public Health Nurse, Hamilton, 2016)

The data is also supporting the analysis of route traces and usage statistics which, in addition to facilitating informed transit planning and network design optimization, is also being used by advocates. Ryan McGreal, having been made a research partner to SoBi Hamilton with access to anonymised system data, recently conducted an analysis of bikeshare traffic on the Cannon Street bike lane. This was prompted by complaints from certain politicians, who felt that the infrastructure was being significantly under used. This perceived failure, based on data from sensors positioned along the 3.3 km track (see Figure 6.7), was disappointing given the amount of advocacy mobilized to implement the infrastructure in the first place. Based on personal experience of the location however, McGreal suspected that the positioning the sensors would make sense only if the traffic being counted used the street as an end-to-end corridor. If bike riders were using Cannon for shorter trips, then the arrangement would likely miss a much of this activity. The findings from his study confirmed his original suspicions. He found that most bikeshare trips that touch on the Cannon cycle track do so for only a short distance as part of a route between origin and destination. Around two-thirds

of trips travelled only 1-5 blocks along the cycle track, with less than one percent of the trips studied traversing the lane's full length.

Figure 6.7: Bike counters installed on Cannon cycle track



Source: Ryan McGreal, Raise the Hammer (2017)

There is also evidence to suggest that the protected cycle track may be enjoying a higher rate of usage than the unprotected bike lanes on either side, though this hypothesis requires additional study. Planners have confirmed that the city intends incorporating bikeshare data into their traffic analysis going forward.

6.6 Summary

SobiHamilton emerged from a largely working-class city in the process of political and cultural transformation. An important aspect of this transformation was the priority given by the city - in the form of the active transportation department - to citizen engagement, collaborative infrastructing and more progressive and transparent forms of governance. The design and implementation practices associated the development of the city's scheme reflected these considerations and produced a technology which is innovative, responsive and accessible. In this sense, SobiHamilton embodies the citizen-centric development called for in much of the critical literature (Agyeman, 2013; Hannig, 2016; Feenberg, 2017) and acts as a counterpoint to the instrumentalism and expedience which characterized the Dublin case.

SobiHamilton was produced by a network of professional and community expertise operating at a variety of scales. It was supported and financed by the province of Ontario and was championed by progressive elements within the city who pioneered new techniques and practices for enrolling a broad spectrum of interests and stakeholders in the decision-making process. This has resulted in 'design' being a cooperative function involving a multitude of sectoral and community interests. As a consequence, the technological platform it produced articulates the values and viewpoints of a diversity of stakeholders and positions the scheme more broadly within discourses of sharing and collaborative consumption which prioritize social equity above profit driven motivations. The emphasis on community focused innovation also addressed the primary barrier to equality identified in the literature (Hannig, 2015) by ensuring that knowledge generated by expert regimes would not prevail over of the needs and wishes of broader society. This is complimented by the financial, procedural and informational measures coded into the systems' design, and by the business processes developed to support them. The use of technology as a mechanism for participation and feedback throughout the life cycle of the project has also been significant in this regard. The role of the not-for-profit organisation proved pivotal here, not only as a source of innovation and creativity but also as a tactical way of reconfiguring the practice of governance in the city. It became the instrument through which new and experimental forms of representation were explored and new ways of consensus building enacted. Staffing the organisation with advocates of progressive urbanism more generally also lent the project a degree of legitimacy and integrity which may have been absent had the scheme been controlled by purely corporate interests. SobiHamilton was also seen to act as a catalyst for broader social transformation through the alignment of the project with a multiplicity of related causes and campaigns thereby strengthening political agency within the city and consolidating its capacity to influence change.

Chapter 7 - Analysis

Introduction

The purpose of this chapter is to provide a theoretically informed analysis of the two case studies. The chapter mobilizes the tools provided by instrumentalization theory to develop and enrich the largely descriptive narratives from the preceding chapters and position the cases within a broader conceptual framework. As such, it enhances the capacity of the analysis to develop useful insights and identify casual relationships.

As described in Chapters 2 and 4, instrumentalization theory is used hermeneutically to situate the creation of the two schemes within the broad cultural assumptions, logics and decision-making practices producing them. Given the particular findings from each study, the analysis is especially concerned with critiquing the modes of corporate and bureaucratic governance through which bias has operated to conserve hierarchical power in Dublin, and also with understanding the processes of instrumentalization through which Hamilton has enacted enlightened and liberating notions of citizenship.

The chapter begins with a separate reading of each case which is structured around the core ideas of subjectivication and objectification. This format supports an investigation of the interplay between human identities, technologies and processes of instrumentalization. Table 7.1 below, reproduced from chapter 4, illustrates the relationships between these ideas.

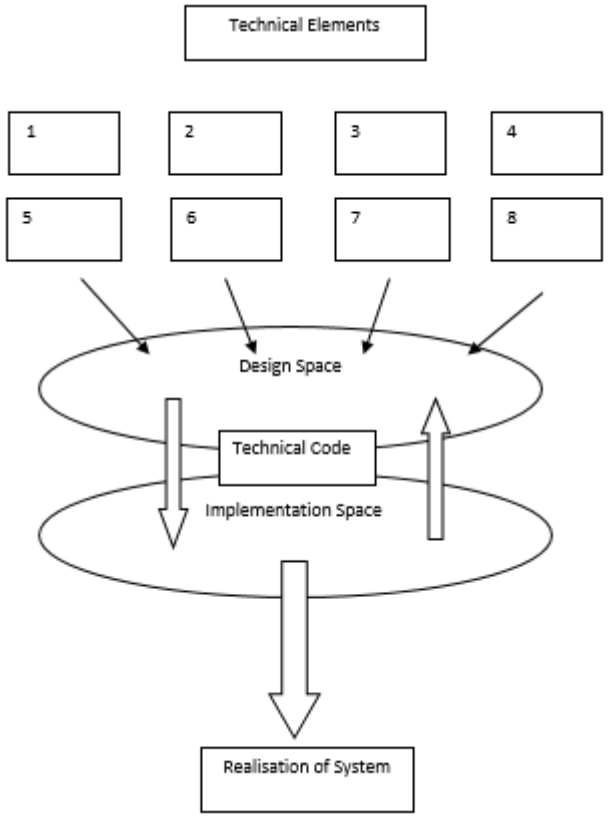
Table 7.1: Instrumentalization and associated concepts

	Functionalization	**Realization**
Objectivication (Technology)	Decontextualization Reduction	Systematization Mediation
Subjectivication (Human)	Autonomization Positioning	Vocation/identity Initiative

Following this, the chapter also provides a second level analysis which serves to develop, compare and contrast key aspects of the cases critical to their respective designs. In keeping with the hermeneutic approach, this discussion reflects upon the relationality and interdependencies between local or situated decision-making on the one hand and the broader socio-political and technical milieu on the other. In the process it develops themes and insights which may guide the design of citizen-centric technologies more generally.

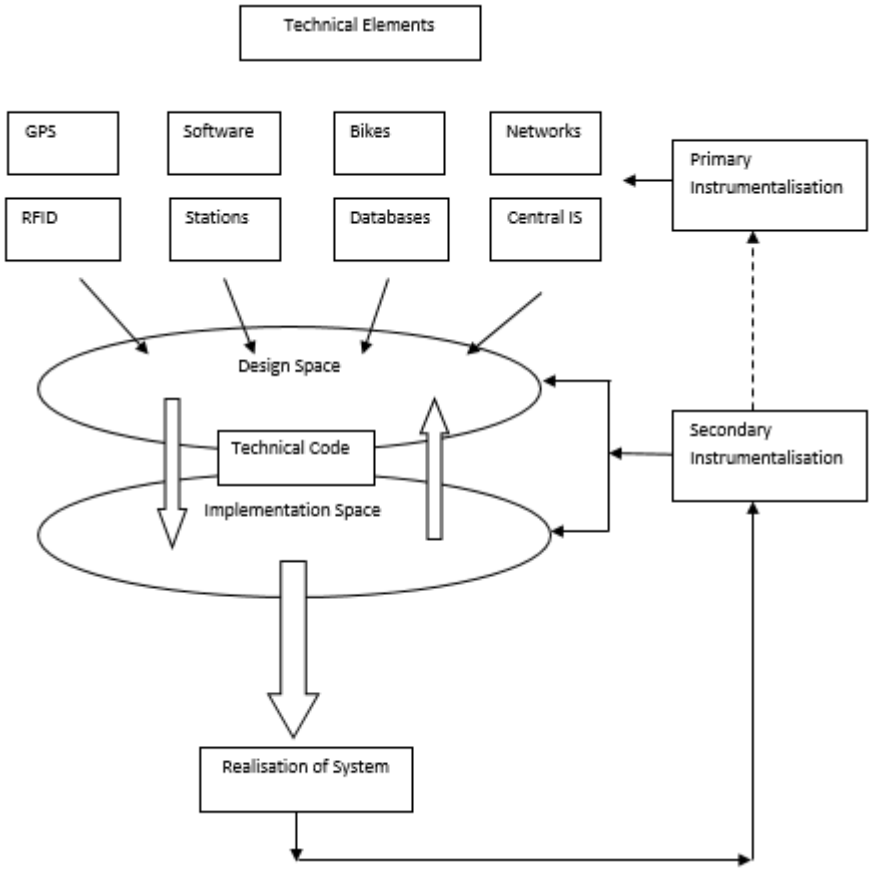
In addition, and as noted in Chapter 4, the conceptual framework guiding this analysis is an elaboration of that proposed by Feng and Feenberg (2008). This adaptation, which includes a feedback loop between concretized design and ongoing processes of instrumentalization, addresses limitations in its original formulation by incorporating the conceptual means to map technology's response over time to the influence of socio-political change, experiential learning and technical innovation. As originally formulated by Feng and Feenberg, the design space is framed as conditioned by, and reflect of, technical codes, which in turn produce stabilized or concretized solutions. This illustration, however, suggests that such solutions may be end-points in the design process and temporally static. Given the evolutionary thrust of Feenberg's work, this failure to adequately incorporate technology's ongoing and emergent nature can only be interpreted as an oversight. The revised schema is intended to more accurately reflect both the essence of instrumentalization theory and the empirical findings developed through both studies. The model also emphasizes that, while the primary locus of secondary instrumentalization is located in the alliances, strategies and decision-making practices developed through the implementation phase, valuative mediations may also permeate choices made during the conceptual design. Figures 7.1 and 7.2 below illustrate this adaptation.

Figure 7.1: Original Conceptual Framework



Source: Feng and Feenberg (2008)

Figure 7.2: Modified Conceptual Framework



7.1 Dublinbikes: Subjectivication

Autonimization – Strategic Positioning

Throughout the conception, design and implementation of the Dublinbikes scheme, there is an operation of a technical code which acts to support the institutional forms and ideologies of the projects' primary stakeholders and which embodies Feenberg's notion of social rationalization; a concept derived from Weber.

> "*I introduce the term social rationality to refer to phenomena Weber treated under the rubric "rationalization". What I retain from Weber is the emphasis on forms of thought and action that bear some resemblance to scientific principles and practices and the role of the modern organisations in generalizing those forms in society at large."* (Feenberg, 2010: 158)

Key to this notion of rationalization is operational autonomy which rests on the capacity of bureaucracies to atomize the public through processes of reduction, exclusion and decontextualization.

> *"The operational autonomy of management and administration positions them in a technical relation to the world, safe from the consequences of their own actions."* (Feenberg, 2010: 70*)*

In practice this autonomy was realized primarily through the strategic control of the planning environment. Ethically informed governance requires - or should require - that collaborative, consensus-building practices be constitutive elements of the systems and practices of planning (Healey, 2006). In the Irish context, such systems and practices - incorporating legislative and regulatory frameworks, review boards and democratically constituted policy committees – had been designed to both constrain the role of powerful interests and give political actors a meaningful opportunity to contribute to spatial, environmental and infrastructural development. In their idealized forms, they aspire to Habermas's communicative approach which is "*oriented to achieving, sustaining and reviewing consensus - and indeed a consensus that rests on the intersubjective recognition of criticisable validity claims*" (Habermas, 1984: 17). This position embraces the notion that true collective reasoning requires a pluralist epistemology which recognises the integrity of a diverse range of knowledge, values and experience.

However, these processes of governance are unlikely to promote inclusionary practices unless they occur within a culture which is sympathetic to their ideals. In practice, they proved unable to withstand the effects of hierarchical power which was used strategically in order to preserve the identities, cultures and ways of life of elite interests.

In this respect, the case contextualizes the narrative of powerful corporate actors parasitically feeding on the political and economic vulnerabilities of local governments. Dublinbikes reveals relationships which are far more premeditated, calculating and symbiotic. While the scheme is a manifestly cynical exercise by JCDecaux in offsetting the environmental and cultural consequences of its primary business interests, the manner of its configuration and implementation has also had the effect of protecting DCC's historical and functional identity. In this respect, it embodies a regime characterized by both neoliberal and technocratic ideologies which necessarily negates the public's right to participate in decision making processes materially impacting the quality of their lives.

Despite the backdrop of an increasingly articulated smart city narrative which officially promoted openness and transparency, the findings from this case suggest that engagement throughout the life cycle of the project was of the most impoverished kind. This can be attributed to both distal and proximal forces. Under the impress of neoliberalism – an orthodoxy seeded by central government policy initiatives - and combined with an historic, managerialist style of local governance - inclusivity and participation were either non-existent or merely concepts used rhetorically to legitimize an illegitimate project. This manoeuvring was also conspicuous when the research attempted to enrol the co-operation of key organisational actors.

Neither the DCC manager with executive responsibility for the planning and implementation of the Dublinbikes project, nor representatives from JCDecaux would agree to be interviewed for the research. In the interest of rigor and probity, the current CEO of Dublin City Council was also invited to participate in the interview process. While not part of the governance structures affecting the initial design and configuration of the scheme in the late 2000s, his reflections and insights may nevertheless have been valuable in exploring and contextualizing its history and that of the organisation. He is also currently responsible for collaborating with other agencies and stakeholders in developing smart city strategies and policy initiates which may impact on the schemes' future technical and social trajectories. Furthermore, the

request emphasised that the research was part of an overall effort by the Programmable City project to provide empirical and theoretical insights which could inform debates across a number of areas relevant to his domain, i.e. city management, the provision smart urban infrastructure and social and technical innovation. The CEO refused to support the research. This refusal has an additional significance given that he had engaged willingly with other Programmable City researchers whose work had incorporated various aspects of urban management and administration.

This strategic 'positioning' or autonomizing has the effect of hermetically sealing the organisation from critique in a manner evocative of Weber's notions of bureaucratization and oligarchy, i.e. the tendency in hierarchically structured organisations to concentrate power in the hands of the few with the effect that organisational forms and cultures can be (re)created with relative ease. For critical theory of technology, this conservation of hierarchy is also evident in the production of technology itself.

> "*Operational autonomy enables them (bureaucracies) to reproduce the conditions of their own supremacy at each change in the technologies they command. Technocracy is an extension of such a system to society as a whole in response to the spread of technology and management to every sector of social life."* (Feenberg, 2010: 71)

This hegemonic process succeeds largely due to the legitimization that bureaucracies and technocracies achieve through their claims to neutrality and value free efficiency, despite the fact that actualized, highly rationalized systems are as prone to error and bias as the minds which conceive them.

> *"The usual commonsense notion of bias attributes unjust discrimination to prejudice and emotion. But efficient operations are often unfair even where bias in this ordinary sense is avoided. I have introduced the concept of 'formal bias' to describe prejudicial social arrangements of this type. Formal bias prevails wherever the structure or context of rationalized systems or institutions favors a particular social group."* (Feenberg, 2010)

Essentially, Feenberg is saying that the factors shaping technology under the influence of social rationalization are not explicitly or intentionally prejudicial *per se*; rather the technical rationales at work in modern bureaucracies have embedded in them historically and culturally biased knowledge which tends to be oblivious to broader social values and which operate to reproduce patterns of inequality and injustice which

are sympathetic to the interests of privileged groups. This formal bias is comprised largely of 'constitutive' and 'implementation' variants which correlate broadly with primary and secondary instrumentalizations, i.e. constitutive bias is evidenced in the values inscribed in a theoretical system and tends to be independent of context, while implementation bias is realised subsequently through contextualizations in the real world. It may be that implementation bias is closer to what Feenberg envisioned when developing these ideas. In 1991 he wrote "*The essence of formal bias is the prejudicial choice of the time, place and manner of the introduction of a relatively neutral system*" (Feenberg, 1991: 180). Constitutive and implementation bias then represent additional analytic constructs which deconstruct the nature of technical systems allowing a critical hermeneutic reading of the ways autonomy is enacted through technical action. In the case of Dublinbikes, design praxis leading to its concretization would be characterized by bias in both its forms. At a conceptual level, and in the manner of its deployment, the scheme can be seen to embody objectification processes which operationalize the interests and rationales of the projects' powerful stakeholders.

7.2 Dublinbikes: Objectivication

Decontextualization –Reduction

At a primary level the system was designed by JCDecaux as a functional, 'efficient' technology, but one devoid of mechanisms which might support enhanced reciprocity, usability and environmental sustainability. Its ongoing failure to translate discursive demands into their system equivalent reflects a constitutive bias indifferent to notions of society as complex and adaptive with emergent needs and values. There is little, if any, evidence that aesthetic or normative considerations were influential either during the initial design process or throughout an intervening period characterized by dynamism and innovation within the industry. On the contrary, the instrumentality of the configuration reflects a marked absence of dialogue or contestation, and frames citizens as decontextualized consumers.

Once this design passed through the political and cultural milieu of Dublin we see a secondary instrumentalization shape this system in conformity with the assumptions and interests of the city's executive elite. While it may be argued that at a macro level, the pervasiveness of Public Private Partnerships and the trend towards entrepreneurial governance explain the initial decision to migrate the provision and

management of the system to a private entity, the particular enactment of these processes in Dublin remains a function of the history, culture and practices of local governance. It was the systemic failure by DCC to effectively regulate advertising infrastructure in the city which proved the genesis for the bike scheme in the first place. Despite the rhetoric to the contrary, the system was merely an incidental and opportunistic means of resolving an unrelated issue; a mechanism by which the effects of advertising on the aesthetics, identity and sustainability of the city could be mitigated, and local governments' own structural and ideological shortcomings could be masked. Hence the reason DCC could, without compunction, cede the management and development of the scheme to an organisation with a manifest disregard for legal, professional and ethical norms. Expedience also explains the rationale behind partnering with the Coca Cola Corporation to part finance the systems' ongoing operation. This apathy, combined with negligent (or complicit) contract management, has led to a technological path dependence which has limited the avenues through which the system may now grow. This aspect of the system emphasises the degree to which the 'concretized' technology is mediated and shaped by ongoing, post-implementation practices and ideologies.

Despite the constraints and dependencies inscribed at a conceptual level by JCDecaux, which in themselves reflect the interplay between primary choices and a system of values, the concretized design still bears the impress of local history and politics. The spatial distribution of infrastructure, the prescriptive nature of subscription processes and the manner of the system's operation, reflect historic patterns of prejudice, inequality and paternalism. Furthermore, the scheme's lack of meaningful digital and informational integration with other systems and modes is only partly explained by the constraints of the conceptual design. It is also a metaphor for DCC's own institutional isolation and inertia.

> *"It has always been the way. Dublin Bus doesn't talk to CIE [Public Transport Authority], doesn't talk to Irish Rail, doesn't talk to Luas [Light Rail System]. Sibling rivalry! That is standard operating procedure for all Dublin transport issues, incredible, ridiculous institutional rivalry. It is almost impossible to get coordination. Look how long it took us to get into integrated ticketing; we were pulling our hair out for ten years."* (Eamon Ryan, Green Party Politician and Former Government Minister, 2016)

The result is a segregated, legacy technology, disconnected from its technical, social and cultural environments. This insularity may have particular consequences if and when bikeshare spreads to other local authority areas within the greater Dublin region. It may be for example, that riders are forced to transition from one provider to another in order to complete trips which straddle jurisdictional boundaries.

DCC of course have countered that the scheme is a sustainable and efficient mode of urban transportation which, assessed on a trips-per-bike-per-day basis, has proven highly successful (DCC, 2011). However, this rationale conveniently ignores the fact that the service, which is all but free for those who can access it, was implemented in a dynamic, densely populated environment which is served by a much-maligned public transportation network (Pope, 2010; Bohan, 2013; Ryan, 2017).

Furthermore, to infer causal relationships between contested notions of performance and quality on the one hand, and 'success' on the other, is a non sequiturs which confuses explanandum with explanans. In a progressive democracy one might reasonably expect that notions of success would encompass a technology which embraces a broader range of social values (Flanagan et al., 2005). As Feenberg (2011) has noted, efficiency is not an absolute concept since it cannot be quantified in the abstract but is relative to particular and contingent demands and contexts. Once technologies have stabilized we no longer recognize its bias at all and apprehend it as independent of the partiality from which it emerged.

In a general sense then, the manner of the scheme's implementation and management has, thus far, precluded any recontextualizing strategies which might have reoriented the technology normatively and resolved the tensions between design and the requirements of society. In effect, the opportunity to infuse function with meaning has been missed.

Democratic rationalizations are about mediating this dialectic and producing new technical codes which can prioritize traditionally excluded values in new technical configurations. This scheme has thus far been characterized by a marked absence of such strategies or ambition. The boundaries that define the structural and cultural identity of governance in the city have remained intact and have acted to resist any intervention – political or technical - to change the status quo. The configuration of the technology is an integral part of this process of self-protection and renewal. Ontologically therefore, the scheme's dominant meaning or purpose is that of an instrument to preserve and promote neoliberal-bureaucratic norms and practices which

in turn contribute to the rationalization process that creates Dublin's political and cultural life.

Furthermore, it may be argued that Dublinbikes blurs the distinction between formal and substantive bias. Given the duplicity and cynicism shown by senior local authority managers throughout the life time of this project, it is difficult to imagine that the particular constellation of technical, functional and operational specifications that define the scheme were entirely the result of a mere vulnerability to self-interest caused by a detachment from their consequences and outcomes, i.e. formal bias. Something more deliberate and conscious may well have been at work here in the character of the distributed system. Feenberg suggests that substantively biased systems – which encompass intentional, wilful prejudice - tend not to survive because their irrationality makes them transparently inefficient or malign (Feenberg 2010). However, the level of executive control wielded by governance in the city has rendered the system impervious to any such processes of evaluation or contestation. The failure of DCC to participate in the research - or otherwise address these matters - has left the issue of bias open to interpretation.

7.3 SobiHamilton: Subjectivication

Vocation - Imitative

Subjectivication in the form of Feenberg's secondary moments - vocation and initiative – were shown to be important recurring themes in the Hamilton Project. While these qualities characterized many of the stakeholders, they were especially applicable to the three principles - Topalovic, Social Bicycles and SobiHamilton. Together they employed leadership, tactical awareness, collegiality, advocacy and experimentation to make an improbable project a reality. Their efforts leveraged an important moment in the city's trajectory when the political, cultural and economic contexts aligned, and meaningful change was possible. Despite the opportune timing however, the project still required a catalyst.

> *"Somebody had to take the leadership role, somebody had to organize and to capture all of that civic engagement and put it together. Somebody had to tie all that together and present it as a package and he [Topalovic] took a big political risk as a staffer. This is not a city that rewards innovation and progressive thinking. No good deed goes unpunished in this town right!"* (Ryan McGreal, Raise the Hammer, 2016)

Initiative, in the form of micro-political manoeuvring, was an important mechanism for guiding the city council to behave in ways that were alien to it.

> *"I would say that Peter hacked the political context to make the bike share happen in the sense that he understood what it would take to get those councillors to support it politically, and he made that happen! I would hesitate to use the word manipulated, but he understood what he would have to demonstrate and deliver in order to get those votes [of city councillors] and those votes went against their knee jerk reaction which would be to say no! It's politics the way bureaucratic staff have to practice it. The city doesn't have a culture of risk taking or encouraging greatness but is does this in spite of itself through Pete."* (Ryan McGreal, Raise the Hammer, 2016)

There is already evidence that the democratic initiatives he pioneered in realizing the bike project have shifted the culture of institutional governance and decision making. Light Rail Transit (LRT), for example is another major transportation initiative from Metrolinx currently being planned for the city. This time, collaboration with a diversity of communities and constituents was placed high on the project's agenda at the outset. In March of 2015, as the bike project was launching, the city's Mayor brought a motion to Council to establish a "Citizens' Jury" that would review the city's light rail transit plan. This Citizens' Jury is a forum of residents randomly selected from every ward in the city and brought together to review the literature, consult with experts, hold public consultations and then come to a consensus on how to move forward, considering the best interest of the city as a whole. Their final report, which reflected a multiplicity of perspectives and experiences, was submitted to City Hall in March of 2017 and councillors have already committed to adopting many of its recommendations. Engagement, until recently regarded as a concept appropriate to more cosmopolitan, liberal cities, is now becoming a taken-for granted part of the municipal decision-making process.

Topalovic also showed considerable foresight and guile in creating a not-for-profit to manage and operate the scheme. It is largely beyond the reach of political interference and carries genetic material from both the vendor and from progressive elements within the city. In practice, it represents a design space which circumvents many of the barriers that might otherwise constrain it. Feenberg (2008) for example notes that while designers appear *like powerful actors* in reality they do not operate in a vacuum. They must accommodate the requirements of a multitude of power relations, interests and ways of knowing. The creation of a not-for-profit, in effect, resulted in a

centre of innovation through which Topalovic and others, were free to use dialogue, and creative appropriations at various levels of sophistication, to refine many areas of the system. The choice of not-for-profit model was also part of carefully conceived strategy to mobilize support.

> *"The real difference between running a system with a not-for-profit like in Minneapolis and here in Hamilton, and say a corporate entity, is that there's a qualitative difference in how the community perceives and interacts with the bikeshare. And I think the fact that it's a non-profit has been the catalyst for building broader support for cycling generally. So even though it's framed very much as a transit project, in reality many of the social networks that supported it - and were strengthened by it - were around cycling. That was key actually. In fact bikeshare naturally connected so many networks; cycling, transit and safe streets but sustainability too."* (Pete Topalovic, TDM, Hamilton, 2016)

7.4 SobiHamilton: Objectivication

Systematization - Mediation

From a technological perspective, the artefact was conceived, designed and implemented with systematizations and valuative mediations as its overriding characteristics. The objectification process reflects the myriad of people and organisations, rationales and philosophies that coalesced around its development to produce a platform with functional and socio-cultural value. The various layers of development and adaptation that the initial design concept experienced as it passed through Hamilton's political and cultural landscape (secondary instrumentalization) conspicuously reflect the interests and preoccupations of a city in transformation. The concretized design incorporates multiple agendas, objectives and values, and expresses them as their technical equivalent. The socially sanctioned patterns of network distribution, the goals and objectives which system data serve, the user - centric development of social and digital tools, even the alignment occurring at an industry level to produce common standards and specifications all represent the translation of discursive demands into system specifications. This eclecticism has made the process of integrating the scheme with its environment all the more effective, and introduces a third register to Feenberg's work, that of cognition or phenomenology. This relates to the subjects' immediate and *pre-discursive* reactions to the normative, aesthetic and imaginative potential of technology.

> "*Openness should be seen as an active participation through projecting the possibilities of things in the ethical and aesthetic imagination."* (Feenberg, 2013)

The design reflects this pluralism. Ontologically, SobiHamilton is as much a platform for citizen engagement, participatory design, and devolved governance as it is a piece of transit or cycling infrastructure; epistemologically, it is the product of both lay understanding and experience, and professional and institutional networks of expertise. The successful assimilation of a variety of technical capabilities and affordances, which have their genesis in such a diverse set of demands, empirically challenges the substantivist argument that technology discloses or reveals a culturally impoverished world, driven by functionalism and devoid of meaning. On the contrary, the secondary instrumentalizations seen here have created a technology that embodies a rich system of meanings and relations that reflect many ways of being and knowing.

The scheme also challenges the thesis that optimum design or efficiency is compromised by externalities like sustainability or democracy. Just as the distinction between technical efficiencies and external values is contingent on past social and political negotiations and conflicts, it may be that the technical code which evolved in Hamilton will form part of the canon which guides future development in other cities and across other projects.

The success of SoBi's technology suggests that this may already be happening. However, achieving the same level of contextualization (or systematization) achieved in Hamilton will require more than simply adopting a technology or architecture. The uniqueness of place, with all of its contingency and relationality, means a successful technology must emerge organically, at least in part, from the experiences and needs of those who appropriate it.

> "*There's no one optimal technical solution, there can't be. There are far too many factors that are not necessarily compatible across geographies. There are local laws and regulations. Even funding might be dependent on things like pollution and air quality mitigation which are factors that are not even across different cities and different systems. Then there are the demographics of your population and who you're targeting, the topology of the city, whether or not the weather supports the use of solar technologies, what kind of data are you interested in generating, what kind of cycling infrastructure is available to the scheme, and on and on and on."* (Project Manager, NABSA, 2016)

This captures the challenges faced by cities as they work to contextualize these technologies to meet the cultural and social needs of their citizens and it may explain why some cities, in the face of such complexity, either choose to implement off the shelf solutions - simply cut and paste from other cities - or allow the technical code to be controlled by private or bureaucratic interests which are motivated by profit, self-serving notions of efficiency or administrative convenience. These arrangements tend to produce technologies which have been isolated from social constraints and typically serve privileged interests. In other words, they exemplify primary instrumentalization and have a formal bias which bears the impress of autonomy and strategic positioning. From the perspective of Feenberg's critical theory, Hamilton is a reminder that development and the ideals it embodies are historically contingent – another refutation of essentialism - and as discursive power shifts within society then so too does the character and content of the technology it produces.

7.5 Cross Case Analysis

The form and function of institutional agency across both cities is perhaps the most pointed contrast between the two research sites. Dublinbikes was developed by a local authority with no prior history in, or expertise of, implementing transportation infrastructure (the provision of transportation infrastructure in Ireland is a function of the national government). As such, the project operated outside the scope of the National Transport Authority and so was neither aligned with, nor subject to, strategic policy objectives for either the state or the broader geographic area. This would have made any attempt to develop collaborative arrangements with individual transit operators (bus, rail, tram, etc.) problematic, especially in light of the competitiveness and friction that characterized the culture of transportation management in the capital. Therefore, the exclusionary practices employed by DCC contributed both to the degree of control exercised by the organisation in its handling of the project and to the scheme's subsequent partiality and bias. It also left the fortunes of Dublinbikes to an institution noted previously by Coletta et al. (2017) as having a series of systemic issues (i.e. a piecemeal approach to strategy, an absence of joined up thinking, weak governance, a lack of formal engagement processes, limited skills capacity, and a staid cultural mindset with respect to procurement, experimentation and operations). The

absence of any remediating influences at state level has led, at least in part, to the production of a system which reflects and reproduces this dysfunction.

By comparison, SobiHamilton was supported and financed by the provincial government's transportation department and the project was required to co-ordinate with it its capital programme for regional transit development. Essentially, Metrolinx, acting in a supra-local capacity, used its position in the decision-making hierarchy to largely by-pass local governance and a fractious political environment which might otherwise have operated to resist the implementation. Once this potential impasse had been averted, Topalovic, a transportation professional with a wealth of experience operating within the bureaucratic and technical spheres, was well positioned to leverage his relationships with Metrolinx and other inter-city officials to integrate the scheme into Hamilton's transportation infrastructure. This process was supported by a climate of sharing fostered also by the Ontario government.

> *"That was expected from Hamilton, it was expected of all the provincial cities actually. So, in practice that's carshare, bikeshare, shared spaces and shared ideas right and technology allows to do all that effectively. It was expected for example that Toronto would help us with this project and they did. We're all in the sharing economy and we see value in that. That comes from the province. In a lot of ways, they call the shots; they set the tone."* (Pete Topalovic, TDM, Hamilton, 2016)

As a force shaping the nature of secondary instrumentalization, the impact of the province cannot be overstated. It contributed significantly to the structural, economic and cultural climate within which progressive executive decision-making took place and one could reasonably argue that without its active participation - and legitimization - the project may never have materialized.

We also see the effects of other sources of institutional and organisational agency permeating Hamilton's decision-making environment. The North American Bike Share Association, itself a construct of the National Association of City Transportation Officials, emerged in response to the need for reciprocity and collaboration across the industry. It also actively encourages creative problem solving (innovative dialogue, engagement and experimentation for example) as a way of promoting smart bikeshare and negotiating the technical and socio-political barriers constraining the industry. In effect, this congruence between governmental and industry stakeholders created an epistemic community which aligned to promote

particular values and rationales. Essentially, it represented a coalition of stakeholders who operated to advocate particular approaches to urban management and governance. In this instance, Metrolinx, NACTO and NABSA acted in loosely coupled yet complimentary ways to define a set of goals and normative assumptions which structured thinking and promoted certain practices and logics. The concept of epistemic community also resonates with Bijker's notion of the technological frame (1997). This refers to the shared cognitive frame of reference that characterizes how individual social groups or stakeholders perceive the technology production process. A frame may include the problem definitions, goals, rules of thumb, assumptions or strategies adopted by each group in response to the creation of a particular technology. In effect, a frame marks the boundaries between relevant social groups (Bijker, 2007). A high degree of coherence between these frames leads to an epistemic community of the type which emerged in Hamilton as a multitude of organisational and societal interests cohered around the concept that 'success' should incorporate equity, access and democratic participation as part of its rationale. By contrast, the isolationist mentality of Dublin's executive body precluded the development of any such coalition. Convergence here was largely between DCC and the operator JCDecaux, whose respective frames coalesced around the caveat that the scheme should first and foremost protect their interests.

At a municipal level, Topalovic's championing of SobiHamilton positioned him at the nexus of both macro and micro level forces shaping the socio-technical environment. In effect, he acted to synthesise and direct various sources of agency in a purposeful way. In the process, he created the conditions for a normative reconfiguration of governance practices.

> "*Engagement is certainly becoming more the norm here. So, yes, I would say I was an early adopter of new techniques, but the city is exploring new approaches now too. I mean we always did a lot of public information centres, but this project has helped us realize that public information centres don't work especially well. People don't come unless the issues are very contentious, plus the timing doesn't suit everyone and so on. So as a city we've had to adapt and I think we're doing that.*" (Pete Topalovic, TDM, Hamilton, 2016)

This kind of remediating agency resonates with Feenberg's notions of organisational subordinates operating to subvert conservative regimes, making them amenable to cultural and structural reconfiguration. Perng (2017), commenting in a similar vein,

notes that this form of leadership can operate to destabilized government as a centre of control, knowledge and expertise and also disassemble and relocate 'the government' as a locus of innovation into the context of everyday life.

Under the influence of Topalovic's initiative, we see the production of knowledge, expertise and technology become reconfigured to operate through universities, civic organisations, bureaucrats, technologists, environmental groups, community advocates and citizens. Through a process of collaboration, we see the emergence of an open, inclusive and participatory form of governance which articulates the values, viewpoints and practices of a diversity of stakeholders. This also embodies the notion of 'agonistic' relationships noted previously (Bjögvinsson et al., 2012; Perng, 2017), i.e. the concept that diverse and sometimes conflictual interests can, through experimentation, negotiation and consensus building, create progressive networks of technical and human infrastructure.

> "*Competing alliances can build on incompatible views and practices where social, technological and institutional arrangements in support of these views and practices assemble differently motivated initiatives, individuals and governmental units and agencies to participate.*" (Perng, 2017: 6)

The articulations of urban governance in Hamilton also resonate closely with those advocated by urban planner, Patsy Healey, who proposes that constructive and just government should incorporate forms of what she describes as *inclusionary intention and argumentation* and *participatory discursive democracy'* (Healey, 2006). These modes essentially synthesize the formal aspects of government, which provide structure, rules and resource allocation (hard infrastructure), with consensus and relationship-building, and mutual learning (soft infrastructuring). As evidenced in Hamilton, these forms and practices are likely to cultivate social, intellectual and political capital to *promote co-ordination and the flow of knowledge and competence among the various social relations coexisting within places. (Healey, 2006; 239).* She goes on to note that the practice of planning should be cognisant of the concerns of all members of a political community and, as such, all members should have the opportunity to express their views, and to challenge decisions made on their behalf, through rights and opportunities coded in the process. The democratic forms emergent in Hamilton, based as they are on dialogue, negotiation, and accountability, offer such safeguards.

While the success of SobiHamilton is clearly a function of the governmental practices supporting it, it is also true that the nature of the infrastructure and its particular design were instrumental in augmenting this process. Healey notes, for example, that participatory governance, due to structural, economic or other contexts, may struggle to deliver positive outcomes for disenfranchised communities, however the inherent generativity of SoBi's architecture has supported the capacity of both hard and soft infrastructures to reconfigure patterns of resource distribution. It achieved this by encouraging a culture of experimentation and disruption. Discussing generativity, Zittrain (2008) observed that:

> "*A less generative device may work more smoothly because there is only one cook over the stew, and it can be optimized to a particular perceived purpose. But it cannot be easily adapted for new uses. A more generative device makes innovation easier and produces a broader range of applications because the audience of people who can adapt it to new uses is much greater.* (Zittrain, 2008: 30).

Significantly, this openness to possibility was achieved organically and in the absence of an overarching or highly articulated smart city narrative. 'Smart', in the context of this project emerged as signifying a set of understandings and practices concerned with pragmatically addressing real urban problems and encouraging changes to mobility practices which are sustainable – socially, environmentally and economically. In this sense, it is deeply implicated with a broader articulation of a city in the process of political and cultural reconstruction and one committed to using technological infrastructure as a vehicle for achieving real democratic reforms. This resonates closely with the 'real' smart city as envisioned by Hollands (2008) which positions ICTs as enhancing democratic public debate about the kind of urban spaces citizens wish to live in. Hamilton is also paradigmatic of a broader culture of sharing which, as noted by Agyeman and McLaren (2009), stands in opposition to entrepreneurially motivated development. They propose that the sharing culture challenges the discourse of the instrumental smart city, and, by extension, its preoccupation with inward investment through the development of a 'high-tech core'. It positions the culture of sharing and collaborative consumption being developed in Hamilton as a vison of how the smart city may disconnect from a purely competitive, profit-motivated agenda.

By contrast, Dublin demonstrates a fundamentally different governmental terrain; one which espouses decidedly anti-political and elitist ideals. While neoliberal forms of governance may consciously foster cooperative practices by cultivating partnerships and alliance, such alliances typically function to support economic innovation. As noted (somewhat prophetically), by Healey (2006), such alliances may become merely mechanisms for the reconfiguration of the institutions of government for the benefit of corporatists elites. This broadly resonates with the rationales and ideologies informing Dublinbikes which can be positioned within a view of the city proposed by Florida (2005). He suggested that urban policy should be focused on tending to the lifestyle and consumption choices of the middle classes as a way of transforming the city into a creative and, by extension, economically productive hub. However, as Peck (2005) notes, the realization of these policies in the real world typically result in forms of segregation and gentrification which are ultimately incompatible with social cohesion and broader notions of community building.

From the perspective of democratic representation, Dublin did produce a coalition of 'implicated publics' but one which developed reactively and in resistance to explicit forms of suppression and exclusion. Whereas civic activism in Hamilton was energized at the outset by a variety of municipal actors operating in tandem with Topalovic, Dublin's coalition - comprising environmental and community campaigners - developed in response to practices explicitly formulated to exclude democratic representation. Given the extent of DCC's control, however, this coalition failed to develop sufficient momentum to pressurize change. In a manner which resonates with previous research conducted by Fox-Rogers et al. (2011) and Grist (2008; 2012*)* we see a systematic interpretation of planning and development regulations aimed at protecting both private sector and bureaucratic interests. Many of the major decisions associated with the project were engineered to remove the legal requirement for public engagement, while others were positioned to significantly limit their exposure to subsequent processes of evaluation and arbitration. In addition, a prohibitively expensive appeals process essentially acted in concert with a policy of deliberate obfuscation to frustrate democracy and marginalize voices of dissent.

Where decisions were subjected to a formal appeals process, we see the appeals board act, contrary to the advice of its own investigators, and in contravention of Planning and Development regulations, to facilitate DCC in expediting the project. Here, the effects of national politics, the reliance on public private partnerships and

the shift towards corporate modes of governance, materially influenced the behaviour of a statutory body with responsibility for regulating the planning activities of local authorities across the state. This serves as a verification of observations made by Murphy et al. (2014). Reflecting on An Bord Pleanála's complicity in ongoing process of neoliberalization, they note that:

> *"The Board [appeals board] must now have regard in discharging its functions to include the 'national interest', it may be deduced that economic interest rather than the 'common good' was intended by the legislation to provide broader scope and justification for granting permission for an application that materially contravenes the development plan. Taken together, it can be seen that the role of the Board has shifted from decision maker to a facilitator of development and has increased the already privileged position of private development interests relative to the general public. (Murphy et al., 2014: 58)*

The result was a form of mutuality or reciprocity which operated to maintain the political and cultural status quo at both a municipal and national level. In effect, this also comprises an epistemic regime but one which understands success in terms of self-protection and neoliberal development. Aligning Dublinbikes within a smart city discourse of openness and innovation has been a transparent attempt to mitigate this and reposition the scheme as delivering benefits which, in reality, are largely absent. Here the smart city construct has essentially acted as a form of what Meyer and Rowan (1977) described as organisational decoupling - creating and maintaining gaps between symbolically adopted formal policies and actual organizational practices. In effect, it involves organisations maintaining policies which ensure legitimacy in the eyes of stakeholders while simultaneously maintaining the status quo for practical, cultural, or ideological reasons (DiMaggio & Powell, 1983). For Dublin, the smart concept has operated largely as a branding exercise devised strategically to position the city as a centre of economic, technical and social innovation.

However, as a technology which embodies spatial and economic bias, Dublinbikes represents a metaphorical and literal expression of the structural and cultural problems characterizing urban governance more generally. This disparity between rhetoric and reality is likely to continue. As noted by Coletta et al., (2017), Smart Dublin - the organisation established to coordinate and manage Dublin's smart city programme - has no control over many of the initiatives being implemented across the city. Its function is one of articulation (creating a smart city narrative), initiation (introducing new potential projects and partnerships to the city) and promotion

(marketing Dublin as open for smart city businesses) (Coletta et al., 2017). It is therefore unlikely to have sufficient executive authority to address many of the political and cultural problems which produced Dublinbikes. Since its inception in 2015 it has:

> *"… little addressed the existing accidental and uncoordinated nature of Dublin as a smart city and in many ways actively contributes to that accidental nature through proliferating smart city projects that are largely uncoordinated and non-interoperable beyond a shared, overarching narrative."* (Coletta et al., 2017)

Dublin's smart city therefore has proven little more than an entrepreneurial governance strategy concerned with economic development and with a marked absence of any practical initiatives likely to promote social and political inclusion. In this regard, it merely perpetuates the culture of institutional autonomy it was supposedly created to address and creates forms of citizenship unlikely to challenge the underlying political and ideological rationales shaping urban development. Accordingly, Dublinbikes is implicated in a much broader process of identity making informed by the imperatives of the market and bureaucracy rather than by rights, entitlements and fairness.

7.6 Conclusion

The collective findings from this research, understood through adapting Feenberg's framework, demonstrate that technology is not value neutral but is inherently political and embodies the abstractions, values and cultural assumptions shaping the technical code within which production takes place. The inclusion of a feedback loop in Feenberg's conceptual framing between concretized design and ongoing process of instrumentalization also provides the conceptual apparatus to understand, map and problematize the dichotomy between the static nature of Dublinbikes and the emergent and responsive properties of Hamilton's scheme. The findings also demonstrate the potential of remediating strategies to resist the imposition of technocratic, instrumentalist modes of thinking by empowering marginalized groups, alleviating inequality and fostering social cohesion. However, the capacity of such interventions to create new and citizen-centric socio-technical arrangements was shown to be conditional on a multiplicity of situated and context dependent forces operating at various spatial scales. It was the alignment of these forces in Hamilton that allowed deep democratization to emerge which acted to systematically address many of the

structural, procedural and operational barriers to equality identified in the smart bikeshare literature.

Within this environment smart bikeshare emerged not purely as a form of oppositional counter cultural challenging the orthodoxy of private mobility but also as a positive framework of human and technical capital through which new and emancipatory modes of governance have been explored and enacted. These emergent practices have already led to more inclusive forms of policy making and implementation practices across the city. In addition, the alignment of bikeshare with a network of transit and related infrastructure supported the creation of knowledge regimes sympathetic to pluralism and urban justice and leveraged the scheme's potential as a nexus of tactical urbanism. In effect, SobiHamilton has been the source of new discursive frames which institutional and civic actors have assimilated into their respective organisations and communities leading to the creation of new political identities and new forms of technical agency. This is in marked contrast to Dublin where historic ways of knowing and working have been masked behind a veil of obfuscation and where institutional and state actors proved unwilling to make the ideological and practical leap needed to support meaningful learning.

More generally these cases are a reminder that despite the pervasiveness of a mode of technology production characterized by capitalist-bureaucratic norms, there remains the potential for another type of modernity; one which embodies fundamentally different articulations of subjectivication and objectification. Feenberg (2010) proposes that this would be achieved through the democratization of technically mediated institutions where power would migrate away from centralized control and towards historically subordinated actors.

> "*As more actors gained access to the design process, a wider range of valuative considerations would inform technical choices. These formal changes would result in new technical designs and new ways of achieving the efficiencies that characterize modern technological activity."* (Feenberg, 2010: 77)

This framing resonates closely with the technical praxis seen in Hamilton; a praxis that has produced a technology which reflects Simondon's notion of progressive concretization and Feenberg's equivalent concept of layered innovation, i.e. the iterative process of condensation by which intrinsic (technical) and extrinsic (social) variables, emerging from different regions of society, come to define the instrumental

and normative character of realized devices. It is also the process by which function and meaning – the double aspects of technology – are merged and preserved.

In this sense the research re-affirms the value of studying socio-technical systems as a way of mapping and problematizing broader processes of urbanization. Socio-technical systems are an assemblage of cultural, political, economic, historic, aesthetic and technical elements and, as such, their production becomes an enactment or instantiation of broader processes of urbanisation. As illustrated in this research, critical refection on the nature of technology production makes visible the relationships, processes, contingencies and interdependencies shaping cities and so provides the conceptual means to understand and address urban problems systemically rather than symptomatically.

In conclusion, the cases are a reaffirmation that so long as our engagement with technology is conditioned by, or subordinated to, a mere 'enframing', then an improvised, decontextualized experience prevails. However, when the technical code supports a free engagement with technology through appropriation, experimentation and dialogue, then the tools (and identities) created have the potential to be radically different in character. Meaning, in all of its complexity, can be expressed (or substituted) through innovations and functional design attributes and, in the process, the nuance and subtlety of the human experience can be captured through technical potentials. As seen in Hamilton, this will require new forms of technical citizenship to identify and pursue new opportunities and new directions of progress. Whether or not this will happen is open to question. As Feenberg (2011: 13) has noted: *"all theory can hope to do today is to identify open possibilities, not confidently predict the future."*

Chapter 8 - Conclusions

Introduction

This thesis has explored how design and implementation practices unfolding in different geographic locations and conditioned by situated contexts operate to pattern the delivery and operation technology. The study was particularly concerned with the ways in which the technopolitics charactering particular sites of production led to fundamentally different articulations of the same technical proposition; articulations which preserve and perpetuate contrasting notions of citizenship, equality and democratization. The research was investigated through an exploration of smart bikeshare systems and their heterogeneous assemblages of technologies, actors, institutions, practices and processes which act within, and respond to, a diversity of historical, political and economic variables. As such it offered an opportunity to unpack and problematize the praxis by which these technologies were actualized in the real world and in the process address the projects' primary question: that is, how may the design and implementation of smart bikeshare systems preserve notions of equality, democratization and smart citizenry?

The approach to answering this question has been twofold. Firstly, it required a comprehensive review of the smart bikeshare literature to develop an appreciation of the structural and ideological barriers acting to undermine equity within the sector. This revealed the industry to be broadly aligned with the same processes of neoliberal and technocratic development characterizing the smart city and manifest primarily in the socio-spatial disparity characterizing the distribution of infrastructure. It is also evidenced in the bias inscribed at the level of design, acting to operationalize the exclusion of low-income citizens. Furthermore, the review highlighted cultural barriers to equity such as poor information exchange between cities and citizens which leads both to mistrust in city governance and an under-appreciation of the merits of cycling as a sustainable mode of transport. The review also noted that, for the most part, smart bikeshare has missed the opportunity to play a constructive role in cultivating an ethos of sharing and collaborative consumption and mitigating various forms of cultural and socio-economic disadvantage. Secondly, the project empirically examined the modes of production characterizing two archetypal systems, both to understand the rationalizations creating (and legitimizing) these barriers in a real-world setting and, as a counterpoint, to explore the types of remediating strategies

capable of (re)positioning citizens and communities as integral to the planning and design process. The study was supported by a theoretical framework developed from critical STS studies with the conceptual and analytic tools to analysis both the technical and ethical aspects of the system production.

The findings from the cases provide an important corroboration of much of the critical and participatory design literature which articulates agency as having the potential to resist a doctrine of decontextualization and bias and which embraces its capacity to foster reflexive, democratic rationalization. Within the context of this research this was demonstrated by SobiHamilton's capacity to operate not only in the technical realm as an example of innovative mobility infrastructure, but also to function through other, more normative, modalities. The system is informed by progressive notions of community, citizenship and sharing which position it as integral to, and reflective of, a new liberatory and inclusive politics emerging within the city.

This chapter leverages the findings from the study to develop a set of principles which, despite the variability and contingency of place, may be applied to encourage more equitable system design across multiple settings. The chapter also explores a series of policy recommendations, which together, are likely to provide the structural contexts to support such efforts. Implications of the study for theory are also examined and critically reflected upon. The chapter concludes with a series of recommendations for further research which are intended to compliment and extend the findings from this project and address some of the limitations inherent in the research design.

8.1 Design Implications

As previously noted, cities have typically taken developmental paths and forms which vary as a function of governance, legacy infrastructure, policy priorities, administrative geographies and dependencies with other places (Coletta et al., 2017). Furthermore, the particularities of the smart bikeshare sector introduce additional variability which contributes to the complexity of the design process, i.e. local laws and environmental regulations, funding opportunities, population demographics, prevailing weather conditions, urban topographies, data requirements, availability of cycling infrastructure, and so on. Hence, there is no one design solution that will work optimally in every environment. However, despite the relationality and dependencies of place, the findings from the research make possible a number of recommendations

for equitable system design, especially when placed within the context of existing literature and prior scholarship.

While 3rd generation schemes may have represented considerable progress in the mid-to-late 2000s with respect to previous iterations of smart bikeshare technology, this design has been superseded by approaches which can be loosely described as next or 4th generation, models. These are characterized by both technical and social innovations, i.e. dockless architectures, GPS technology, enhanced integration with other modes, and the incorporation of collaborative digital platforms and web technologies to encourage reciprocity and facilitate improved communication with riders. The model developed in Hamilton, however, represents an important fusion of 3rd and 4th generation approaches by synthesizing, and developing on, key aspects of both.

The retention of a 'network'– essentially comprising bike rack hubs – is an important innovation that offers service users a degree of predictability while also providing municipal authorities with a means of managing the distribution of infrastructure. As a design principle, this should act to reduce the anxieties of cities either new to bikeshare or wishing to transition from legacy systems. A number of cities have recently expressed concern for example that a wholly dockless approach would result in bikes accumulating in an ad-hoc, unregulated way, creating urban chaos in the process (New York Post, Aug 11th, 2017). SoBi's solution resolves this dilemma by offering local authorities both flexibility and control.

Furthermore, the cost differential between bike racks and the hardwired, digital stations required by 3rd generation schemes significantly lowers barriers to more equitable service provision. In practice, the flexibility of SoBi's architecture has been the catalyst for approaches to infrastructure distribution which would otherwise have been untenable:

> *"This [Sobi's approach] represents a sweet spot. I mean you have a lot of flexibility about where you install these hubs, there's no heavy-duty wiring to worry about, there's no physical work required on the street to install them so when you run a community input programme you can actually deliver a lot of those suggestions. I mean, there can be a lot of constraints with other kinds of infrastructure, but with this hybrid model the distribution patterns can reasonably reflect the input."* (Bikeshare designer, Motivate, 2016)

In addition, technical innovations, such as GPS, geo-fencing and a variety of GIS and social media tools, when configured sensitively, have acted to create synergy between the scheme's physical and informational components while simultaneously enhancing equity, participation and performance. The design approach has also addressed the systemic nature of technology by positioning the scheme within a supportive framework of dynamic pricing structures, training, citizen-centric operations, and collaborative decision-making which have reduced friction and encouraged meaningful integration with the city's cultural and technical spheres. How such processes unfold in contextually disparate environments may of course vary, however, the normative and technical tools used in Hamilton should offer design stakeholders a way of understanding how technologies and people may combine in mutually beneficial ways.

In this sense, the research is an important corroboration of the emerging consensus within the bikeshare literature which, while acknowledging the role of emergent technologies in addressing issues of equity, emphasizes the need for consensus building as integral to the development of sustainable and socially responsive programmes. While SoBi's design architecture may offer practitioners a useful archetype or staring point from which to conceive solutions, the co-operative principles seen in Hamilton may also be mobilized to adapt other configurations. Paul DeMaio, bikeshare consultant and Manager of Washington DC's Capital bikeshare scheme, reflecting on the evolution of the city's scheme, observed that:

> *"So, in 2008 we had a system here [Washington] which had fixed stations which required a 6 months period or more for the local electricity company to make operational and so service took a long time to get up and running. We're now using solar stations which take an hour and a half to put in, or to take it out for that matter. That has allowed us to be far more responsive. It has also meant that issues of accessibility can be worked through with local communities far more effectively."* (Paul DeMaio, practitioner, 2016)

DeMaio, under the guidance of the city's Chief of Commuter Services, has also developed engagement processes which echo those seen in Hamilton i.e. the use of survey tools, social media platforms, interactive maps and so on.

Even when technical innovation is not an integral part of the process, programme development can still act as a form of social cohesion by motivating communities to take a proactive role in shaping their environments. Sarah Shipley,

programme manager of Kansas City's bikeshare, which uses a standard 3rd generation networked design, explains:

> *"I guess what's different in our case, is the way we went about implementing it. We saw it very much as a form of advocacy and used the spirit of co-operation you find here in the mid-west and treat it essentially as a 'barn raising' exercise. More than 100 volunteers gave their time to put the bikes together and get the system up and running. Many still come back and help out when they can."* (Sarah Shipley, practitioner, 2016)

What Hamilton and these additional examples from Washington and Kansas emphasize, is the socio-technical nature of system production and the potential of collaborative and integrative practices to materially influence technical activity. In terms of implications arising from this thesis, they demonstrate the capacity of such processes to produce modes of design and development which embrace reasoning as a wider activity than seen in much of the industry to-date. In Dublin for example, despite opportunities to reconceptualise its system with the help of community and academic partners, the scheme remains an indictment of the instrumental model of production, with design practices operating within the strict imperatives of autocracy and control. As such, it represents as important empirical example of how self-interest and indifference to social contexts are ultimately antithetical to pluralist forms of knowledge and design praxis.

In sum, while certain technologies and architectures have inherent in them an additional capacity to encourage a climate of reciprocity and experimentation, the outcomes for citizens are far more likely to be dependent on the willingness of decision-makers to engage meaningfully with a diversity of interests and realize such interests using the technical means at their disposal. As such, the resocialization of technology through processes of secondary instrumentalization is not conditional on a set of historic technical conditions. Rather, it requires a critical sensitivity to circumstances and opportunities which may make systems more just, legitimate and practical.

As the research has demonstrated, however, the world of design does not operate in a vacuum. Decision-making at the proximate level is intimately linked to the broader regulatory and economic environments and so realizing smart bikeshare's political and instrumental value to cities can be supported through a number of policy initiatives which are discussed below.

8.2 Policy Implications

The findings from the case studies, and from the work of previous scholars, make it axiomatic that developing public smart bikeshare within a framework of integrated planning and strategic development is essential to ensure it contributes meaningfully to the transportation eco-system and by extension to the amelioration of social and economic disadvantage. Configuring schemes to be tightly coupled with public transit for example leads to a high degree of interoperability with other modes, increases mobility, and maximizes its potential to support public health, manage congestion, support environmental objectives and reduce socio-cultural disadvantage. Realizing this potential will require decision makers operating at local, provincial and national scales to embrace smart bikeshare as a legitimate public transit mode and ensure its support though access to key resources such as public land and sustainable funding.

> *"We subvent our railways and we subvent our bus services. Why shouldn't we subvent our bikeshare schemes? Relying on advertising models is basically saying that it isn't really public transportation at all. Of course, one of the failures of the economic system we have is that the external costs aren't absorbed by the user. If we put the full carbon, social and environmental cost onto the different transport modes I suspect bikeshare would be far better funded."* (Planning Professional, Dublin, 2016)

This also resonates with policy recommendations from the European Cyclists' Federation policy framework for smart public-use bikesharing which emphasises the importance of *a* sustainable, equitable use of public resources, *"be those direct or indirect, taking into consideration all costs of such systems, and not socialising private costs while maximising private profits."* (European, Cyclist' Federation, 2017: 2)

This process of integration is likely to be more effective when overseen by state transportation authorities, operating in conjunction with dedicated local expertise. Metrolinx, for example, has responsibility for strategic planning, the development of integration across public modes and the promotion of active transportation (walking and cycling). State authorities are also likely to have responsibility for technical integration such as ensuring the alignment of information systems for public transport customers and managing integrated ticketing for example. While SobiHamilton is aligned equitably with its physical transit infrastructure, increased technification is likely to bring additional challenges associated with digital interoperability. As such, Hamilton should engage proactively with this issue at the outset in order to avoid the

potential difficulties associated with retrospective planning. Given the flows of transport delivery to-date and the priority that provincial authorities have given the transit landscape more generally, one would reasonably assume that this process could be managed effectively and in a climate of co-operation.

State agencies also typically have responsibility for procuring and licencing transport services provided to cities by private operators. As such, and in the event that bikeshare services are not provided in-house, they are likely to have the experience and expertise to ensure the interests of the general public are preserved through robust procurement and contract management. Had the National Transport Authority in Ireland, for example, been the commissioning authority for Dublinbikes then one might reasonably expect that many of the operational, technical and strategic issues associated with the scheme would have been averted, i.e. unstable funding, unregulated service quality, technical lock-in and path dependency, an absence of system development, physical and digital isolation and a lack of control/ownership of key infrastructure. Furthermore, given that such authorities operate exclusively in a transportation capacity, they are less likely to be compromised by municipal politics and local institutional inertia which could act to undermine their capacity to pursue solutions independently and in the public interest.

Where state authorities wish to divest responsibility for managing schemes to a third party, then the use of not-for-profit organisations may represent a productive way of simultaneously controlling the participation of private capital while also supporting citizen focused innovation. As noted by Besley et al. (1999), private sector activity in the public good is value-driven while non-profit organizations are typically motivated by altruism and a desire to help the beneficiaries of public goods. In addition, Solana (2014), proposes that public, private, not-for-profit partnerships (PPNPs) tend to produce arrangements characterized by improved trust, a willingness to take risks, enhanced reciprocity and more sustainable outcomes. The experience from Hamilton serves to emphasize this point.

While many cities have opted to implement single operator systems, there may be value in considering the proposition of creating hybrid public/private or multi-player eco-systems. The European Cyclists' Federation (2017) for example has proposed that licencing private systems to operate in tandem with state owned, public infrastructure could address historic problems of uneven service distribution and develop bikeshare as an equitable mode available to under-represented demographics.

> "*Eco-systems need to be created to allow, if not actually incentivize multi-competitor environments to drive innovation and service to the community. A carefully designed service area strategy for all forms of public-use bike share is a critical component of a wider urban mobility strategy for any city / metropolitan area, tailoring it to local needs and desired outcomes."* (European, Cyclists' Federation, 2017: 3)

Such arrangements should be properly regulated to ensure positive outcomes for citizens and implemented to address issues of system interoperability (through common registration and payment processes, information exchange and integrated ticketing for example) thereby supporting ease of use across systems and administrative jurisdictions. Dublin for example has recently licenced two operators – 'Urbo' and 'Bleeperbike' - two dockless bikeshare companies, to run alongside the existing Dublinbikes scheme (Ginty, 2018). In the coming months, it is expected that these schemes will expand into Dublin's other local authority jurisdictions. The interactions and dependencies that develop between these companies and municipal actors will indicate the implications of such arrangements for transportation disadvantage, social cohesion, urban justice, the culture of sharing and so on. These new arrangements may also have implications for design itself. As an initial constraint, the licencing arrangement in Dublin requires users of these schemes to dock bikes at traditional bike racks, which essentially means that SoBi's hybrid approach to architecture is the one being implemented. The two vendors have also already collaborated on a common registration process, which means that signing up to either system will allow new members to use the services of both companies (Duffy, 2018). Developing co-operative and reciprocal relationships with these operators might effectively extend the reach of Dublinbike's with improved outcomes for access and service quality.

'Smarter' bikeshare will also be dependent on the production and sharing of fined-grained, spatio-temporal data, which can support ease of use, operations management (geo-fencing, system rebalancing, station siting, theft-prevention/unauthorized use and so on) predictive modelling and optimization, modal integration, strategic mobility planning and collaborative forms of innovation. DublinBike's RFID based data, which was proprietary until 2013, has limited capacity to meaningfully enhance these processes. Data is also important in positioning smart bikeshare as a form of mobility-as-a-service and as part of the broader IoT eco-system. The creation of the General Bikeshare Feed Specification (GBFS) in North America

has been important in this regard by providing publicly available, standardized data sets that can be incorporated into mapping, navigation and transit platforms. Through SoBi, the standard has already been used to support integration with 3rd party transportation apps which, in addition to providing riders with real-time, multi-modal information, allows them to manage registration, booking and payment processes without the requirement to interface with the vendors' website. As discussed in Chapter 6, the standard emerged from a coordinated effort by vendors in North America which, in addition to open data production, has also worked to negotiate barriers to bikeshare penetration through information exchange and collaborative problem-solving processes. A similar initiate in Europe, developed in under the auspices of the European Commission from Mobility and Transport for example, would be an important mechanism through which the industry, municipalities, citizens and stakeholders might work in concert to achieve mutual goals.

As discussed in Chapter 5, smart bikeshare may also function as an environmental sensing platform in a manner operationalized in MIT's Copenhagen Wheel project. North American cities Portland and Chicago, and Fukushima in Japan, have already begun experimenting with these technologies to produce data which supplements information generated from municipal sensing networks (Curtis, 2015; Beser, 2016; Bousquet, 2017). When combined with the appropriate GIS tools, riders can support this process by creating important secondary data and in the process broaden the scope of bikeshare to include the dimensions of collective production and eco-collaboration.

In Hamilton, it was observed that the availability of data (routes traces and usage patterns) could be a catalyst for social and environmental activism by enabling communities to problematize municipal decision-making and advocate more effectively for access to bikeshare and related cycling infrastructure. This reaffirms bikeshare's potential as a political platform through which democratization may operate.

Exploring smart bikeshare as an environmental platform might also be a useful way of mapping the skills, practices and structures required within state institutions to assimilate a variety of data (GPS, audio-visual, temperature, noise and so on) into business-as-usual activities.

> *"So, you might think using bikeshare data hinges primarily on the willingness of private operators to make their data available to cities. There is that aspect to it of course, but without a framework in place to use it productively then it's just going to wind up abandoned somewhere. You need people with expertise, but you also need a culture that supports combining data from across different parts of the city to tell bigger stories."* (Outram, 2016)

In the right context therefore, smart bikeshare may act as a catalyst for orienting siloed municipalities towards 'process' rather than 'functional' excellence, i.e. encouraging a more flexible approach to management which mobilizes resources from across traditionally distinct functional areas. Using data this way might have utility for a city such as Dublin for example, where the administrative terrain is disconnected and uncooperative.

In sum, and considering its potential instrumental and political value, bikeshare data should be open and accessible, and sufficiently granular to maximize its utility across these domains. In addition, and to address ethical concerns, the use of private data should be in accordance with data security and privacy legislation. In the case of Europe for example, this would include the hosting of such data within European geographic and regulatory space, where protective legislation can be meaningfully applied. Given the risks as described in Chapter 3, data should also never be shared with, or sold to, third parties without the appropriate consent.

8.3 Implications for Theory

This project has been an important confirmation of the role of ideology and politics in the production of technology. Using an analytic framework which explicitly incorporates these dimensions has allowed the research to map and critique the rationalizations and ethical considerations operating to materially shape both the instrumental and valuative aspects of system design. A number of interpretative or post-structural approaches were considered at the outset, but as described in Chapter two, these adopted ontological positions which lacked a critical core and limited their capacity to produce useful insights. SCOT, for example, excludes consideration of pre-existing power relations from the design process assuming as it does that all 'relevant groups' are present during the process of innovation. As such, only those groups actively influencing design can be represented using this model. Therefore, groups marginalized or excluded by power asymmetries essentially become invisible. The theory also focuses largely on the proximate influences shaping production and as such

is incapable of adequately accounting for the effects of the wider socio-cultural and political milieu. Other sociomaterial approaches are equally problematic. They propose an ontological position where human and non-human actors (technical artefacts for instance) are essentially indistinguishable, with the characteristics or essence of each being an emergent property of the networks within which they participate. Poststructural approaches such as these may have some epistemological value in highlighting the ways in which knowledge and discourse are constructed through the negotiations of key actors and at an ontological level they also recognise that technology 'matters', i.e. through its engagement with humans it can effect material and symbolic changes in the world. However, the primary problem of politics and power remains. Theoretical positions such as actor-network or assemblage theory, for example, lack a meta-narrative or ontological framework which prioritizes the role of inequality, injustice and struggle in shaping urban processes. Referring to assemblage theory, Brenner et al (2011) note that it attempts to reframe such processes with no reference to key concepts and concerns to critical urbanism such as:

> "*…capital accumulation, class, property relations, exploitation, state power, territorial alliances, growth coalitions, structured coherence, uneven spatial development, spatial divisions of labor and crisis formation, among others. Yet the social relations, institutions, structural constraints, spatiotemporal dynamics, conflicts, contradictions and crisis tendencies of capitalism do not vanish simply because we stop referring to them explicitly."* (Brenner et al., 2011)

The result is what Sayer (1992) describes as a 'naïve objectivism' which presupposes that the rich descriptions of the relationships and interdependencies between human and non-human actors that it produces are self-explanatory rather than requiring mediation by "*theoretical assumptions and interpretive schemata*".

Critical theory of technology addresses these shortcomings by understanding technology production as a dialectical process within which design (and the rationalizations producing it) operates to support the way of life of one or another influential social group. As such, while it is cognisant of specific social groups and the strategies they employ, it also focuses on the broader cultural resources and taken-for-granted assumptions brought into play in the design processes. These in turn are conditioned by political and bureaucratic ideologies, such as modes of governance, capital accumulation and the preservation of hierarchy and authority.

Instrumentalization theory supports an exploration of how these ideologies operate in practice through constitutive and implementation bias to produce technologies which conform not only to the plans and interests of particular actors but to produce and reproduce historically constituted power relations and socio-cultural forms. Furthermore, it also provides the normative and analytic tools to explore how oppressive or anti-democratic orthodoxies might be subverted and more socialist technologies created for the common good. In effect, it problematizes 'regimes of truth' informed by technocratic and instrumental reasoning and advocates instead a reflexivity which produces new identities and socio-technical practices.

Within the context of this research, instrumentalization theory allowed the production of smart bikeshare to be understood explicitly as a process of political contestation with the meaning of systems dependent on the social, economic and cultural contexts from which they emerged. It also allowed the research to map two fundamentally different smart city ontologies. In Dublin the smart city construct – promoted as a platform for enhanced participation, collaboration and consensus building – emerged as essentially illusory. In reality, it serves powerful private interests and is, for the most part, a collage of disconnected projects given apparent coherence through discourse and image management. Hamilton, where the 'smart' construct is as yet embryonic, is beginning to formulate a strategic direction and an associated set of policy initiatives – primarily around transportation – within which pragmatic, solution-oriented decision making can occur. Based on the evidence thus far, should an overarching smart city narrative emerge here, it is likely to be one grounded in progressive notions of citizenship and rights to the city. In effect, Hamilton is defining a different technical code and one with social value at its core. In this sense the bikeshare schemes can be seen to be reflective of, and conditioned by, fundamentally different articulations of the smart city.

In addition, the adapted conceptual model of the design process provides the additional means to understand technology's post-implementation responsiveness to changing technical, social and environmental imperatives. As noted in chapter 7, this adaptation emphasizes that concretized solutions, rather than be an end in themselves, may incorporate new technologies, ideas and discursive frames when guided by reflexive rationalizations and integrative practices. Conversely, it serves to highlight the visibility of those systems which remain resistant to such influences. Since the implementation of DublinBikes for example, the city has continued to experience

technological change, with citizens continually adopting new technical devices and solutions, therefore, the static nature of the system, and the underlying reasons for it, have become more apparent and problematic. By contrast, SobiHamilton's willingness to continually adapt to technical and social variables has been one of its defining characteristics. Updating the formulation as proposed by Feng and Feenberg (2008) aligns the model more closely with instrumentalization theory and emphasises both the processual nature of design and the capacity of technical actors to materially reconfigure solutions, post-implementation. As such, it represents a more coherent theoretical and methodological lens through which critical analysis may be applied to other technical systems.

In this regard, critical theory of technology may be mobilized empirically to describe and critique design across multiple domains. Given the emancipatory agenda it shares with all critical theory, it may be most productive in sites where issues of contestation and democracy are to the fore. Not all technologies appropriate and shape people's lives in quite the same way. While the design and distribution of 'smart lighting' infrastructure, for example, may be no less the product of ideologically biased decision making, it is unlikely to inspire the kinds of concern, criticism and political activism seen in response to environmental or surveillance technologies. Nevertheless, this need not necessarily constrain its use. Feenberg's work has been used as an analytic lens to investigate the political implications of a diversity of technology design processes. These include gaming software (Grimes & Feenberg, 2012), online education platforms (Hamilton & Feenberg, 2009), surveillance technologies (Friesen et al, 2005), social media forums (Bakardjieva, 2009) and GIS systems (Hacklay, 2013), amongst others.

Important implications for theory then are that critical approaches to the understanding of technology are essential in accounting for the structural factors constraining democracy's ability to generate new ideas, knowledge and modes of practice, while also preserving the possibility of a world where change may be possible and desirable. There should also be close critical inspection of theoretical positions which avoid explicitly engaging with technology as political and in the process ignore the opportunity to investigate the role of macro-level historical and cultural forces working to shape outcomes. Such theoretical positions may act to depoliticize technology production, or inadvertently contribute to its reification as neutral.

8.4 Opportunities for Further Research

In keeping with the overall aims of the thesis, this section focuses on research opportunities which may develop smart bikeshare as an equitable and inclusive form of mobility. As such, it is concerned with complimenting and augmenting the findings from this project and in the process address a number of constraints and limitations encountered through the initial investigative process.

Longitudinal Study of Hamilton

A key difference between the cases in this study has been their relative maturity. Having been implemented in 2009, Dublinbikes represents a system which has developed and stabilized over an extended period of time. As such, the research findings from Dublin - and the analysis and critiques that followed - have an additional scope and reliability. By comparison, Hamilton is a relatively new system and, as a consequence, the narrative it supported is partial and incomplete. It remains to be seen, for example, how the scheme responds practically and ideologically to new economic, political and operational challenges, e.g. pressure from private capital, political or cultural resistance to system expansion, increased complexity in the city's transit environment (which, as noted previously, may strain processes of integration for example), or the threat of competition from other operators. Can Hamilton retain its core values of participation, equity and innovation or will pressures from the external environment produce adaptations that essentially empty the scheme of its valuative content? In addition, what impact, if any, will broader smart city developments have on this process? A longitudinal study would address these questions and, in the process, might identify strategies for enhancing democracy's resilience over the longer term.

The potential of legacy technologies

This research opted for empirical depth as a way of exploring the contingencies and interdependencies between design and place. While this approach produced theoretical insights which can be reasonably and logically applied to other sites of production, the findings could nevertheless be extended through research which focuses specifically on how the same conceptual design - incorporating the same potentialities - is realized in different locations. This might identify strategies likely to condition or recalibrate

legacy systems in order to make them more dynamic, functional and egalitarian. As noted in Chapter 5, for example, there is evidence of significant geographic variability in the nature of JCDecaux's architecture across Europe, with its system in Brussels operating in significantly more creative ways than its Dublin equivalent. As a starting point, a taxonomy of 3rd generation schemes aimed at categorizing deployment strategies and functionality would be useful in this regard and aid in directing more detailed analysis. Understanding how other cities have animated networked-based approaches though adaptations involving GPS and GIS systems, social media platforms, hybrid bikes or solar technologies may allow us to relate such innovation back to the social, political and environmental contexts within which it occurs.

Washington, for example, has demonstrated that the retention of networked infrastructure does not preclude experimentation with solar powered stations for cities with the appropriate climatic conditions. The concept may even be a technically viable option in Dublin. In May of 2018, DCC announced that, as part of its Smarter Dublin programme, it intended to provide the city with 800 solar powered 'compactor' refuse bins. By its own estimates, it foresees this initiative reducing the amount on on-street bins by 20% (Power, 2018). If the idea is feasible in this context it may also be possible to retro-fit Dublin's network (even in part) with modular units capable of being moved with relative ease and minimal cost. This would introduce an element of demand responsiveness currently absent in the system.

The historic contractual arrangements in Dublin, operating in tandem with institutional inertia, make this type of experimentation improbable, particularly in the short term. Should innovation occur in Dublinbikes, it is far more likely to be predicated on exploiting the capabilities of 'Urbo' and 'Bleeperbike' through strategic alliances and technical arrangements that address the partiality of its current configuration. As such, it represents an interesting opportunity to conduct longitudinal research which maps the unfolding dynamic between key stakeholders and its effects on issues of access and disadvantage. Will DCC be willing (or able) to exert sufficient influence to encourage the kinds of reciprocity already occurring between the schemes and Dublinbikes, or will intractability and indifference continue to characterize Dublin's institutional culture? What legal, regulatory and technical barriers might need to be negotiated as part of such a process and what role, if any, might implicated publics and engagement play? More generally, such research could contribute to our understanding of the potential of new, private entrants to the market to compliment

and extend legacy infrastructure for improved social outcomes. This research could be augmented by examining how other cities are currently negotiating this terrain. It may be, for example, that co-operative models are being developed internationally which have the potential to inform strategic planning and development in Dublin.

8.5 Concluding Remarks

Smart bikeshare is an emergent form of urban mobility with an inherent, but largely unrealized, potential to positively reconfigure the functional, cultural and socio-political rhythms of urban life. What this thesis has highlighted is the role of ideology in shaping the delivery and operation of systems and the capacity of design to translate and promote both neoliberal and democratic forms of governance. Realising the latter will depend on the imaginative capacity of key actors, operating at multiple spatial scales, to reconceptualise and restructure the ground rules and assumptions operating to create systems. Where collective reasoning, consensus building, and dynamic planning can be made to prevail, then schemes can be infused with meanings and values which transcend mere functionality or institutional self-interest. This is the challenge facing cities as they attempt to produce technology which meets social needs. Ontologically then, the thesis reaffirms Feenberg's notion that technology is best seen not as a thing but as a 'site of contestation' where the dialectic between operational autonomy and democratic rationalization plays out. The outcomes, at an ontic or case by case level, will either conserve social hierarchies and political regimes on the one hand or champion those values subjugated and marginalized by asymmetries in power on the other. It will be interesting to see how the smart bikeshare industry develops. Its trajectory should tell us if schemes such as Hamilton are mere peculiarities or if they are symptomatic of a more fundamental trend towards a socialist technology.

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Appendix 1: An Taisce Report on Advertising

LEGAL PLANNING AND ENVIRONMENTAL ASSESSMENT OF OUTDOOR ADVERTISING STRUCTURES IN DUBLIN.

An Taisce Dublin City Association
Tailor's Hall, Back Lane, Dublin 8. Tel. 01-4541786.
SEPTEMBER 1999

INTRODUCTION

Old photographs reveal that advertising billboard structures go back to the mid 19th century, and were particularly associated with railway stations from an early date.

By the mid 20th century a standardised form of outdoor advertising structure developed known as the forty eight sheet poster. This comprised a large timber framed structure placed on the gable walls of buildings in cities and towns to accommodate advertising posters which were printed nationally to a standardised form for advertising campaigns.

The 1960s and 1970s, in particular, saw a major growth in the use of outdoor advertising posters, and particularly of the forty eight sheet type, notably in Dublin city, including the derelict areas around the road widening routes.

In the 1980s, in a limited number of locations, much larger advertising structures forming double forty eight sheet hoardings for a single specially printed advertising image appeared.

On of two most significant developments of the late 1980s was the development of prismatic sign. This was based on the principle of accommodating three advertising images on a single site through rotating triangular strips. Another significant development which began in the late 1980s, but only had a significant effect in the mid 1990s was the use of smaller, illuminated, back-lit advertising panels, particularly on corner gable walls and on public houses.

In parallel to this development of public, on-street, outdoor advertising, has been the increasing use of advertising at sports grounds and sports fixtures, much of which is aimed towards being picked up by television programmes.

The other major area of outdoor advertising was the development of the illuminated, back-lit box incorporated into bus shelters, a design, which, while it goes back to the late 1970s, only became widely used during the late 1980s and throughout the 1990s notably in Dublin. This is awarded as a single contract by CIE, originally to Adshel, and now to More O'Ferrall.

LEGAL STATUS OF ADVERTISING HOARDINGS.

When the 1963 Planning Act came into force, all structures then existing were retrospectively validated including advertising hoardings. Photographs of Irish cities and towns of the period reveal an extensive distribution of hoardings on the gable walls of buildings, many of which would remain and would, therefore, have pre-1963 planning status.

The 1963 Planning Act required that any new advertising structures to get planning permission and in cases where structures were erected and maintained without planning permission for legal enforcement action to be taken against them.

The Situation in Dublin.

From the 1960s a pattern emerged of major non-compliance with the Planning Acts, which became particularly serious during the 1970s. Detailed studies on the situation in Dublin reveal that the majority of the advertising hoardings erected between the mid 1960s and mid 1980s were without planning permission. In the limited cases where planning permission was granted this was generally for a short-term period only. However, in most cases where planning permissions were granted for a limited time duration, say of two to three years, the advertising poster companies involved simply left the hoarding continuing to stand without applying for a new permission for its extended use. Between the mid 80s and mid 90s Dublin Corporation, in particular, operated a very obvious anti advertising hoarding policy in the consistency of its refusals. While a number of the prismatic signs erected in the late 80s and early 90s were granted temporary permissions, these were generally only for a few years duration, and the majority of these would now have expired.

The Corporation took a particularly severe look on the use of back-lit illuminated box signs, which have been refused permission on an almost entirely uniform basis.

Failure of Legal Enforcement Action.

Despite the generally negative policy by Dublin Corporation and, indeed, other Irish local authorities against applications for outdoor structures, this has been combined with an extraordinary inadequacy in meeting responsibilities for planning enforcement. Unauthorised outdoor advertising structures form the most visible element of illegal development in breach of the Planning Acts in Ireland, the number and extent of unauthorised structures, both in Dublin and other cities' local authority areas is a serious indictment of the competence of Irish local authorities in exercising their statutory planning enforcement functions. It is clear that advertising poster companies are quite plainly aware of local authority enforcement negligence and operate to a principle of braving out the illegal use of a site for more than five years, beyond which the local authority is then debarred from taking enforcement action.

The five year enforcement rule is a much misunderstood issue. The fact that an unauthorised development may have been allowed to prevail for more than five years without enforcement action being taken, does not in any way mean that it is authorised or legal. It does not change the illegal status of the development, which can only be validated by means of a planning permission. Furthermore, maintenance work to an illegal structure, even one more than five years old is itself illegal.

Another major issue complicating the illegal enforcement problem is the illumination of hoardings. Many hoardings which either had valid pre -1963 or were unauthorised have been treated with illuminated strip light panels which, in a significant number of cases, have no planning permission. This represents an unauthorised material alteration and change of use.

REAPPRAISAL OF NEED FOR OUTDOOR ADVERTISING.

Outdoor advertising accounts for seven per cent of advertising media spend. However, outdoor advertising as a medium predates television and the widespread circulation of colour magazines. For this reason, there are now serious arguments to suggest that it is no longer necessary, though clearly advertisers and advertising companies would not think this. Almost all forms of advertising have an incidental benefit in supporting the media, for example television, radio, newspapers and magazines. In addition to this, a number of specific forms of outdoor advertising also act as a subsidy, either to public transport through the use of hoardings on CIE railway stations, enable bus shelters to be maintained, or support sporting bodies and organisation on race tracks and football fields.

However, on-street poster advertising is unique in that it provides no incidental public benefit. It facilitates advertisers with an unfettered medium from which the public have no means of escape, provides commercial activity for outdoor advertising companies and, in particular, provides an income to property owners. The hidden parties in outdoor advertising, whose role is given far too little attention are the property owners who grant consent to advertising companies to allow their buildings to be used as a support structure for advertising hoardings and to derive a considerable income benefit as a result. There have, indeed, been cases where property owners have derived more income from advertising structures than from the functional rental use of the building itself, such as the O'Connell Street corner of Batchelor's Walk in Dublin. There is a direct correlation between property owners who are willing to accommodate advertising structures on their buildings and who at the same time have no visual or environmental concern for their own buildings, or for the quality of the surrounding area.

THE ADVERTISERS.

Outdoor Media Association.

While there are a large number of smaller advertising companies involved in the maintenance of structures of different types, the three major companies, which together have formed the Outdoor Media Association are David Allen (incorporating Summerbrook), More O'Ferrall and TDI. David Allen/Summerbrook is by far the largest company developing outdoor advertising structures of all types. More O'Ferrall was originally the leading outdoor advertising company, and is now the holder of the CIE bus shelter franchise. While it has a large number of forty eight sheet poster sites, a significant proportion of these would be either pre-1963 or dates from the 1960s or 70s, unlike David Allen, the major proportion of whose forty eight sheet hoardings would date from the mid 1970s. TDI holds the CIE bridge and rail and bus station contract, but through its acquisition of Metro, has acquired a number of older poster sites. The majority of the CIE sites, particularly those on railway stations would have pre-63 planning status.

A major survey conducted by An Taisce in Dublin during the summer of 1998 revealed that the largest proportion of advertising structures was held by David Allen. The following facts were discovered:

1. Fifteen back-lit illuminated box signs have been erected and maintained by David Allen without planning permission, the majority erected in the mid 1990s.

2. The majority of David Allen/Summerbrook structures either erected without planning permission, or where temporary planning permission was granted have been maintained beyond the expiry period.

3. The majority of forty eight sheet poster sites with no valid planning status, having been erected after 1963 without planning permission or beyond the expiry period of the planning permission. While it is acknowledged that the majority of these have been in place for more than five years, this does not validate their legality of planning status.

Other Advertising Companies.

There are a number of other smaller companies, including Canberra, Signways and Nitelites, which together would have a relatively small proportion of market share compared to the Outdoor Media Association members. With one exception, illuminated plastic box signs maintained by these companies were found to be without planning permission and the same ratio of unauthorised use was found in relation to prismatic hoardings and poster sites.

Discussions between Outdoor Media Association and Dublin Corporation.

With the recognition by both parties of the unsatisfactory legal situation with regard to advertising structures in Dublin, the Outdoor Media Association and Dublin Corporation have been involved in extensive discussions for the last 18 months. Advertising companies are now taking a more targeted approach in seeking to maintain or develop more high earning poster sites in traffic junction and areas which suffer from traffic jams. The terms of discussions between the OMA and the Corporation are based on the principle of the OMA offering the "removal of an agreed number of sites from a particular area in return for permission being granted for others to be retained or other new sites to be erected". Part of this is also motivated by the desire on the part of the advertising companies to use the Europanel site in order to accommodate standardised European outdoor advertising campaigns.

There are serious questions as to the degree to which Dublin Corporation is entitled to enter into a "deal" with advertising companies, as such discussions exclude prescribed bodies and interested property owners and third parties. When a planning application is lodged, a planning authority is obliged to take regard of the submissions from prescribed bodies and third parties. It would be very undesirable if the Corporation were to enter into a quid pro quo deal, say to remove sites from a number of locations in return for granting their retention or approval in others, if neighbours and property owners concerned about the amenity of advertising hoardings adjoining their own buildings and residences were excluded from the planning process by a prejudicial pre approval when the planning application came in. Most of the hoardings which the advertising companies are offering to be removed as part of this "deal" are in the secondary locations, which do not have major impact on traffic junctions, and most of them are also illegal, although having been left to stand for more than 5 years duration. It, therefore, represents a serious indictment for Dublin Corporation that it should be involved in a negotiated deal to secure the removal of hoarding structures, which the local authority itself should have taken legal action to remove at the appropriated time.

Unfair Involvement of Advertisers in Unauthorised Development.

There is a widespread lack of knowledge, both among the public and among the building community that the majority of advertising structures in Ireland are, in fact, illegal. Advertising poster erection companies, advertising agencies, the placement agencies which sell space on advertising hoardings to companies and the marketing departments of major Irish companies are all totally aware of this, but continue with the large scale use of unauthorised outdoor sites. Following the investigation made during the summer of 1998, An Taisce wrote to around forty advertisers and companies pointing out to them that they were using sites around the city which were illegal and that they therefore had initiated advertising campaigns without ensuring that authorised sites only would be used. The vast majority of companies in reply to An Taisce's submission expressed concern and surprise that this was the case, having entered into advertising campaigns in ignorance of the actual situation and undertaking to ensure that in future campaigns authorised sites only would be used. In the case of a handful of companies, they either refused to reply or stated that the legality of hoardings used by them was not an issue that concerned them, such letters generally being written in the expectation that Dublin Corporations ineffectual enforcement regime would not bring them to court.

CONCLUSIONS.

1. The major proportion of outdoor advertising structures in Dublin are unauthorised.
2. The large number of cases where unauthorised advertising structures have been allowed to stand without Enforcement Action for more than five years still remain unauthorised.
3. Outdoor advertising structures which do not directly subsidise directly either public transport or other media, are an unnecessary form of advertising with no public benefit.
4. The presence of advertising hoardings, whether around the city centre, on gable walls of buildings, in residential areas or in approach roads around the city constitutes a visual and environmental blight.
5. The extent of maintenance of unauthorised use of advertising structures serious compromises the credibility and integrity of the Local Government (Planning and Development) Acts and of the planning system.
6. The use of unauthorised advertising hoardings by State agencies and semi-State companies constitutes the abuse of public funds.
7. The use of unauthorised hoardings by companies and brands represents a subsidy of unauthorised development and renders such companies co-parties to legal actions on unauthorised advertising sites, since the company using the site is in the position of licensee.
8. The internalised discussions between the Outdoor Media Association and Dublin Corporation are potentially prejudicial to Dublin Corporation's determination of ensuing planning applications in excluding prescribed bodies and third parties.
9. The extent of unauthorised advertising hoarding development in Dublin calls into question Dublin Corporations administrative competence as a planning authority.

RECOMMENDATIONS.

1. The situation must be brought into effect within an immediate time frame by which the only outdoor advertising structures permitted to remain are those with a valid planning permission.

2. Advertisers using hoardings should insist on a planning certification procedure to the effect that all hoardings used in an advertising campaign are legal and that unauthorised sites will not be used.

In order to implement these recommendations, the following action is required:

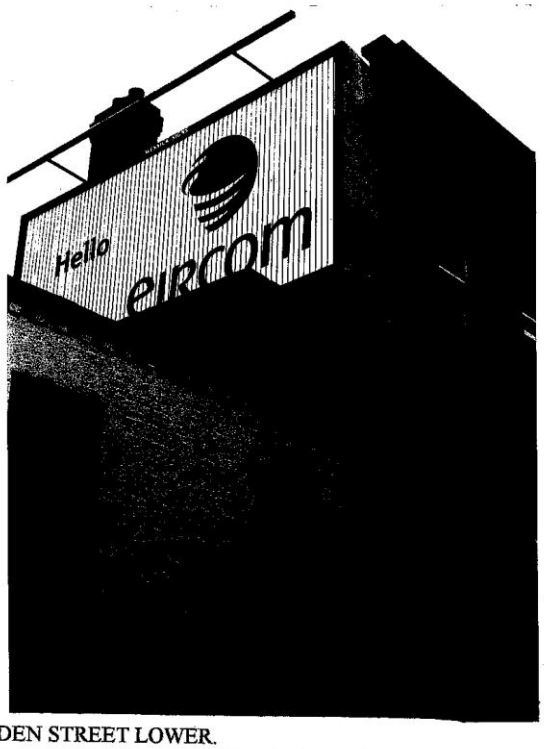
1. That each advertising company will agree to appoint a planning consultant taken from an independent panel nominated by the Irish Planning Institute to investigate the planning status of all advertising panels held by the company and to produce a comprehensive list showing the location of each panel and the planning status, if any with in three months.

2. That all companies will agree to immediately terminate the use of unauthorised panels, including those which have been allowed to stand without planning permission for more than five years.

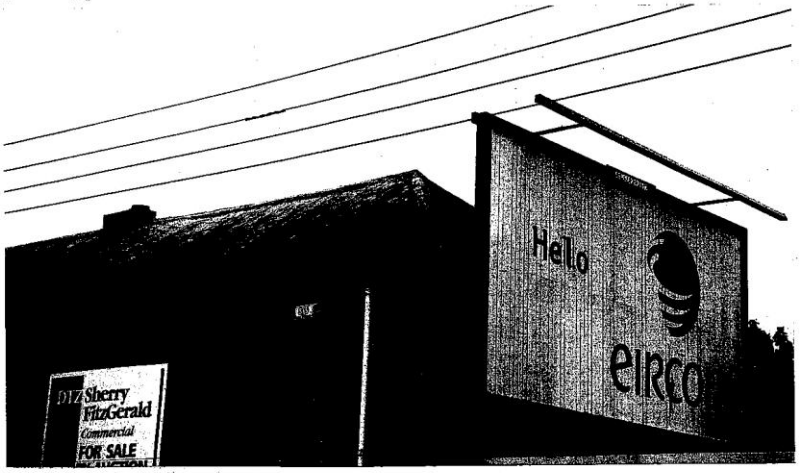
3. Advertising companies will offer a certification procedure by means of these independently prepared planning consultant's lists so that advertisers may ensure that only legal sites are being used in their campaigns.

4. That Dublin Corporation and other local authorities published will through the mechanism of Development Plans or, where appropriate, material alterations to Development Plans will determine appropriate locational and design standards for outdoor advertising structures.

UNAUTHORISED ADVERTISING STRUCTURES
26TH SEPTEMBER 1999



37-38 CAMDEN STREET LOWER.
While there was a poster sign on this site of undetermined planning status, Wesnick replaced it with a massive boxed prismatic structure in September 1999 without planning permission.



22-24 GROVE ROAD
2 Summerbrook prismatic signs remain in position on the Grand Canal Conservation Area despite Dublin Corporation Planning Permission refusal for retention on the 1st July 1999 (ref. No. 1362/99)

Appendix 2: System Interoperability and Expansion

An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

Oifig an Árd Runaí • *Office of the Secretary General*

Priomh Oifig
44 Sráid Chill Dara, Baile Átha Cliath 2, Éire.
Head Office
44 Kildare Street, Dublin 2, Ireland.
Lo-Call 1890-443311 +353-1-604 1348
+353-1-604 1349 www.dttas.ie
secretarygeneral@dttas.ie

PAC-R-884

Correspondence 3B.3
Meeting 78 – 21/03/2013

12 March 2013

Ms Niamh Maguire
Committee Secretariat
Committee of Public Accounts
Leinster House
Dublin 2.

Dear Ms Maguire

You wrote to me on 25th February 2013 concerning issued raised by Deputy Niall Collins TD on the expansion of the Dublin bikes schemes both within Dublin and across the country.

I attach a note which I hope addresses in full all the issues raised.

Should you need anything further please contact me.

Yours Sincerely

Tom O'Mahony
Secretary General

Information Note

Letter from Deputy Niall Collins T.D.

On issues relating to the Dublin Bikes scheme and Regional Bikes scheme.

There are a number of matters raised in the note from Deputy Niall Collins T.D. to the Chairman of the Public Accounts Committee. These are addressed in turn below.

Tendering of the Expansion of the "dublinbikes" scheme

The existing "dublinbikes" scheme was installed by, and is operated by, JC Decaux under contractual arrangements with Dublin City Council.

In common with most other bike sharing schemes throughout the world, the bike docking systems and software systems managing the renting and use of the bicycles is proprietary. In this case the system is the JC Decaux system.

In planning the expansion of the system, the issue of interoperability with other bike suppliers was examined. Because, like other cities, the system is proprietary, it is not possible for another supplier to provide bikes which could be used at the JC Decaux developed bike stations. The docking systems on the bikes, as well as the associated software systems, are unique to JC Decaux and protected by patents.

Accordingly, in planning an expansion that builds on, and utilises, the very successful existing scheme, it is necessary to negotiate such an expansion with JC Decaux. It is not possible for another supplier to tender for an expansion that requires the new bikes to be capable of using the existing bike stations. At the request of the National Transport Authority, Dublin City Council consulted with the European Commission in relation to the procurement of the expansion through a negotiated process with JC Decaux, and has satisfied itself that this is appropriate in the circumstances.

Engineering Consultant "Arup" reviewing work of earlier consultant

In mid-2011, the National Transport Authority was tasked with carrying out an initial feasibility study into the costs and implications of introducing bike sharing schemes into the cities of Cork, Galway, Limerick and Waterford. That work, which was completed in about six weeks, was a high level study.

In late 2012, the National Transport Authority was asked to further develop that initial work and to complete the technical design for these schemes to a level sufficient to enable them to

be tendered and installed. Arup Consulting Engineers were retained to carry out this work. While they, of course, reviewed the earlier feasibility study, their brief is much more extensive than the earlier work. They are tasked with doing significant work to fully design each of the proposed bike stations, inclusive of all required survey work, and to prepare the comprehensive specification and contractual information required for the technical elements of the tender documents for the supply, installation, operation and maintenance of these schemes.

Company Proposing a Specific Solution

In the case of the proposed schemes in the regional cities, it is intended to run, subject to final approvals, a public tender competition for the supply, installation, operation and maintenance of these schemes. Any company wishing to tender for that contract (or contracts) can respond to the tender advertisement, when issued. The NTA expect to be in a position to award this contract prior to the end of 2013.

Appendix 3: System Components of Both Schemes

Dublinbikes

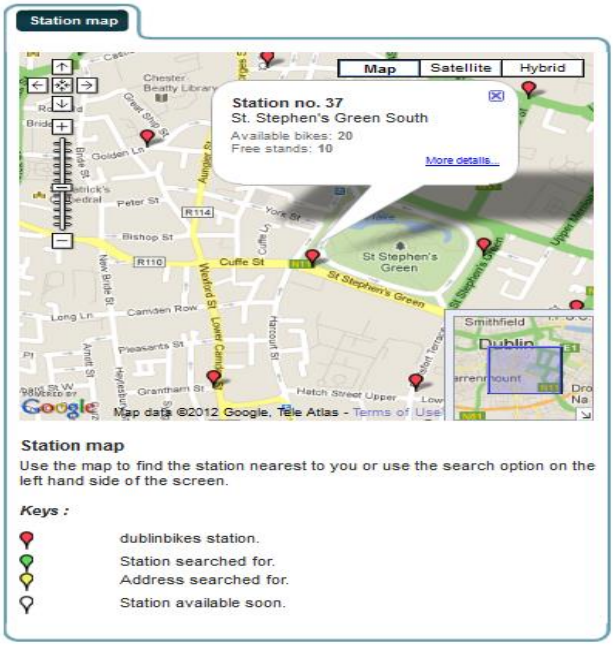
Figure A1: System Interface

Source: Dublinbikes, 2017

Figure A2: System Docking

Source: Dublinbikes, 2017

Figure A3: Bike and Dock Availability



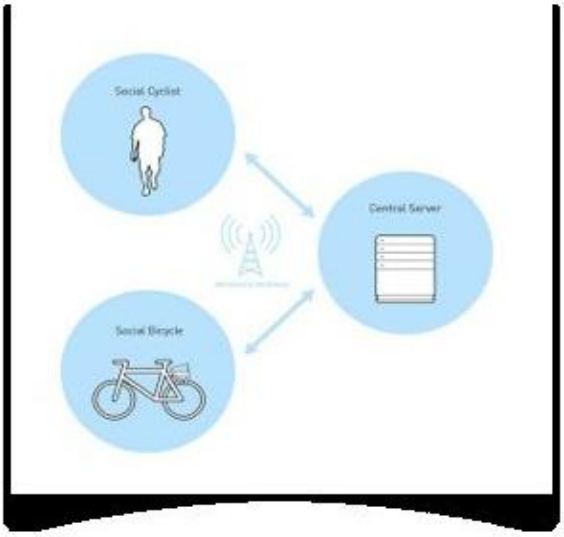
Source: Dublinbikes, 2017

SobiHamilton

Figure A4: Core Components of the SoBi Scheme

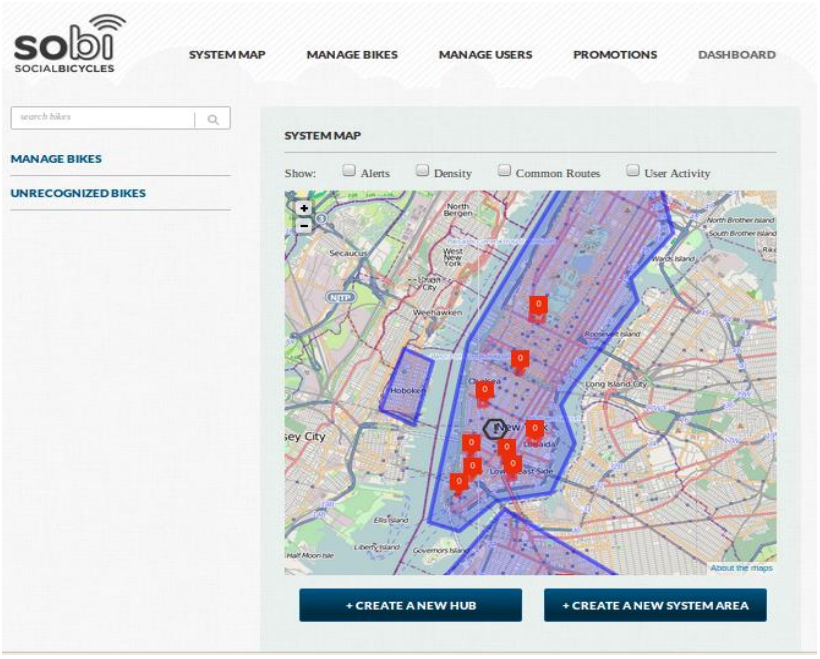
Source: SoBi, 2017

Figure A5: SoBi System Overview



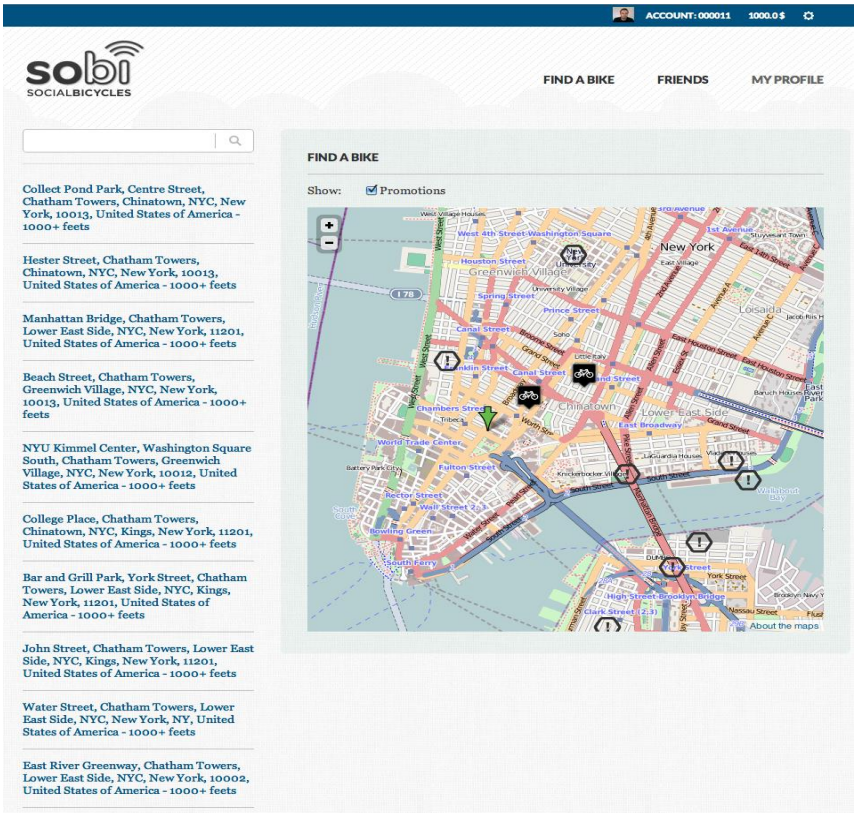
Source: SoBi, 2017

Figure A6: Dynamically Creating Cycling Zones



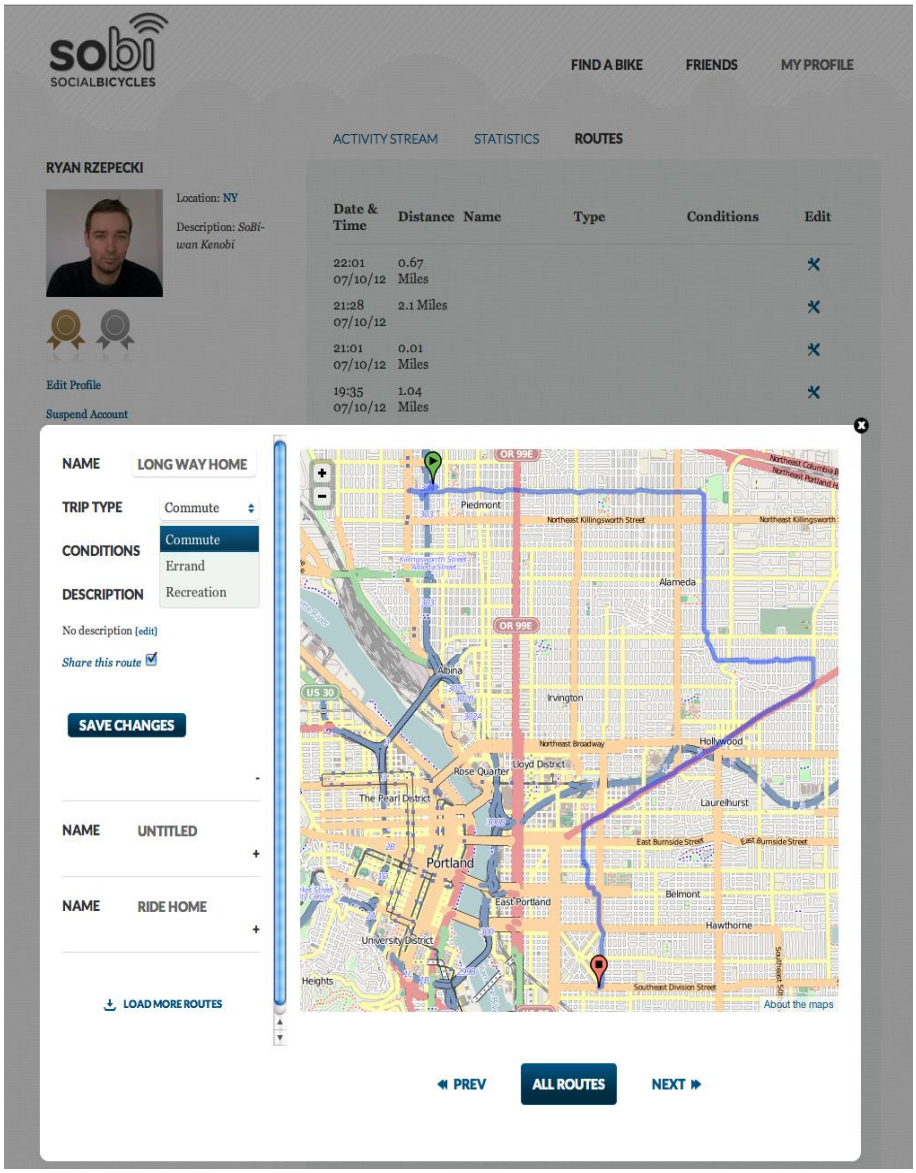
Source: SoBi, 2017

Figure A7: Locating a Bike Using the SoBi Interface



Source: SoBi, 2017

Figure A8: Naming and Annotating Trips



Source: SoBI, 2017

Appendix 4: Ethics Application

Maynooth University Tier 2-3 Application form for Ethical Review

For office use only – Application reference number: SRESC-201X-XXXXX

Maynooth University
Social Research Ethics Sub-Committee

Protocol for Tier 2-3 Ethical Review of a Research Project Involving Participation of Humans

Please note the following:

1. The ethics committee will review the protocol and have the final decision on Expedited Review submissions. If the committee decides that this project is not eligible for expedited review you will be notified and the protocol will automatically be accessed by standard review.
2. Before submitting this application, all researchers named within it should have read and agreed the contents.
3. While attachments may be appended, it is important that you do not simply refer to them, but that you fully address all points in the text of this form. Please keep in mind that your application could be read by someone who is not a specialist in your field, so it is important to make your explanations as clear and thorough as possible.

INSTRUCTIONS: Place your cursor inside the box that follows each question and begin to type – the box will expand as you type. Please submit this completed form, with all supporting documentation, to the Maynooth University Research Support Office Ethics Committee Secretariat. Please include selected review level in the e-mail subject line: **research.ethics@nuim.ie**

1. **Select Review level**

Tier 2 Expedited Review [×]
Tier 3 Standard Review [ ]

2. **Specific criteria**
Please select the specific criteria, from the following https://www.maynoothuniversity.ie/research/research-development-office/research-ethics list that entitles the project to be exempt from standard review.

Tier 2, Select from Criteria Number 1 to 4 (if applicable)

3. **Information about the researcher(s), collaborator(s), and/or supervisor (if the researcher is a postgraduate student)**
Please include letter from the supervisor (*see template at the end of this form*) outlining how the student is suitably prepared/qualified and will have adequate support to carry out the type of research proposed.

Name:	Qualifications or Student No:	Address/Dept.	Email: *Provide Maynooth University contact details*	Telephone: *Provide Maynooth University contact details*	Role in the project:
Robert Bradshaw	BSc, MSc 13251567	NIRSA Dept of Geography MUIM	Robert.bradshaw@nuim.ie	01-7083350	Doctoral Candidate
Rob Kitchin	PhD	NIRSA Dept of Geography NUIM	Rob.kitchin@nuim.ie	01-7083372	Supervisor and Principal Investigator for overall project

1

4. Previous ethical approval for this project (if applicable)
(please attach a copy of your approval letter)

Other Ethical Approval	Reference
Maynooth University Ethical Approval [×] Yes [ ] No	No Reference - See below *
The overall project, The Programmable City, principal investigator Prof. Rob Kitchin, has received approval from the Research Ethics Sub-committee. This application seeks approval for a sub-project/work package.	
Other Institutions [×] Yes [ ] No [ ] Under review	ERC - Same conditions as above. Approval subject to sub-projects being approved.

" Sent by Research Ethics email account 17/12/12: "The Social Research Ethics Sub-committee has reviewed the ethical protocol for your research programme 'The Programmable City'. In light of the scale of this programme of research we envisage a two stage ethical review process. At this point, the Committee are happy to grant stage one approval, approval in principle for the programme of research to commence. The second stage of the approval process requires that once the individual researchers are recruited and exact specification of their sub-projects developed each of the individual work packages is submitted for a second round of critical ethical review. We look forward to receiving the various work packages in due course."

5. Title. Brief title of the research project:

Overall Project: The Programmable City.

Sub-Project: Technology and Social Innovation: Exploring Design within the Bikeshare Sector

6. Research Objectives. Please summarize briefly the objective(s) of the research, including relevant details such as purpose, research question, hypothesis, etc. (about 150 words).

This research project will explore the potential of design processes and implementation practices within the smart bikeshare sector to support social innovation. The research understands smart bikeshare schemes to be highly heterogeneous sociotechnical systems comprising a variety of technologies, institutions, stakeholders and processes which in turn operate within a diversity of social-cultural and political milieus. Using a theoretical framework derived from constructivist technology studies, the research will explore the potential of these systems to re-imagine bikeshare as a mechanism which can support emancipatory and democratizing practices. Such practices include knowledge sharing, distributed decision making, participatory design and improved transparency and accountability in government bodies. The research will explore these themes through the followings questions:

- How does technology and design enable democratisation and social innovation within the

bikeshare sector?

- What rationalizations (geographical, political, economic, social and cultural) legitimise the adoption of certain bike share designs and implementation practices and resist others?
- To what degree are real-world implementations explained by the research's conceptual framework

7. Methodology.

a. Where will the research be carried out?

Location(s)	Dublin, Boston, Boise (Idaho, USA) and Hamilton (Ontario, Canada)
Proposed start date	The research will be conducted between April 2014 and April 2017
Approx Duration	*30 Months*

b. Please describe briefly the overall methodological design of the project.

The research will employ a multiple case study methodology. Public bikeshare schemes operating in the following cities have been chosen for inclusion in the study:

Dublin – Ireland
Boston, Massachusetts – USA
Boise, Idaho – USA
Hamilton, Ontario - Canada

The case studies were selected not on a random or stratified sampling logic, but on the basis of the configuration of their bike share scheme and the potential to support valuable insights into how different assemblages of technologies, actors, institutions and socio-cultural contexts combine to create and legitimatize particular designs and implementation practices. The axis of comparison will be democracy and social innovation and the manner in which these assemblages coalesce to support or resist it.

In contrast to previous research in this area which has tended to be quite instrumental - quantitatively assessing the impact of schemes on categories such as transit modal share or CO_2 off set - this research will be qualitative and exploratory in nature and will be supported by primary and secondary data sources. Primary sources will comprise interviews and, where feasible, direct observations. Interviews will be either in-depth conversations or semi-structured in nature and direct observations may provide additional insights into how both service users and service providers experience the schemes. Secondary data sources will include an analysis of organizational documents, tendering and procurement processes, policy documents, patents, marketing material, and any other sources which support an understanding of the contexts within which system design and implementation take place.

c. Depending on the methods/techniques to be used, please elaborate upon the research context(s), potential questions / issues to be explored, tasks/tests/measures, frequency/duration of sessions, process of analysis to be used, as appropriate.

Interviews will be conducted with key stakeholders in the four case study sites to explore their opinions, attitudes and practices with respect to smart bikeshare schemes and what social innovation might mean within this context. For the purpose of this research, social innovation can be defined as new strategies, ideas and practices that meet social needs and will encompass concepts such as

citizen science, participatory decision making, collaborative design, and knowledge sharing.

The fours schemes chosen for inclusion in the study represent diverse socio-technical assemblages, with each scheme being conceived, designed, funded and implemented in ways that reflect the imaginaries and ideologies of important organisational and institutional actors. Interviews will attempt to unpack these ideologies and understand their effects on the schemes and their users across the four case study sites..

Questions guiding the research are:

- Why the cities implemented their respective smart bikeshare programme? What were their objectives and how the design and implementation of the schemes met these objectives?
- What factors influenced the choice of design and implementation strategies of the schemes?
- How does the design and implementation of each scheme supports the concept of social innovation, i.e. do the schemes enrol riders in collaborative business and information processes, are the schemes integrated with public transportation networks, do the schemes use social media platforms to support relationships with and between riders, and so on?
- What impact, if any, has the funding and implementation models and business partnerships had on the capacity of the schemes to adapt and change?
- Do the schemes anticipate any changes in the future? If so what is the nature and rationale for these changes?
- What challenges might exist (political, economic, cultural) to innovations such as those described above ?
- How might these challenges be overcome?
- What lessons have been learned based on experiences to-date? What might be done differently were the schemes to be designed and implemented again?

These questions are indicative and framed with key decision makers in mind. Related themes will be explored with user and advocacy groups. Guiding questions will be:

- How do system users experience the informational and digital resources of the schemes?
- How are users framed or imagined in each of the sites i.e. passive recipients of services and information or active participants in the creation of systems they appropriate?
- How might schemes be enhanced from the perspectives of system users? What types of innovation - both technical and social - would users advocate?
- How willing are users to engage in collaborative relationships with service providers and decision makers?

Secondary sources, such as documents, organisational practices, analysis of socio-cultural and political contexts etc will be used to support and triangulate interview data.

Analysis: Interview data will be transcribed, anonymised in line best practice guidelines and the wishes of participants and entered, coded and analysed in Maxqda.

Secondary data will be interpreted and where appropriate entered, coded and analysed in Maxqda.

8. Participants.

a. Who will the participants be?

To support a holistic understanding of system creation, implementation and use, interviewees will comprise adults from the following stakeholder groups: system designers, user and advocacy groups, civil servants, politicians, NGOs and consultants. Additional participants may be recruited using a non-random snowball technique where research subjects may recommend further participants based on their experience and industry knowledge.

b. Approximately how many participants do you expect will be involved?

While the precise number of interviewees may vary across cases depending on issues of access, availability or relevance, it is anticipated that each case will require approximately 20 interview participants, i.e. 80 in total

c. How will participants become involved in your project? If you have formal recruitment procedures, or criteria for inclusion/exclusion, please outline them here.

Participants will become involved through being formally approached by the researcher due to their involvement in the establishment and running of a bike share scheme. Initial contact will be made via email, with follow up phone calls, with participants invited to participate. Subsequent participants will be recruited through snowball sampling, based on recommendations and introductions made by initial interviewees. Initial contact has been made with each bike share scheme to determine how receptive they would be to the research. The only formal grounds for exclusion is having no role in the bike share scheme.

d. What will be the nature of their participation? (e.g. one-time/short-term contact, longer term involvement, collaborative involvement, etc.)

Interviews are likely to be based one-time contact. Additional short, supplementary conversations, or additional interviews, might be required for clarification purposes.

e. If participants will include those with whom the researcher engages in a relationship of power e.g. student/employee/employer/colleague, explain how the possibility of the power relationship and/or conflict of interest will be minimized.

N/A

f. Will the participants be remunerated, and if so, in what form?

N/A

9. Persons Under 18.

a. Will the research be carried out with persons under age 18? [ ] Yes [×] No

Please see section Child Protection Policy (in particular section 5)
http://foi.nuim.ie/section16/documents/ChildProtectionPolicyandGuidelines.pdf

b. If yes, will the sessions be supervised by a guardian or a person responsible for the individual(s)?
[ ] Yes [ ] No

***NOTE**: If the sessions are to be unsupervised, you are required to undergo Garda vetting. Research cannot begin until Garda clearance has been completed. For Maynooth University researchers, this is facilitated by the Maynooth University Admissions Office (708-3822, admissions@nuim.ie).*

10. Vulnerable Persons.

a. Will the research be carried out with persons who might be considered vulnerable in any way?
[ ] Yes [×] No

b. If yes, please describe the nature of the vulnerability and discuss special provisions/safeguards to be made for working with these persons.

NOTE: *Depending on the nature of the vulnerability, sessions may need to be supervised or the researcher may need to undergo Garda vetting as stated above under point 4. In such cases, the researcher must also be prepared to demonstrate how s/he is suitably qualified or trained to work with such persons.*

11. Risks.

a. Please describe any possible risks or conflicts arising from the research techniques or procedures such as: power relationships or other conflict of interests i.e. supervisor-student relationship, physical stress/reactions or psychological emotional distress or reactions.

The research is being conducted with consenting adults and does not involve sensitive personal questions or work with vulnerable communities. All of the schemes are public in nature, though they involve private actors, and are presently operational in their respective cities, and since the research is designed to document how the schemes are organised, managed and run it will have minimal risk with respect to participants.
Potential risks however can arise from obtaining various private information from the participants, including demographic characteristics, their location information at specific times and over a (short or longer) period of time, their practices, attitudes and opinions about certain services, technologies or practices that they might not want otherwise shared.

b. If you anticipate the possibility of risks, how will these potential risks be addressed and what measures have you put in place to minimize them?

Though the schemes will be identified in the research, individual interviewees will be offered complete privacy and confidentiality and the data will be anonymised according. Major and detailed identifying information including names, places, names of occupations and other potentially identifying information will be removed and replaced with descriptions reflecting their significance within the research context (see full discussion on section 12(b) and anonymisation and confidentiality in section. While undertaking the research, participants' permission to disclose their personal and locational information, as well as the level of details, will be reviewed in order to achieve the levels of anonymisation appropriate to individuals and contexts.

12. Informed Consent.

Please answer the following questions about how you inform participants about your research and then obtain their consent:
NOTE: *Please see the template at the end of this form showing standard information that must be included on all consent forms.*

a. Do research participants sign a written consent form and receive a copy for their records? If not, do they receive an information sheet that provides what they need to know before deciding to participate?

Yes

b. When, where, and by whom is consent obtained?

Before interviews are carried out the title of the research, its purposes and interview questions will be explained to the participants. They will also be provided with a consent form as used by the Irish Qualitative Data Archive (IQDA)/Digital Repository Ireland (DRI), which explains the rights of the participants to decide if they wish to be audio taped, to ask questions and to withdraw from the research at any point. The form also provides options for the participants to indicate if and how they wish to be identified or acknowledged in subsequent publications, and how the data generated by the

research are to be achieved and accessed. Should interviewees require the consent of their organisations or institutions to participate in the research, additional information sheets and consent forms will be made available. Any subsequent interviews will require a separate consent from the interviewees before they commence.

c. If children or vulnerable persons are involved, please explain your procedure for obtaining their assent.

N/A

d. For projects in which participants will be involved over the long term, how will you ensure that participants have an ongoing opportunity to negotiate the terms of their consent?

The participants will be informed of the right to negotiate their terms of participation or withdraw from the research, in oral and written forms before the research starts. Throughout the research process, they will also be reminded of their rights and opportunities of negotiation at any point of time.

e. What will the participants be told about the study?

The participants will have described to them the purpose of the research and the questions it addresses. They will also be given an opportunity to discuss the project and their participation in it in detail if they wish.

f. What information, if any, will be withheld about the research procedure or the purposes of the investigation? Please explain your justification for withholding this information. If any deception will be involved, please be sure that the technique is explained above under methodology, and explain here why the deception is justified.

N/A

13. **Follow-up.** As appropriate, please explain what strategies you have in place to debrief or follow up with participants.

During the process of interviews permissions will be asked for contacting the participants again at a later stage of the research for further discussions or clarifications if required. Participants will be allowed to review their interview transcript.

14. **Confidentiality/Anonymity of Data.**
Please consult Maynooth University data protection procedures:
http://dataprotection.nuim.ie/protection_procedures.shtml

a. Recording of personally identifiable information about research participants

Identifier *(Typically, by their very nature projects involving repeated contact with research participants require the collection and retention of identifiers)*	**Y/ N** (Select all those applicable)
Name and Contact Details	Y
Details regarding Geographical location, culture, ethnicity etc.	Y
Video recording	
Audio recording	Y
Other please specify	
Not applicable	

b. If yes, to any of the above please explain how confidentiality and/or anonymity are assured?

The project will adhere to the 'best practice' ethical guidelines/protocols and data generation and handling
procedures developed by the IQDA/DRI concerning confidentiality and anonymity.

c. If yes, to any of the above please explain the following: how you will safeguard this information; if identifiers will be removed from the data, at what point will they be removed; if identifiers will not be removed, why they must be retained and who will retain the key to re-identify the data.

Identifiers will be removed at the first possible instance - that of transcription. From this point on the files will be use ID codes and pseudonyms. The keys will be retained by the researcher for administrative and legal purposes if required. They will not be shared beyond co-researchers, will be encrypted and stored separately to the data, and will not be archived.

d. After data analysis has taken place, will the data be destroyed [ ] or retained [X]

If the data will be retained, please explain for how long, for what purpose, and where it will be stored; if there is a key code connecting subjects' data to their identity, when will the link be destroyed?

It is a condition of the funding that the data are archived for future re-use. The data will be archived in the Irish Qualitative Data Archive, and follow the archiving procedure set out by the IQDA/DRI, with appropriate levels of access set as stipulated by the participants of the study. This archiving will not include the key and the data will be anonymized. Consent for archiving and re-use of data is part of the consent process. The length of time to be housed in the archive is indefinite.

e. If the data will be destroyed, please explain how, when, and by whom?

Electronic data should be overwritten
Paper data should be destroyed by confidential shredding

***NOTE**: Include this information in the consent form, information sheet, or consent script.*

15. **Ethics in subsequent outputs.** What are your plans for protecting the safety and integrity of research participants in publications, public presentations, or other outputs resulting from this research? How will subjects' permission for further use of their data be obtained?

When obtaining consent and signing a written consent form, participants will have opportunities to discuss, negotiate and indicate their willingness of being identified or acknowledged in subsequent research publications, presentations, reports or other outputs. In cases where participant do not want to be identified, their names will be removed and comments made unattributable. Also, their consent and levels of anonymity they wish to maintain will be discussed before signing the consent form for archiving interview transcripts and audiotapes.

***NOTE**: If the data is not anonymised, additional consent would have to be obtained before the data could be deposited in an archive such as the Irish Qualitative Data Archive (http://www.iqda.ie/) or the Irish Social Science Data Archive (http://issda.ucd.ie/).*

16. **Professional Codes of Ethics.** Please append a professional code of ethics governing research in your area to this protocol, and/or provide a link to the website where the code may be found.

For office use only – Application reference number: SRESC-201X-XXXXX

This research will adhere to the 'best practice' ethical guidelines/protocols and data generation and handling procedures developed by the Irish Qualitative Data Archive/Digital Repository Ireland with respect to data generation, preparation and archiving. These guidelines/protocols adopt international best practices (http://www.iqda.ie/sites/default/files/IQDA_Best_Practice_Handbook.pdf and http://www.iqda.ie/content/deposit-data).

and also the Ethical Guidelines of the Sociological Association of Ireland http://www.sociology.ie/docstore/dls/pages_list/3_sai_ethical_guidelines.pdf

17. Declaration

This declaration must be signed by the applicant(s) ***(electronic signature is sufficient)***.

I(we) the undersigned researcher(s) acknowledge(s) and agree that:

a) It is my (our) sole responsibility and obligation to comply with all Irish and EU legislation relevant to this project.
b) That all personnel working on this project comply with Irish and EU legislation relevant to this project.
c) That the research will be conducted in accordance with the Maynooth University Research Ethics Policy.
d) That the research will be conducted in accordance with the Maynooth University Research Integrity Policy.
e) That the research will not commence until ethical approval has been granted.

Signature of Applicant(s): Robert Bradshaw

Date:9/2/2015

Maynooth University Tier 2-3 Application form for Ethical Review

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Check List

1)	Completed application form	[×]
2)	Letter from supervisor if applicant is a student	[×]
	if applicable – copies of:	
3)	prior ethical approval	[ ]
4)	ethical approval from other institutions	[ ]
5)	proposed information sheet	[×]
6)	proposed consent form	[×]
7)	Documentary evidence for the use of existing data records, sourced from third party organisations, that consent was originally sought for data to be used for research purposes.	[ ]

Appendix 5: Information Sheet and Consent Form

Respondent Information Sheet

The Programmable City: Work Package 5

Thank you for agreeing to participate in this study. The Programmable City project concerns how the city is translated into software and data, and how does software reshape the city. This particular work Package seeks to understand the role of software and digital technologies in driving public policy development and implementation. In particular the research will explore the potential of design processes and implementation practices within the smart bikeshare sector to support social innovation

The research is being carried out at the National University of Ireland Maynooth.

The investigators are

Prof. Rob Kitchin, NIRSA, National University of Ireland, Maynooth, Phone: (01) 708 3372; Email: Rob.Kitchin@nuim.ie

Robert Bradshaw, Doctoral candidate, National University of Ireland, Maynooth, Phone: (01) 708 3350; Email: robert.bradshaw@nuim.ie

With your permission, the interview will be recorded. Afterwards it will be written up/transcribed. Both the recording and interview notes/transcription will be stored in a locked cabinet in the project head office at NUI Maynooth.

Once all the interviews are completed, the audio recordings and interview notes/transcripts will be deposited in an archive, where other bona fide researchers may consult them. You may be happy to be personally identified in these public materials. However, if you wish, your name will be removed, and your comments made unattributable.

If during your participation in this study you feel the information and guidelines that you were given have been neglected or disregarded in any way, or if you are unhappy about the process, please contact the Secretary of the National University of Ireland Maynooth Ethics Committee at research.ethics@nuim.ie or +353 (0)1 708 6019. Please be assured that your concerns will be dealt with in a sensitive manner.

Once again, we thank you for your participation. However, it is important for you to know that your participation in the research is entirely voluntary. You may withdraw your consent to participate at any time, without obligation.

Having read this information sheet, please read and sign the consent form.

Consent Form

Project Title: The Programmable City

The investigators are
Prof. Rob Kitchin
Robert Bradshaw

Material gathered during this research will be treated as confidential and securely stored in a locked cabinet at NUI Maynooth. You have the right to access any of your interview materials (tapes, transcripts and notes) at any time.

Please answer each statement below concerning the collection of the research data.

1.	I have read and understood the information sheet.	Yes No
2.	I have been given the opportunity to ask questions about the study.	Yes No
3.	I have had my questions answered satisfactorily.	Yes No
4.	I understand that I can withdraw from the study at any time without having to give an explanation.	Yes No
5.	I agree to the interview being audiotaped and to its contents being used for research purposes.	Yes No

Below, are sets of statements that give you, the interviewee, a series of options about how you wish your interview to be used. Please answer each statement.

6.	I agree to being identified in this interview and in any subsequent publications or use.	Yes No

IF YOU ANSWERED "YES" TO Q.6, GO DIRECTLY TO Q.8
IF YOU ANSWERED "NO" TO Q.6, PLEASE ALSO ANSWER Q.7

7.	Where used my name must be removed and my comments made unattributable.	Yes No

8.	I agree to the interview notes/transcripts (in line with the conditions outlined above) being archived and used by other bona fide researchers.	Yes No
9.	I agree to my audiotapes (in line with the conditions outlined above) being archived and used by other bona fide researchers.	Yes No
10.	I would like my name acknowledged in the report and on the project web site (without linking it to content or quotation).	Yes No

Name (printed) _____

Signature _____ Date _____

Your contribution is greatly appreciated. Feel free to contact us if you have any further questions.

Prof. Rob Kitchin
Phone: (01) 708 3372
Email: Rob.Kitchin@nuim.ie

If during your participation in this study you feel the information and guidelines that you were given have been neglected or disregarded in any way, or if you are unhappy about the process, please contact the Secretary of the National University of Ireland Maynooth Ethics Committee at research.ethics@nuim.ie or +353 (0)1 708 6019. Please be assured that your concerns will be dealt with in a sensitive manner.