arnoud van waes

PLATFORM INNOVATION

in urban mobility transitions

the case of dockless bike sharing

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colofon

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Platform innovation in urban mobility transitions

The case of dockless bike sharing

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Een studie naar innovatieve deelfietssystemen
(met een samenvatting in het Nederlands)

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Preface

In the summer of 2017, the city of Amsterdam was overwhelmed by thousands of bikes that were put on its streets. They were not the typical privately owned Dutch bikes you would expect and that the global cycling capital is so fond of. These bikes were different: bright colors, odd designs, catchy brand names, parked all over the city and available to anyone with a smartphone. The strange bikes were distributed by foreign startups and apparently not only in Amsterdam. They were rapidly launching on a large scale in cities across the world, from Beijing to Berlin and from Melbourne to Manchester. This fueled high expectations among urban authorities globally as cities welcome more cycling in their endeavor to create clean, healthy and accessible cities. At the same time they also caused immediate controversy as not everyone welcomed these bikes. Bike sharing could be a sustainable and affordable solution to complex urban challenges. Were we witnessing an urban mobility transition in the making?

Three years later, most of these bikes left the streets of Amsterdam and much of the initial excitement is toned down. Leftover bikes are now for sale at local thrift stores. In China, most cities now have colorful bicycle graveyards filled with hundreds of thousands unused two-wheelers. In this dissertation I unravel the journey – the rise and fall – of this seemingly promising urban mobility innovation.

1

Introduction

Platform innovation has emerged as a potential driver for urban mobility transitions. But platform innovation also challenges transition dynamics in various ways, by shaping new business models, by challenging prevalent urban institutions and by influencing urban experimentation dynamics.

1.1 Digital platform enabled innovation in urban mobility transitions

The world is increasingly becoming more urban and mobile. Urban mobility has a vital economic and societal function for cities. However, urban mobility has several negative impacts including traffic congestion, pollution, greenhouse gas emissions, fatalities and injuries and energy consumption (Moradi & Vagnoni, 2018). While carbon emissions in most sectors have decreased since the last decades, emissions in the transport sector have increased. Urban mobility (including cars, two-wheelers and public transport) is estimated to account for 40% of all transport emissions (IEA, 2020). Despite progress in electrification and efficiency improvements of these vehicles, emissions continue to rise, primarily because of increasing demand for urban mobility caused by economic prosperity and changing lifestyles. Hence, incremental improvements and technological fixes will not be sufficient and fast enough to induce the necessary dramatic reductions. This means more radical shifts to new sustainable urban mobility systems are needed. This need for more radical shifts towards urban sustainability is also pushed for by global agendas such as the United Nations Sustainable Development Goals, that highlight the need to create resilient and sustainable cities (UNDP, 2020). In this dissertation, I will refer to these transformative changes as urban mobility transitions.

The convergence of urban mobility and digital technologies has given rise to promising innovations that could contribute to a transition towards sustainable urban mobility. This so-called 'shared mobility' enables travelers to gain short--term access to transportation modes on an on-demand basis and includes car sharing, personal vehicle sharing (peer-to-peer), ride sharing, ride sourcing, scooter sharing and bike sharing (Shaheen & Chan, 2016). Digital technologies and platforms play an increasing role in this transition (Meyer & Shaheen, 2017). This is especially demonstrated by the influx of various shared mobility services that provide individual, short-term rental based and dockless mobility. Technological innovations as well as new business models are changing the landscape for short distance trips (EEA, 2019). In particular, bike sharing has seen an impressive growth in recent years. The global number of shared bikes grew from 139.000 in 2010 to an estimated 15 million in 2019 (Nikitas, 2019). This boom is partly facilitated by digital platform technologies.

Arguably, such digital platform enabled innovations may have an impact on sustainability transitions, because they give rise to new business models and

challenge urban institutions. A key feature of these new business models is that they promote access over ownership. Such service based business models have sustainability potential as they create and capture value from efficient utilization of resources. Many goods stand idle most of the time so sharing existing goods enables more intensive and efficient use (Frenken & Schor, 2017). In addition, service based models may prevent purchases of new goods and thereby help address overproduction and resource exploitation (Acquier et al., 2017). The emergence of new business models that stimulate sharing and efficient use of resources is argued to result from a need for austerity and frugal spending after the recession, combined with growing environmental awareness and the ubiquity of internet and communication technologies that makes sharing possible at scale (Cohen & Kietzmann, 2014). The digital nature of platforms also greatly reduces costs and efforts of implementing business models which may enable rapid scaling of sustainable innovations (Kolk & Ciulli, 2020).

However, the introduction of platforms enabled innovation is not without consequences for city governments. A key challenge is that platforms can be launched without prior assessment of externalities and public interests, leaving democratic deliberation and public debate ex post affairs (Frenken & Pelzer, 2020). Hence, many city governments were caught by surprise when platforms like Airbnb and Uber launched. In general, this is not uncommon in the so-called 'platform economy' as new platform based business models often operate under regulatory frameworks that were not designed for them (Kenney & Zysman, 2016). Platforms often strategically claim they operate in a grey zone for which regulatory frameworks are absent. They supposedly position themselves as companies in the tech sector, while disrupting other sectors such as mobility or tourism (e.g. home sharing platform Airbnb vs hotel industry and taxi platform Uber vs incumbent taxi providers).

Despite the potential to influence transitions (both positively and negatively), there are hardly studies that explore the relationship between platform enabled urban innovations and transitions to sustainable urban mobility. This dissertation examines this relationship focusing on the case of digital platform enabled bike sharing.[1] Combining a smart-lock, GPS and digital platform technology

1. Throughout this dissertation is referred to the terms 'platform enabled bike sharing', 'free-floating bike sharing' and 'dockless bike sharing'. These terms refer to the same phenomenon: a service that provides easy access – fee-based – to a network of free standing bikes available through digital means such as a smartphone. The former term – platform enabled bike sharing

has created a new business model for – dockless – bike sharing. This business model has facilitated easy access for users – using a smartphone application – to shared bikes and for firms it allowed for rapid scaling across geographic borders as not much new physical infrastructure was needed. This new model for bike sharing has been touted by its advocates as a promising low cost alternative and sustainable urban mobility mode for short distance trips. The fact that the new business model does not rely on public funding is attractive for city authorities (Nixon & Schwanen, 2019).

Although this new urban mobility service provides a range of opportunities, the new business models are also challenging existing formal and informal urban institutions. When companies situated themselves in cities across the world – often without formal consent – by distributing bikes rapidly, there was little time for cities, planners and citizens to assess the demand for these types of services (McKenzie, 2020). Platform enabled bike sharing received mixed reactions from citizens and challenged regulations, for example around the use of scarce public space. In the meantime, companies attracted users to their bike sharing platform and thereby strategically attempted to shape legitimacy and build trust among users. More generally, many cities struggled with legality of these types services (Frenken et al., 2018; McKenzie, 2019, 2020). Urban authorities responded differently to platform enabled urban mobility innovations. Some cities implemented pilot programs to assess its impact and experiment with this new form of urban mobility. Other cities, such as Amsterdam in the case of platform enabled bike sharing, banned it. These different responses also reflect a need for new forms of governance and collaborations between private and public actors, to better navigate challenges in the future. Additionally, platform enabled urban mobility services may also influence prevailing informal institutions and existing modes of urban mobility such as private car ownership and public transport (Van Waes et al., 2018; Zvolska et al., 2019). These institutional challenges make platform enabled bike sharing an interesting case to study platform innovation in urban mobility transitions.

Although digital platform enabled urban innovations – in this case bike sharing – are promoted by its advocates as an effective and sustainable solution to urban mobility challenges, that does not automatically mean they bring about positive outcomes (Duarte, 2016; Médard de Chardon, 2019; Spinney & Lin, 2018). The case

– is mainly used in the Introduction and Conclusion section to highlight the link to digital platforms. That latter term – 'dockless bike sharing' – is used in the subtitle of this dissertation and refers to the independency on docking station parking infrastructure.

of bike sharing shows how business model innovation can have unintended and negative impacts. Fierce competition, an oversupply of low-quality bikes and a race to the bottom that eventually led to bankrupt providers and bicycle graveyards are no exceptional stories in the world of bike sharing (Feng & Ye, 2020; Haas, 2017). Hence, to reap the benefits of platform enabled bike sharing, it is critical to improve our understanding about these issues as ignoring them may lead to setbacks in positive urban mobility transformations. As there is room for agency and urban authorities can have impact, as well as the entrepreneurs, there is an opportunity for improved outcomes in the future that harness potential benefits while simultaneously regulating negative influences on urban sustainability transitions.

The above suggests that platform enabled urban innovations potentially influence three important aspects relevant to urban mobility transitions. They challenge urban institutions (e.g. by deliberately going against regulations, by creating new practices and challenging prevalent norms), they change dynamics of experimentation (e.g. by introducing new initiatives unasked on the streets instead of an orderly planned approach in collaborative and joined initiatives, by organizing pilots and experiments) and they introduce new types of business models (from product ownership to service delivery). The next section will provide an overview of how these three concepts in the sustainability transitions literature have been explored thus far in more detail.

1.2 Institutions, experimentation and business models in transitions

Digital platform enabled bike sharing – as an empirical phenomenon – shows dynamic interactions between institutions, business models and experimentation – all of which have been recognized as important aspects in transitions to sustainability. To better understand how these type of dynamics are influenced by platform innovations, this section explores how each of these concepts are discussed in relation to the sustainability transitions literature.

1.2.1 Institutional change in sustainability transitions

To better understand the relationship between institutional change and sustainability transitions, first the socio-technical system concept is elaborated upon. A socio-technical system is formed by different elements such as technology,

infrastructure, regulations, markets, users and culture.[2] Their mutual alignment provides stability to the socio-technical system. Transitions – the transformation of socio-technical systems – are complex and challenging because changes and realignments within and between these different dimensions are needed. They involve a broad range of actors and typically unfold over considerable time-spans – 50 years and longer (Geels, 2004; Markard, Raven, & Truffer, 2012). For this reason, a transition towards more sustainable urban mobility system is not only about introducing sustainable alternatives such as electric vehicles or bike sharing, it also requires changes in user preferences, practices, infrastructures, culture, policies and governing institutions. A transition to more sustainable urban mobility systems requires a fundamental reordering and realignment of both the social and technical components of systems.

Analyzing sustainability transitions through an institutional lens allows to understand why socio-technical systems are resistant to change and provides better understanding of agency in transitions. The notion of institutions has played a central role in the field of sustainability studies from its beginning. The regime concept has essentially been about institutions. In one of the foundational publications Rip & Kemp (1998) use the concept of rules to define a technological regime as: *"the grammar or rule-set embedded in a complex of engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artefacts and persons, ways of defining problems – all of them embedded in institutions and infrastructures"*. Geels (2004) has further elaborated on the notion of regimes and refers to socio-technical regimes rather than technological regimes. Similarly to the idea of technological regimes, the socio-technical regime concept refers to the dominant rules of the game that govern the interplay and configuration between the socio-technical systems dimensions and its actors, but widens the focus beyond the production side of socio-technical systems (Geels, 2004). The rules comprise of regulative, normative and cognitive rules and guide activities of actors (Scott, 2014). These form the core of socio-economic structure, which shapes stability and continuity, but also form barriers to more far-ranging change, such as often implied in sustainable development. The socio-technical regime forms the deep structure that

2. The transportation system consists of: regulations and policies (e.g. traffic rules, parking fees, emission standards, car tax), maintenance and distribution network (e.g. repair shops, dealers), industry structure (e.g. car manufacturers, suppliers), markets and user practices (mobility patterns, driver preferences), fuel infrastructure (oil companies, petrol stations), vehicle (artefacts), culture and symbolic meaning (e.g. freedom, individuality), road infrastructure and traffic system (e.g. lights, signs) (Geels, 2002).

accounts for the stability of an existing socio-technical system (Geels, 2004). It refers to the semi-coherent set of rules that orient and coordinate the activities of social groups that reproduce the various elements of socio-technical systems (Geels, 2011). The dominant regulative, normative and cognitive rules are institutionalized in regulations, technical standards, laws, policies, behavioral norms, practices, routines, lifestyles or cultural values and shared beliefs. These types of institutions are culturally, materially and socially embedded and therefore resistant to change. They influence action as they lead to patterns of behavior. The regime represents these types of formal and informal rules that shape and are reproduced by actors in a system (Geels, 2004, 2011).

Transitions have been interpreted as processes of institutional change (Fuenfschilling, 2015). From this perspective, a transition entails de-institutionalizing existing configurations and institutionalizing new, more desirable, ones. A key question then for sustainability transitions is how to create new and change existing (unsustainable) institutions and transform them in desirable ones. The role of both businesses and urban experimentation in enabling institutional change are identified as promising avenues for research (Kohler et al. 2018).

Besides explaining why socio-technical systems are resistant to change, the concept of institutions can also be used to conceptualize the dynamic interplay between actors and structures (Geels, 2004). Furthermore, it is argued that the transitions literature has overlooked the micro-level of innovating actors and the contributions of individual strategies to transitions dynamics (Farla et al., 2012; Markard & Truffer, 2008). In addition to technology development, entrepreneurial activities need to be complemented by broader activities such as market formation, value-chain creation and regulatory and institutional changes (Karltorp and Sandén, 2012; Bakker, 2014; Planko et al., 2016). To this end, the interactions between actors and institutions have increasingly been studied. In particular, the role that businesses play in targeting institutional change – by creating, changing or maintaining institutions – in the context of sustainability transitions has been identified as a direction of future research in transitions studies (Kohler et. al. 2018). Hence, a closer look at how companies target institutional change can improve our understanding in how transitions unfold.

To create, change or maintain institutions, firms engage in institutional entrepreneurship — defined as *"activities of actors who have an interest in particular institutional arrangements and who leverage resources to create new institutions or*

to transform existing ones" (Maguire et al., 2004). Institutional entrepreneurs are then organized actors – with sufficient resources – who identify possibilities for creating and transforming institutions (DiMaggio, 1988). Particular strategies for institutional entrepreneurs are discussed in the institutional work literature (Hoogstraten et al., 2020). Institutional work is the purposive action of individuals and organizations aimed at creating, changing and maintaining institutions (Lawrence & Suddaby, 2006a). Business actors (individuals, firms, industry associations) may shape societal discourses and problem framing, lobby for specific policies and regulations, develop industry standards, legitimate new technologies, or strategically shape collective expectations (Geels and Verhees, 2011; Konrad et al., 2012; Binz et al., 2016; Rosenbloom et al., 2016). Studies have shown how businesses and other actors shape their institutional environments with discourse activities and framing, through political coalition building and lobbying, or by strategically influencing collective expectations (Garud et al., 2010; Konrad et al.,2012; Hess, 2014; Sühlsen and Hisschemöller, 2014; Rosenbloom et al., 2016). Relatedly, the creation of legitimacy for firms or business models is an essential element in the struggle for public and policy support.

Thus, when radical innovations such as new technologies or business models are developed, institutional change is likely to happen (or institutional rigidity prevents such innovations to become mainstream), because they generally do not fit existing institutions inherited from the past (Hoogstraaten et al., 2020). This works in both ways. The diffusion of a new technology or business model requires adaptation of formal and informal institutions to accommodate the adoption of this innovation. But it may also require effort to adapt the original innovation to make it fit to prevailing institutions.

In brief, institutional analysis in transitions literature is a developing body of work. This dissertation aims to explore the relation between platform enabled innovation and institutional dynamics in transitions. The next section continues to elaborate on the role of business models in transitions and as a lens to study platform enabled urban mobility transitions.

1.2.2 Business models and transitions

Firms have been acknowledged to play critical roles in sustainability transitions, as they develop new products, services and business models (Berggren et al., 2015; Farla et al., 2012). Surprisingly, the business model perspective has received

fairly little attention in the sustainability transitions literature. As several studies recognize the need for conceptual perspectives that connect the firm level, and firms' actions to the system level and transitions dynamics (Bidmon & Knab, 2018; Farla et al., 2012; Sarasini & Linder, 2018; Wesseling et al., 2020), a business model perspective can provide such linkages.

This dissertation contributes to the emerging interest in business models for sustainability transitions. A business model can be seen as the realized strategy of entrepreneurs or firms (Casadesus-Masanell & Ricart, 2010). At a general level, a business models is a description of an organization and how it functions in achieving its goals (e.g. profitability, growth, social impact) (Massa et al., 2017). Business models have a substantial influence on the success and impact of technologies and how they are deployed and used. Business models are a key aspect of innovations because they generate value. As Chesbrough (2010) notes: "*the economic value of a technology remains latent until it is commercialized in some way via a business model*". And "*a company has at least as much value to gain from developing an innovative new business model as from developing an innovative new technology*". A commonly used definition of the business model concept is lacking (Zott & Amit, 2010), although in general, a business model is regarded as a device for creating, capturing and delivering value. A business model helps understand how an innovation is organized in terms of value proposition, revenues, costs and relations, and how it is brought to the market (Teece, 2010). The business model "*describes the rationale of how an organization creates, delivers, and captures value*" (Osterwalder & Pigneur, 2010). Hence, the configuration of these components enables firms to create value and gain competitive advantage over competitors. The 'value proposition' connects firm activities with the demand side and describes the value created for customers. For a business model to be a source of competitive advantage it must meet particular customer needs. The 'value network' describes its relation to external actors such as suppliers, customers and competitors. The 'revenue model' describes the cost structure and how value is captured through monetization (Bohnsack et al., 2020). Business model research has extended into the field of sustainability to explain how organizations achieve their social and environmental goals. Studies on Business Models for Sustainability[3] explored how organizations can create value for all stakeholders

3. A business model for sustainability is defined as: *"A business model for sustainability helps describing, analyzing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries"* (Schaltegger et al. 2016).

(Schaltegger, Hansen, et al., 2016). However, it can be a struggle for organizations to create social, environmental and economic value all at once due to inherent tensions in the concept of sustainability (Hahn et al., 2014).

The link to sustainability transitions has only been made more recently. This is relevant as exploring the role of business models for socio-technical transitions can contribute to our understanding of how a socio-technical system can transform towards greater sustainability (Bidmon & Knab, 2018). Although the potential of business models for sustainability transitions is acknowledged, the topic has received limited attention and few studies have combined business model perspectives with sustainability transitions theories (Sarasini & Linder, 2018; Wesseling et al., 2020). The transition research agenda shows *"there is scope to test whether business model innovation can assist in sustainability transitions or defer radical change*" (Köhler et al., 2019). Only recently, scholars started to address linkages between business models and transition dynamics (e.g. Boons et al., 2013; Boons & Lüdeke-Freund, 2013; Huijben & Verbong, 2013; Wells, 2013). Bidmon & Knab (2018) identified three roles of business models in transitions: 1) as part of the socio-technical regime, existing business models hamper transitions by reinforcing the current system's stability; 2) as intermediates between the technological niche and the socio-technical regime, business models drive transitions by facilitating the stabilization process of technological innovation and its breakthrough from niche to regime level; 3) as non-technological niche innovation, novel business models drive transitions by building up a substantial part of a new regime without relying on technological innovation. The authors also recognize that business model innovation is challenging as new business models may face resistance from prevailing institutions. They argue that positioning new business models is not easy because prevailing business models have become embedded in existing structures such as formal contracts, investments, subsidies, infrastructures, financial structures and well as expectations, behaviors, common interests and routines between actors (Bidmon & Knab, 2018). Similarly, Bolton & Hannon (2016) show that for business model innovation to enact systems change, also structural reforms of political, regulatory and market institutions are needed. Wesseling et al. (2020) show how dimensions of the socio-technical system (i.e. market & users, culture, industry, policy, science & technology) and business model innovation interact. Their case study on electric vehicles demonstrates how business models either stabilize the status quo (regime) or provoke change. Some business models fit-and-conform to existing institutions by proposing and capturing value in ways that align with mainstream

user preferences, practices, norms and values (e.g. framing electric driving as a clean alternative to gasoline cars). Other business models stretch-and-transform institutions such as user behavior and cultural values associated with car-based transport (e.g. promoting a cool image of electric vehicles and triggering the public to think differently about sustainable car use).[4]

By studying bike sharing from a business model perspective – and as an example of an innovative business model – this dissertation brings attention to the potential of digital platform enabled business models. There is great relevance in bringing together transitions literature and insights from studies on business models as digitization and the so-called platform economy have given rise to digitally enabled platform business models – often labeled as sharing economy platforms – that can affect transition dynamics. Kolk & Ciulli (2020) draw attention to digital platform business models for sustainability transitions literature because of their sustainability potential. These new type of business models may potentially contribute to sustainability transitions as they create and capture value from the efficient utilization of resources. The case of bike sharing is an example of such a service-based business model in the urban mobility sector. Their ability to affect transitions makes digital platform innovations and associated business models an increasingly important aspect of transitions. Transition scholars call for identifying *''how digitization is potentially changing the geography of sustainability transitions more widely.*" (Köhler et al., 2019). Digital platforms may have an influence beyond the place they were initially conceived. They also enable relatively easy application across boundaries as the digital nature greatly reduces costs and efforts of implementing and applying business models across boundaries. Hence, they enable fast scaling of innovations. In this way, they may quickly obtain substantial power to influence patterns of sustainability transitions (Kolk & Ciulli, 2020).

This dissertation also draws attention to unsustainable aspects and outcomes of (business model) innovation — the elephant in the room of the transitions field. In the sustainability transitions literature, there has not been much attention for unsustainable trends and sustainability aspects of a transition (Antal et al., 2020). Research tends to focus on hopeful developments, but the shadow side of innovation – things getting worse – is understudied (Shove & Walker, 2007). The sustainability aspect of transitions (how sustainable is a transition?) has been

4. The *fit-and-conform* and *stretch-and-transform* terminology comes from Smith & Raven (2012).

identified as a challenge because it may lead to problem shifting. [5] Scaling up sustainable innovation and solving one environmental problem may create or intensify another one (Van den Bergh et al., 2015).

This is also identified as a broader issue in the sharing economy literature as the emergence of digital – sharing economy – platforms is not uncontested (Acquier et al., 2017; Frenken, 2017; Frenken et al., 2017). Besides economic consequences, the sharing economy is claimed to have positive environmental and social effects (Böcker & Meelen, 2017; Botsman & Rogers, 2011). However, scholars also highlighted emerging distortions (Ciulli & Kolk, 2019; Frenken & Schor, 2017). For example, Murillo et al. (2017) signal a *"boomerang effect"* in which low prices of access to shared vehicles may lead to increased use at the expense of more sustainable options such as public transport, cycling or walking. Some platforms also promote a paradoxical discourse. By referring to *"sharing"* they tend to mask *"pseudo-sharing"* practices – commodity exchanges wrapped in a vocabulary of sharing – and a logic of neo liberal financialization (Belk, 2014). Also the scaling potential of platforms generates controversies and paradoxes (e.g. Airbnb) (Slee, 2016; Srnicek, 2016). Platforms promote market disruption and increased competition, however their scaling potential backed up with large venture capital investments, combined with strong network effects of the platform business model tends to lead to monopolies of new technology giants.

Additionally, providing access over ownership – and thereby more efficient utilisation of resources – can be regarded as a positive contribution to sustainability. However, business models that stimulate access to shared mobility services (such as bike sharing) alone are not sufficient to ensure more sustainable practices. Curtis & Mont (2020) highlight that the bike sharing market in China was saturated by hyper-competitive companies, which created an oversupply of underutilized bikes. Hence, they argue that sharing economy platforms are not sustainable by default, and they demand for strategic and deliberately designing and implementing business models (Curtis & Mont, 2020) (In section 1.4, similar concerns related to the case of bike sharing are discussed).

In sum, digital platform enabled urban innovations lead to new business models. However, the role of business models in transitions is a fairly new and an underexplored area in the transitions literature. Therefore, extant literature can benefit

5. For example, increased production of electric vehicles leads to reduced transport emissions but also requires more lithium extraction.

from more thorough examination of business models in sustainability transitions. In particular, the business model lens is used to study free-floating bike sharing (FFBS) as a case of digital platform enabled urban innovation. These new business models have great potential for transitions because they promote access over ownership and it is argued that they allow for relatively easy implementation across geographical borders. On the other hand, platform enabled business models may also bring about negative side effects, a topic that has not yet received much attention in the transitions literature. It is critical to improve understanding unsustainable outcomes as ignoring them may lead to setbacks in positive urban mobility transformations.

1.2.3 Urban experimentation to navigate platform innovation

As explained in the introduction, platform enabled urban innovation may influence the dynamics of experimentation. First, in contrast to more deliberate forms of urban experimentation, platform enabled urban innovations – free--floating bike sharing in this case – were often just launched into urban spaces without a formal form of deliberation. This radical approach can be considered experimental as companies just put their innovation on the streets and see what will happen. Second, in response to these launches, urban governments organized pilots or urban experiments to both learn from the impact of free-floating bike sharing and to also regulate it.

To further explore how urban experimentation could navigate platform enabled innovations, this section turns to studies on experimentation. The sustainability transitions literature has studied the role of experimentation in socio-technical change and transitions extensively. Originally, the field of transitions focused on analyzing transition dynamics and the role of experimentation by studying different types of (past) experiments. But over the years transition scholars have also engaged with the question of how to proactively enable transitions, in particular through experiments. Experiments may sow the seeds that lead to a fundamental transformation of a system into a new potentially more sustainable socio-technical configuration that, if diffused more broadly, will radically alter the existing system. There is a long research tradition on studying various forms of experimentation. Based on an extensive systematic review – 170 publications from the 1990s to 2015 – of this literature, an experiment has been defined as *"an inclusive, practice--based and challenge-led initiative, which is designed to promote system innovation through social learning under conditions of uncertainty and ambiguity"* (Sengers et

al., 2019). The authors traced back different types of conceptualisation of experimentation in the sustainability literature. Early studies (1990s) on socio-technical experimentation describe niche experiments. This conceptualization revolves around the idea that the introduction and diffusion of new sustainable technologies requires protected spaces – niches – for experimentation. Transition experiments take a societal challenge as a starting point, aiming to proactively explore radically new ways to meet societal needs, such as the need for energy, mobility or health. Sustainability experiments are planned initiatives that embody a highly novel socio-technical configuration likely to lead to substantial (environmental) sustainability gains. Grassroots experiments refer to networks of activists and organizations generating bottom-up solutions for sustainable development that respond to local situations and interests and values of the communities involved.

With the trend of rapid urbanization the quest of sustainable development will largely be an urban challenge. Therefore, since around 2015, studies on experimentation have taken an urban turn, leading to a growing body of literature around urban experimentation and its role in sustainability transitions (Bulkeley et al., 2016; Frantzeskaki et al., 2018; Marvin et al., 2018; Raven et al., 2019; Voytenko et al., 2016). Introducing socio-technical innovation in urban environments is characterized by local challenges, multiple stakeholders, multilevel interdependencies, technological uncertainty and fragmented decision-making. In response to such complexities, the notion of living labs – as a new and open way of governing socio-technical experiments in cities aimed at cocreation – has received much attention in academic and policy spheres (Evans, Karvonen & Raven, 2016; Turnheim, Kivimaa & Berkhout, 2018). The living lab concept refers to both a method for experimentation and innovation as well as the physical space in which this is situated (Dekker et al., 2019). Living labs are increasingly mobilized and heralded in sustainability transitions literature as a way to trial, learn from and govern socio-technical innovations and urban transformations in real-life urban environments to address local sustainability challenges (Bulkeley et al., 2016; Voytenko et al., 2016). Living labs can be defined as *"physical regions or virtual realities where stakeholders form public-private-people partnerships of firms, public agencies, universities, institutes, and users all collaborating for creation, prototyping, validating and testing of new technologies, services, products and systems in real-life contexts"* (Westerlund and Leminen, 2011).[6]

6. Examples of urban experimentation are cities experimenting with re-purposing car parking space into public space offering amenities such as seating, bike racks, public art, or exercise equipment (Bertolini, 2020). Another example is the city of Rotterdam that aimed to

Literature emphasizes the potential of urban experimentation for promoting institutional change towards sustainability. However, the relationship between experimentation and institutional change has been a rather neglected topic (Fuenfschilling et al., 2019). According to scholars, future research could focus on questions concerned with the conditions, processes and pathways through which urban living labs and experiments emerge, on how cities become experimental, how experiments *"scale up"* and shape wider institutional change beyond their initial geographies (Köhler et al., 2019; Bruno Turnheim et al., 2018).

The urban turn in studies on experimentation has given rise to various studies that focus on the influence of socio-spatial dimensions (Dignum et al., 2020; Torrens et al., 2019; van den Heiligenberg et al., 2017). The way in which experiments are embedded (or fail to become embedded) in local contexts such as cities and regions deserves attention (Coenen 2012, Sengers, 2019). According to Hansen & Coenen (2015) the consensus is still that place-specificity matters while there is little generalisable knowledge and insight about how exactly place-specificity plays a role for transitions. Heiligenberg et al. (2017) show that some environments are more favorable for experimentation than others. Success factors of experiments are user involvement, cooperation in local and regional networks, sharing learning experiences, and supportive local policies and visions. Dignum et al. (2020) show how urban socio-spatial conditions shape particular patterns in urban experimentation. They find that local policy is important to urban experimentation, as well as learning, and funding. Torrens et al. (2019) demonstrate how urban environments can be conducive to experimentation. Urban experiments can be seen as battlegrounds were contestation around an innovation and conflicts between participants can be addressed. Hence, urban living labs may assist in navigating tensions around platform enabled bike sharing.

In sum, urban experiments, and living labs in particular may be adequate tools to navigate, learn from and govern platform enabled innovations. On a general level, this dissertation contributes to debate about urban experimentation by assessing the value of urban living lab experimentation in navigating digital platform enabled urban innovations such as bike sharing.

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stimulate learning about urban mobility patterns in relation to Mobility as a Service. As part of the experiment participating citizens received a mobility budget to stimulate the use of public transport and different forms of shared mobility services instead of using their car (De Verkeersonderneming, 2018).

1.2.4 Brief summary

Digital platform enabled urban innovations increasingly influence important aspects of the dynamics of urban mobility transitions. However, so far platform--enabled innovations have rarely been studied in transitions studies (Köhler et al., 2019; Kolk & Ciulli, 2020). Digital platforms potentially challenge transition dynamics in various ways. They (1) shape new business models, (2) challenge prevalent urban institutions and (3) change urban experimentation dynamics. This dissertation looks across these issues and explores their relations from a platform innovation perspective by studying in detail the case of bike sharing systems. The dissertation also makes a number of more specific contributions by exploring particular relations and issues within these aspects of transition dynamics.

1.3 Research question and objectives

The main goal of this dissertation is to better understand dynamic interactions between business models, institutional dynamics and experimentation in the context of navigating platform innovation in urban mobility transitions. To this end, the following research question – focusing on the particular case of platform enabled bike sharing – is being answered:

How does the emergence of platform enabled bike sharing interact with urban mobility transitions?

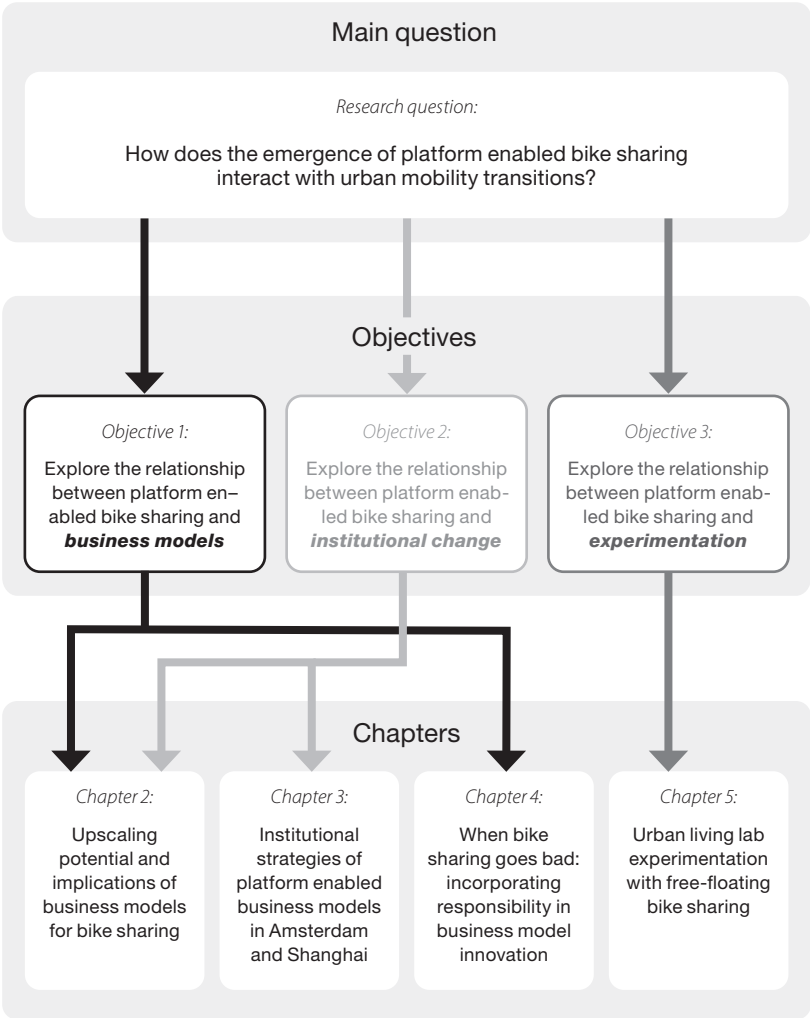
This question will be approached from the three perspectives discussed above (i.e. institutional dynamics, business model innovation and urban experimentation), leading to three corresponding objectives of this dissertations. In addition, broader implications for analysis and governance of platform innovation in urban mobility transitions will be discussed. The main research question and objectives are addressed in four studies that will represent the four chapters of this dissertation. See Figure 1-1 for a schematic overview of how the research question, objectives and chapters are connected. The chapters are further introduced in section 1.6.

1.4 Empirical background and justification

This dissertation focuses on new bike sharing business models as cases of digital platform enabled innovation. This case is studied in different geographical environments.

As highlighted earlier in this introduction, the field of sustainability transitions could pay more attention to digital innovations and by focusing on platform enabled bike sharing this dissertation responds to this call (Köhler et al., 2019; Kolk & Ciulli, 2020). Besides this promising direction for research, the field of sustainability transitions has also largely overlooked cycling.

Figure 1-1: Organising framework for separate studies in this dissertation that contribute to answer the research questions



That is surprising because cycling may be key to solving many of the challenges that cities face today. The individual benefits of cycling are in line with collective benefits. Cycling is low-cost, low-polluting, and health-improving way to travel (Handy et al., 2013). As noted earlier, transition scholars tend to focus new developments (Shove & Walker, 2007), and cycling is not particularly a new thing. Despite promising developments the role of cycling is often overseen in public, policy and academic debates, even in the Netherlands where car centered innovations such as electrification of cars, car-sharing or autonomous vehicles tend to dominate debates about the future of mobility. Nevertheless, an emerging coalition of city and regional authorities, entrepreneurs and academics increasingly consider cycling as a crucial part of responding to a range of societal challenges (Behrendt, 2016; Nikolaeva & Nello-Deakin, 2019). Cycling addresses urban challenges such as congestion, pollution and bicycles occupy significantly less road and parking space. Cycling is especially put on the map as a consequence of the global Covid-19 pandemic. Cycling spurred across cities globally due to the crisis. It has caused a cycling boom as many people started using bikes instead of public transport. In response, urban governments increased investments in cycling infrastructure (Vandy, 2020).

Recently, innovations in cycling are emerging as a particular area of research (Nikolaeva et al., 2019). At first, cycling seems like a mundane transportation mode and the bike a simple and low tech vehicle to get around. The history of the bike dates back to the 19th century and its design has not fundamentally changed over time (Bijker, 1995). However, a closer look shows that especially in the last years, cycling is changing due to the bike's integration with technology. Bikes have developed from low to high-tech means of transport.[7] Digital platform technologies are a key driver that have spurred innovations in cycling. They have given rise to new business models around bike sharing. This has also led to a changing cycling industry, as new players enter, from startups, car industry incumbents, venture capital investors to tech companies. This is an interesting dynamic because we may witness systems change unfolding.

Platform enabled bike sharing – or free-floating bike sharing – is an example of such an innovation that was facilitated by developments in the platform

7. For example, the electric powered bike enables cyclists to increase their travel distance. Smartlocks allow to open bike using a smartphone. GPS beacons aim to prevent theft as bikes can be localized. The bike is also increasingly connected to its environment, for example as technology allows the bike to communicate with its environment such as traffic lights.

economy. This new model for bike sharing was invented in 2015 by students from the University of Beijing, China. By combining digital platform technology, a smart lock and a smartphone app a disruptive business model was born. This model allows bikes to be picked up and parked everywhere without the need of physical parking or docking stations. This is an interesting case to explore the influence of platform innovation on institutional dynamics, business model innovation and experimentation in urban mobility transitions.

One reason is that the case may remind of the *"hype-disappointment cycle"* that refers to the pattern that early beliefs and hopes of new technologies are often too high partly because of promises from product-champions, which leads to disappointments when problems appear or technical progress is slower than expected (Geels, 2005). Indeed, companies created high expectations and promises about transforming urban mobility and in comparison to traditional bike sharing. Free-floating bike sharing would enhance accessibility to cycling and at the same time help urban authorities with environmental targets without the need for public funding. It is also believed to be an interesting alternative to traditional forms of bike sharing. It would lead to reduced costs for operating and deploying a bike sharing system because no extensive upfront investments for docking station based parking are needed (Nixon & Schwanen, 2019). Traditional – station-based – bike sharing programs often involve substantial financial investments in infrastructure and maintenance (McKenzie, 2019). Additionally, a promise is that a network of digitally connected bikes could be automatically managed with limited maintenance on the ground. From a spatial perspective, this model of bike sharing is a solution to more optimal use of public space as no additional parking facilities are needed. In contrast, public bike sharing systems take up space and have an infrastructure.

Platform enabled bike sharing is also an interesting case because the global roll out was not without consequences and led to various challenges. Given the lack of regulations, the rapid influx of bike sharing companies caught many cities by surprise. In some cities, authorities were confronted with an abundance of low-quality bikes, aggressive entry strategies, limited communication and bankrupt companies. In turn, cities responded differently to the global roll out of free-floating bike sharing. In Amsterdam, considered the cycling capital, these companies were banned shortly after they launched whereas other cities such as Manchester and Shanghai embraced bike sharing and adopted a more collaborative approach. In Utrecht, the municipality set up a living lab together

with researchers and a bike sharing company. Cities attempt to strike a balance between assessing the potential of this model, anticipating risks and securing its benefits while at the same time not regulating too strictly. Different responses, across geographies, to a similar platform enabled urban innovation, provides a suitable setting to study differences in institutional strategies (See Chapter 3).

Platform enabled bike sharing is a relatively new phenomenon and research examining its impact is still at an infant stage. Nevertheless, a few pioneering studies critically examined this new model of bike sharing and identified concerns. Duarte (2016) suspects the fact a positive development such as rise of bike sharing systems – which is due to cycling advocates – is now suddenly joined by new (global) player such as information-technology companies, banks and advertising firms. The author argues this is not for the sake of the environment and better quality of life in cities, but other interests are at stake such as the extensive gathering of personal data for marketing purposes, taking advantage of the friendly image associated with bicycles. The way this new bike sharing model produces valuable data is also highlighted by Spinney & Lin (2018). This new form of bike sharing has given rise to new terrains of capital accumulation that work through sharing. The authors explore whether the new model of bike sharing is disruptive and *''transformational''* or an *''extension of existing exploitative capitalist relations''*. They argue the latter and conclude that in its current form it will unlikely achieve a societal transformation. Médard de Chardon (2019) argues that these new bike sharing systems are effective examples illustrating how urban regimes select existing market solutions as societal and environmental fixes but with alternative outcomes to those promoted. They observed that many shared bikes are underused, undermining benefit claims while privileged urban citizens are more likely to enjoy increased mobility choices and accessibility. The author states that this model of bike sharing *''are techno-fixes masquerading as needed mobility transition tools''*. These pioneering studies justify to study free-floating bike sharing as case to investigate the role of business models and unsustainable outcomes (See Chapter 4).

1.5 Methodological approach

The specific methodological approaches are discussed in detail in each separate chapter. However, some more general remarks about the methodological approach of this dissertation can be made.

1.5.1 Engaged research and transdisciplinarity

My personal motivation to embark in this research endeavor is closely related to the type of project that this dissertation is part of. This research is embedded in the Smart Cycling Futures project[8], a transdisciplinary research collaboration between cities, universities and practitioners (te Brömmelstroet et al., 2020). This project aims to investigate the role of cycling innovations in a transition to more sustainable and resilient cities. Creating and maintaining urban living labs for experimentation with innovation has been a corner stone of the project, in which researchers played an active role. By working on real-world problems and being engaged with the objects of study, these types of research projects differ from traditional academic research projects.

At the start of this research project, the living lab experiments were not predetermined. The living lab approach allowed for selecting an innovation that was topical and addressed a pressing urban challenge. Free-floating bike sharing emerged during the first year of the project as an unfolding and pressing challenge for urban actors in the living lab (van Waes, 2017). This created an opportunity to engage with these free-floating bike sharing companies to learn about potential and challenges in an experimentational setting.

Furthermore, the focus on platform enabled urban innovation has also been informed by my background as a Technology Assessment researcher. Research experience in this field has influenced my thinking about digital platforms and platform innovation. Before embarking on this doctoral endeavor I studied the emergence of digital platform technology in the sharing economy in relation to public values (see e.g. Frenken et al., 2019; Frenken et al., 2017).

The active involvement of researchers in initiating experimentation for sustainability transitions is part of a bigger transition in transition studies. From the beginning the field of sustainability transitions has been highly interdisciplinary. Over the years, research from transitions studies has also become influential in policy and practice. Hence, transitions research has been positioned as a transdisciplinary (mode-2) science (Rotmans, 2005). This means that there is an increasing commitment to conduct research that not only describes transformation processes but also initiates and catalyzes them (Köhler et al., 2019; Luederitz et al.,

8. www.smartcyclingfutures.nl

2017). There is a shift from more distanced research (mode-1), towards participatory, action oriented research, in real world environments. In other words, there is an increasing commitment to descend from the ivory tower and work collaboratively on real-world problems. This trend has given rise to methodological approaches such as living lab experimentation that are aimed at the co-production of knowledge that provides evidence relevant for practitioners. However, this trend also raises questions about the societal role of transitions researchers, as they are increasingly becoming important and influential in transition processes (Wittmayer & Schäpke, 2014).

My personal approach of being an engaged researcher was to actively contribute to public and policy debates about free-floating bike sharing in the Netherlands. This included writing opinion pieces in national newspapers and magazines based on empirical research and observations; contributing through newspaper, radio and television interviews; and informing local and national policy makers on regulatory issues of bike sharing (see Appendix for an overview of contributions). This personal motivation to seek societal relevance and generate policy-relevant insights aligns with the growing demands for policy-relevant evidence in transition studies. With regards to academic research, for me this meant that I – at the start of the project – immediately started doing field research (e.g. interviewing stakeholders such as experts, companies and policy-makers) to get a sense of societally relevant and pressing issues. This approach enabled an iterative process between practice and theory. By actively engaging with the object of study – which is also an unfolding development – I was at some point considered an independent experts on this topic. Hence, this public engagement also enabled opening doors that helped my research. For example, it enables building a relevant network of researchers, policy makers at a local and national level and bike sharing companies in the Netherlands and China. Such a position provided opportunities to share and discuss research. Getting a podium at public events or expert meetings for policy-makers brought attention to my research and provided the opportunity to share preliminary insights and receive feedback from a broad range of actors from practice. Even though these opportunities and efforts clearly enriched the process of data collection, the key challenge is to be able to take a critical distance. For example, I noticed increased willingness to participate in my interviews. Private actors have an interest in putting forward a positive framing of bike sharing and promote specific regulatory measures through your research. It is then critically important to be aware of the fact that your object of

study – platform enabled bike sharing companies – are also subject of a broader public debate.

In addition to a more personal methodological reflection, the Smart Cycling Futures project is a fruitful backdrop to critically reflect on the role of researchers in living labs experimentation more generally. Hence, this research contributes to methodological challenges of the transitions field. To this end, in Chapter 5 and the Discussion section is reflected upon living lab experimentation and the influence of researchers. In this way, this dissertation sheds light on how experimentation, and knowledge co-production is done in practice and what type of challenges and dilemmas it brings for transitions researchers.

1.5.2 Methods and data collection

For this dissertation a total of 59 semi-structured interviews were conducted with founders, CEOs or managers of bike sharing companies (28), public transport operators (2), public transport authorities (2), municipalities (13), regional governments (5), academic researchers (7) and experts (2). Interviews were held in 3 different national contexts (the Netherlands, UK[9] and China) and 6 different urban contexts (Amsterdam, Rotterdam, Utrecht, Eindhoven, Zwolle and Shanghai). Another important source of information that contributed to better understanding of the subject to study was participant observation during internal meetings that were held around setting up living lab in the city of Utrecht. The process of setting up and engaging in this living lab around bike sharing was closely monitored. Participating in such meetings is an essential part of engaged research as it allows to build relationships with other participants and share insights from research. To gain more understanding about the particular field of bike sharing, these sources were supplemented with the attendance and participation in public events and expert meetings about bike sharing. See Table 1-3 for an overview of the sources per research chapter.

As part of this research and involvement in the public an policy debates around bike sharing in the Netherlands, a survey among 476 users of FFBS in Amsterdam was conducted (Dec 2017 – Jan 2018) in collaboration with the national government (Ministry of Infrastructure & Water). The findings of this survey highlighted

9. Interviews were held in Manchester with a free-floating bike sharing company, government authorities and an intermediary organization. These interviews were used as background information and not included in the research chapters.

that users were mainly young, highly educated, working men. The majority (76%) were locals. The service was mainly used because public transport stops were too far away, it was easy to park and bike were easily accessible. The FFBS bike was mainly an alternative for public transport and walking trips (Van Waes et al., 2018). Similarly, two year later as part of learning about bike sharing within the living lab in Utrecht another a survey was conducted among 250 users of the selected FFBS system in collaboration with Windesheim University of Applied Sciences (Dec 2019 – Jan 2020). Findings show that mainly tourists (39%) and locals (37%) use the bikes and commuters account for 10%. Similar to what the findings in Amsterdam suggest, bike sharing mainly replaces bus (33%) and walking trips (23%). Car trips are replaced only to a limited extend (4%) and a small portion would consider getting rid of their privately owned bike (7%). Main motivations are the easy use and flexibility (compared to the traditional station-based bikes) (Farla, 2019).

Although these findings were used as input for policy meetings at the national and city level, they were not used in any of the research chapters in this dissertation directly.

1.6 Thesis outline

Chapter 2 focuses on the potential and implications of bike sharing business models in urban mobility transitions. The aim of the study in this chapter is to analyze the upscaling potential of different types of business models for bike sharing. In the chapter a typology is developed, distinguishing 4 business models based on co-existing models in the Dutch bike sharing landscape. To assess the upscaling potential of these business models and their implications a prospective transitions framework is developed. Results show how free-floating bike sharing has upscaling potential but institutional strategies and business model innovation are required to align with institutional environments.

Chapter 3 focuses on strategies to institutionalize platform enabled bike sharing in cities. In particular the study focuses on how free-floating bike sharing companies engage in strategic activities that attempt to create or change the conditions that allow their service to succeed. The chapter presents a comparative study of companies in two different settings: Amsterdam and Shanghai. Results show how institutional strategies respond to varying spatial conditions consisting of local institutions, issues of power and place-specific physical elements.

Chapter 4 is concerned with the unintended outcomes of platform enabled bike sharing business models and how to manage them. Combining literatures on business models and Responsible Innovation, the study examines socio-ethical aspects of business models. The chapter presents a case study of free-floating bike sharing business models in three Dutch cities i.e. Amsterdam, Rotterdam and Utrecht. The study shows how socio-ethical factors can play a key role in the success or failure of platform enabled business models and provides recommendations on to anticipate unforeseen and negative impacts.

Chapter 5 takes a governance perspective looking into the role of experimentation in navigating platform enabled cycling innovations. In this study, the notion of strategic urban experimentation is coined as a new way of engaging with and learning from innovation by city authorities, companies and universities. The chapter presents a study based on a 3-year monitoring and analysis of four cycling innovation living labs, including platform enabled innovation. The study provides insights in the practice (challenges and dilemmas) of doing transdisciplinary living lab experimentation. The study presents insights about strategic urban experimentations processes, the role of place and reflexivity about roles in transdisciplinary research.

Finally, **Chapter 6** summarizes the main findings, provides conclusions and discusses implications for research and governance.

Chapters 2-4 are based on separate journal articles in which I was the leading researcher and author in all stages of the research i.e. conceptual framework, data collection, data analysis, writing. Table 1-1 shows the contribution of co-authors to these papers. The publication status of these papers is shown in Table 1-2.

Table 1-1: Overview of contributions of co-authors

	Chapter 2	Chapter 3	Chapter 4	Chapter 5
Conceptual framework	Arnoud van Waes Koen Frenken	Arnoud van Waes Jacco Farla Rob Raven	Arnoud van Waes Tom Long	Arnoud van Waes Rob Raven
Data collection	Arnoud van Waes	Arnoud van Waes	Arnoud van Waes	Arnoud van Waes Anna Nikolaeva
Data analysis	Arnoud van Waes	Arnoud van Waes	Arnoud van Waes	Arnoud van Waes
Feedback on writing	Jacco Farla Koen Frenken Jeroen de Jong Rob Raven	Jacco Farla Rob Raven	Rob Raven	Rob Raven Anna Nikolaeva

Table 1-2: Chapters and publication status

	Publications
Chapter 2	Published as: van Waes, A., Farla, J., Frenken, K., de Jong, J. P. J., & Raven, R. (2018). Business model innovation and socio-technical transitions. A new prospective framework with an application to bike sharing. Journal of Cleaner Production, 195, 1300-1312. *https://doi.org/10.1016/j.jclepro.2018.05.223*
Chapter 3	Published as: van Waes, A., Farla, J. & Raven, R. (2020) Why do companies' institutional strategies differ across cities? A cross-case analysis of bike sharing in Shanghai & Amsterdam. Environmental Innovation and Societal Transitions, Volume 36, September 2020, 151-163 *https://doi.org/10.1016/j.eist.2020.06.002*
Chapter 4	Published as: Long, T. & van Waes, A. (2021). When bike sharing business models go bad: incorporating responsibility into business model innovation. Journal of Cleaner Production, 297, 126679. *https://doi.org/10.1016/j.jclepro.2021.126679*
Chapter 5	Submitted as: van Waes, A., Nikolaeva, A. & Raven, R. (2021). Challenges and dilemmas of strategic urban experimentation. An analysis of four cycling innovation living labs. To Technological Forecasting and Social Change. *(second revision)*

Table 1-3: Overview of the chapters

Chapter title	2. **Upscaling potential and implications of business models for bike sharing**	3. **Institutional strategies of platform enabled business models in Amsterdam and Shanghai**	4. **When bike sharing goes bad:** incorporating responsibility in business model innovation	5. **Challenges and dilemmas of strategic urban living lab experimentation**
Focus	Upscaling potential of business models for bike sharing	Institutional strategies of FFBS companies	Negative and unintended outcomes of FFBS business models	Challenges and dilemmas of urban living lab experimentation
Area	The Netherlands	Amsterdam Shanghai	Amsterdam Rotterdam Utrecht	Amsterdam Utrecht Eindhoven Zwolle
Theoretical perspective	• Business models • Socio-technical transitions	• Geography of transitions • Institutional work	• Responsible Innovation • Business models	• Strategic Niche Management • Urban experimentation
Methods	• Stakeholder interviews • Desk research • Newspaper analysis	Stakeholder interviews Desk research	• Stakeholder interviews • Desk research	• Stakeholder interviews • Literature review • Participant observations • Workshop / meetings
Data sources	• 9 bike sharing companies in the Netherlands • 4 policy documents • 5 press releases • 14 company websites • Survey among users of FFBS in Amsterdam	• 8 interviews with bike sharing companies in Amsterdam and Shanghai • 2 interviews with experts and researchers in China • 7 policy documents • 7 company websites	• 10 interviews with bike sharing companies in Amsterdam, Rotterdam and Utrecht • 3 interviews with municipalities of Amsterdam, Rotterdam and Utrecht	• Literature review consisting of 52 articles. **Interviews** • 10 interviews with municipalities • 5 interviews with provinces • 7 interviews with academics • 2 interviews with transport authority • 1 interview with intermediary • 1 interview with firm • Observations from workshops and meetings

2

Upscaling potential and implications of business models for bike sharing

Abstract

Most transition studies are historical in nature and fail to arrive at prospective conclusions about future potential. In this chapter a new prospective transition framework is developed, which revolves around the interplay between business models and socio-technical contexts. By looking at the dynamics of increasing returns, industry structure and the role of institutions, the upscaling potential of innovative bike sharing business models as introduced in Dutch cities over the past ten years (two-way station-based, one-way station-based, one-way free floating, and peer-to-peer sharing) is analyzed. It is found that station-based business models are well institutionalized but harder to scale up, while the recent one-way free-floating model has the greatest scaling potential if institutional adaptations and geo-fencing technologies are successfully implemented. Peer-to-peer sharing is likely to remain a niche with special purpose bikes.

This chapter is based on: van Waes, A., Farla, J., Frenken, K., de Jong, J. P. J., & Raven, R. (2018). Business model innovation and socio-technical transitions. A new prospective framework with an application to bike sharing. Journal of Cleaner Production, 195, 1300-1312. https://doi.org/10.1016/j.jclepro.2018.05.223

2.1 Introduction

Over the past two decades, there have been many empirical and conceptual studies on the emergence of sustainable technologies, in particular, in the realm of sustainable energy and transportation (Hekkert & Negro, 2009; Schot & Geels, 2008; Smith & Raven, 2012). These studies analyzed the conditions under which a niche technology succeeded in challenging an existing socio-technical regime (Geels, 2002) as well as the role of supportive technological innovation systems in such transition processes (Hekkert, Suurs, Negro, Kuhlmann, & Smits, 2007). In contrast to the abundance of historical studies on transitions, only few studies have adopted a prospective lens regarding the future upscaling potential of niche innovations.

Prospective studies so far focused on the upscaling prospects of technologies and infrastructures (Hofman et al., 2004; Markard et al., 2009; Naber et al., 2017; Truffer et al., 2017). Our study also deploys a prospective analysis, but focuses on business models (Jolly, Raven, & Romijn 2012; Vasileiadou, Huijben, & Raven 2015). Doing so, we follow the growing interest in sustainable business models in recent years (Bocken et al., 2014; Bohnsack et al., 2014; Lüdeke-Freund & Dembek, 2017).

Exploiting radical innovation opportunities usually requires an organization to deploy new kinds of business models (Johnson, Christensen, & Kagermann, 2008). In the context of the current chapter business model innovation may help to potentially overcome some of the key barriers to the upscaling of sustainable technologies (Wustenhagen & Boehnke, 2008). For instance, sustainable energy technologies such as solar energy often come with new ownership models, value chains, customer relationships and financial flows, as they do not easily fit the traditional business models that evolved around large, centralized energy systems. Another example are digitally-enabled sharing economy platforms, which come with new business models that make privately owned assets available for rental services. Despite this potential relevance of business models in the scaling of sustainable technologies, one can also expect that in the absence of deeper political, regulatory and market reforms, it is unlikely that business model innovation in itself will be sufficient to enact system wide changes, as argued by Bolton & Hannon (2016). This makes an analysis of the relations between business models and socio-technical transitions an interesting and topical avenue for research.

To date, business model innovation has rarely been studied in the context of socio-technical transitions (Boons et al., 2013; Boons & Lüdeke-Freund, 2013; Huijben & Verbong, 2013; Wells, 2013). To analyze the upscaling prospects of competing business models, we develop a new prospective framework by going back to Nelson's (1994) co-evolutionary perspective on industry emergence as the interplay of technology, industry structure and supporting institutions. Co-evolutionary thinking has been foundational in many of the widely used transition frameworks today such as the multi-level perspective (Geels, 2002) and technological innovation systems (Hekkert et al., 2007). We believe therefore that our new framework provides a fruitful starting point for our analysis. By means of the framework, one can identify mechanisms supporting and hindering upscaling. In doing so, one can provide a qualitative prediction regarding the future potential of each business model, that is, to assess an innovation in terms of its likelihood to diffuse at a small or larger scale.

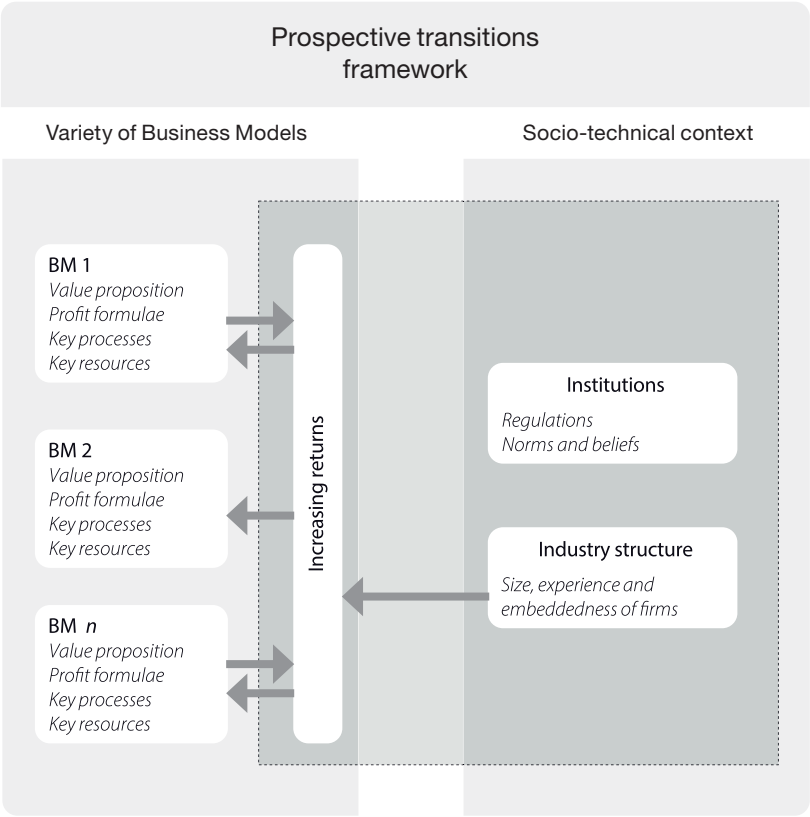
Our framework is used to analyze the prospects of four alternative bike sharing schemes as introduced in Dutch cities over the past ten years, where bike sharing is broadly defined as services that provide temporary access to a bike. The emergence of bike sharing, and cycling innovations more generally, can be understood as being part of a currently unfolding urban mobility transition. The research question is as follows: What is the potential of current business models for bike service innovations to scale up? To understand the prospects of bike sharing in the context of a transition process, we will pay attention to incumbent elements in the socio-technical mobility system, including actors (individuals, firms, organizations), institutions (regulations, norms, beliefs) as well as material artefacts and infrastructure (Geels, 2004; Markard et al., 2012). In studying this phenomenon, we have the possibility to study a potential mobility transition "*in the making*".

2.2 Theoretical framework

We propose a prospective transition framework that serves as a heuristic device to assess the upscaling potential of niche innovations, such as new business models, and their potential to reconfigure an existing regime or to evolve into a new regime. Our framework, visually depicted in Figure 2-1, is a generic one as to allow for a comparative analysis across alternative business models. The analysis is meant to identify the endogenous (i.e. internal to the business model) and exogenous factors that may stimulate and hinder diffusion and further upscaling, as well as their mutual (mis)alignment through increasing or decreasing returns on

investments. We follow the view that upscaling involves co-evolutionary processes of increasing return to adoption of an innovation and the co-evolving industry structure and institutions (Frenken, 2015; Nelson, 1994). We apply the prospective transition framework to business model innovations rather than technologies or infrastructures. Our framework distinguishes between innovation dynamics (in particular increasing returns to adoption), industry structure (in particular the size, experience and embeddedness of firms) and institutional dynamics (in particular changes in regulations, norms and beliefs). Analyzing niche innovations along these three dimensions, as well as their interplay between the dimensions, allows us to assess the drivers, barriers and future upscaling potential of innovative business models, and accordingly, the odds of socio-technical transition.

Figure 2-1: Visual representation of the prospective transition framework applied to business models



2.2.1 Business models

Business models of different four bike sharing schemes are central to our analysis. Attention for business models in the academic community goes back as far as the late 1950s, but the concept only started to receive substantial academic attention in the late 1990s during the rapid growth in internet-enabled businesses. Basically, a business model explains *"the rationale of how an organization creates, delivers, and captures value"* (Osterwalder & Pigneur, 2010, p.14). In various perspectives on business models researchers typically distinguish between the fundamental building blocks of a business (e.g., Johnson, Christensen, & Kagermann, 2008; Osterwalder & Pigneur, 2010; Zott & Amit, 2012). Following Johnson et al. (2008) we here break down innovative bike sharing business models into four building blocks.

First, the customer value proposition relates to how the business model fulfils a particular customer need. Examples of different propositions of bike sharing services are a 'last-mile' solution, tourist mobility or local urban transport. Second, the profit formula defines how the company generates financial value for itself, for example, through a subscription, pay-per-use model, or advertisements. Third, key processes refer to those processes that enable the delivery of the proposition. Examples are processes such as maintenance and redistribution of bikes. Fourth, resources refer to those resources to deliver the proposition. For instance, besides bikes, some systems are based on physical parking infrastructure such as docking-stations.[10] Finally, we adopt the view that according to Zott & Amit (2012), business model innovation can occur by adding new activities, by linking activities in novel ways or by changing one or more parties that perform any of the activities.

2.2.2 Increasing returns

In new industry development, the ultimate rise of a dominant technology or business model can be explained from increasing returns to adoption in the

10. We note that other conceptualizations exist in the literature for unpacking business models, such as the business model canvas model offered by Osterwalder and Pigneur (2010), which distinguishes between nine building blocks. Whilst this conceptualization offers a somewhat more fine-grained analysis of business models, we argue that the four elements proposed by Johnson *et al.* (2008) provides a sufficient mapping for our interest into how different business models in bicycle sharing relate to different challenges in institutional dynamics.

process of upscaling[11]. As the number of adopters grow, producers see cost per unit decline as they go down the learning curve and quality goes up through complementary innovations by suppliers, users and infrastructure providers. Equally, individual users often see the value of an innovation or service increase as the number of users increases, and 'network externalities' arise. This explains why, typically, the variety of business models decreases once a technology scales up, as only few profit from increasing returns to adoption.

In the case of bike-sharing schemes, more users enable a larger network of pick-up and drop-off locations for bikes, which increases the value of using the service. Such increasing returns to adoption of a bike sharing scheme holds for all four business models (explained below). More generally, in the context of urban innovations, increasing returns from spatial network externalities are important. The spatial density at which a service is made available determines in large part the attractiveness of a service, given that users want to minimize distances to the service (Arthur, 1989). Innovation diffusion is thus in large part a self-reinforcing dynamic driven by increasing returns to adoption for both producers and users (Arthur, 1989). Hence, one aspect of the upscaling potential of a business model concerns the extent to which it profits from increasing returns.

Particularly important in passing the threshold of widespread diffusion is the status of substitutes. In some cases, substantial switching costs are involved for adopters that change from one system to the next. These costs need to be compensated for by a larger user base yielding higher network externalities. Consequently, the higher the switching costs, the more actors have an incentive to wait for others to adopt first (Shy, 1996). Switching costs are not given, but to a large extent depend on firm strategies and the institutional environment. In particular, if a new technology or business model can be made compatible with existing standards, infrastructures and regulations, switching costs are generally low. Furthermore, if user practices can remain largely unchanged while adopting the next technology as an alternative to the old one, costs for consumers become more acceptable.

11. In some cases, increasing returns do not lead to a single dominant design, but to a sustained co-existence of multiple business models serving different user groups.

2.2.3 Industry structure

Industry studies also teach us that the prospects of a business model at the early stage of industry development does not only depend on the business model characteristics, but also on the types of firms adopting it. Firms entering an industry with "*pre-entry experience*" in related industries tend to survive much longer than firms that cannot leverage any relevant industry experience (Klepper, 2002). In particular, the experience of founders and investors plays an important role in the choice of business model as well as their ability to scale up operations successfully. Furthermore, a high degree of local industry embeddedness may help them to adapt to local institutions as well as to change such institutions in their favor (Boschma et al., 2017). For instance, in particular foreign suppliers of bike sharing schemes in the Netherlands (NL) tend to collaborate with locally well-known cycling champions to increase their ability to shape institutions in their favor.

The size of firms also plays a role in industry evolution. Larger firms have more access to resources and can leverage economies of scope when diversifying from an existing industry into a new industry (Lieberman & Montgomery, 1998). They can more easily overcome chicken-and-egg-problems by investing heavily in rolling-out a new service at initially low prices. As we will argue below, the largest provider of shared bikes in the Netherlands (OV-fiets) is the national railway organization, with substantial resources and experiences available. In this way, a critical mass of consumers can be reached allowing both the firm and its users to benefit from increasing returns to adoption. At a later stage, the initial losses can be recovered by increasing prices once consumers are locked-in. Smaller firms, by contrast, are more reliant on a large investor to access such resources. Though small startups may be more open to explore new business models, the upscaling is often dependent on the adoption of a new business model by large incumbents (Bohnsack et al., 2014).

2.2.4 Institutions

As a third dimension in this co-evolutionary process, Nelson (1994) emphasizes the critical role played by institutional changes supportive of the further development and diffusion of the new technology or business model. As new technologies have their specific physical and social properties, institutions generally need to be adapted, or even invented, to solve specific problems or conflicts that arise. These may concern health and safety regulations, property rights, labor

rights as well as the norms and beliefs embedded in existing practices. Transitions research has suggested that in the absence of deeper political, regulatory and market reforms, it is unlikely that business model innovation in itself will be sufficient to enact system wide changes (Bolton & Hannon, 2016). Hence, an assessment of how business models may shape broader transition processes requires not only an analysis of business models and the firms adopting them, but also of the potential (mis)fits between a business model and its institutional context.

Scott's (2008) distinction between regulative, normative, and cultural-cognitive institutions is relevant in the context of socio-technical transitions (Geels, 2004; Raven et al., 2019). Regulative institutions can be formal rules, policies or laws that concern for example bike parking. Their legitimacy is embedded in legal frameworks and other systems with formal authority. Normative institutions comprise of norms, habits, roles and responsibilities. Their legitimacy is embedded in moral and ethical systems. Cultural-cognitive institutions represent values, shared beliefs and assumptions. Their legitimacy is embedded in cultural repertoires. An innovative business model then, may align with and reproduce existing regulations, norms and/or beliefs already in place or, alternatively, challenge and depart from them. These prevailing institutions may thus pose barriers to the development and diffusion of an innovative business model, whilst changing them may be beyond the direct control of individual actors. Hence, upscaling requires *"institutional work"* (research, lobby, campaigns, etc.) to gain legitimacy for the new service in question within the context of an established institutional regime (Lawrence et al., 2009). Only when the new practice is considered as a legitimate activity, firms and investors will be willing to invest heavily to roll out a new service (Zimmerman & Zeitz, 2002).

In sum, we view a transition process as the co-evolution between increasing returns to adoption, and changes in industry structure and institutions. During this process, different business models compete for users which benefit from increasing returns to adoption, rendering a single dominant business model a likely outcome. The scaling up process, however, also needs to be supported by sizeable and experienced suppliers and other stakeholders as well as by changing practices and regulations that provide legitimization. These factors, and the way they co-evolve, differ across business models. An analysis of the upscaling potential of bike sharing business model thus needs to analyze the nature and extent of increasing returns favoring its further adoption as well as the background of actors and the relevant institutional contexts involved.

2.3 Bike sharing typology

Our empirical object of study is bike sharing business models employed in The Netherlands (NL). We believe that it is important for sustainability scholars to engage with cycling as a key area for innovations in (urban) mobility transitions, besides the more conventional case study choices such as electric vehicles (Bakker & Farla, 2015), biofuels (Nilsson et al., 2012) or bus rapid transit systems (Sengers & Raven, 2015). Cycling is a relatively mundane and long-standing practice, which is often neglected in sustainability transition research in favor of more technology-driven innovations (for exceptions, see Gössling, 2013; Raven et al., 2017; Sheldrick, Evans, & Schliwa, 2017). Furthermore, cycling is a far less powerful industry than the global automobile agglomerates. As a result, compared to the car regime, planning for cycling and cycling innovations is arguably under much more direct control of city actors, who are increasingly seen to be critical actors in sustainability transitions and experimentation (Evans et al., 2016).

The Netherlands is known for its well-established cycling culture (Kuipers, 2012). The first public bike sharing system in the world – Witte Fietsenplan – was founded in Amsterdam in 1965. Although the idea of publicly available free bikes failed initially in this city, a revolutionary idea was born at that time. More successful is a widely used and nationwide system (OV-fiets) operated by the Dutch railways, which has been in place for over 10 years and mainly serves to cover "*the last mile*" for train passengers (Van Den Bergh et al., 2007). This bike sharing system currently experiences competition of various competing business models for sharing bikes. These developments in NL are part of a much wider process with over 800 cities worldwide already embracing bike sharing (Fishman, 2016).

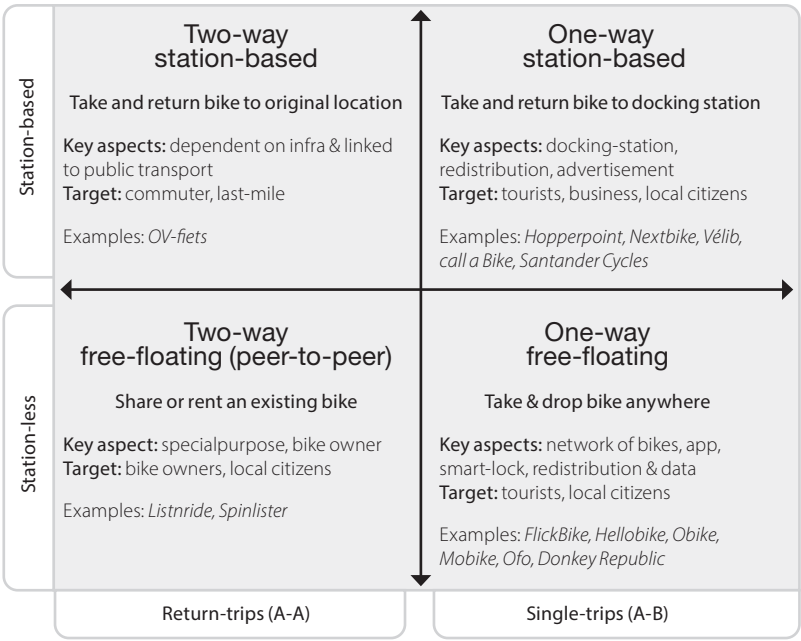
Bike sharing business models provide an interesting research entry to empirically apply our prospective transitions framework, with an eye on investigating enablers and barriers towards socio-technical transition. First, the emergence of bike sharing systems can be understood as being part of a broader unfolding urban mobility transition. Second, a new generation of bike sharing business models is enabled by the combination of a digital lock, GPS and smartphones, which are rapidly growing and challenging more traditional models of bike sharing.

Analytically, bike sharing business models can be mapped along two dimensions. One dimension distinguishes between return trips versus single trips. *"Two-way"* bike sharing systems require the user to return to the bike back to the location

where it has been picked up (A-A), while "*one-way*" systems allow users to pick and drop the bike anywhere (A-B). The second dimension along which bike sharing business models can be distinguished concerns parking. In some systems, it is compulsory to park the bike in a designated docking-station, while in more recent free-floating systems, a shared bike can be parked like any other private bike.

Cross-tabulating the two dimensions results in Figure 2-2 which classifies the four business models. The oldest model (since 2004) in NL is the aforementioned OV-fiets, which adopted a traditional two-way station-based model. While the one-way station-based model is well established in large European cities like Paris (Vélib'), Berlin (call a Bike) and London (Santander Cycles), it has been less common in NL. More recently, since 2016, innovative one-way free-floating systems have been introduced. Users download an app and with the app can lock and unlock a bike anywhere they like. Finally, a number of peer-to-peer systems emerged where residents can rent out their own bike and request the lender to return the bike where it has been picked up. This peer-to-peer sharing model, however, has only limited success so far.

Figure 2-2: Bike sharing business model typology



2.4 Research design

The research was designed following conventional comparative case study methodologies and following traditions in interpretative and qualitative research (Yin, 1994). Such a design was deemed most appropriate given that bike sharing schemes are (in most cases) a relative new and highly dynamic phenomenon. The four business models shown in Figure 2-2 are central to the comparative analysis. To get an overview of different bike sharing services in NL a desk study was conducted, as part of a broader study into cycling innovations in NL. Based on web-searching 'deelfiets' (shared bike) or 'deelfietssysteem' (bike sharing system) we selected 9 cases that are operational in NL for more in-depth analysis. Table 2-4 in the appendix provides an overview of the cases.

Data collection, analysis and developing a case study narrative occurred in an iterative and engaged fashion. Specific data was collected through semi-structured interviews with seven out of the nine cases (see also Table 2-4, in this chapter respondent quotes are referred to by r). Interviewing these actors in a rapidly developing bike service market was an iterative process. New developments (such as policy changes) and insights from one interview led to new questions for the next interview. The semi-structured interviews ranged between roughly 30 and 90 minutes. All interviews were conducted face-to-face and recorded. See Table 2-3 in the appendix for the interview protocol. All interviews were transcribed and were sent back to the interviewee for approval.

Next to this, other sources were included to triangulate data as much as possible. including websites of providers, policy documents, news reports and press releases. In the period of June 2017 – December 2017 the ongoing debate in newspapers was closely followed by collecting and coding 33 relevant articles in 2 major Dutch newspapers (25 in Het Parool and 8 in NRC). This debate reflected the (institutional) dynamics between bike sharing providers and municipalities. Additionally, data-collection also included analysis of (4) policy documents, (5) press releases and (14) websites of different providers.[12] The prospective transition framework elements functioned as sensitizing concepts for the empirical analysis (Blumer 1954). Descriptions of key concepts from the literature focused attention to particular empirical phenomenon, which

12. Additionally, a survey amongst 476 users of one of the providers of one-way free floating bike sharing services in NL, enabled a deeper understanding of actual user practices and perceived benefits of this scheme (Van Waes, Münzel, & Harms, 2018).

enabled a further conceptualization of the nexus between business models, increasing returns, institutions and industry structures (see Table 2-1).

Emerging typologies of business models and explanations and assessment of the potential of these business models to scale up where presented at various events, where feedback was collected in a transdisciplinary fashion. Results from initial analysis were presented at three policy- and practitioners conferences[13], on radio and television. These engagements with stakeholders subsequently resulted in new empirical observations and analytical reasoning. Throughout this engagement the first author maintained a diary database with observations, citations and reflections.

Table 2-1: Key concepts and descriptions

	Concept	Description
Business model concepts	Value proposition	Refers to the particular business model proposition offered to target customers of a particular bike sharing service, such as a 'last-mile' solution for commuters from public transport stations or local urban transport for citizens or tourists.
	Profit formulae	Refers to the revenue model through which a bike sharing service provider extracts financial value from the services offered such as a pay-per-use model or advertisements.
	Key processes	Refers to the particular actions or steps necessary within a business model to enable the delivery of the value proposition, such as the need for maintenance or to redistribute bikes
	Key resources	Refers to the particular financial, material, human or other assets involved in the delivery of the value proposition of a particular bike sharing service. Examples are bikes, docking-stations and personnel.
Co-evolutionary concepts	Increasing returns	Refers to the benefits that producers and users of bike sharing services experience when the number of users increases. Examples are costs reductions through economies of scale (supply side) or improved user accessibility through higher spatial densities (demand side). Also switching costs for adopters to change from one to the next bike sharing system determine the attractiveness to use it.
	Industry structure	Refers to the size, experience and local embeddedness of suppliers involved in the bike sharing services provided.
	Institutions	Refers to the regulatory environment, norms and values in which bike sharing services develop, such as legal frameworks and public values regarding bike ownership and urban space.

13. Nationaal Fietscongres, Tilburg, the Netherlands (21 September 2017), Inspiratiedag Tour de Force, Ede, the Netherlands (23 november 2017), Annual meeting Fietscommunity, Utrecht, the Netherlands (30 November 2017).

2.5 Results and analysis

See Table 2-2 for an overview of the different elements of the business model per type and the prospective transitions analysis.

2.5.1 Two-way station-based

Business model
The two-way station-based model is provided by OV-fiets and Keobike. The value proposition of the two-way station-based model is offering a "*last-mile*" solution. Target customers are public transport commuters who arrive by train or bus and need to cover the so-called last mile to their final destination. The bikes offered are standardized bikes, which can be obtained at transport stations[14] by using a chip card (public transport smart card) and can be rented for the day. This model functions as an extension of the public transport system (OV-fiets and Keobike) and is designed to mainly facilitate round trips (from a station to a destination and back to the station). The public transport companies see two-way station-based bike sharing mainly as an extension of their services: *"We don't want to be a public transport company focusing on bus-transport only. We aim to be a mobility company, which means we must also provide other modalities such as cycling"* (r2). The profit formula entails revenues and costs. Revenues are obtained by charging a fee per trip. Costs are linked to the key resources and key processes. Besides the bikes, fixed stations, parking infrastructure and personnel for distribution and repair are key resources in this system. For upscaling this model, often public funding is needed (Provincie Noord-Brabant, 2017). Key processes entail maintenance, repair, active redistribution[15] and intake.

Prospective transitions analysis
Due to the current widespread adoption of OV-fiets the two-way station-based scheme is the most established bike sharing model in NL. It is widely used by commuters. The main challenge of scaling OV-fiets is *"to meet demand and ensure the availability of bikes and parking places"* (r1). The system is dependent on infrastructure assets and physical locations, making it costly, and therefore less scalable. *"To rebalance a system is the Achilles heel of bike sharing systems: that is very costly"* (r1).

14. The OV-fiets is obtained from manned parking stations. The Keobike is obtained from automated stations.
15. This model does allow single way bike sharing (from A to B), but then an extra fee is charged because that requires rebalancing the system.

From the supply side there are (low) increasing returns to adoption of the two-way station-based model, based on the fact that the suppliers gain a better bargaining position in relation to the suppliers of bikes and infrastructure. From the demand side, users have increasing returns to adoption based on spatial network externalities: the value of the subscription rises when there are more stations where the bikes can be collected. However, currently bikes are only available at public transport stations, making the spatial availability limited. Also, these companies do not aim to provide bikes outside stations (r1). The costs of switching to this model are low.

This model is integrated in the public transport system and is exploited by incumbent public transport companies (industry structure) which provides a monopoly on strategic locations for bikes. This model is embedded in the chain of intermodal transport, fostering the combination bike-train transport. The exploitation of this bike sharing model is not the core business of its providers as is illustrated by the following quote: *"Cycling plays an important role in the chain of mobility. We learned from research that the decision to take the train is strongly influenced by the extent to which it is easy to reach the train station or your final destination from the train station"* (r1).

In terms of institutions, two-way station-based models such as OV-fiets have been supported by (local) governments in the past.[16] The placement of stations is embedded in existing procedures. With regards to informal institutions and user practices, there are no frictions: two-way station-based bike sharing has public support and is more popular than ever.[17]

2.5.2 One-way station-based

Business model

The value proposition of the one-way station-based model is to facilitate local transport from one designated location to another i.e. this system allows users to make one-way trips, often within a city. In this system bikes can be obtained from

16. OV-fiets is supported by the national government, as they are located at key locations and it plays a key role in solving bike parking problems at major train stations (Ministerie van Infrastructuur en Milieu, Fietsersbond, Federatie Mobiliteitsbedrijven Nederland, Interprovinciaal Overleg, Metropoolregio Rotterdam Den Haag, NS, ProRail, Rover, Stadsregio Amsterdam, 2016).

17. OV-fiets has seen an increase of bike rides of 33% in 2017 (NS, 2018).

multiple locations and the user is not obliged to return the bike to its original location. Target customers are city residents as well as temporary visitors. The profit formula is based on pay per use and subscription fees and advertisements on bikes (revenues) and the costs are linked to bikes, the docking-station infrastructure and personnel. A key resource of this model is fixed docking-stations. Initial investments by local authorities for bikes and docking-stations was needed so the provider could focus on exploitation (r4). More broadly, entrepreneurs emphasize this type of funding is key for bike sharing systems, because start-up companies cannot bear the risk of investing large amounts in bikes and infrastructure (r5; r4). Operationally, the system is automated and no personnel is needed. However, redistribution is often needed to rebalance the system, which is costly. This is why some providers charge extra fees for users that return a bike at another station. Key processes, then, entail redistribution, maintenance and repair.

Prospective transitions analysis

The one-way station-based model is relatively small in NL. The dependency on docking-station infrastructure makes one-way station-based systems less scalable than those not dependent on docking stations. From the supply side the same increasing returns to adoption apply as in the case of two-way station-based systems. Similarly, from the demand side users profit from an increasing network of stations and bikes. However, compared to the two-way station-based system, users profit more from spatial network effects as this model is based on making trips between different docking-stations; the number of docking stations will often exceed the number of public transport stations. Switching costs to users are relatively low, depending on the subscription fees of the service.

In NL, a few actors are exploiting this business model, varying from a small local entrant (Hopperpoint) to an established international one-way station-based provider (Nextbike), who collaborates with a regional public transport company. Collaborating with local public transport companies contributes to better local embeddedness and integration in intermodal transport. The model is supported and sometimes partly funded by local authorities. Local governments initially supported the placement of docking stations. The regional government financed half of the Hopperpoint system so it could launch in two cities (Provincie Noord-Brabant, 2016). Institutional barriers are relatively small and relate mostly to the fact that docking stations sometimes need space in the public realm.

2.5.3 One-way free-floating

Business model

The value proposition of the free-floating model is that it allows users to take and drop a bike anywhere in a city without the use of physical infrastructure.[18] A bike can be localized and unlocked using a smartphone application. Once a bike is locked after use, it is open to new users again. Some providers (HelloBike, Urbee, Donkey Republic, Mobike)[19] use digital geo-fencing technology through which a geographical area can be 'fenced' in an online app, which indicates the areas where bikes can be parked. These areas can be public spaces, or public or private bike parkings.[20] Target customers are temporary visitors such as tourists but providers also aim at local citizens[21] or businesses that can provide the service to their employees. These users are offered access to a bike – varying from regular bikes to e-bikes – within walking distance. Some providers use bikes with a design that is very different – often smaller – from Dutch bikes. Often these bikes are also not adjustable in size as their model is standardized.

The profit formula is based on pay per use, deposits[22] and potentially selling user data in the future (revenues). There are no substantial costs related to infrastructure such as docking-stations. Costs are linked to key resources: a dense network of available bikes equipped with digital locks that can be opened with a smartphone application. Investments in free-floating models mainly come from the private sector. Free-floating providers are often extensively backed by large investors and technology companies (For example, Chinese market leaders Ofo and Mobike are backed by respectively Alibaba and Tencent) which allows for a large scale diffusion of bikes. Investments in the (local) free-floating models from NL and Denmark are much smaller and also have public funding.

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18. Hybrid systems also exist, for example BTNbikeshare in Brighton UK. These systems use docking-stations but also allow to drop a bike within a designated zone.
19. Providers could charge extra when returning the bike to a different designated area to account for rebalancing costs.
20. A geo-fencing zone can be an 'allowed' area that users have to park a bike in not to be fined and/or preferred areas that users can finish a bike trip in. The former usually covers a large geographical area (e.g. city centre). The latter is usually smaller, linked to parking infrastructure, and contained within the former.
21. This group might become more important in order to build legitimacy among citizens.
22. For some one-way free-floating models, registering requires a substantial deposit payment (Obike: €79,-). These systems charge lower rates (€0,25/15 minutes) compared to competing systems. When introduced in a city, the pay as you go fee is very low to attract new customers.

Parking space is an important (public) resource for this model as the bikes are parked throughout cities. Another key resource is user data. Data on the type of user, cycling routes and geographical locations can be used by the bike service provider for decision-making. It allows to adapt the business model (in terms of pricing or relocating bikes), to regulate user behaviour (in terms of where to park bikes trough geo-fencing) or to market additional products or services based on a geographical location. Some providers focus on the (future) exploitation of user data for marketing ends (via the app or on the bike) (r9). "*We want to create a geo-based marketing plan. When you plan your route, restaurants with discount coupons will be highlighted. We develop algorithms that display advertisements based on your location and time.*" (r5).

Whereas for station-based models both docking-stations and bikes are obvious sites of marketing, a strong brand visibility on the bike itself is a key resource for the one-way free-floating model because it enhances their visibility on the streets. A strong brand identity helps their recognisability in geographically different areas both in a national and international context and attracts new users to the system. For this reason, some providers want to keep their own branding (r3) whereas other providers adjust their bikes to local city branding (r5).

Besides maintenance and repair, which is often outsourced to local social working places, redistributing and rebalancing the pool of bikes throughout a geographical area is a key process. Managing the float of bikes entails controlling locations and relocating bikes when bikes are not evenly spread or when they are parked outside designated parking zones.

Prospective transitions analysis

Both from the supply and demand side there are increasing returns to adoption of this service. Users subscribing to this service enjoy spatial network benefits: the more bikes are put on the street, the easier users can locate and unlock a bike in their vicinity. This model can scale independently from dedicated parking infrastructure. Also switching costs to these services are low. Using these models requires subscribing via an app and registering a bank account. The key enabler of this innovative business model is the combination of the digital lock, GPS and the smartphone. The widespread smartphone ownership supports the development and diffusion of these systems as these are required for reserving and unlocking the bikes.

From an industry structure perspective: the market for these models consists mainly of newcomers with both local and international backgrounds. Global providers are often backed by venture capital investors, who are often not typical actors with a mobility or cycling background but mainly technology companies involved in e-commerce, social media, mobile and online payments, or ride--hailing. Some are market leaders in their home country and aim for international expansion. These actors are usually newcomers in the markets they enter, making them not yet locally embedded. A strong financial position does make them independent from substantial public funding to roll out a bike sharing system in a city. *''We do not claim any public subsidy" (*r10). Besides global players there are also smaller providers with a local (Dutch) or international (Danish) background. Some of these are (financially) supported by local authorities and integrate their system with an existing mobility card (r5).

The one-way free-floating system does not match with local formal (or regulatory) institutions as it interferes with bike parking policy. As this model relies on public space for bike parking, which is relatively unregulated in NL (the Dutch are used to parking their bike on any place on the street), the recent emergence of one-way free-floating systems has become a problem in major cities such as Amsterdam. In this city, public space is scarce making bike parking in general already a challenge. The one-way free-floating bikes lead to uncontrolled bike parking situations: bikes are put on streets, fill up bike parking places or block pavements (Schravesande & Amghar, 2017). [23]

The lack of clear rules for bike parking is also an explanation for the rapid diffusion of one-way free-floating systems. When one provider announced the introduction of their service in Amsterdam the municipality allowed them to do so: *"there are no rules, so go ahead"* (r8). However, the rapid diffusion of different providers made the municipality of Amsterdam to temporarily ban them. The city representative explained*: "We don't want the shared bikes to take up scarce public space". "The goal of bike sharing concepts should be that they lead to less bikes in the city. But now it seems that they lead to more bikes"* (Gemeente Amsterdam, 2017a). A judicial basis for this decision was found in a rule – that also applies to traditional bike rentals – that providers are not allowed to provide services in the public space.[24]

23. Out of the 5.000 to 7.000 bikes that were placed by four providers in Amsterdam, 750 (14%) were parked at locations where it was not allowed (Gemeente Amsterdam, 2017b).

24. Traditional bike rental companies for example have to adhere to certain rules with regard to the number of bikes offered in front of their shops.

Bikes and rented bikes can use public space for parking. However, bike sharing (or rental) companies cannot use public space to offer their services.

In response to these developments in Amsterdam, and in anticipation of the introduction of bike services in other cities, major cities are currently developing new rules and conditions for bike services.[25] Some municipalities changed their regulative institutions.[26] In The Hague, for example, the municipality changed its local legislation in order to regulate free-floating bike services and to avoid unattended bikes in the public space. Such rules are in favour of station-based models because in this system bikes cannot be left unattended (Gemeenteraad Den Haag, 2017).

The above cases show that the development of one-way free-floating is hindered by formal institutions. This model lacked public acceptance and legitimacy, at least, in its introduction phase, in some (parts of) cities. The model has become controversial in some locations due to their rapid and widespread roll out in a short time period, which impacts liveability and public space in cities (Schravesande & Amghar, 2017).[27] In two months' time, the city of Amsterdam received around 200 complaints about bikes that were put on the streets by providers (Gemeente Amsterdam, 2017b). In a new policy plan, the municipality states: ''*the free introduction of bike sharing in Amsterdam has shown that public support quickly disappears when the needs of target groups (citizens and commuters) and existing urban problems (bike parking) are not taken into account*.'' (Gemeente Amsterdam, 2017b).

However, one-way free-floating models that apply geo-fencing technology have potentially a better match with formal institutions. First of all, these providers are aware of the potential challenges of one-way free-floating: *"Our system is designed in a way we could operate a free-floating model. But that is not desirable from an*

25. Examples of such rules are designated locations for shared bikes, a maximum amount of shared bikes in a bike parking or providers that financially contribute to public infrastructure. Controlling such agreements would require sharing data from the provider with the authority (van Waes, 2017).
26. Business models are also adapted in response to these institutional pressures. For example, a city announcing that bikes cannot just be parked in public space made a provider to focus on privately owned but publicly accessible parking spaces (R3).
27. One-way free-floating bike sharing does not always lead to major issues. For example in Rotterdam (the Netherlands) or Manchester (UK) this model was introduced without much resistance.

urban perspective because this will lead to bikes spread out everywhere. Also from an operational perspective this is a challenge: when maintenance is needed you need to go to a lot of different places to pick up bikes" (r5). Second, this model allows for controlled diffusion of bikes: *"An important element in our business compared to free-floating is that it is respectful to public space. We put hubs only where there is a bit of space and we also check with cities before we set up these hubs. If they say: please don't do these ones, we won't do it"* (r3). Third, different providers stress the importance of collaborating with local governments such as for example Mobike, that highlights collaboration with stakeholders to take into account different local interests (Mobike, 2017b).

2.5.4 Two-way free floating (*"peer-to-peer"*)

The peer-to-peer model started only recently and differs markedly from other business models in that the bikes are not company-owned but provided by private bike owners. The value proposition of the peer-to-peer model enables bike owners to rent out a bike they own to others. This user will have to take the bike from the owner's location and also return it there, making it a two-way model. Currently two platforms provide this service: Listnride and Spinlister. Offerings on the platform show a niche market focusing on special purpose bikes such as e-bikes, racing bikes and cargo bikes. This can be understood from the returns that bike owners can make. Cheap bikes for everyday use are abundant and carry little use value. Hence, few bike owners will offer such bikes. By contrast, special-purpose bikes are more scarce and of higher quality. Hence, the owner of such bikes can make a considerable return by renting out such bikes. Target customers are thus both bike owners and bike users in need of special purpose bike trips. The profit formulae of providers of this service is based on linking demand and supply of bikes. They charge a transaction fee (revenue) and costs are related to the development of the digital platform (key resource).

Table 2-2: Business model and prospective transitions analysis

	Business model analysis		
Business model	Customer value Proposition	Profit formulae	Processes
two-way station-based	• Facilitate public transport commuters in last-mile transport • Target customer: commuter	• Pay per use	• Active distribution and intake • Maintenance and repair
one-way station-based	• Local city transport from one designated location to another • Target customer: city residents, temporary visitor	• Pay per use • Advertisements	• Maintenance and repair • Requires redistribution
one-way free floating	• Take and drop a bike anywhere • Some providers work with geo-fence technology and designated public or private parking areas • Target customer: locals, temporary visitors	• Pay per use • Deposit • User data • Advertisement	• Redistribution • Maintenance and repair • Float management
two-way free-floating (peer-to-peer)	• Digital platform that enables bicycle owners to rent out their own bike • Target customer: users in need of special purpose bikes	• Income from transaction fee • Revenue from rental	• Development of platform

	Prospective transitions framework			
	Resources	Increasing returns	Industry structure	Institutions
	• Bicycles at public transport stations • Parking facility • Personnel for distribution and repair • Permits • Subsidy by local government	• Embedded in public transport system • Dependent on infrastructure • Increasing returns • Low switching costs	• Dominant model • Large public transport firms • Strategic positions at hubs • Bike sharing = not core business but complementary service	• No friction with formal and informal institutions • Bike viewed as part of mobility chain. • Use is embedded in intermodal transport
	• Bicycles • Automated docking stations • App • Subsidy by local government	• Dependent on infrastructure • Increasing returns • Low switching costs	• Small in NL • Entrant • Dutch and German actors	• No friction with formal and informal institutions. • Supported by local/ regional authorities
	• Network of bicycles • Smart lock • App • Data • Public or private space • Private investments • Subsidy by local government	• Independent from infrastructure (some models work with geo-fencing zones) • Increasing returns • Low switching costs • Spatial network externalities	• Emergent • New entrants • Both global (China, Singapore) and local actors (Dutch and Danish) • Global actors backed by venture capital • Some local actors backed by public funding	Formal: • Friction with formal institutions • Bike parking unregulated • Providing service in public space regulated • Geo-fencing allows for regulation and is supported by local authorities Informal: • Lack public support & legitimacy due to impact on public space
	• Digital platform / website	• Few users from both demand and supply side • Independent from infrastructure • Based existing capacity	Digital platforms	Formal: • No friction with formal institutions Informal: • Bike ownership which may be a barrier

Prospective transitions analysis
The number of people sharing or renting out their own bike to peers via a digital platform is currently low in NL. Nevertheless, in theory this model has upscaling potential because no physical assets are required, it is not dependent on infrastructure and it is based on the existing bike capacity, which is large in NL. Both from a supply and demand side there are increasing returns to adoption. Suppliers are bike owners and the more bikes are listed, the more users could benefit, not too distant from their home. Also switching costs are low.

However, the interest in sharing or renting a bike seems low. So for the platform, it is a challenge to attract bike owners to list a bike. Also, the current form implies a two-way system, which limits user flexibility. Face-to-face meetings between owner and lender are thus necessary to hand over the bike key. When digital locks are applied onto privately owned bikes, the peer-to-peer transaction can be automated, which could lower the barrier for both owner and renter to engage with this type of bike sharing. The actors are not directly locally embedded as this model of bike share is deployed by digital platforms, operated from Germany and the US.[28] This model also does not conflict with formal institutions such as parking policy because bikes are parked at and rented from peoples private homes. However, informal institutions such as bike ownership might form a barrier to this model of bike services. On the one hand bike ownership means that there is a large capacity of bikes to be shared, on the other hand it is also a barrier to this type of bike sharing because it means there is less demand.

2.6 Cross-case analysis

Our framework allows for an overall comparative analysis across different business models on their future upscaling potential. See Table 2-2 how the transition potential of each of the four business models is analyzed along three dimensions. From the cases, we observe that increasing returns matter for all business models, but less so for peer-to-peer sharing, which remains limited to niche markets, in particular for special purpose bikes. We also observe that the traditional station-based models face physical challenges in upscaling their business model. Station-based systems are dependent on parking infrastructure which is both

28. Peer-to-peer bike sharing could also occur without the use of digital platforms, however that is less visible.

costly and spacious, which explains why such systems are often dependent on subsidies from local governments.

On the other hand, the advantage of these systems is that they are embedded in current mobility practices. They are integrated in intermodal mobility chains, mainly exploited by incumbent public transport actors, therefore widely used, publicly accepted and thus legitimated. The traditional models are widely supported by authorities and do not conflict with formal institutions governing the public space.

Innovative free-floating models have solved the physical barriers that station--based systems face. They are not dependent on infrastructure which makes upscaling easier. The cost of switching to these models is low. Also, more than the traditional models, these models have spatial network externalities: the wide availability of bikes increases the utility of adoption and the attractiveness to use the service.

Although this industry mainly consists of entrants without specific experience in transport, their promise motivates the backing by strong private investors (with a background in technology, e-commerce and social media), with no further dependency on public funding. Having large investors allows providers to enter the market with a high quantity of bikes and compete at very low prices. However, here the barrier to upscaling is of an institutional nature. Free-floating models have an unpredictable impact on public space, in particular parking congestion in popular areas, which has led to a ban in some cities. It also became apparent that one-way free-floating systems were incompatible with formal institutions e.g. local rules for bike parking and offering a service in public spaces, which made them, at least temporarily, illegal. What is more, in relation to informal institutions, part of the general public also perceives one-way free-floating systems as illegitimate. It is clear that strict regulation will hamper their upscaling potential.

Interestingly, one variant of the one-way free-floating model is based on geographical zones (geo-fencing) and may be supported better by local authorities in the near future, because the locations of bikes can be controlled. In this way, the municipality can put restrictions on the parking locations, which can be implemented in the app and updated when needed (in principle, even during the day). Rather than using physical infrastructure to control and regulate the impact of bike sharing on public space, providers deploying this model apply a digital

infrastructure. In particular, geo-fenced free-floating model would, in principle, combine the "*best of both worlds*": the user-friendliness of one-way free-floating systems and the ability to control public space of station-based systems.

Finally, the two-way free-floating model, or peer-to-peer model, is currently a niche for renting special-purpose bikes. In principle, this model has upscaling potential as it is not dependent on infrastructure and is based on existing bike capacity. This model operates in the private sphere and does not conflict with public institutions. However, from a user perspective, user friendliness is limited (the system is two-way and face-to-face meetings are necessary). This can be solved by applying digital-lock technology. The personal attachment to one's own bike, as an informal institution, may nevertheless limit the scaling potential of this model in the near future.

2.7 Concluding remarks

We developed a new, prospective transition framework that we used for assessing the upscaling potential of bike sharing business models. The framework, which we derived from Nelson's (1994) co-evolutionary perspective, was further refined by using more specific insights on the dynamics of increasing returns, industry structure and the role of institutions. Although the future course of innovations is inherently uncertain, we conclude that this prospective transition framework is a useful heuristic device to assess the future potential of business model innovations.

Empirically, we assessed the future potential of four alternative bike sharing systems as introduced in NL. Many new firms are entering the market with bike sharing services and related innovations. This market has become very volatile where it used to be relatively stable over the last 10 years with only one successful bike sharing innovation: OV-fiets. Although currently no data is available on the total number of bike sharing trips in NL compared to all bike trips, it must be noted that despite the increase in bike sharing innovations, bike sharing is still a niche in the Dutch urban mobility and cycling regimes.

Our analysis addressed the potential of current business models for bike service innovations to scale up. The combination of a business model perspective with a prospective transition analysis allowed us to explore the interactions that may lead to upscaling of the innovations. We conclude that all models profit from increasing returns to adoption as the success of any bike sharing system will

depend on its spatial network effects. However, we found that the innovative free-floating models (one-way and two-way) benefit more than the traditional models from these spatial network effects. The traditional models are supported mainly by incumbent actors, while one-way free-floating models are exploited by new entrants that are backed by large investments. The resources from large investors make it possible to reach a critical mass needed for realizing increasing returns for producers and users alike. Institutionally, traditional models are much better embedded in the existing urban mobility regime, mainly because they have been around for quite some time. Innovative, free-floating models are not yet embedded in local legislation and among the public. However, cities are developing frameworks for one-way free-floating models at this moment. The traditional business models in cycling services face the classical business model challenge inherent to any capital-intensive enterprise: how to get access to substantial resources for large scale investments in infrastructures, which do not directly increase profits, but are required for successful and wide-spread operation of a particular service. Arguably, the new generation of business models are facing these classical business model challenges to a lesser extent, enabled by digital technologies such as the internet, location devices and smart phones, which make large-scale infrastructural investments unnecessary.

However, the innovative cycling services require entrepreneurial skills related to strategically reconfiguring institutions such as rules for using public space and ownership cultures. One may argue that such skills for institutional entrepreneurship may become core to the success of entrepreneurs in cycling services, as has been suggested in other case studies on the sharing economy (Grinevich et al., 2017). The recent conflicts between municipalities and innovative bike sharing services suggest that an institutional alignment is currently missing, but this may also be considered as a first step for institutional change to happen as it created widespread awareness of the possibilities as well as difficulties of scaling up bike sharing schemes.

To answer our research question we thus need to evaluate the resource needs of the traditional business models against the institutional alignment that the innovative, free-floating models require. Because cities in NL are developing policies and pilot projects with the innovative cycling services, their future looks quite promising. As the traditional business models target a different consumer group of commuters looking for a last-mile solution, they may exist for a long time next to the new business models.

We suggest three avenues for further research. First, a drawback of the current framework is its static representation. We suggest exploring what a more dynamic perspective (over time) on the co-evolution of business models and socio-technical regimes could look like. Second, our framework misses a clear actor-perspective. Our research suggests a critical need for strategic work of entrepreneurs to change institutions. Hence, integrating our research with recent literature on institutional work and institutional entrepreneurship may be fruitful (Battilana et al., 2009). We also suggest including a user perspective in the analysis, possibly by conducting a broad survey among (potential) users of different models. Third, the current research has focused on NL, which is a rather unique environment in terms of cycling. Research into international contexts could lead to new insights about bike sharing and the relationships between business models and mobility transitions.

2.8 Appendix

Table 2-3: Interview protocol

Concepts	Guiding interview questions
About the company	When is the company established and by whom? What was the motivation? What is your background and experience? Where are you active and why?
Business model	
Value proposition	What value is delivered and to whom?
Profit formula	How does the company create value while providing value for the customer? What are costs and revenues?
Key processes	What processes are needed to deliver value? What are key activities?
Key resources	What resources are needed to deliver value? How is the company financed?
Industry structure	What is the current status and size of the company? Who do you view as your competitors? Are you engaged in partnerships? What is their experience?
Institutions	
Formal	What kind of formal, rules, regulations and procedures you deal with? What is your view on local policy with regard to bike sharing? How do you meet rules? How can the development of bike sharing be supported? What are barriers?
Informal	What norms and (public) values are linked to your company? What is your view on the public bike sharing debate? What habits or cognitive frames are supporting or hindering the development of bike sharing?

Table 2-4: Key characteristics of bike services

Resp.	Interviewee + date	System	Est.	Launched in NL	Locations	Business model	Bike ownership
r1	Project manager 27-April 2017	OV-Fiets	2004	2004	300+ Dutch train stations	Two-way station-based	Company owned
r2	Project manager 12-April-2017	KeoBike	2016	2016	20 locations in villages at the Veluwe and province of Utrecht	Two-way station-based	Company owned
r3	Co-founder 3-Sept-2017	Donkey Republic	2016	201	Amsterdam Rotterdam	One-way station-based	Owned by company or local bike rental partner
r4	Co-director 3-April 2017	Hop-perpoint	2015	2015	Eindhoven Tilburg	One-way station-based	Company owned
r5	Managing director 1-Feb-2017	HelloBike	2016	2016	Amsterdam (Zuid-As business district)	One-way station-based	Company owned
R6	www. spinlister. com	Spinlister	2011	2016	Global	Two-way free-floating (peer-to-peer)	Bikes owned by users
r7	www. listnride. com	Listnride		2017	Global	Two-way free-floating (peer-to-peer)	Bikes owned by users
r8	Founder 27-Sept-2017	FlickBike	2017	2017	Amsterdam	One-way free-floating	Company owned
r9	Country manager 23-Aug-2017	Ofo	2014	2017	Global	One-way free-floating	Company owned
r10	Advisor 15-2-2018	Mobike	2016	2017	Rotterdam	One-way free-floating	Company owned

Description	Ownership structure	Bikes & users	Funding
System linked to the national train system. Focus on last mile transport.	Since 2008 owned by NS (provider of rail services) and Prorail (exploitation of infrastructure) (government owned by Dutch state)	14500 bikes available (end 2017) 2400000 rides per year	Public funding used for upscaling this system (e.g. Provincie Noord-Brabant invested in 2017 in OV-fiets at local stations)
System linked to regional bus system. Focus last mile transport in rural areas	Owned by Sytus (regional bus company), a subsidiary of Keolis, a French public transport company	240 bikes	Budget was created from savings on public transport (bus). Public transport is subsidized by the province.
System using designated zones to take and drop bikes. Based on digital lock, GPS, smartphone and geo-fencing. Focus on local city transport	Private company	450 bikes	Private investors, public funding (e.g. EU and local)
Automated bike sharing system using fixed docking-stations focusing on the business market (employers, businesses, municipalities). System also open to incidental private users.	Private company and partnership with company specialized in bike parking infrastructure	50 bikes, 1000 users, 8 docking stations	Province of Brabant provided 50% of initial investments in the system (€800.000)
System using designated zones to take and drop bikes. Based on digital lock, GPS, smartphone and geo-fencing. Focus on business.	Subsidiary of The Bikevertisement Company (a private company linking cycling to advertisement)	500 bikes	Municipal investments, companies at Zuidas and national subsidy
Platform for rental of private (special purpose) bikes.	Private company	N.A.	-
Platform for rental of private (special purpose) bikes.	Private company	N.A.	-
System using designated zones to take and drop bikes. Based on digital lock, GPS, smartphone and geo-fencing. Focus on local city transport	Private company	1000 bikes	Private investors
System that allows to take and drop bike anywhere. Focus on local city transport.	Private company, backed by technology companies	Plan to start	Venture capital
System that allows to take and drop bike anywhere. Focus on local city transport.	Private company, backed by technology companies	Started with 150 bikes	Venture capital

3

Institutional strategies of platform enabled business models in Amsterdam and Shanghai

Abstract

Bike sharing has the potential to contribute to more sustainable urban mobility. Companies providing this service need to generate legitimacy for their venture when entering new cities. They may have to change formal and informal institutions in cities they want to operate. In this chapter I explore how and why companies' institutional strategies differ across cities. Strategies of emerging free-floating bike sharing companies in Shanghai and Amsterdam are compared. These cities provide a counterintuitive starting point: Shanghai is a car-dominant city which has embraced bike sharing, whereas in Amsterdam – a typical cycling city – it was banned soon after its introduction. It was found that companies use similar launching strategies, but different institutional strategies as they respond to varying spatial conditions consisting of local institutions (e.g. rules, norms and cultures) physical place specific elements (e.g. infrastructures and urban mobility challenges) and issues of power (e.g. support and resistance).

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3.1 Introduction

Bike sharing systems are increasingly spreading around the world (Fishman, 2019). Shaheen, Guzman, & Zhang (2010) reported over 139.000 shared bikes in an estimated 125 cities in 2010, while Nikitas (2019) now estimates a global bike sharing fleet of 15 million. Bike sharing can be seen as part of the 'Sharing Economy' and is a relatively new addition to urban mobility systems. Bike sharing can make urban mobility more sustainable depending on ridership and the modal shifts it may induce. Originally many systems were publicly funded or sponsored by city authorities, mainly because of expensive necessary docking stations. However, combining smart locks, GPS and smartphone apps makes it possible to have a bike sharing system without such costly infrastructure. These so-called free-floating bike sharing (FFBS) systems can operate without public financial support. Chinese companies Ofo and Mobike, with millions of bikes in over 200 cities (Mobike & WRI, 2018; Ofo, 2018) are examples responsible for the fast growth of bike sharing worldwide. This development also led to new urban and institutional challenges such as oversupply of bikes, nuisance, conflicts with parking regulations and a lack of public acceptance in some places (van Waes, Farla, Frenken, de Jong, & Raven, 2018).

The introduction of FFBS in cities can – in a way – be compared to the introduction of platform-based business models like Airbnb and Uber. These digital platforms allow for relatively easy introduction across cities worldwide because they work with existing physical assets. When they launch their service in a city, they may conflict with local regulations or user habits and successful continuation may become difficult because of these local institutions. For such companies it is then necessary to legitimize their business, either by adapting their business model to the local situation or by trying to change local formal and informal institutions. The latter strategies have been studied in the literature on institutional entrepreneurship and institutional work (Battilana et al., 2009; Lawrence & Suddaby, 2006b). In the case of FFBS, unlike pure platform-based initiatives, there is a need to put assets, i.e. bikes, into the city. Because these assets are not extremely expensive, fleets of bikes are launched into cities overnight. The idea is then to quickly attract a large user base, which could socially legitimize the venture even before it is legally accepted (Pelzer et al., 2019).

This chapter focuses on cycling, and especially bike sharing as an exciting development that may challenge complex urban mobility regimes. Bike sharing can contribute to the growing global niche of non-motorized transport including

private bikes and diverse assisted vehicles (e.g. e-scooters, e-bikes, often referred to as micromobility). The combination of digital technologies, distributed access and non-motorised transport can potentially transform individual, motorized transport that we see in most cities today. By closely focusing on strategies that niche actors deploy, we can unveil current developments that may change urban mobility regimes all over the world.

This study investigates FFBS companies' institutional strategies across different geographical contexts by comparing the development and implementation of FFBS in Shanghai (China) and Amsterdam (Netherlands). The starting point is the counterintuitive outcome of this new form of urban mobility in these two cities. In Shanghai – a car-dominated city – FFBS was widely adopted, while in Amsterdam, often referred to as the global cycling capital, it was banned by the municipality soon after its introduction. This suggests that the idea that a business model in one city can simply be replicated in another city is naïve. Globally operating companies have to finetune their operations to each new city where they want to launch. However, there is still much to be learned about how space-specific institutional strategies are related to the local circumstances in different cities. This leads to our research question: How and why do companies' institutional strategies differ across cities?

To answer this question two lines of inquiry are mobilized. The first is concerned with better understanding how place-based distinctiveness influences innovation processes and the second with the role of companies' institutional strategies. Both literatures have become increasingly visible in the sustainability transitions literature.

The first body of research is drawing on economic geography and urban studies concerned with the question how particular geographies enable or constrain sustainability transitions (Hansen & Coenen, 2015). A part of this scholarly work is pointing at cities as a particular site for sustainability transitions and the ways in which differences in urban institutional arrangements are important (Raven et al., 2019). A general insight from this field is that transitions occur differently across places, i.e. there is a particular place-based distinctiveness to urban sustainability transitions. However, there is still more to be known about how place-specificity matters for urban transitions. The second line of enquiry is drawing on neo-institutional literature to explore dynamics of institutional change, particularly in relation to the role of agency therein (Battilana et al., 2009; Lawrence & Suddaby, 2006b). A general insight from this literature is that the ability of actors to change

institutions depends on the range of regulatory, normative and cultural-cognitive strategies that actors deploy (e.g. Fuenfschilling & Truffer, 2016; Jolly & Raven, 2015; Van Waes et al., 2018). Companies' institutional strategies and struggles for legitimacy have been recognized as an important avenue for research in the sustainability transitions field (Köhler et al., 2019). Combining both lines of research enables an improved understanding of the spatial conditions that influence companies' institutional strategies across different urban contexts. Hence, the purpose of this research is to explore and understand spatial variety in companies' institutional strategies by investigating and comparing FFBS across cities. Because of the rich empirical data in this case study our ambition is to inductively propose possible relations and mechanisms that link institutional strategies to place-specific elements on the basis of a framework derived from the literature.

In section 3-2 a framework is developed to understand institutional strategies across cities. Section 3-3 outlines the research design and cases. Institutional strategies are analysed in section 3-4 and compared in section 3-5. Section 3-6 and 3-7 respectively discuss the findings and conclude this research.

3.2 Theoretical background

3.2.1 Bike sharing and institutional strategies

Bike sharing research has mostly focused on station-based systems, the traditional model available in cities across the world including Paris, London, New York, Berlin and Beijing (Barquet et al., 2016; Fishman, 2016; Lihong et al., 2015; Mátrai & Tóth, 2016; Shaheen et al., 2010). Only recently – in par with its rapid emergence – researchers started investigating FFBS. So far, this new form of urban mobility has been explored through user, governance, business model, upscaling and socio-technical transition perspectives (e.g. Du & Cheng, 2018; Ma, Yuan, Van Oort, & Hoogendoorn, 2020; Ma, Lan, Thornton, Mangalagiu, & Zhu, 2018; Nikitas, 2019; Petzer et al., 2019; van Waes et al., 2018). An institutional perspective, however, is missing, which could provide better understanding in processes of implementing new forms of urban mobility.

Because when introduced to cities, FFBS is a radically new model for bike sharing. Therefore, FFBS companies have to create legitimacy for their new venture and they have to change formal and informal institutions in the city where they want to operate. Here we define institutions as highly routinized actions that have

become more durable structures, which provide stability and create recognizable patterns in social interactions (Scott, 2014). Institutions can be distinguished into regulative, normative and cultural-cognitive institutions (Scott, 2014). Regulative institutions refer to formal rules, policies or laws; normative institutions consist of common norms, habits, roles and responsibilities; and cultural-cognitive institutions are based on shared values, beliefs and assumptions. Actors who purposefully initiate changes that contribute to transforming existing or creating new institutions have been termed institutional entrepreneurs (DiMaggio, 1988; Perkmann & Spicer, 2008).

The institutional work literature more specifically explains how actors engage in institutional entrepreneurship. Scholars have identified a variety of institutional strategies aimed at creating, maintaining or disrupting institutions (e.g. Lawrence and Suddaby (2006); Pacheco, York, Dean, & Sarasvathy (2010); Klein Woolthuis, Hooimeijer, Bossink, Mulder, & Brouwer (2013), Fuenfschilling & Truffer (2015)). Following Scott (2014), such strategies can target regulative, normative or socio--cognitive institutions. Strategies that focus on influencing the regulatory institutional setting include lobbying, negotiating defining, advocating, litigating, policing and delimiting organizational fields. Strategies that focus on influencing the normative setting include framing by creating identities and constructing images, challenging prevalent norms, forming normative networks and altering traditional meanings. Strategies that focus on influencing the cultural-cognitive settings include mimicry – associating a new practice with existing ones; isomorphism – mimic successful models for own legitimacy; developing new meaning systems; theorizing; educating and spreading knowledge.

Relevant for our work is a pioneering paper by Winslow & Mont (2019). They examined institutional strategies of bike sharing companies in Barcelona. They show that companies deployed regulative strategies such as lobbying to influence policy makers and regulatory frameworks, collaborating with other bike sharing companies and local authorities, and defining boundaries of the bike sharing field. Normative strategies included creating identities to appeal to users and governments, challenging traditional consumption norms (e.g. bike sharing as alternative to cars or private bikes), forming normative networks with other companies (e.g. creating a common identity) and altering traditional meanings (e.g. sharing between strangers instead of an activity in the private sphere). Cultural-cognitive strategies included developing new meaning systems (e.g. creating own vocabulary) and educating (e.g. creating and spreading knowledge about bike sharing).

As bike sharing can be seen as part of the sharing economy, relevant insights are also provided literature on sharing platforms. Uzunca, Rigtering & Ozcan, (2018) show that existing institutional structures matter. By comparing sharing economy platforms (Airbnb & Uber) in different institutional settings, they found that Uber with its disruptive strategies could transform institutions and gain legitimacy in countries with weak institutional structures. In more institutionalized economies, the company struggled with old institutions such as taxi-unions. In line with this, Pelzer et al. (2019) showed that Uber failed to get legitimacy in a highly institutionalized taxi-regime. Uzunca et al. (ibid) also highlight the importance of local community acceptance and distinguishing between different institutional levels. Getting local legitimacy also depends on whether national governments leave the regulation of an innovation to local authorities or establishes standards nationwide. Studying Airbnb in New York, Amsterdam and London, Boon, Spruit & Frenken (2019) found that both users and non-users play an important role as they deploy institutional strategies (users theorize and educate about benefits of home sharing whereas non-users demonize it by pointing to risks and impacts).

3.2.2 Geography and institutional strategies

Several studies have emphasized the importance of place-specific elements for processes of innovation and sustainability transitions. Hansen & Coenen (2015) point out that formal and informal institutions as key constituting factors of space are related to geographical differences in economic activity and performance. They identified five place-specific elements that may influence sustainability transitions: 1) urban and regional visions and policies; 2) informal localized institutions; 3) local natural resource endowment; 4) local technological and industrial specialization and 5) consumers and local market formation. Truffer, Murphy & Raven (2015), describe three main dimensions which a geography of transitions should address: socio-spatial embedding, multi-scalarity and issues of power. Socio-spatial embedding relates to the conditions in specific places, like cultures, institutions, political systems or networks, which enable actors to promote new technologies, new lifestyles or new policies. Multi-scalarity points at the ways in which innovations emerge in particular places in relation to other innovations and developments within and across different spatial scales, often through the work of individual and organizational actors that work across those scales. The concept of power relates to the possible imbalance of who controls, wins and loses in transition processes.

Table 3-1: Framework of geographical and institutional elements and descriptions of what to look for in the data

	Element	Description
Socio-spatial embedding	Regulatory	*Setting* Policies and formal rules for the mobility system and for bikes and bike sharing; rules regarding bike parking and bike infrastructures *Strategies* Lobbying for regulations related to bike sharing; proposing measures to organize bike sharing; negotiating and collaborating with authorities; delimiting organizational fields
	Normative	*Setting* Urban vision, common expectations, norms, roles and responsibilities in the urban mobility system related to bikes and bike sharing; how are bikes part of the urban mobility system? *Strategies* Creating identities and constructing images around bike sharing; challenging prevalent norms by promoting bicycles (sharing) as an alternative to cars and bicycle ownership; forming normative networks, altering traditional meanings; standardization
	Cultural-cognitive	*Setting* Cultural meaning, shared values and ideas about bicycles and bike sharing; existing practices related to bikes; cycling culture(s); what is the impact of FFBS? *Strategies* Associating and linking bike sharing with existing practices or institutions (mimicry); isomorphism; developing new meaning systems such as vocabulary or currency; educating and spreading knowledge about cycling and bike sharing
	Physical place-specific elements	Elements related to the geography of a city and related to the physical transport infrastructures; natural resource endowment
Multi-scalarity	Networks, knowledge	The networks and knowledge links that connect innovation locally and organizations across different spatial scales (e.g. regional, national, global)
Issues of power	Support and resistance	Who wins and who loses when innovations scale up? Whose voices and concerns are heard?

Some pioneering work on spatial dimensions of institutional work is also available. Marquis & Battilana (2009) argue that with globalization the local has still remained important, and local particularities have even become more visible and salient. They show that organizations are simultaneously embedded in local communities and in broader global environments. And they point out that some mechanisms behind variation across places may be related to physical geography, such as climate and distance. In their study they pay attention to understanding the importance of regulative, socio-normative and cultural-cognitive institutional influences of local communities on organizations. Lawrence & Dover (2015) also explore the roles that places play in institutional work. Places may motivate actors to affect institutions, as well as provide material and symbolic resources used in those efforts. They found that places contained, mediated, or complicated institutional work, depending on how place is conceptualised.

We conclude that despite these pioneering publications, further work is necessary to understand spatial variety in institutional strategies across different geographical contexts. A geographical perspective on institutional strategies could show an uneven landscape of these strategies. A focus on place suggests the importance of location as both a background for action (enabling/constraining) and as a target for institutional strategies. As such, we investigate the recursive relations between institutional strategies and place-specific conditions through which sustainable innovations may emerge differently across places.

3.3 Research design

Based on the theoretical notions that we identified in the literature we developed an analytical framework for our research to combine the two lines of inquiry discussed above. We worked with a framework that primarily distinguishes between regulative, normative and cultural-cognitive institutions, and inductively identifies strategies that the FFBS companies applied across city contexts. The scheme (cf. Table 3-1) is meant to be used as a starting point for the interpretation and identification of meaningful relationships in our data.

We started out with the three main dimensions by Truffer et al. (2015). Within the dimension of socio-spatial embedding we place the three institutional pillars by Scott (2014); these local institutional elements enable or constrain actors to promote innovations. We distinguish between local institutional settings and strategies. We added physical place-specific elements (as non-institutional

elements) to the factors that may enable or constrain innovation in a specific place, as indicated by Marquis and Battilana (2009). The element 'natural resource endowment' that Hansen and Coenen (2015) indicated was also added here. The dimension of multi-scalarity helps us identifying the relations across different spatial scales. Here we may find how globally operating FFBS companies engage in local urban projects. This dimension also reminds us of the local-global model of niches (Geels & Raven, 2006). Sengers & Raven (2015) showed that knowledge and networks can be the media for multi-scalar links. The final dimension of power sensitizes us to support for and resistance against FFBS, which may point to specific groups (users, citizens, tourists) winning or losing because of bike sharing.

The research was designed following conventional comparative case study methodologies and following traditions in interpretive and qualitative research (Yin, 1994). The main data used were interviews, newspaper articles and policy documents. The qualitative case analysis investigated the ways in which FBBS is discursively presented, contested, rejected and implemented. This type of analysis is a common research strategy in institutional analysis, because discourses as expressed in texts, speech, visuals and so on, form a critical part of institutional change (Phillips et al., 2004). Data was triangulated as the combination of different sources helped to reconstruct the development process of FFBS in each city. A detailed reconstruction and structured analysis of events and strategies was built into an explanatory narrative around the spatially-informed analysis of institutional strategies. Next to this, four public meetings about FFBS and regulations were attended in the Netherlands.[29]

Semi-structured interviews were conducted with FFBS companies (founders or local managers) in each city in the period of January 2017 to April 2018 including fieldwork and site visits in Shanghai. See Table 3-2 for an overview and characteristics of the companies. In Amsterdam also policy-makers were interviewed.

Interviewing these actors in Shanghai was more difficult: despite repeated attempts it proved difficult to reach governments. The interviews ranged between roughly 30 minutes and 1.5 hours, were conducted face-to-face and were recorded with permission from the interviewee (see Table 3-4 in the Appendix for an overview). In this chapter, interviews are referred to by r1-r8. One

29. Deelfiets maakt doorstart, (29 January 2018, Pakhuis de Zwijger, Amsterdam), Inspiratiedag Tour de Force (23 November 2017, Ede-Wageningen), Deelfietsbijeenkomst CROW Fietsberaad (2 November 2017 and 2 February 2018).

interview was conducted in Chinese and one interview was partly in Chinese and partly in English. A local researcher provided support with the translation between Chinese and English.

The elements shown in Table 3-1 functioned as sensitizing concepts for the empirical analysis (Blumer, 1954). These descriptions of key concepts from the literature focused our attention to particular empirical phenomena, which enabled a further conceptualization of the nexus between place-specific institutions and other elements and institutional strategies. The interview transcripts were analyzed with coding-software Nvivo. Coding helped to structure interview data and group and compare institutional strategies in relation to spatial factors. Per case we also coded websites of FFBS companies, newspaper articles, research articles and policy documents as additional data sources.

Table 3-2: Company characteristics and operation in Amsterdam and Shanghai

Companies	Established	Markets	Amsterdam **	Shanghai
Hellobike	2016 in Amsterdam	Netherlands	●	-
Flickbike	2017 in Amsterdam	Netherlands	●	-
Obike	2017 in Singapore	Asia, Europe	●	-
Donkey Republic	2016 in Copenhagen	Europe	●	-
Mobike	2016 in Beijing	Asia, Europe, North America, South America*	●	●
Ofo	2014 in Beijing	Asia, Europe, North America, South America*	●	●
Hello Chuxing	2016 in China	China	-	●

**In 2019, both Ofo and Mobike ceased all international operations and put sole focus on the Chinese market (Liao, 2019; Moore, 2020). However, Mobike is still active in the Netherlands, but since 2020 operating independently from the Chinese mother company Meituan-Daiping.*

*** In Amsterdam FFBS is temporarily banned. Some companies (e.g. Mobike and Ofo) planned but did not operate due to the municipal ban. In response, most companies relocated to other cities in the Randstad region such as Rotterdam, Delft and Utrecht. Other companies that were operating in Amsterdam*

3.4 Case study results

3.4.1 Settings and strategies in Shanghai

A welcoming introduction of FFBS in Shanghai
FFBS was invented in 2016 in Beijing and Shanghai. China is the largest bike sharing market and Shanghai is estimated to be the largest bike sharing city worldwide with approximately 1.7 million bikes in September 2017 (Jiang Hui, 2018). The Chinese government estimates that there are more than 23 million shared bikes in China in 2018 (Ministry of Communications, 2018). At the time of its introduction in Shanghai, FFBS was both welcomed and criticized. It was welcomed because it offered potential solutions for some of the urban challenges in Chinese cities, e.g. congestion, last mile problem, illegal auto rickshaws and air quality. Mobike was the first company to launch with approximately 100.000 bikes (Lan et al., 2017). No specific regulations were in place for FFBS and the company got oral permission to launch. As the first player in the market, Mobike sought government support, mainly for bike parking space and infrastructure (Lan et al. 2017). Initially, the city supported Mobike because FFBS provided an opportunity to solve the first and last mile problem (Lan et al., 2017). Local governments even invited the company to place bikes in their districts (Shanghai Municipality, 2016) and endorsed the company as the official partner for low-carbon city development: *"FFBS enables the city's transformation to sustainability and breaks the locked--in transport structure in Shanghai, which combines the feature of tech and sharing. The main goal of Shanghai 2035 is to achieve more than 85% green transport in all travelling. In this way, FFBS gives direction to the Shanghai planners and officers."* (Chen Xiaohong, 2016).

The initial support for Mobike in 2016 led to a massive influx of other FFBS companies backed by venture capital investors. Many different FFBS companies (including Mobike, Ofo and Hello Chuxing) put bikes overnight on the streets of Shanghai, based on oral permissions by the city. At its peak the market consisted of approximately 70 companies. Soon after, criticism was voiced because the abundance of bikes had a negative impact on public order. In this early stage, different companies aimed to attract a large base of users in a short time period. They provided large quantities of bikes, some of low-quality, which led to oversupply and low usage rates. Broken bikes were often left abandoned on streets. Additionally, some companies went bankrupt which resulted in 'bike--share graveyards' (see Figure 3-1) and large quantities of unused bikes scattered

Figure 3-1: Bike-share graveyard in the Chinese city of Xiamen

Photograph: Chen Zixiang/The Guardian (Haas, 2017).

along streets (Haas, 2017). In 2018 the market showed signs of consolidation and three main players, all established in China, are left in Shanghai: Mobike[30], Ofo and Hello Chuxing (formerly named Hellobike).

Framing and aligning with local urban challenges

These main players actively promoted FFBS as a potential solution to solve urban problems, and in particular those caused by the existing transportation system. Shanghai has a strong demand for last-mile transportation. Rapid urbanization and geographical expansion leads to traffic congestion and to increasing travel demand (Shen, 2002). Also, the construction of public transport infrastructure lags behind, especially in new districts, where people live a long distance from a metro station (Chu et al., 2018). Before the advent of FFBS, illegal auto-rickshaws fulfilled the need for last-mile transport. However, there is a desire to remove these and it appears that FFBS has reduced this problem by 53% (Mobike & WRI, 2018). FFBS companies promote FFBS as a solution to these challenges: "*Ofo is created in the university with the aim to meet the needs of students. In 2016, we entered the cities because of the call for solving the last mile issue, promoting low carbon transport, and reducing traffic congestion.*" (r5). By tackling urban challenges and actively responding to the needs of the city, FFBS gained legitimacy.

30. In 2018, Mobike was renamed Meituan Bike in China, as the company was acquired by Meituan-Dianping, China's largest provider of on-demand online services, such as food-delivery.

Promoting FFBS and cycling over car-ownership
In particular, the prevalent norm of car use is perceived as a challenge among companies. Cycling as a practice is underdeveloped in today's Shanghai. Car ownership is a status symbol in Shanghai (Zhu et al., 2012), but the shift in user behavior from car to bike is promoted by governments and companies. Before the advent of FFBS, Shanghai was a car-dominated city and the bike played a small role in urban transport. Most major Chinese cities operated public bike sharing systems with varying rates of success (Lihong et al., 2015). In the '80s and '90s China was viewed as 'the kingdom of bicycles' with one bike per person. After the car-era (2000s) Mobike claims to have the mission to introduce cycling again. "*In China, in the 80s, bikes were popular among the people. Due to rapid economic development, right now people buy cars. Also now we can choose buses and the subway. Not really a large number of people use the bike anymore. Currently, also air pollution is becoming a serious problem. Therefore, we want to bring bikes back to cities*." (r7). Companies also engage in cultural-cognitive activities, such as the initiation of a 'World Cycling Day' together with the United Nations, and educate about sustainability and health benefits of cycling.

To appeal to new audiences, companies create an identity around bike sharing by promoting FFBS as a fashionable, high-tech, convenient and eco-friendly product, rather than transport for the poor. Also images around bike sharing are constructed. Companies often refer to the notion of 'innovation from China', i.e. FFBS is one of 'the four new great inventions from China', which have reached a large scale and should be supported to expand overseas (next to high-speed rail, mobile payment and e-commerce). Emphasizing this helps to gain support for FFBS among cities and users.

National guidelines and local regulations
On a national level, the FFBS market developed rapidly and the national government tried to keep control of its growth and impact on cities by providing guidelines in august 2017 (Ministry of Transport, 2017). The guidelines acknowledge the role that FFBS plays in satisfying travel demand, effectively solving the 'last mile' problem, alleviating traffic congestion, establishing a green transport system, and promoting the development of a sharing economy. As such, the guidelines show a positive attitude of the national government towards FFBS (Yang, 2018). The government wants users to register to FFBS systems with real names and children under 12 cannot use shared bikes (after a fatal accident with a child in Shanghai). Since the interference of the national government approximately 30

cities, including Shanghai, drafted local regulations to guide the operation and maintenance of bike sharing (WRI blog 2018).

At a city level, despite flaws of FFBS, the Shanghai municipality views bike sharing as a *"a convenient transportation service for the public to travel short distances"* (Shanghai Municipality, 2017a). The municipality has also been supportive to FFBS companies, for example by providing office space. Both Mobike and Hellobike were based in government supported offices (r7, r8).

Companies also realized that collaboration and regulations were a necessity, for example about parking space: "*In the beginning, as a private company, we thought we could provide FFBS alone because we had the technology. We wanted to showcase that start-ups can make a contribution to the public good. But as FFBS developed, we realized that we could not solve a lot of problems without the government. For example, in many parts of the city there is no bike parking space! We have to get the government on board to make FFBS work*." (CTO, Mobike in Ma, Lan, Thornton, Mangalagiu, & Zhu, 2018). Companies complained about the lack of bike infrastructure in downtown areas (r7). Hence, they lobby for and participate in the creation of cycling and parking infrastructure.

In 2018, the municipality introduced rules for FFBS. All bikes need to be registered (with a number plate) and the number of licenses for shared bikes is limited to avoid excessive supply.[31] Also the areas where bikes can be used are restricted. Mobike and Ofo are allowed to operate in the central district, whereas Hello Chuxing operates in a suburban district. Designated parking spaces are marked along streets to avoid clogging the pavements and bikes must be equipped with GPS in order to enable geo-fenced parking in the future. The municipality furthermore aims to reduce the risk of illegal use of deposits by companies (Shanghai Municipality, 2017b). Also, the municipality builds cycling infrastructure in response to increased use of FFBS and in line with their sustainability ambitions. The government allocated bike lanes and provided space for Mobike to build parking spaces at central locations, so-called Mobike Preferred Locations (Techweb, 2017). Also companies are involved in cycling infrastructure investments (r5).

31. Although companies got initially oral permission, the introduction of these new regulations did not refrain companies to illegally put more bikes on the streets.

Data sharing

Given the young field of FFBS, there is limited understanding and knowledge about its potential impact. For governments collaboration with companies helps to understand the market and how to govern FFBS (Ma et al. 2018). Companies in Shanghai are motivated to share data with urban planners and local governments as this can assist them to make better decisions in cycling infrastructure development (r5, r7). On the other hand, by positioning themselves as providers of valuable data for urban transport planning and engaging in (and funding) research collaborations with established institutes helps to legitimize FFBS. For example, Ofo worked on a report about FFBS on a national level with the Research Institute of China's Ministry of Transport, and for a study on the impact of FFBS on cities, Mobike collaborated with Urban Planning & Design Institute of Tsinghua University (Mobike, 2017a; Spinney & Lin, 2018).

Self-regulation

To show good behaviour, companies also engage in self-regulation. For example, Mobike mobilized users (Mobike-Hunters) that help solve illegal parking problems by fixing misplaced bikes and to tackle vandalism or theft (r7). In rewards, they receive credits that can be used for bike sharing. By creating new vocabulary and currencies, companies engage in developing new meaning systems. For example, Donkey Republic calls their bikes "*Donkeys*," referring to a past, before the introduction of motorised vehicles (Winslow & Mont, 2019).

FFBS companies influenced the regulatory process by collectively lobbying for specific rules and by developing industry standards. For example, Mobike played an active role in the development of guidelines and sector regulations for the quality of the bike. Many players in the market catch up by offering a large number of low-quality bikes. According to the company, such "*cheap and crappy bikes are not sustainable*" (r7) and they could damage the reputation of the FFBS industry. Hence, Mobike assisted the government to set a standard that shared bikes should be designed to last at least three years.

Platform integration

A strategy by companies is to integrate their service or app into broader existing platforms such as social credit-rating systems, supported by the Chinese national government.[32] This allows users with a good credit score to join a FFBS platform

32. There are two social credit systems: the National Citizenship Information System and the private

without paying a deposit. Companies can use it to verify the user's identity. The promotion of this non-deposit model helps the companies gain public support and trust from the government (r5, r8). New meaning systems are also deployed, such as rating systems to influence user behavior related to the use and parking of bikes. Bad behavior is penalized by the provider (r8).

FFBS builds on common practices such as the wide spread use of on-demand mobility platforms (e.g. ride hailing service Didi), that were already widely used before bike sharing took off. FFBS is also integrated in existing social media and mobile payment platforms such as WeChat (multipurpose social media app) and Alipay (mobile payment platform). Partnerships with these platforms have been important for adoption of FFBS because of three reasons. First, WeChat and Alipay are popular platforms in China with a large customer base. Both are owned by companies who have a stake in FFBS companies. These apps are embedded in everyday practices. For example, mobile payments are very common in daily life. Second, collaboration with these platforms helps FFBS companies to gain legitimacy. FFBS companies are relatively new and have little social recognition, thus partnerships with well-known platforms increases customers' trust. Third, integration allows for easy access as users do not need to download new apps but can open a shared bike using a social media app they already use (Yu, 2017).

Another cultural cognitive strategy is to associate with successful business models of digital platform companies (isomorphism) like Didi, Uber and Airbnb. An Ofo manager highlighted: *"We are doing bike rental, but we never call ourselves a bike rental business. Just like Uber never called themselves a taxi business. They call themselves an internet company. The business model of an internet company is based on volumes. The bigger volumes we get, the bigger the profit we will earn in the future."* (r4).

3.4.2 Settings and strategies in Amsterdam

Contested introduction of FFBS in Amsterdam

Amsterdam was the first Dutch city in which FFBS companies introduced their service in 2017. In a short period of time over 5000 bikes were put on the streets

Sesame Credit Platform. The latter is owned by Ant finance, a company that supports Ofo and Hellobike.

by multiple companies (including Flickbike, Donkey Republic, oBike). Before, bike sharing was mainly provided by OV-fiets, a 2-way station-based system focused on last-mile commuting, and by traditional bike rental shops focusing on tourists. When FFBS was introduced in Amsterdam, there were no clear rules for bike sharing. This rapid introduction led to public resistance. An oversupply of bikes led to full bike parking facilities, clogged up sidewalks and a low user rate relative to the supply of bikes. Within 3 months after companies launched in the summer of 2017, the municipality banned FFBS. The municipality stated that *"the introduction of bike sharing in Amsterdam has shown that public support quickly disappears when the needs of target groups (citizens and commuters) and existing urban problems (bike parking) are not taken into account."* (Gemeente Amsterdam, 2017). Bike sharing lacked legitimacy and public acceptance among parts of the citizens. For companies this is a major challenge: *"Public acceptance is a big challenge. Debates are dominated by people who probably won't use bike sharing, but they determine the course of development rather than the ones that potentially benefit the most from bike sharing"* (r1).

FFBS as a problem or solution for public space

A key issue in relation to FFBS in Amsterdam is scarce public parking space. The city representative explained: *"We don't want the shared bikes to take up scarce public space. The goal of the bike sharing concepts should be that they lead to less bikes in the city. But now it seems that they lead to more bikes"* (Gemeente Amsterdam, 2017). Shared bikes are mentioned as one of the causes of problems in 'Meerjarenplan Fiets' (2017-2022), a vision document stating: *"People from Amsterdam together own almost one million bikes. Add the shared and rental bikes and it becomes clear that this enormous amount of bikes also leads to problems and challenges"* (Gemeente Amsterdam, 2017c). Another local problem are abandoned private bikes: in 2017, more than 80.000 bikes were removed from public space by the municipality. Because of increased bike use, pressure on bike and parking infrastructure is increasing, which has been identified as one of the main challenges for the city. Companies challenge the city's view as they promote bike sharing as a potential solution to scarce public space and abandoned bikes. *"Only a riding bike creates societal benefits. Bike parking facilities are often filled with abandoned bikes or bikes that are just used once a week by commuters. This is unnecessary when you match demand and supply, which is possible with bike sharing. Bike sharing is a good solution for full bike parking facilities"* (r6). Some companies indicate they want to re-use abandoned bikes in their bike sharing system and thereby solve this problem (r1, r4).

Lobby for regulation and pilots

From October 2016, when FFBS was temporary banned, an institutional vacuum appeared. The municipality announced to develop a regulatory framework. In the meantime, companies continued to attempt to get foot on the ground in Amsterdam by deploying different institutional strategies. Companies aim to influence the regulatory process by advocating rules for FFBS and proposing concrete measures (e.g. caps on the total amount of bikes, caps on bikes per rack, define designated parking areas and minimum use rates per bike per day). In response to concerns about data use and privacy, all companies state they are willing to provide and share their data. Besides advocating regulation of bike sharing, companies were seeking for collaborations and lobbying for FFBS pilots. In other Dutch cities like Utrecht, Rotterdam, Delft and The Hague pilots are set up to learn from practice instead of strictly regulating FFBS beforehand (r1, r6). Input from pilots can be used to develop regulatory frameworks.[33] In this light, companies engage with researchers and policymakers to learn about the impact of FFBS on urban mobility and user characteristics, which could feed policy decisions (Van Waes et al., 2018).

To inform development of a regulatory framework, both the public and companies were consulted, resulting in an initial proposal published in December 2017. This entailed a two-year pilot with maximum three companies with each a maximum fleet of 3000 bikes, a minimum use of four trips per bike per day and designated parking places (Gemeente Amsterdam, 2017b). However, the majority of FFBS companies disagreed with these plans as too strict conditions and requirements might hamper profitability of FFBS (r1, r2, r6). In 2019 these plans were canceled as, according to the municipality, there is little public support for a city wide bike sharing system. Only small-scale local experiments, where bike sharing could contribute to a mobility challenge will be supported (Gemeente Amsterdam, 2019).

Competition and cooperation

FFBS in Amsterdam was contested and the market was characterized by fierce competition. Some companies delimited the bike sharing field by de-legitimating (competing) business models publicly and thus legitimating their own model. Local companies advocate and promote a business model that involves local

33. This call for FFBS pilots also resonates with broader debates about experimentation with digital innovation in public policy in the Netherlands (Maas, van den Broek, & Deuten, 2017).

communities with attention for the local urban context. They publicly disapprove models by Asian companies that would focus only on tourists and accused them of not taking into account local values (r2).

A strategy by various companies was to collectively develop an interoperability bike sharing standard. Due to the introduction of different bike sharing companies in different cities (besides already existing systems), national and local governments are concerned that the availability of different systems goes at the expense of user-friendliness. Therefore, governments support the development of a system that enables users to access different systems in different cities with one single account. Such a standardized system commuters to use a shared bike in their home and work city without subscribing to multiple systems. In addition, for companies it would allow allocating scarce parking place amongst each other. For major Dutch cities, including Amsterdam, this interoperability is a requirement for allowing shared bikes in the city. It was expected that local government would need to enforce interoperability on FFBS companies (Tour de Force, 2017). However, in January 2018, ten (competing) companies formed a network and signed a letter of intent to develop OpenBike – one account for bikes sharing in different cities (Duursma, 2019). *"Eventually we want you to be able to access a bike everywhere with one account, whether this is an station-based bike, a free-floating bike or a lease bike"* (Van Tongeren, 2018).

Attracting local users and changing bike ownership

In Amsterdam bike use and ownership are high (Gemeente Amsterdam, 2017). A crucial challenge is to attract local citizens as users of FFBS. The municipality explicitly emphasized that it prefers bike sharing for locals rather than for tourists. This is informed by an ongoing debate in Amsterdam about how mass tourism causes overcrowded areas, making these parts unattractive to live. An assumption was that only tourists would use FFBS and the problems of FFBS were associated with mass tourism.[34] Exploiting public space to make profit was perceived as unacceptable (and also the legal basis on which it was eventually banned). The city prefers that traditional rental services rather than FFBS serve the tourist market. Bike sharing companies should target locals with private bikes (parked in public space), non-cycling citizens and frequent visitors (commuters). *"For inhabitants of Amsterdam it can be an interesting alternative to their own bike"* (Gemeente Amsterdam, 2017b).

34. However, a user survey of one provider showed that merely locals rather than tourists were using the shared bike (Van Waes et al., 2018).

In response to the city's ambition to attract citizens rather than tourists as target users, companies argue that they see opportunities to attract locals, but emphasize that socio-cultural change is needed. As such they challenge existing commuting practices and a strong cultural norm of bike ownership. *"We believe that behavioural change is needed for people who commute to Amsterdam and use their own bicycle parked at a train station. You will have to provide an alternative which provides a similar experience compared to using their own bike. You'll want to use it as your own bike."* (r2). *"Access to a bike should be more attractive than owning one in the future. Because [. . .] you don't need to own a bike to cycle"* (r1). Particular strategies aim at attracting citizens over tourists. For example, that by riding a shared bike, local users can redeem a voucher, which can be used in shops or bars (r4).

3.5 Cross-case comparison

Table 3-3 shows the main differences and similarities between the Shanghai and Amsterdam case. In both cities, FFBS was introduced in an unregulated market. Companies launched without formal consent. The business model of FFBS depends on a dense network of bikes available on the streets. As different competing companies put large numbers of bikes on the streets, without some form of coordination or collaboration among companies (e.g. systems were not interoperable), the excessive numbers of bikes led to immediate problems. In response to this setting, in both cities companies deployed strategies such as lobbying, negotiating and collaborating with the aim of influencing regulatory frameworks in favour of FFBS.

Differences appear when looking at local normative and cultural-cognitive settings and strategies and place-specific physical aspects. At first sight, FFBS seems to better match with the setting in Amsterdam than Shanghai. In Shanghai there was no bicycle culture and limited cycling infrastructure, while both elements were amply available in Amsterdam.

In response, for FFBS to become adopted in Shanghai, cycling in general had to be promoted. Hence, companies attempted to create bike institutions, illustrated by a variety of strategies. Companies deployed normative strategies that challenged prevalent norms such as car use. Companies promoted FFBS as a solution to traffic congestion, last mile problems, illegal auto-rickshaws and air quality. Cycling used to be transport for the poor, but to appeal to new audiences and generate legitimacy, new identities and images were constructed: cycling and FFBS was (re)branded as a cool and innovative way of transport, invented in China.

Table 3-3: Summary of differences and similarities between the Shanghai and Amsterdam cases

	Shanghai	Amsterdam
Regulatory	Setting • Initially no formal rules for FFBS; companies launch with large numbers of bikes without formal consent • City has laissez-faire and supportive attitude • City government develops regulations, cycling and parking infrastructure	Setting • Initially no formal rules for FFBS; companies launch with large numbers of bikes without formal consent • City bans FBBS three months after introduction • Concerns about public space, mass tourism and privacy • FFBS in future only on small scale
	Strategies • Companies emphasize cooperating with city • Companies lobby and negotiate rules concerning cycling and parking infrastructure and quality of bikes • Official partnerships for low-carbon city development between city and companies	Strategies • Companies lobby for pilots, cooperation and propose new regulations (incl. caps on number of bikes, parking spaces and minimum use rate per day) • Companies delimit field and delegitimize (foreign) competitors due to unsustainable model and strategies
Normative	Setting • City aims to stimulate clean transport, alleviate congestion and solve the last-mile problem • Car causes urban problems • Car ownership is a status symbol whereas bikes were generally seen as transportation for the poor • Car and public transport are the norm	Setting • City's view is that bike sharing should lead to less and not more bikes on the streets • Bikes (including FFBS) cause urban problems (e.g. parking) • Bike is the norm: wide spread bicycle use and ownership among inhabitants
	Strategies • Companies challenge prevalent norms of car use and ownership by promoting bike sharing as an alternative • Companies frame FFBS as a solution to urban challenges: congestion, last mile problem, illegal auto-rickshaws and air quality • Company mobilizes users to fix parking problems • Companies build network to safeguard reputation of FFBS • Companies create identities by framing FFBS as fashionable, high-tech, convenient and eco-friendly • Companies construct image of FFBS as 'innovation from China'	Strategies • Companies challenge prevalent norm of bike ownership by promoting bike sharing as an alternative. They do recognize that changing Dutch culture of bike ownership is a huge challenge • Companies frame FFBS as a solution to bike related problems such as the abundance of parked bikes • Companies propose to reuse abandoned bikes for FFBS • Formed network of companies to promote and develop interoperability standard

Table 3-3: Continued

	Shanghai	Amsterdam
Cultural-cognitive	**Setting** • Cycling not embedded in daily life • Use of digital services (payments, social media, ride-hailing, food delivery) embedded in daily life • Limited knowledge about impact of FFBS	**Setting** • Cycling is embedded in daily life and part of culture • Limited public support for FFBS: fear of hinder and that bikes are mostly used by tourists and concerns about privacy • Limited knowledge about impact of FFBS • FFBS is associated with other digital platforms that serve the tourist market such as Airbnb and Uber
	Strategies • Companies integrate and associate bike sharing with existing practices, business models and often used services such as ride-hailing, social media & payments to ease adoption and gain legitimacy • Companies develop credit and rating systems • Companies stimulate cycling in general and engage in educating cycling and impacts of bike sharing • Companies stimulate research, collaborate with established research institutes and share data to generate knowledge about bike sharing	**Strategies** • Companies focus on local users r ather than tourists • Companies offer to share data and engage in research collaborations / create knowledge
Physical place -specific elements	• Car-dominated city • Widespread network of metro stations • Prominent last-mile problem • No extensive cycling infrastructure • Public space available to park bikes; limited use of private bikes	• More than 1 million bikes in Amsterdam • Cycling infrastructure widely available • Scarce public space for bike parking • Abandoned bike problem • Mass tourism causes overcrowded areas
Multi-scalarity	• National guidelines show the government's positive stance towards FFBS • National government involvement leads to local rules to guide operation and maintenance of bike sharing • Image 'innovation from China'	• National government advocates an interoperability standard for bike sharing to enhance use in different cities
Issues of power	• Users quickly adopt bike sharing, legitimizing FFBS • Companies strategically aligned incumbent digital businesses and authorities	• Citizens complain about shared bikes on the streets • Municipality bans bike sharing

Cultural-cognitive strategies aimed at building (elements of) a cycling culture by trying to make FFBS part of daily practices. Associating and integrating their service with existing platforms and practices helped to ease adoption, and being available and visible on important social media environments enhanced access and legitimacy among an enormous user potential. Companies also developed new meaning systems such as a credits and rating systems. This highlights cultural-cognitive differences between the two cases as for example, linking a bike sharing service to a government credit rating systems would be unacceptable in the Netherlands. Additionally, companies engaged in knowledge production and published reports about FFBS in collaboration with established (government related) research institutes. Trusted by governments generated legitimacy among users.

This case shows that companies in Shanghai could rely on existing practices and digital infrastructures. However, they could not rely on extensive physical infrastructures that support cycling and bike sharing. Because of the good match with transport problems in Shanghai, authorities welcomed FFBS and started to work together with the companies in building cycling infrastructure. In sum, the widespread adoption of FFBS can be viewed as a contributor to reviving a cycling culture in Shanghai, as companies actively engaged in building physical and institutional elements of a cycling system.

In contrast, Amsterdam already had an established cycling system with a strong (private) cycling culture in which cycling is the norm and infrastructure amply available. Looking at the institutional and physical setting, the strategies of companies were putting existing institutions under pressure. The Dutch cycling system is based on high bike ownership, extensive bike infrastructure and its own rules. FFBS challenges this system in different ways because it is based on sharing and depends on using public parking space.

Thus, the challenge for companies in Amsterdam was to promote bike sharing as an alternative to bike ownership, rather than promoting bike sharing as an alternative to cars. High private bike ownership hindered the adoption of FFBS. Also, there was no clear match between FFBS and local urban problems. Pressing transport problems were related to the existing cycling system: abandoned bikes and scarcity of bike parking spaces. According to the city, adding FFBS to Amsterdam would make these problems bigger instead of solving them. Hence, normative strategies aimed at reframing FFBS as a solution rather than a problem

by focusing on parking issues, orphan bikes and avoiding tourists as users. The latter was necessary as FFBS was associated with problems of mass tourism. Also there were broader concerns about privacy. Foreign companies using public space (allocated for private bikes) to make a profit was perceived to be at odds with local cycling culture. In the end, companies did not get the opportunity to show the potential positive impact of FFBS. Limited public support stood in the way and companies failed to convince local authorities. This response shows emphasis on maintaining the cycling system as it is, and that FFBS in its current form was not perceived to fit this system.

In sum, comparing the cases, the cultural-cognitive setting enabled FFBS in Shanghai as it helped ease adoption (mobilizing practices and integrating in existing platforms), whereas the cultural-cognitive setting in Amsterdam was constraining (FFBS associated with problems of mass tourism and conflicts around privacy).

3.6 Discussion

In this section we discuss our main findings. First, we observed similar launching strategies in both cities, followed by diverging institutional strategies. In addition to Winslow & Mont (2019), who also observe that companies use regulative, normative and socio-cognitive strategies to institutionalize bike sharing, we provide a comparative analysis of how these strategies differ across urban geographies. We show how institutional strategies differ as companies adapt to place-specific elements. The types of strategies are strongly influenced by local physical and institutional settings. In line with Winslow & Mont (2019), the lack of regulations enabled rapid growth of FFBS in Shanghai and Amsterdam. In both cities similar types of regulatory strategies are deployed in response to a lack of regulatory frameworks. FFBS is dependent on infrastructure for cycling and parking which makes agreements with authorities a must. With regards to normative strategies, we see that companies target different prevalent norms that are shaped by different settings. In Shanghai car use was challenged whereas in Amsterdam it was bike ownership. With regards to cultural-cognitive strategies, we show that these can lead to different outcomes depending on the place. Associating and linking a novel business model with a successful existing business can create support and legitimacy in one setting, whereas it may lead to controversy in another. For example, associating FFBS with companies like Uber, Airbnb and Didi or integrating FFBS in social media or payment platforms helped ease adoption in China, but would raises criticism in the Netherlands. This finding

aligns with earlier research showing that culture, values and social norms matter in the adoption by users of bike sharing systems (Yin et al., 2018).

The comparison between Shanghai and Amsterdam shows that mobility 'regimes' differ across urban contexts. Institutional strategies that challenge existing 'regimes' thus may have to differ across places. A company that operates in different cities may have to challenge different prevalent norms and cultures or mobilize different existing practices that are part of spatially different 'regimes'.

Second, we observe that the degree of cycling institutionalization affects the types of strategies deployed by companies. In less institutionalized settings it is easier to build bike institutions. In highly institutionalized settings it is more difficult because existing institutions will be actively maintained. Companies in Shanghai had less problems in creating bike institutions, and were supported by and collaborating with governments. In Amsterdam, companies were putting existing bike institutions under pressure and as a result they were not supported by authorities and the community – actors maintaining these institutions. This corresponds with Pelzer et al. (2019) and Uzunca et al. (2018) who show that it is easier for a company to influence institutions and gain legitimacy in weak institutional settings than in more strong environments, where they may struggle with existing institutions. This also aligns with Boon, Spruit & Frenken (2019), as non-users were influential in maintaining existing institutions by demonizing FFBS.

This relates to our third observation about the role of power. It is argued that transitions theory should better account for the role power plays in transition processes by more carefully considering how power is mobilized and who are winners and losers (Lawhon & Murphy, 2012). Our study shows how power in the form of support and resistance has played a critical role in shaping the outcomes. In Shanghai, companies navigated power constellations by strategically aligning with major incumbent digital businesses and authorities. These relational strategies to align with the powers-that-be failed to be successful in Amsterdam, where authorities took the side of communities and local business owners that successfully complained about how FBBS reinforced existing problems of the bike system.

Fourth, regarding multi-scalarity, and as called for by Binz, Coenen, Murphy & Truffer (2020), our framework accounted for how place-specific processes are

influenced by 'distanciated' developments and institutional arrangements. Our case shows how dynamics at different scales influence institutional strategies locally. For example, experiences of globally operating companies inform local strategies. Yet these companies adapt their strategies as they learn about local conditions. For instance, in Amsterdam companies promised to solve bike related problems (e.g. parking capacity, abandoned bikes) instead of problems stemming from car mobility (e.g. traffic congestion, pollution). In addition, FFBS companies not only respond to local conditions, but also to institutional developments, constraints and opportunities at the national level to institutionalize their venture at a local level. In Shanghai this was e.g. seen in relation to the social credit-rating system. In the Netherlands, the national ambition to develop an interoperability standard let to joint initiatives at a local level.

3.7 Conclusion

This chapter aimed to answer the question how and why do companies' institutional strategies differ across urban environments? To this end, and as our contribution to the field of sustainability transitions, we developed a framework that combines literature on institutional strategies and geography of innovation that allows to better understand processes of transformation. It is of course not surprising that differences appear when examining strategies in two different environments. However, with this study we intended to unravel the underlying mechanisms of interactions between institutional strategies and place-specific aspects. The framework was applied on FFBS companies' institutional strategies in two different spatial and institutional contexts: the cities of Shanghai and Amsterdam. We conclude that this framework was useful as it improved our understanding of how companies respond and adapt their institutional strategies to local urban conditions. For future research we suggest applying, testing and refining the framework on other cases in other contexts.

By investigating FFBS, we presented a case that unfolds in a complex transition context which consists of a heterogeneous urban mobility regime of multiple transport modes (e.g. car, public transport, cycling, walking); multiple niches competing for the future (e.g. autonomous vehicles, electric vehicles, mobility as a service, cycling) and complex geographies (i.e. globally connected niches competing with a consolidated global regime around car dominance but with distinct local variations).

To answer the research question: we find that companies use different institutional strategies as they respond to local institutions such as regulations, prevalent norms around urban mobility and existing cultures and practices, physical place specific elements such as infrastructures and urban mobility challenges and issues of power such as support and resistance. Empirically, this study corroborates earlier work that shows how physical and institutional place based aspects matter in sustainability transitions. Our contribution to this field is a case that focuses on how cycling innovations challenge urban mobility regimes in different contexts. Hence, we call for more systematic research into the (im)possibilities of achieving urban sustainability trough cycling innovations.

This brings us to the practical implications. For businesses who enter new markets, a unified strategy deployed in different environments is likely not to be effective. To succeed, strategies must be attuned to local spatial and institutional settings. A key message to these businesses is to be aware of place specific regulations, normative and cultural-cognitive institutions as well as place-specific physical elements and actors that may potentially lose because of the innovation. It may seem attractive to focus on launching in places with a supportive physical infrastructure or supportive regulations, however, prevalent norms, local cultures and issues of power may be as important for success. Similarly, for public organizations, potential implications for governance include the need to develop place-based sensitivity in urban transitions, as well as the need to understand linkages across scales. Depending on whether an urban innovation may support or oppose local sustainability goals, public organizations may decide how to deal with local actors that win or lose because of this innovation.

3.8 Appendix

Table 3-4: Overview of interviewees

Interview reference	Actor	Interviewee	Date
r1	Flickbike (Amsterdam)	Founder	7-2-2018
r1	Donkey Republic (Amsterdam)	Founder & Local manager	8-2-2018
r3	Obike (Amsterdam)	Local manager	13-2-2018
r4	Ofo (Amsterdam)	Local manager	24-8-2017
r5	Ofo (Shanghai)	Local manager	23-4-2018
r6	Mobike (Amsterdam)	Local manager	15-2-2018
r7	Mobike (Shanghai)	Local manager	30-3-2018
r8	Hello Chuxing (Shanghai)	Local manager	24-4-2018
r9	World Resource Institute China	Sustainable Cities Program Director and China Transport Program Director	23-4-2018
r10	Researcher Urban Mobility	Department of Urban Planning and Design Xi'an Jiaotong-Liverpool University	23-4-2018

4

When bike sharing goes bad

incorporating responsibility in business model innovation

Abstract

Innovations to business models are particularly promising for tackling grand societal challenges. However, innovation outcomes can be unpredictable. To minimise negative impacts and enhance the success of business model innovation processes, we argue that socio-ethical issues must be incorporated and managed. Research on responsible innovation, which seeks socially desirable and ethically acceptable innovations via the incorporation of socio-ethical issues, is well developed but has often used a technocentric lens. Consequently, it is unclear how socio-ethical issues interact with business model innovation. This chapter explores how business model innovation interacts with socio-ethical issues and aims to understand the ways responsible innovation can help inform business model innovation processes and outcomes. To this end, platform enabled bike sharing business models in the Netherlands are explored. A theoretical framework is constructed considering purpose, process and product dimensions of business model innovation. Results illustrate how socio-ethical factors can play a key role in the success or failure of business model innovation.

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4.1 Introduction

Business model innovation (BMI) is seen as particularly promising in terms of tackling sustainability challenges, such as achieving sustainability mobility, as well as delivering business benefits (Chesbrough, 2010; Freudenreich et al., 2020; Geissdoerfer et al., 2018). The sharing economy is one example of a set of innovative business models, enabled by digital platforms, that are disrupting existing industries (Meilă, 2018; Owyang et al., 2013) and helping to tackled sustainability challenges (Belk, 2014; Curtis & Lehner, 2019). For example, car sharing platforms offer temporary access to cars, reducing consumption by increasing the use of 'idle goods' (Bondorová & Archer, 2017; Geissinger et al., 2019). Platforms also reduce costs and enable rapid scaling of innovations (Kolk & Ciulli, 2020).

However, as with other BMIs, the promise and potential of platforms, has often not matched actual outcomes and impacts (Acquier et al., 2017; Geissinger et al., 2019; Meilă, 2018). For example, the "*boomerang effect*" has shown that low cost access to shared vehicles (e.g. ride sharing) may increase their use at the expense of more sustainable options such as public transport, cycling or walking (Murillo et al., 2017). While the explosive growth of these types of platforms has created wider social and ethical issues such as privacy concerns, adverse impacts on public space, nuisance or tax avoidance (Frenken et al., 2019; Meilă, 2018; van Waes et al., 2020).

Platforms, as new innovative business models, show that even where sustainable advances are possible, that unexpected, unintended and negative impacts can occur. This raises the question of how best to manage BMI[35] in a way that delivers sustainability advances, while minimising unintended and negative impacts, as current traditional approach to innovation or risk management appear to insufficiently take account of these effects. Answering this question involves the synthesis of business model and responsible innovation literatures. Responsible innovation (rI) responds to this challenge by seeking to ensure that innovations avoid doing harm on the one hand, and provide positive impacts on the other, by taking socio-ethical issues into account through anticipative, inclusive, reflexive and responsive approaches (Stilgoe et al., 2013; Voegtlin & Scherer, 2017; Von

35. We define BMI as *"the conceptualisation and implementation of business models. This can comprise the development of entirely new business models, the diversification into additional business models, the acquisition of new business models, or the transformation from one business model to another"* (Geissdoerfer et al., 2018).

Schomberg, 2013). RI seeks to go beyond only motivating positive outcomes (intention), to also enable positive outcomes, by incorporating an explicitly moral perspective to traditional innovation practices (Bennink, 2020); it emerges alongside similar techniques, such as Design Thinking, but takes a more explicit moral stance (Nathan, 2017; Pavie & Carthy, 2015). By combining the definitions of RI and BMI, a responsible BMI approach can be defined as the 'conceptualisation and implementation of new business models in a transparent and interactive process by which societal actors and innovators become mutually responsive to each other, with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its outcomes. Socio-ethical issues include social issues: where the issue at hand is beyond the control of single individuals, and where the issue creates conflicting opinions (e.g. how best to manage privacy); and ethical issues: those that require an actor to choose between options that must be evaluated as right (ethical) or wrong (unethical) (e.g. the 'trolley problem' faced in the development of self-driving cars).

However, the issue of 'responsible' BMI is largely ignored within both the RI and BMI literature. For instance, one the one hand, while most definitions of sustainable business models explicitly or implicitly include ethical concerns (Stubbs & Cocklin, 2008), most do not include the responsibility to 'avoid harm', focusing only on the responsibility 'to do good'[36]. Some limited engagement with the concept of 'value destroyed' is the only exception (Bocken et al., 2013; Yang et al., 2017). On the other hand, the RI literature largely takes a technological focus, with those studies exploring non-technological aspects either omitting the business model or engaging with it superficially (Jarmai et al., 2020; Long, Iñigo, et al., 2020). These omissions are problematic, as business models influence the success and impact of technologies and how they are deployed and used (Chesbrough, 2010), meaning it is likely that the business model also influences the socio-ethical impacts of a technology. This raises the prospect of 'responsible technologies' being applied 'irresponsibly' due to the business model used.

In this research, we therefore aim to improve our understanding of the role of socio-ethical factors in BMI processes, and the influence they have on BMI

36. This aligns with the field of sustainability transitions, where research tends to focus on hopeful developments, but 'unsustainable trends' and the shadow side of innovation is often understudied (Antal et al., 2020; Shove & Walker, 2007). This is problematic as scaling up sustainable innovation may solve one problem, but may create or intensify another one (Van den Bergh et al., 2015).

outcomes. We posit, that for responsible outcomes, socio-ethical factors must also be integrated into BMI processes (Hope & Moehler, 2015), as well as technological innovation processes. We aim to explore the interplay between socio-ethical factors and BMI processes and design. We thus seek to answer the following research question: How does BMI of platform enabled bike sharing interact with socio-ethical aspects?

By tackling this question, we will improve our understanding of how to avoid unintended and negative outcomes, potentially improve our understanding around BMI failure, as well as critical role BMI for sustainability more broadly (Bocken et al., 2014; Chesbrough, 2010; Schaltegger et al., 2016). Established factors, such as triple bottom line issues or levels of resource allocation (Geissdoerfer et al., 2018), play key roles in the success or failure of BMI. However we argue that incorporating an RI lens and the consideration of socio-ethical factors into analysis of BMI creates a more complete picture of BMI processes and impacts and introduces socio-ethical factors as an additional category for BMI failure and design-implementation gaps. In doing so, we answer calls to further explore the barriers and challenges – in this case, socio-ethical issues – facing BMI (Geissdoerfer et al., 2018). This will be of value to those innovating business models and stakeholders, including communities, users and governments.

Free-floating bike sharing

To realise our research aim, we explore the emergence of a new generation of bike sharing enabled by platform business model innovation: free-floating bike sharing (FFBS). This represents an interesting case, as advocates claim FFBS as an innovative business model able to achieve sustainability mobility.[37] Although FFBS is a relatively new phenomenon, pioneering studies demonstrate how the emergence of this business model created wider socio-ethical issues. The business model and launching strategies are associated with causing *"significant disruptions and stresses"* (Ma et al., 2018; Médard de Chardon, 2019; Meilă, 2018; Spinney & Lin, 2018). Recent studies have documented a range of impacts, such as the privileging of access to these new forms of mobility for more affluent groups (Médard de Chardon, 2019), through to companies taking advantage of the friendly image of bikes for gathering of personal data for marketing purposes (Duarte, 2016). Spinney & Lin (Spinney & Lin, 2018) highlight how platform enabled bike sharing

37. Although the term 'free-floating bike sharing' includes of the word 'sharing', in principle these systems are about rental. The service bikes sharing systems provide is to make bikes available for shared use, based on tariff and a short period of time.

has given rise to new terrain of capital accumulation. While, Van Waes et al., (2018) and Petzer et al., (Petzer et al., 2019) discuss the impact of FFBS on public space leading to public nuisance. Curtis & Mont (Curtis & Mont, 2020) observe that the free-floating bike sharing market in China was saturated by hyper-competitive companies, which created an oversupply of (often low-quality) bikes, leading to under-utilized bikes. Van Waes et al (2020) show non-collaborative approaches of how business models are launching in cities without formal consent. Hence, such platforms (such as free-floating bike sharing) are not sustainable by default, meaning their business models require strategic and deliberate design and implementation.

To this end, this research set out to explore incorporating responsibility into BMI. The remainder of the chapter is structured as follows. In section 4-2, key literature is explored, before articulating a theoretical framework. In section 4-3, the empirical context and methods used to answer the research question are outlined. In section 4-4, different companies and city responses are described. In section 4-5 the results of applying the framework are described. In section 4-6 findings are discussed. Second 4-7 ends with a conclusion.

4.2 Literature review

4.2.1 Responsible innovation

RI seeks to solve grand societal challenges while also avoiding potential unforeseen and negative consequences that can occur with innovation (Von Schomberg, 2013). Initially conceived within a science and technology domain under the term responsible research and innovation (Burget et al., 2017), RI is widely defined as: *"a transparent, interactive process by which societal actor and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)"* (Von Schomberg 2013:1). More recently, RI is increasingly seen as an umbrella concept (Grunwald, 2011), with wider definitions emerging from management science highlighting three dimensions as the responsibility to 'do no harm', the responsibility to 'do good', and the responsibility of 'innovation governance regimes' to facilitate these aims (Voegtlin & Scherer, 2017). We argue that these definitions are not mutually exclusive and draw on both the science and technology studies-based definition of Von

Schomberg (2013) by incorporating the frameworks developed by Stilgoe et al. (2013) and Stahl et al. (2017) while recognising the value in the umbrella definition offered by Voegtlin and Scherer (2017), which is able to incorporate the science and technologies studies perspective, as well as management-based approaches, such as BMI.

The responsibility to avoid harm has largely been pursed through forward looking frameworks, which seek to overcome the deficiencies involved in retrospective regulatory approaches (Stilgoe et al., 2013). These approaches focus on process, such as the 3Ps framework; this examines socio-ethical issues via purpose (the motivations and justifications), process (the activities involved in the innovation process), and product (or outcomes, and their societal and environmental impacts according to specific indicators) (Stahl et al. 2017). Alternatively, the AIRR framework, highlights four key dimensions, including anticipation, inclusive deliberation, reflexivity, and responsiveness (Stilgoe et al., 2013). Anticipation requires that 'what if…' questions are asked by innovators, which helps to ensure an openness to many possible outcomes and to think systematically about possible impacts, seeking to address dilemmas of control (Genus & Stirling, 2018). Inclusive deliberation encourages a diverse set of societal stakeholders to be included in the innovation process. While reflexivity focuses on questioning and exploring the moral boundaries and roles of innovators. The fourth dimension, responsiveness, seeks that the necessary resources and capabilities are available to appropriately respond to any issues raised through the first three dimensions.

The responsibility to do good and generate positive outcomes draws on approaches such as eco-innovation, shared value creation or sustainable business models (Boons & Lüdeke-Freund, 2013; Markman et al., 2016; Porter & Kramer, 2011; Schaltegger et al., 2016), which we will explore in more detail in the following sections, and includes efforts to link more established inclusive innovation approaches, such as 'Design Thinking' (Nathan, 2017; Pavie & Carthy, 2015). While a key third responsibility highlights the importance of governance, raising questions of how best to ensure that innovation processes incorporate and adhere to the responsibility to do no harm and do good (Scherer & Voegtlin, 2020; Voegtlin & Scherer, 2017).

While research on RI in business or industry settings is growing, to date it has failed to explore innovation within business models. Instead, it largely focuses

on technological innovation, for example within the health, agri-food or ICT sectors (Eastwood et al., 2019; Gremmen et al., 2019; Long, Blok, et al., 2020; Stahl et al., 2017), or taking conceptual or review approaches to establish the relevance of the concept for industry actors (Halme & Korpela, 2014; Nazarko, 2019). Critically, engagement with business models or related innovation process are largely missing or superficial (Hope & Moehler, 2015; Jarmai et al., 2020; Long, Iñigo, et al., 2020).

4.2.2 BMI, sustainability and responsibility

Business models are conceptual tools that show the underlying value creating logic of organisations (Osterwalder et al., 2005). They define how a business creates value, chooses customers and users, which markets to enter, and are generally seen to include a value proposition, revenue model, key activities and key resources (Boons & Lüdeke-Freund, 2013; Chesbrough, 2010; Osterwalder et al., 2005; Osterwalder & Pigneur, 2013).

BMI is a key lever for enhancing sustainability, termed Sustainable BMI (Geissdoerfer et al., 2018). Sustainable BMI focuses on creating sustainable value, through changes to how an organisation, and its wider network, create value (Bocken et al., 2014). While we focus on the broader category of BMI, sustainable BMI research is helpful and relevant due to its focus on wider sustainable value, and explicit incorporation of societal and ethical factors (Boons & Lüdeke-Freund, 2013; Geissdoerfer et al., 2018).

In terms of normative BMI guidance, Boons and Lüdeke-Freund (2013) proposed that: (1) the value proposition integrates environmental and/or social additional to economic ones; (2) the supply chain is managed responsibly; (3) the customer interface motivates users to take responsibility; and (4) the financial model takes account of social and environmental externalities, ensuring fair distribution. While, in their review of sustainable BMI, Geissdoerfer et al. (2018) find that SBM definitions generally incorporate pro-active multi-stakeholder management, the creation of both monetary and non-monetary value for a broad range of stakeholders and incorporate a long-term perspective. The importance of stakeholder values is also well established in the SBM literature (Breuer & Lüdeke-Freund, 2016; Randles & Laasch, 2016).

Hence, clear synergies are observable between range of aspects of RI and sustainable BMI. Both use grand societal challenges as points of departure, via the aims or 'purpose' of an innovation, or the value proposition of a business model. Additionally, pro-active stakeholder management and stakeholder theories (Evans et al., 2017; Freudenreich et al., 2020) correspond well with stakeholder inclusion, and concepts of inclusive deliberation found in RI dimensions (Lubberink et al., 2017; Stilgoe et al., 2013). Indeed, one of the few contributions on responsible business models highlights the importance of stakeholder values to the business model design process (Hope & Moehler, 2015). However, such contributions are often focused on 'doing good', failing to conceptualise this deliberative inclusion process as one that also involves avoiding harm. Indeed, RI arguments that inclusive deliberation improves innovation outcomes and enhances societal embeddedness is corroborated by recent BMI research drawing on stakeholder theory (Freudenreich et al., 2020). Business modelling tools provide a rare exception, briefly highlighting the avoidance of harm, either through the concept of 'value destroyed' (Yang et al., 2017), which tries to capture negative impacts, within a value conception, or more broadly through negative externality conceptions (Bocken et al., 2013).

Yet, what a RI lens may add to the BMI literature are additional explanations for why positive 'do good' outcomes occur and/or are successfully embedded in society, or how BMI manages to avoid harm. Indeed, recent calls within the BMI literature highlight that there is a current lack of understanding why business models fail, including in terms of the design-implementation gap, both issues that can be attributed to socio-ethical factors, according to RI (Geissdoerfer et al., 2018; Stilgoe et al., 2013; Voegtlin & Scherer, 2017; Von Schomberg, 2013).

4.3 Methods

4.3.3 A framework for responsible BMI

In this section, we synthesise previous RI and BMI approaches to form a framework to explore how socio-ethical factors interact with BMI processes. A central tenet of our framework asserts that socio-ethical factors influence BMI and that BMI and the business models impact socio-ethical factors (see Figure 4-1).

We incorporate the '3Ps' approach to RI as this provides a broad and inclusive framework able to capture input, process and impact factors of BMI (Stahl et al., 2017).

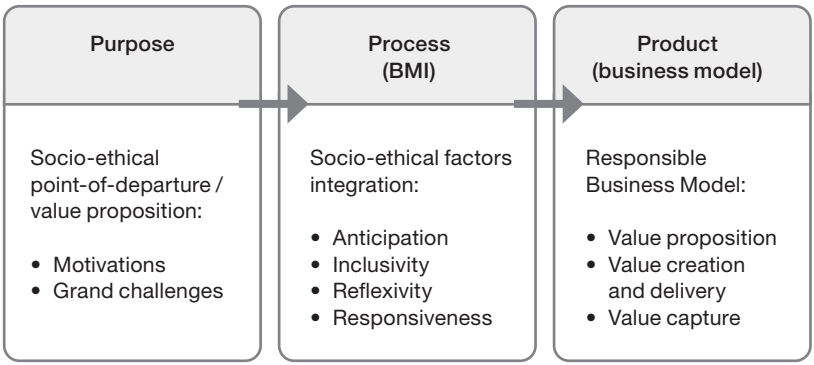
Purpose considers input factors, highlighting the motivations for BMI, the extent of any initial awareness of socio-ethical factors, and to what extent grand societal challenges represented an input into the formation of the value proposition – a key similarity between RI and BMI (Boons & Lüdeke-Freund, 2013; Stilgoe et al., 2013; Voegtlin & Scherer, 2017). The context, motivations, values and philosophy of the organisation and its innovators are all key data, providing explanations for why certain processes were (or were not) undertaken and provides a point of departure. For instance, it is likely that the motivations and values of the entrepreneur (Bronson, 2019; Randles & Laasch, 2016) influence the innovation process, such as levels of inclusivity, and the outcomes.

Process focuses on how the BMI process unfolds. Here, we draw on the AIRR framework dimensions of anticipation, inclusivity, reflexivity and responsiveness (Stilgoe et al., 2013). Anticipation covers the extent to which companies consider and anticipate potential (socio-ethical) impacts of their BMI; here we seek to capture not just expected 'value' additions, to the innovators, users or stakeholders (Yang et al., 2017), but also wider socio-ethical impacts. Inclusivity considers who is deliberately included in the innovation process, and how. For example, whether stakeholders are just consulted versus being included in a co-creative approach. Stakeholder inclusion is a core component of BMI (Freudenreich et al., 2020; Stubbs & Cocklin, 2008), however, RI suggests that for successful innovation, stakeholder inclusion must include consideration of socio-ethical issues (Lubberink et al., 2017), where social and ethical aspects are explicitly considered. It should be noted that it is not the stakeholder inclusion that is seen as novel, but rather the explicit incorporation of social and ethical themes and topics in the process. Reflexivity is used to describe the extent to which companies' question or consider their role and relevant moral boundaries. Through the responsiveness dimension, we seek to capture adjustments to the business model and/ or innovation process. The influence of these RI dimensions differs according to the values and motivations evident in the 'purpose' aspect (Bronson, 2019) and stage of the innovation process (Long, Blok, et al., 2020), for instance, responsiveness is likely to be more important towards the end of the innovation process, compared to anticipation, which may be more important towards the beginning.

Figure 4-2 provides a simplified representation of the conceptual framework, while Table 4-1 gives an overview of the key concepts and their operationalisation.

Figure 4-1: Interaction between socio-ethical factors and business model design and operation.

Figure 4-2: Conceptual framework



Product focuses on the output of the BMI process: the new business model launched. We utilise a simplified 'value' based approach in order to judge and structure how the business model interacts with its environment. We distinguish between the Value Proposition (what value is provided and to whom), Value Creation & Delivery (how is value provided) and Value Capture (how does a company make money and captures value), while incorporating principle of responsible and sustainable business models (Bocken et al., 2014; Boons & Lüdeke-Freund, 2013; Chesbrough, 2010; Hope & Moehler, 2015; Osterwalder & Pigneur, 2013; Von Schomberg, 2013).

4.4 Data collection and analysis

We explore how BMI interacts with socio-ethical factors through the context of bike sharing in three Dutch cities, illustrating different impacts and responses: Amsterdam, Rotterdam and Utrecht. This is an interesting setting as the Netherlands is a typical cycling country and the technology used (i.e. bicycle) is

long-standing and widely accepted.[38] This allows business models effects to be isolated more easily from novel technological effects. We examine seven innovative bike sharing companies, analysing the BMI process (covering conceptualisation and implementation) and the socio-ethical impacts. We focus on 'one-way free-floating' bike sharing business models (van Waes et al., 2018), which have been met with mixed results across cities. Given the novelty of these bike sharing systems and the propensity for start-up companies to be dynamic and subject to change, we took a case study approach (Yin, 2012).

Data was collected from 2017 to 2020 from primary and secondary sources. Semi-structured interviews were conducted in two rounds (See Table 4-3 for an overview. Interviews are referred to in the text as r1 through to r12). Two rounds of data collection allowed us to capture and reconstruct the unfolding of FFBS in different cities. During the first round (2017), FFBS was in the start-up phase and launched by different companies in Amsterdam, Rotterdam and later in Utrecht. Interviews were conducted with founders and/or managers of FFBS companies. Interviews were structured according to the business model dimensions (mainly focusing on Input and Product factors in Section 4-3). One company was not open for an interview, so insights about this company (Obike) were generated through secondary data sources.

During the second round (2020), the bike sharing sector had stabilized. Market saturation took place (i.e. some of the early companies left and new companies entered) and municipalities implemented regulations. Table 4-2 shows the launching date per company in each city, illustrating their operating period. Policymakers were also interviewed to improve understanding of how municipalities dealt with the impacts of FFBS. This round of data collection was oriented at BMI and the end product (mainly focusing on Pr ocess and Product factors in Table 4-1).

Due to the dynamic character of the sector and the companies, the data collection approach had to be adaptive and flexible, and as such, was iterative in nature, with initial interviews informing subsequent ones (Easterby-Smith et al., 2012). Interviews took around 60 minutes, were conducted face-to-face or via video chat apps and recorded for transcription.

38. Proportion of bike use in Amsterdam, Rotterdam and Utrecht (other modes: walking car, tram, metro and bus), respectively: 25%, 19% and 29% (Kennisinstituut voor Mobiliteitsbeleid, 2019).

Table 4-1: Operationalisation of conceptual framework

	Socio-ethical factors and definitions	Empirical evidence (i.e. examples of what to look for / indicators)
Purpose	**Motivations and grand societal challenges:** The extent of any initial awareness of socio-ethical factors, and extent grand societal challenges represented are an input into value proposition formation.	• Motivations, values and philosophy of the organisation • Awareness of potential socio-ethical aspects related to business model. • Mentions of links between BMI and grand societal challenges. • Additional motives for operating business model (e.g. marketing, data collection, building a mobility platform, etc.)
Process	**Anticipation:** Efforts taken to consider and anticipate potential socio-ethical impacts	• Awareness about potential unforeseen impact of business model • Systematic efforts to think about and avoid potential negative impacts as well as highlight new innovation opportunities and what desirable futures look like • Formal or informal use of scenario planning, foresighting techniques, horizon scanning, or similar.
	Inclusivity: Considers who is included in the innovation process, and how	• Efforts to include a diverse set of societal stakeholders in the innovation process (e.g. engagement with cities, companies, users, universities) • Engagement efforts through consulting, collaboration or other deliberative or dialogue-based approaches, which include consideration of socio-ethical issues. • Efforts to manage stakeholders locally, including raising and discussing socio-ethical aspects.
	Reflexivity: Extent to which companies question their own role and relevant moral boundaries.	• General reflections on industry, business models, current and future developments • Reflections and awareness about roles and responsibilities • Reflection and consideration of the internal and wider values and systemic aspects that influence socio-ethical aspects (e.g. contemporary industry practice around the collection of user data and the ethics attached to this, or reflection of societal impacts of regulation).
	Responsiveness: Adjustments to the business model and/or innovation process in response to issues raised relating to anticipation, inclusivity and reflexivity.	Alterations made to the business model in response to: negative societal impacts, changing local circumstances (e.g. changing discourse, limited public acceptance, introduction of legislation) and stakeholder (community, regulator) feedback or responses.

Table 4-1: Continued

	Socio-ethical factors and definitions	Empirical evidence (i.e. examples of what to look for / indicators)
Product	Value proposition	• Degree to which applied value propositions incorporate grand societal challenges (e.g. linking to challenges such as health, environment, social inequality), For whom is value provided? • Socio-ethical impact of applied value proposition, for example, ensuring access for wide set of consumers (non-exclusion of disadvantaged groups) and consideration or recognition of impacts on local communities
	Value creation & delivery	• Activities that reflect principles of sustainability and responsibility • Processes to manage and maintain bike sharing systems (e.g. redistributing bikes, managing disputes or complaints) • Practices that reflect responsible use of public parking space • Lifecycle: footprint and lifetime of bikes • Bike's user experience • Quality and safety standards • Handling of user data
	Value capture	• Primary (e.g. bike sharing fees and subscriptions) vs secondary or additional sources of income (e.g. advertisements, data collection) • Growth strategy and ethos

In addition to interviewing, market and regulatory dynamics were closely observed and monitored. For all cases, data was triangulated using secondary sources (newspaper articles, company websites & press releases, policy documents). Through triangulation we sought to further validate the data through cross verification of additional sources, using different instruments (secondary courses versus primary interview data). The interview and secondary data were used to reconstruct implementation strategies, explore the final business model configuration as well as give insights into the BMI process. The data allowed the impacts of the systems (positive and negative) and associated business models to be considered.

Analysis involved extracting relevant text fragments from the transcribed interviews and supporting documentary evidence that could help answer the research question, and coded into the framework shown in Figure 4-2, covering purpose (inputs), process (BMI) and product (the business model).

Table 4-1 shows how the conceptual framework was used for coding collecting empirical evidence. Following this, we sought to identify patterns among the companies (Yin, 2012), which produced unique case specific themes and patterns. These themes and patterns could then be compared between companies (companies compared to one another).

4.5 Business model launch and city responses

In this section we describe how FFBS was introduced and responded to in cities.

Introduction of free-floating bike sharing companies to the Netherlands
Bike sharing is nothing new to the Netherlands; the first public bike sharing system in the world (Witte Fietsenplan) was founded in 1965 in Amsterdam. Although this model ultimately failed, a radical idea was born. Since 2004, the national railways operate a successful system (OV-fiets) focusing on the last-mile for train passengers. This dominant model faced competition from 2016, as a new generation of bike sharing business models emerged, first in Amsterdam, and later in Rotterdam and Utrecht.

These new business models aimed at facilitating one-way journeys. The value proposition seeks to allow bike pick-up and drop-off anywhere in the city, providing more freedom than other models. Apps are used to highlight the location of available bikes, with the aim that there is always one within walking distance. This model also means there is limited-to-no physical infrastructure, but that parking space within public areas is an important resource. This contrasts to other, traditional bike sharing models, such as 'two-way station-based', where bikes are typically hired from a train station and must be returned to that point after (for example, the above mentioned Dutch OV-fiets), or 'one-way station-based' systems, with a network of physical docking stations in a city and the bike can be parked in these stations (for example, Santander Cycles in London and Vélib in Paris) (van Waes et al., 2018).

One of the first new players was Hellobike (Amsterdam-based start-up founded in 2016) that placed 500 bikes at Zuidas business district having won a tender in 2016. From summer 2017, several other companies introduced bikes and within a few weeks 5000-7000 bikes were put on the streets of the city centre (Gemeente Amsterdam, 2017b). The bikes were placed on the streets overnight, often without formal consent from the municipality. Among these companies were Flickbike

(Amsterdam-based start-up, founded in 2017), Donkey Republic (founded in 2015 in Denmark) and Obike (founded in 2017 in Singapore). The latter company was also active in Rotterdam. In this period, the two largest global bike sharing companies, Ofo and Mobike (both founded in China in 2016), opened offices in the Netherlands. Ofo operated in Rotterdam and since 2017, Mobike operated in Rotterdam, Delft and The Hague. Since 2019 e-bikes are provided in Rotterdam by Jump. Jump was originally founded as Social Bicycles in 2010. In 2018 the company rebranded into Jump, and was acquired by Uber in the same year. In 2020 the company was acquired by Lime, a micro mobility company from the U.S.

City responses

The three cities show different responses to FFBS (Table 4-2 provides an overview of FFBS entry and exit and municipal responses). Within a few months, the rapid growth and its impacts led to a ban on all FFBS companies in Amsterdam in October 2017 (See Van Waes et al. (2018) for a thorough description). FFBS had limited public and political support due to problems with bike parking and the management of public spaces (O'Sullivan, 2017). With no clear rules, the city initially proposed a two-year pilot with three providers, a maximum fleet of 3000 bikes and minimum use of bikes of 4 trips per bike per day (Gemeente Amsterdam, 2017a). In this institutional vacuum, companies tried to influence policy in Amsterdam, proposing alternative regulations and pilot projects. At the same time some companies relocated to other cities such as Rotterdam. Eventually the municipality decided in 2019 that FFBS would not be allowed due to limited public support[39], likely impacted by the practices of many of the companies.

Rotterdam was more welcoming towards FFBS. Initially, in 2017, Obike, Ofo, Mobike and Donkey Republic operated in Rotterdam and the municipality was pleased with their presence (r9). During a pilot phase, the municipality consulted the companies (e.g. quarterly meetings), introducing a licensing system in 2019 which creates agreements with companies (e.g. minimum use per bike per day requirements, rules with regards to customer care, maintenance, redistribution, data sharing). This enables the municipality to intervene in case of nuisance, for example when shared bikes are lying around (NRC, 2019). In 2020, the market has changed – some companies left, and newcomers entered the city – with Mobike, Donkey Republic and Jump as the only remaining companies.

39. Only Hellobike was allowed to stay as they got formal permission to operate at a business district outside the city centre.

Table 4-2: Month of entry and exit of companies in Amsterdam, Rotterdam and Utrecht and local responses

	Amsterdam	Rotterdam	Utrecht
Companies			
Hellobike	Nov 2016-current	-	-
Flickbike	Jun 2017 – Oct 2017	-	-
Obike	Jun 2017 – Oct 2017	June 2017 – June 2018	-
Donkey Republic	May 2017 – Oct 2017	Aug 2017 – current	April 2019 – current
Mobike	-	Nov 2017 – current	-
Ofo	-	Nov 2017 – 2018	-
Jump	-	Oct 2019 – current	-
Municipal response (policy)	Banned FFBS within 3 months after introduction	Welcomes multiple companies and has a licensing system that sets rules	Selected a single company based on a tender procedure and set up a living lab

The Amsterdam FFBS ban also prompted companies to relocate bikes to Utrecht. Like Amsterdam, Utrecht is considered a typical cycling city as a substantial proportion of urban movements is done by bike. However, the municipality was cautious following Amsterdam's experience and set up a two-year living lab experiment, in collaboration with Utrecht University, to learn if and how FFBS can contribute to urban mobility. Donkey Republic is the single FFBS company in Utrecht, operating 700 bikes. The company had to agree on requirements with regards to dedicated parking zones, maintenance and service and sharing user data (r10).

4.6 Results and analysis

In this section, we apply the framework developed in section 2.3 – a populated version can be found in Figure 4-3. We highlight motivations of different companies, key BMI events, before examining the key business model elements related to noted socio-ethical impacts.

4.6.1 Purpose

Motivation and grand societal challenges
As per the sampling strategy, all cases shared a basic business model – FFBS – aimed at providing first/last mile transportation and contributing to sustainable mobility, highlighting that all cases had a grand societal challenge motivation (or purpose). Companies also sought to address local (Dutch) challenges, such as the abundance of bikes, abandoned 'orphan' bikes, bike parking pressure or mobility poverty.[40] For example Ofo, Donkey Republic, Mobike and Flickbike aimed to solve the problem of 'orphan' bikes and decrease bike parking pressure (r1, r3, r4, r5) "*If something breaks, people leave their bikes and buy a new one. If people from Amsterdam no longer have their own bike but rather have access to a shared bike, this will lead to more space in the long term*". Besides start-ups, also existing companies entered the market, complementing existing mobility services. For example, the e-bikes of Jump are accessible through the Uber app. Bike sharing is an addition to their existing – rides – service: the bikes are mainly used for short trips, during rush hour in city centres (r12).

Remarkably, some cases show additional motives that raised potential socio--ethical issues. For example, Ofo views itself as part of a wider 'internet of things' ecosystem which values data collection. The company considers itself a platform – comparable with platform-based companies Uber and Airbnb – that connects bikes and bike sharing companies rather than just owning and producing bikes: "*We always say that we are a platform. Our dream is that in ten years, with one Ofo account, you can open all the bicycles on the streets, in every country.*" (r4). The company also highlights they differ from traditional bike sharing companies: "*We never call ourselves a bike rental business. Just like Uber never called themselves a taxi business. They call themselves an internet company. The business model of an internet company is based on volumes. The bigger volumes we get, the bigger the profit we will earn in the future.*" (r4).

This quote highlights first, that the FFBS companies relied on high volumes for their profitability, which likely influenced their launch strategies. Second, this quote highlights the potential additional value propositions around data collection and digital payments, partly reflected by the close links between FFBS

40. These are also identified by municipalities as key cycling related challenges (Gemeente Amsterdam, 2017; Gemeente Rotterdam, 2018; Gemeente Utrecht, 2015).

companies and large technology and e-commerce companies. The could change the aim to one of maximising interactions and use of the platform to create value, rather than providing bike sharing . Chinese e-commerce giant Alibaba invested in Ofo and since 2018 Mobike's parent company is Meituan-Dianping, China's largest provider of on-demand online services, such as food-delivery.[41] On a similar note, Mobike and Ofo are integrated with widely used Chinese social-media (such as WeChat – a multipurpose app by Tencent, one of the largest internet technology companies in the world), mobile payment (such as Alipay) and food-delivery platforms.

This integration enables a large group of potential users to be reached. Data obtained through users of FBSS – using an app to locate and (un)lock a bike – could be commercially valuable (e.g. geo-based advertising), showing a potentially 'two-sided' business model, with a hidden value proposition. The nature of the model and the collection and use of this data raises questions around transparency and privacy.

Purpose can also change over time. For example, Jump was founded as Social Bicycles, a FFBS company that – like any urban transportation company – collaborated and established long term partnerships (incl. contracts and agreements) with cities to operate bike sharing systems and contribute to sustainable mobility. However, after being acquired by Uber the approach somewhat changed from this collaborative approach to an approach that did not involve close engagement with authorities (rather followed a 'launch first ask questions later' approach).

4.6.2 Process

The elements of the BMI process were more varied, interacting with RI dimensions, which act as differentiators between the cases.

Anticipation
The failures to anticipate problems highlight issues of anticipatory capabilities in relation to the BMI process, including implementation of the business model via the entry strategy. Some companies did not recognise the potential problems that could result from releasing FFBS into space restricted streets. While these models may be appropriate in urban locations, such as Chinese cities with a

41. After this acquisition, Mobike was renamed Meituan Bike in China.

prominent last-mile problem, limited use of private bikes and availability of parking space, within Amsterdam and Rotterdam they were problematic, causing congestion in public spaces (Koops, 2017) (r9).

Examination of the entry strategies suggests some companies (e.g. Obike) expected their FFBS system of thousands of distributed bikes to manage itself, without further human support on the streets (r9). Other cases were more aware of local contexts from the start. For example, the business models of Hellobike and Donkey Republic combined 'dockless' bike sharing with designated parking zones[42], avoiding the 'uncontrolled' parking issues. Companies (e.g. Donkey Republic, Mobike, Flickbike) also had street operation personnel, responsible for maintenance and redistribution of bikes. This raises the question – to be tackled next – of why these cases seemed to have enhanced adaptive capacity, and so be better able to foresee potential issues and mitigate accordingly.

Inclusivity acts as a differentiator among the cases. Although some companies (i.e. Obike, Flickbike, Ofo) claimed they informed the city about their operations, there was no formal engagement or consent with the authorities (r3, r4). A 'launch first, answer questions later' approach helped capture market share, but also resulted in lower inclusivity levels.

The lack of a legal base to regulate these innovative business models (r9) meant there were no formal procedures for dialogue, showing how also urban authorities (i.e. Amsterdam and Rotterdam) were unprepared and lacked anticipative capacity (due to the very quick and unannounced launch). At the same time, these urban authorities were responsible for most of the engagement efforts, aimed at stimulating dialogue with companies and working towards a collaborative and inclusive approach to BMI, through established systems. In Amsterdam and Rotterdam, companies were consulted prior to decisions about regulatory frameworks (r9). In Utrecht, a single company was selected to participate in a living lab. This resulted in fewer issues and highlights co-learning from the Amsterdam experience regarding inclusivity and anticipation (r10) (te Brömmelstroet et al., 2020).

The recruitment of local staff – which varied among the cases – emerged as a facilitating factor for foreign companies to engage with local authorities and try to

42. Bikes can only be parked and (un)locked within these 'geographically fenced' zones which are shown in the bike sharing app

establish longer term relationships. For example, Mobike hired a local bike sharing professional with an established network as a manager, enhancing sensitivity to the local (socio-political) context (r5). In stark contrast, Ofo sent a single Chinese employee to launch across the whole Benelux region in only three months (r4).

Reflexivity
The cases show varied reflexive capacity about roles and responsibility in the FFBS market. For example, some advocated a role for government regulation: *"A bike sharing system will only work when regulated by the municipality"* (Cornelissen, 2017). In contrast, other companies did not understand measures taken. For example, Obike called Amsterdam's ban of FFBS a *"hate campaign"*.

There was also recognition of the impact of irresponsible behaviour and the potential of reputational damage to FFBS in general: *"Since Obike launched in the Netherlands bike sharing got a negative reputation. They had a different approach: quickly making money by putting thousands of bikes on the streets without further management or maintenance and without taking the urban environment into account"* (r11).

Responsiveness
In response to unintended negative impacts of FFBS, several firms continued the innovation process, adjusting the BM. Municipalities played an important role in stimulating this subsequent BMI as they regulated bike sharing through pilots, living labs, assessments and monitoring. Companies can be split into those that responded and adjusted to issues, such as concerns around the use of public space, and those that did not.

In relation to the uncontrolled parking of bikes, and congestion of public spaces due to FFBS, some providers (e.g. Donkey Republic, Flickbike) proposed to work with designated public or private parking areas, adjusting their business models to align to the city's specific contextual needs (r3, r6) (Voermans, 2017).

Some companies adjusted their revenue model, taking local challenges as an opportunity to attract new users. For example, bike parking pressure at train stations can be relieved through bike sharing. Mobike and Donkey Republic collect private bikes (often a second bike parked at a train station) and in return owners could receive a subscription for bike sharing (r7, r9). In Rotterdam, these bikes were donated to social community projects and low-income families.

Companies were also responsive to national and local governments' ambition for interoperable bike sharing enabled by an overarching platform allowing access to different systems. Several bike sharing companies took up this idea; Mobike: *"Eventually we want you to be able to access a bike everywhere with one account, whether this is an station-based bike like OV-fiets, a free-floating bike like Mobike or a lease bike like Swapfiets"* (Van Tongeren, 2018).

4.6.3 Product

The business models that emerged from the process described, went through adjustments in some cases. In the following section, rather than providing an exhaustive description, we draw attention to the most interesting aspects of the business models in relation to socio-ethical issues.

Value proposition

The value proposition of FFBS companies is similar across all cases: providing access to a bike that one can take and drop a bike anywhere in a city (flexibility).[43] For cities, FFBS companies provide an attractive proposition, as they do not demand public funding in contrast to the traditional bike sharing systems with physical docking stations. However, the 'free-floating' aspect was adjusted (in line with responsiveness dimensions) in some cases in response to restrictions by authorities. Although these adjustments – from free-floating to a system with dedicated parking zones – also raised viability questions, as highlighted by oBike: *"Our system works optimally when you are able to pick a bike every 200 meters. Only then it's able to grow, we can see where there is a demand for bikes and where not. All the pilots in cities with only 20 bikes won't work. It is a pity that the municipality took this drastic measure. This gives bike sharing a bad name."* (Voermans, 2017).

This exposes a tension between a 'responsible' value proposition – the ability to ride and park anywhere – and profitability. Additionally, value proposition aspects with questionable business ethics included: additional, hidden, value propositions around data and financing (creating two-sided business models), which drove some cites to ask for further compliance. And, excluding particular areas from bike sharing by the company. For example, the municipality of Rotterdam

43. This study does not primarily focus on users and their experience in using these bikes. Nevertheless, evidence from the Netherlands – where bike ownership is the norm – shows there is a demand for this form of bike sharing, but it mainly replaces walking, cycling (with a private bike) and public transport trips (Farla, 2019; Ma et al., 2020; Van Waes et al., 2018)

suffers with 'mobility poverty' in less develop areas, which could be alleviated through bike sharing (r9). There is evidence they do not provide their service in such areas, due to low demand and risk of vandalism (r11, r12) (van Veelen, 2020).

Value Creation and Delivery

Value creation and delivery aspects relevant to socio-ethical issues included engaging in and maintaining partnerships, the redistribution management of bike fleets, and repositioning disorderly parked bikes in response to complaints.

Collaborative and partnering activities emerged as a critical BMI aspect, differentiating companies who were able to adapt, and those who were not, reinforcing the importance of inclusivity and its links to anticipative capacity. In response to initial problems, collaborative activities have been established – often initiated by municipalities – with both local authorities and communities, through dialogue, market consultations and 'living labs'. The agreements made between municipalities and companies to share data to learn about FFBS is one example, where the municipalities of Rotterdam and Utrecht now require companies to share data through a national dashboard, so authorities can see where bikes are parked and how long they are inactive (r9, r10).

In the early phase, some companies failed to install adequate systems, inconveniencing others. Long-parked bikes cause most nuisance. To counter this, cities have set minimum use per bike requirements. After a while, bikes need to be replaced. But this redistribution is a relatively expensive activity for companies.[44]

Companies engage in several activities to adequately handle complaints, for example regarding long-parked unused bikes. Most companies have personnel on the streets for handling parking[45] or maintenance issues. Companies in Rotterdam are also obliged to have a telephone number through which citizens can file complaints. However, platform orientated companies (e.g. Mobike, Jump) criticize such a rule, as they prefer a cheaper digitized complaints system (for example through their own app with a chatbot) (r11, r12). The municipality doesn't

44. A bike stands still for too long signals limited demand. To prevent this, companies limit parking zones to areas with high demand for shared bikes.

45. Users have a key role to play when it comes to parking. Disorderly parking is one of the main negative side effects of FFBS. Municipalities encourage companies to incentivize responsible parking behaviour, for example by giving credits that can be used for bike sharing (r9, r11). This highlights how key activities are an area of the business model that interacted with (negative) socio-ethical factors.

realize the costs involved of a call center. These are quite high per individual bike ride. Usually, we take care of issues through the app. A human call center leads to more communication which is not handled efficiently (r12). This highlights that activity and resource decisions, critical for value creation and delivery, are influenced by economic concerns of the companies.

The need for maintenance is of course related to the quality of bikes, a key resource of companies. Whereas some companies provide bikes that meet local standards and practices, there were also some companies that introduced low-cost bikes not attuned to the local cycling experience. Especially, the type of bikes, of poor quality and lacked maintenance, caused controversy among municipalities and citizens.

Value Capture
Finally, the primary stream of income comes from bike sharing fees and subscriptions.[46] Companies compete with different fees. [47] But, for companies to maintain affordable FFBS proves to be challenging when they need to comply with requirements by authorities to prevent socio-ethical impacts. Companies are generally positive about such measures, although they could lead to more expensive (and thus less attractive/accessible) bike sharing. As Mobike highlights, "*Nothing is for free. All extra efforts come with costs, which needs to be charged to our users in order to keep bikes sharing financially feasible*" (NRC, 2019). According to Jump, such requirements need to be balanced with price and demand: "*If you set requirements that are not efficient, this will lead to increases in price, which makes the bike less accessible, leading to lower use rates and a less efficient system.*" (r12).

4.7 Discussion

In this research we sought to explore how BMI interacts with socio-ethical issues and impacts. By presenting FFBS as an example of BMI, within a sharing economy context, we explore a case demonstrating unintended and negative consequences and the role that BMI processes played. In this section, key findings and implications for practices and future research are discussed.

46. In section 4.6.1 we discussed how some companies may have hidden value proposition with an additional revenue model besides bike sharing fees.
47. Tariffs varied: €0,50 / 30 minutes with Mobike or Obike ; €0,20/ minute for a Jump e-bike.

Figure 4-3: FFBS business model interaction with socio-ethical factors

	Purpose	Process	Product
responsible innovation	Motivations & societal challenges: • Solving 'last mile' issue • Sustainable mobility	Inclusivity: • (Shift to) cooperative/ co-creative approach • Living lab approaches Responsiveness: • Recognition of problems and BM adjustment Reflexivity: • Reflections about the field of bike sharing and regulation.	Value proposition: • For users: flexibility and sustainable mobility • For cities: sustainable mobility without additional public funding Value creation and delivery: • Inclusive, co-creative approaches with cities, researchers and social working places (data sharing) • Maintenance, redistribution, reuse of bikes • Qualitative bikes Value capture: • Fees and subscription
irresponsible innovation	Underlying motives: • Technology companies: data driven business models • Transparency about hidden value proposition	Not anticipated: • Impacts on public space not anticipated Non-inclusive: • Minimal engagement/ non-cooperative Unresponsive: • Failure to respond to BMI issues (coammunity backlash/ abuse of public spaces) Reflexivity: • Limited	Value creation and delivery: • Uncooperative approach • Limited maintenance and bikes not attuned to local standards Value capture: • Platform integration • Growth strategy: release first, ask permission later

4.7.1 Business model innovation interaction with socio-ethical factors

To address the research question of this research, the results shows how BMI interacts with socio-ethical factors, illustrating how these factors can play a key role in the success or failure of BMI. Almost all companies, including municipalities, within the case were initially unable to anticipate impacts during initial conceptualising and implementation of the business model. We see that following initial implementation there were both intended and unintended impacts, with unintended negative impacts of a socio-ethical nature leading to initial

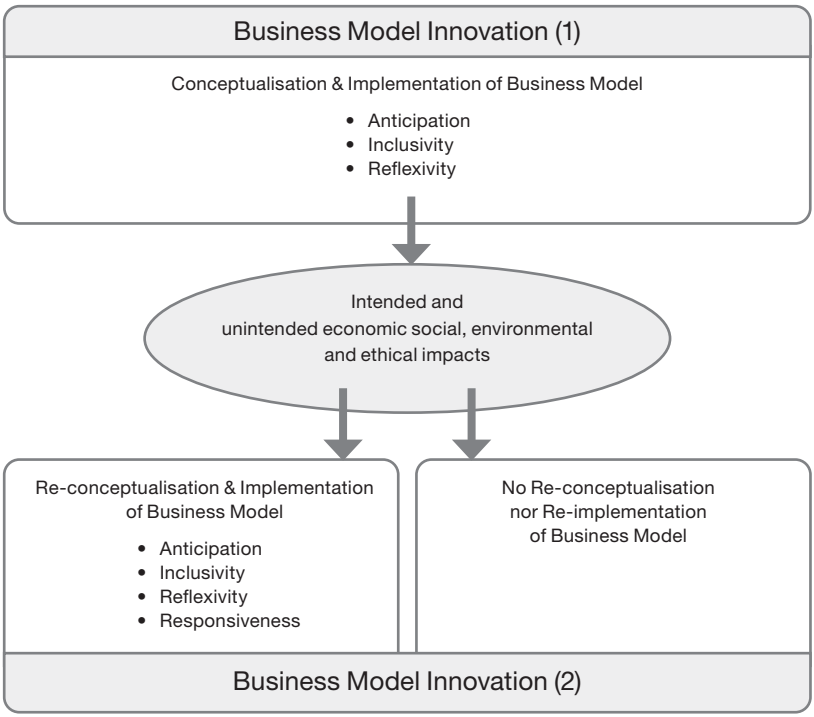
bans. Following this, our case splits into those companies who were able to exercise 'inclusivity' and 'responsiveness' and adjust their business models, and those who either would or could not. This latter category of firms were inflexible in terms of 'incorporating local needs and market conditions' (which included limited bike storage space within the local environment and poor quality, inappropriate bike models).

We illustrate this in Figure 4-4, illustrating the 'process' element of our framework. This shows how RI in our case is actually represented by a process of implementation followed by learning and adjustment, where the key RI dimensions operate at different points. In this sense, BMI and socio-ethical issues interact: the implemented business model creates or aggravates socio-ethical issues, which in turn motivate additional BMI and adjustment. Anticipation, inclusivity and reflexivity have relevance in the initial stage of BMI, while the fourth dimension, responsiveness, only becomes relevant once initial impacts were observable. This is somewhat at odds with the RI literature, which idealistically sees these processes occurring in a way that inhibits and prevents unintended and negative impacts (Lubberink et al., 2017; Stahl et al., 2017; Stilgoe et al., 2013), whereas, in this case, these dimensions operate reactively, to socio-ethical impacts.

We propose that in the absence of institutionalised RI – i.e. where RI is not a norm, nor embedded in organisational or governmental cultures, as is likely the case in many contexts – a period of business model implementation is required as a learning period. This highlights a potential key role for RI and sensitivity to socio-ethical issues during business model experimentation efforts, a burgeoning area of the literature (Bocken et al., 2019). Indeed, we observe that FFBS companies learnt from one another, alongside public authorities, who implemented 'learning' spaces aimed at monitoring and generating insights about impacts (such as the Living Lab in Utrecht and the pilot in Rotterdam).

In highlighting these core results, we empirically confirm our criticism that current RI literatures focus on technological innovation misses the key influence that BMI, and the business models it leads to, can have on the (socio-ethical) impacts of technologies (Jarmai et al., 2020; Long, Iñigo, et al., 2020; Stubbs & Cocklin, 2008). In doing so, we expand the number of contexts that RI approaches may be relevant to and the value of socio-ethical perspective. This raises the question of the extent to which an RI lens is applicable to other non-technical types of innovation, such as social innovation.

Figure 4-4: How a responsible BMI processes unfolded in the case of bike sharing: interaction with socio-ethical issues



We do recognize that anticipating repercussions of the implementation of innovative business models, such as FFBS (combined with the absence of established regulations), is challenging. Each city responded differently with local context specific measures (strict ban, pilot or living lab). Implementing a new business model in practice is guided by an iterative process of learning by doing and adjusting. In this sense, the processes in our case follow previously identified processes. The additional value of RI is its ability to highlight the role that socio--ethical issues specifically, play in these processes and introduces socio-ethical factors as an additional category for BMI failure and design-implementation gaps (Geissdoerfer et al., 2018), alongside existing failure reasons such as changing prevailing mind-sets, triple bottom line challenges or insufficient resource allocation (c.f. Evans et al. 2017). Hence, we acknowledge that BMI failure is not only due to socio-ethical issues, but that a RI lens highlights additional factors and presents a more holistic picture.

4.7.2 Locally embedded and top-down applied platform-based business models

The second observation concerns the influence of underlying motivations behind business models on responsible innovation outcomes. Analysis of the case highlights two types of FFBS companies that deploy business models with different underlying purposes, influencing processes and strategies of responsible innovation and outcomes differently. Hence, the ability and inclination to enact responsible innovation processes and strategies is arguably influenced by, the 'purpose' dimension of our framework.

On the one hand the FFBS field contains of companies that apply a two-sided business model seeking additional sources of value creation (e.g. Obike, Ofo, Mobike, Jump). These companies associate themselves more with well-known platform-based businesses such as Airbnb and Uber rather than urban mobility providers.[48] They operate following a (top-down) platform logic that is reliant on acquiring large market share, leading to aggressive business model implementation strategies – 'launch first and legitimize later' – an approach often taken by platform-based businesses. The narrow profit margins of such platform-based mean high volumes (in this case bikes) are needed. Hence, rapidly reaching a large user base by putting large numbers of bikes on the streets was critical for these companies, which led to fierce competition and eventually could lead to a race-to-the-bottom. Backed by venture capital investors (with deep pockets), companies engaged in predatory pricing and shipped low-cost bikes with short life span, poor service, minimal redistribution and limited maintenance. These companies often also aim to minimise labour costs, often via minimising 'on the ground' personnel trough automation and digitization raising questions over the appropriate relationship with local regulators (Cohen & Kietzmann, 2014).

Their reliance on scale and the way they were run, suggests that their primary ambition (purpose) was not to provide a sustainable solution to mobility challenges, but rather to establish and operate a platform (i.e. ecosystem or app) that creates additional economic value through data collection, advertisements and integration with other services. This would create value for the companies and its shareholders, but little for any other stakeholders – additional economic value at the expense of social value – raising business ethics issues (Freudenreich et al.,

48. Whereas they can be considered more related to traditional public transport companies (a sector with its own logic, rules and practices).

2020; Yang et al., 2017). This observation aligns with studies stressing concerns around the entry of new types of actors that are behind the surge in bike sharing and their additional interests in data gathering (Duarte, 2016; Spinney & Lin, 2018).

On the other hand, there are companies with a more local origin and community-oriented approach focused on local challenges (e.g. Donkey Republic). These provide a service that is more attuned local contexts, with a bike that matches the experience of users and with a business model less reliant on platform dynamics (gradually scaling vs rapid scaling), highlighting a more collaborative and mission-driven logic (Nixon & Schwanen, 2019). These types of firms, whose primary purpose is to provide a local sustainability solution, are likely to be more open to, and more adept at engagement with key stakeholders. Although in our case these companies were still subject to the same BMI implementation mistakes as the platform-based companies, they were able to leverage their focus on the locality and its communities to engage in inclusive deliberation, and establish which parts of the business model needed further adjustment. Hence, these companies benefited from incorporating local stakeholder perspectives and needs (Bocken et al., 2013), as well as being able to adjust to these needs and produce a more locally relevant, socially desirable and ethically acceptable business model.

The RI lens enabled to explore how additional purposes and different 'logics' (Stubbs & Cocklin, 2008) behind the BMI processes, led to different socio-ethical impacts, even while the core value proposition and serve of all companies were the same.

The alternative purpose and underlying logic of the cases (Stubbs & Cocklin, 2008) can then be used as an explanatory factor influencing other aspects of the BMI process, including implementation, and the willingness and ability to enact subsequent BMIs. The underlying logic of the business models influences the type and nature of socio-ethical impacts, creates business ethics issues, and due to a reliance on scale and an inability to adjust, in these cases failure of the business model.

Additionally, we also see how purpose and its influence may not be static, and changes over time, as was the case with Jump, moving from a community-based model, to one more associated with the impacts and effects of the platform based models after its acquisition by Uber. BMI literature has shown how institutional logics impact development trajectories, and our results add by highlighting a link with socio-ethical factors (Stubbs & Cocklin, 2008; Vaskelainen & Münzel, 2017).

The poor fit of the platform-based business model, in conjunction with an aggressive business implementation strategy meant that after 2 years (most of) these companies went bankrupt or left the Netherlands. Obike went bankrupt in 2018 (leaving their bikes for trash on city streets across the world, including in Amsterdam and Rotterdam).[49] In 2019, both Ofo and Mobike ceased all international operations and put sole focus on the Chinese market (Liao, 2019; Moore, 2020). However, Mobike is still active in the Netherlands, but since 2020 operating independently from the Chinese mother company following a management buyout (r11). The founding purpose of these platform-based business models – to operate on a large scale in population dense areas, with limited cycling – demanded a necessary adaptation to the local context (in this case, regulated pilots in NL) which meant that their financial viability was restricted. Our cases highlight how RI principles are relevant not just in the design or conceptualization part of a BMI process, but also during implementation.

4.7.3 Place dependency of (ir)responsible business model innovation

A third observation is that (ir)responsible BMI is context dependent. Although this study did not compare business models between different international contexts, the case of FFBS in Dutch cities should be viewed against the backdrop of the emergence of bike sharing across cities globally. While these business models do not inherently imply socio-ethical problems, this research has shown that the application to the Dutch context led to particular issues, observable through RI dimensions. FFBS was invented and applied on a large scale in China and although it also led to unintended impacts there (such as an over capacity of bikes), there have been additional issues in European cities (such as concerns about data privacy). This business model addressed a recognised urban challenge in China and was socially supported. However, as is clear, it did not mean it could be easily implemented in other urban contexts.[50] This means that the promise of easy implementation and transferability across contexts of platform-based models is potentially naive and ignores the importance of local context. Different contexts appear to lead to specific socio-ethical issues and challenges.

49. In Amsterdam, the redundant bikes that were left for thrash and removed by the city were offered for sale at a local thrift store (AT5, 2018).

50. This aligns with van Waes et al. (2020) that highlight that for effective business model implementation, both local institutional and physical aspects should be taken into account.

4.7.4 Implications for practice and future research

For FFBS companies, and managers working within other sharing economy applications our central recommendation is to apply RI principles to BMI processes. The sharing economy is characterised by high growth rates and often disruptive, technological and service innovations (Belk, 2014; Frenken et al., 2019; Owyang et al., 2013). This makes the sharing economy a prime candidate to experience socio-ethical challenges (Scholten & van der Duin, 2015); as our case shows, socio--ethical impacts are not isolated to high-tech innovations, they are also observable in disruptive non-technological innovations, highlighting the relevance of RI. Managers should ensure engagement and dialogue with stakeholders and implement internal innovation management processes that explicitly include socio-ethical issues, alongside more traditional financial and technological ones. These lessons could be particularly applicable to other innovative 'micro mobility' modes (including e-bikes and e-scooters), a rapidly growing sector with the potential of transforming urban mobility but also accompanied by irresponsible innovation dynamics, and provide an additional perspective to the burgeoning literature on bike sharing (Du & Cheng, 2018; Nikitas, 2019; Ricci, 2015; van Waes et al., 2018). A limitation with regards to generalizability of the results is that this research focused particularly on BMI in the urban mobility domain within Dutch cities. Therefore, studying cases of (ir)responsible business model innovation in other domains within different spatial contexts may reveal different types of socio-ethical issues. Indeed, this research highlights the importance of socio--ethical factors for wider sustainable innovation diffusion and adoption. Broader research questions that require attention concern the types of innovation and contexts in which socio-ethical factors are likely to be important, as it is in these contexts that RI approaches will be most needed in order to enhance sustainable outcomes.

A key area for future research concerns the institutionalisation of responsible BMI processes, and the development of innovation governance systems (Voegtlin & Scherer, 2017). Our examples raise questions of how responsibility is and should be distributed between companies, regulators, and wider society (including users and researchers). This could include facilitating inclusive deliberation efforts and contributing towards anticipative capacity, through to the co-creation of experimental spaces aimed at learning about the innovation, as seen in Utrecht and Rotterdam. In other contexts however, institutionalisation process may rely more on firms themselves, drawing on self-regulatory types of approaches (Scherer

& Voegtlin, 2020; Stilgoe et al., 2013). Linked to this is the issue of speed and scaling. The severity and urgency of sustainability challenges increasingly argues for more rapid innovation diffusions and scaling. Within this context, one can imagine supporting the rapid launching strategies seen within some of the cases. Indeed, rapid experimentation, enabling fast learning of what works and does not. However, this should be seen as distinct from the non-inclusive launch first, ask questions later strategies, which although rapid, face additional socio-ethical challenges. Future research should explore how rapid experimentation can be connected to rapid scaling strategies that are also able to integrate RI principles, and in so doing, reap the innovation diffusion benefits. Another fertile topic for future research would be the interconnection of Design Thinking approaches for BMI and their ability to integrate RI principles. This has received some initial attention within the RI domain, and the BMI context could be an especially interesting avenue (Nathan, 2017; Pavie & Carthy, 2015).

4.8 Conclusion

In conclusion, this chapter shows that BMI processes interact with socio-ethical issues, affecting the relative success or failure of the business models that result. That BMI seems subject to the influence of socio-ethical issues, highlights a potentially new area for the application of responsible innovation, involving companies, regulators and communities. The case of FFBS shows that in the end, cities and their communities are key stakeholders in the BMI process, reiterating the importance of anticipation, inclusive deliberation and responsiveness.

4.9 Appendix

Table 4-3: Overview of interviewees

	Respondent	System	Interviewee	Date
Round 1	r1	Donkey Republic	CEO and co-founder	3-9-2017
	r2	HelloBike	Managing director	1-2-2017
	r3	FlickBike	Founder	27-9-2017
	r4	Ofo	Country manager	23-8-2017
	r5	Mobike	Advisor	15-2-2018
	r6	Donkey Republic	Local manager Amsterdam	8-2-2018
	r7	Donkey Republic	Local manager Utrecht	5-6-2019
Round 2	r8	Donkey Republic	CEO and co-founder	5-2-2020
	r9	City of Rotterdam	Project manager and advisor bike sharing	26-2-2020
	r10	City of Utrecht	Project manager bike sharing living lab	2-3-2020
	r11	Mobike	Manager Rotterdam	26-2-2020
	r12	Jump	Head of Benelux Policy	23-3-2020

5

Challenges and dilemmas of strategic urban living lab experimentation

Abstract

Living labs have emerged as a form of strategic urban experimentation in the context of governing transitions to sustainability among policy makers and researchers. Although this has led to various research directions into living labs, limited attention has been given to the various challenges and dilemmas when doing LLs, in particular in relation to enabling urban transitions. This chapter unpacks challenges and dilemmas that arise for different actors in the process of living lab experimentation. To this end, the research combines theoretical insights from a review of Strategic Niche Management literature, enriched with recent insights from transdisciplinary research on living labs, with empirical data from a qualitative case study analysis of four cycling innovation living labs in the Netherlands. By contrasting challenges and dilemmas identified in literature and those derived from our data, we reflect on key gaps between conceptual aspirations and empirical realities of strategic urban experimentation in sustainability transitions.

This chapter is based on Van Waes, A., Nikolaeva, A. & Raven, R. (2021). Challenges and dilemmas of strategic urban experimentation. An analysis of four cycling innovation living labs. Technological Forecasting and Social Change. (second review)

5.1 Introduction

Urban experimentation and living labs (LL) are increasingly mobilized and heralded in sustainability transitions literature as a way to trial, learn from and govern socio-technical innovations and urban transformations in real-life urban environments to address local sustainability challenges (Bulkeley et al., 2016; Voytenko et al., 2016). Here we refer to such initiatives as forms of 'strategic urban experimentation'. We consider such experimentation 'strategic', because it is often framed as enabling exploration and learning about long-term challenges, uncertainties and ambiguities in short-term projects. However, navigating experimentation and innovation processes in urban environments is a complex endeavor. It is labor intensive, time-consuming and precarious process marked by the delicate interplay of a variety of social, technical, cultural and economic factors (Hommels, 2005). Unlike traditional laboratories, cities do not provide controlled conditions in which innovations can be researched and tested (May & Perry, 2016). Introducing socio-technical innovation in urban environments is characterized by local challenges, multiple stakeholders, multilevel-interdependencies, technological uncertainty and fragmented decision-making. In response to such complexities, the notion of LLs – as a new and open way of governing socio-technical experiments in cities aimed at cocreation – has received much attention in academic and policy spheres (Evans, Karvonen, & Raven, 2016; Bruno Turnheim, Kivimaa, & Berkhout, 2018).

Research on strategic urban experimentation is growing, with particular attention to its role in sustainability transitions (Marvin et al., 2018). So far, literature has addressed how to design LLs (Bulkeley et al., 2018; Voytenko et al., 2016) the role of favorable contextual conditions for experimentation (van den Heiligenberg et al., 2017), how urban experiments can scale up and yield broader impact and how they are socio-spatially embedded (Frantzeskaki et al., 2018) or institutionalized (Raven et al. 2019). The recent research agenda on sustainability transitions calls for more attention to conditions, processes and pathways through which urban experimentation emerges (Köhler et al., 2019), and our paper responds to this call. Our starting point is that challenges and dilemmas of LL experimentation are discussed only to a very limited extent in the literature (for an exception see Hossain, Leminen, & Westerlund (2019)). According to Evans (2015), it is pertinent for living labs to learn about what works and what does not, and yet monitoring and evaluation required to make this happen often attracts less budget (ibid). Our research also responds to the call by Von Wirth et al. (2019) to explore

long-term and comparative dynamics of LLs via ex-durante analyses in addition to studying cases ex-post.

In order to provide a contribution to understanding how strategic urban experimentation works in practice we offer long-term analysis *"from within"* four strategic urban experiments in the Netherlands. Such an approach, we believe, provides better insight into how strategic urban experiments unfold and evolve, what sort of practical challenges emerge in and through strategic urban experimentation, and how these are navigated. Our research question is: what are challenges and dilemmas in doing strategic urban experimentation? To answer this question, four LLs in four cities in the Netherlands are closely followed over a period of three years – from the selection of an experiment to implementation. In particular we look in at different stakeholders in the living lab such as cities, innovators and researchers. The LLs are part of a transdisciplinary research project in which researchers, together with public and private actors, co-created several experiments in LLs with cycling innovations in response to specific local challenges and aiming to facilitate learning by doing.

To this end, this research brings together insights from literature with insights from practice in four ongoing LLs. Section 5-2 starts by highlighting important processes for experimentation from a particularly relevant body of literature, i.e. Strategic Niche Management (SNM), which provides the basis of a conceptual framework to study challenges and dilemmas. This literature is particularly relevant, because it has a long tradition of reflecting on challenges and dilemmas with experimentation in sustainability transitions, although not with a specific focus on urban contexts. This allows us to develop a tentative framework of challenges and dilemmas. This framework is enriched with insights from literature on transdisciplinarity and in particular recent studies on transdisciplinarity in living labs. We explore the relevance of this integrated framework for urban contexts. Section 5-3 outlines the research design and empirical background. Section 5-4 presents empirical insights from four cases of strategic experimentation. In Section 5-5 we discuss similarities and differences between the insights derived from the SNM literature and what we found when comparing it to experiences in urban contexts. We explore how and why challenges and dilemmas are similar or different across the cases, with reference to differences in place-specific conditions. Finally, in Section 5-6, we conclude this chapter and discuss implications of this research for research and practice.

5.2 Experimentation: challenges and dilemmas

In this section we build a framework for identifying challenges and dilemmas in strategic experimentation from literature.[51] We follow a recent systematic review of this literature to generally define an experiment in sustainability transitions as 'an inclusive, practice-based and challenge-led initiative, which is designed to promote system innovation through social learning under conditions of uncertainty and ambiguity' (Sengers et al., 2019). This review demonstrates that there is a long research tradition on strategic experimentation in the transition studies field. This literature shows great diversity into different forms of strategic experimentation i.e. niche experiments, bounded socio-technical experiments, transitions experiments, grassroots experiments and sustainability experiments. More recently, research on and practice of experimentation has become more apparent in urban environments with notions such as urban experimentation and urban LLs. Urban LLs can be considered a sub-set of the general definition above in the sense that urban LLs are set within urban contexts, aim to transform urban (infra)structures, are performed particularly by urban actors and aim to resolve urban challenges.

SNM is a well-established experimentation approach in this literature, which has been used both as a research model and governance approach that conceptualizes the process of experimentation as a strategic approach to niche creation and provides guidelines to set up and manage experiments (Schot & Rip, 1997). These studies, across various empirical domains, have exposed key processes of experimentation: articulation of expectations and visions, building of social networks and learning processes (Berkhout et al., 2010; Kemp et al., 1998). A key aspect of the approach is to design and manage experiments in such a way that they contribute positively to these three core processes, as it is then more likely to establish successful market niches, and eventually contribute to transforming incumbent socio-technical regimes.

By focusing on these internal processes, we go back to original SNM research, that is concerned mostly with how experiments can contribute to creating niches. Later, focus shifted from individual experiments to series of experiments (e.g.

51. This distinction is based on definitions from Cambridge Dictionary. We define a challenge by a situation being faced with something that needs (great mental or physical) effort in order to be done successfully (and therefore tests a person's ability). We view dilemmas as circumstances in which a difficult choice has to be made between two different things you could do.

Geels & Raven, 2006; Raven, 2005). Again later, SNM research started to explore how socio-technical innovations can move from niche level to the socio-technical regime by asking questions about niche-regime interactions (e.g. Raven, 2006; Smith, 2007; Smith & Raven, 2012). Given the limited time scale and focus on individual LL experiments in our cases, we cannot yet focus on the upscaling dynamics or broader impact of these experiments. A key motivation is that our focus is on the challenges and dilemmas of doing strategic urban experimentation. We are in other words in this chapter interested in what happens at the level of individual experiments (the 'local level' in Geels & Raven (2006) rather than dynamics at the level of niches (the 'global level' in Geels & Raven (2006). While it would be interesting to also explore challenges and dilemmas of niche development, this is outside the scope of this chapter, and would require longer time frames than we have access to, given that niche development is a process routinely identified over a 10-15 year period.

In the remainder of this section, each process is discussed in more detail, i.e. what is it about, why it is important and what do we already know about potential challenges and dilemmas of these processes in practice from literature. Based on a Scopus literature search, 52 articles were identified about SNM processes, which will provide the basis for our literature review. See Appendix A for the details on the method of this literature search. The SNM literature has been enriched with insights from additional relevant writings on LLs, and in particular from recent studies on transdisciplinary challenges and dilemma's related to transdisciplinarity. These studies were identified by following up on references as well as expert knowledge available in the author team and reviewer feedback. Table 5-1 provides an overview each concept and related challenges and dilemmas identified in the literature. In the discussion section we reflect on this methodology and its implications for future work.

5.2.1 Visions and expectations

In the early stage of socio-technical innovations, the benefits are often not evident and their value has yet to be proven. Therefore, interested actors make promises and create expectations (Weber, Hoogma, Lane, & Schot, 1999). The articulation of such expectations and the deliberate creation of visions is an important process in establishing an experiment because it provides directions to learning processes, attracts attention and legitimates protection and nurturing (Geels, 2012).

From the literature two distinct challenges, related to visions and expectations, are identified. The first is a lack of a vision or concrete expectations about the socio-technical innovation that is experimented with. This results in a lack of direction to learning and does not allow to attract attention (ibid). The second challenge is to ensure and create robust expectations. Non-robust expectations – not shared among stakeholders – hamper strategic experimentation, because they reflect varying dispositions about the future of a socio-technical innovation, which limits capacity to collectively drive developments. Underlying these non-shared expectations are often different understandings or interpretations of the socio-technical innovation and its (future) contexts of application. Studies show examples of how different interpretations of smart grids (Naber et al., 2017), eco industrial parks (Susur et al., 2019) or district heating (Bush et al., 2017) hindered strategic experimentation.

SNM literature shows three dilemmas related to visons and expectations. The first is a broad vs specific vision about the experiment. Research has shown that visions should be broad enough to allow for multiple solutions, but at the same time, specific enough to offer plausible promises to stakeholders to gain credibility (Weber et al., 1999). Selecting a socio-technical innovation for experimentation and at the same time trying to avoid lock-in and path dependency, is one of the main dilemmas in SNM (Kemp et al., 1998). A too general vision, may invite a great variety of stakeholders, however, as it is too broad it might not provide clear guidance (Lente, 1993; Schot & Geels, 2008). The second dilemma is the attitude towards this vision. A flexible attitude allows for learning, adjusting visions to circumstances and taking advantage of windows of opportunity, but risks to dilute visions to a point where they are no longer transformative. A persistent attitude may impede flexibility, but enables a more consistent approach that maintains the transformative potential of the experiment (Schot & Geels, 2008). The third dilemma concerns too high expectations versus too low expectations. Making high promises early on to attract attention and funding can trigger enthusiasm for some time, but can subsequently be followed by disappointing results and the need for adjusting expectations (Verbong et al., 2008). Thus, expectations should be credible and of high quality i.e. supported by facts, tests and ongoing projects.

Similar observations have been made in transdisciplinary approaches, and particular those in relation to urban experimentation. Challenges and dilemmas include overcoming conflicting stakes, priorities, expectations or problem

definitions in transdisciplinary research (Culwick et al., 2019; Hessels et al., 2018; Scholl et al., 2018). Jahn, Bergmann, & Keil (2012), Lang et al. (2012) and Hessels et al. (2018) argue that a defining feature of transdisciplinary research such as urban experimentation is the challenge of integrating different bodies of knowledge (epistemic level), different interests (socio-organizational level) and establishing a common language that advances mutual understanding (communicative level). In fact, such differences are likely to inform contrasting expectations about what a living lab is about or should serve.

5.2.2 Social network building

Social network building, collaboration and forging alliances are among the key factors for setting up an experiment because it is important to create support for the socio-technical innovation, facilitate stakeholder interaction and provide necessary resources (e.g. time, money, people, expertise) (Berkhout et al., 2010). SNM literature distinguishes between local and global actor networks: local networks consist of actors who work on a specific experiment, whereas global networks consist of actors who have some distance to the experiment, but are related through providing resources such as financial or political support, technical specification and by generating a space in which local actors work. At this global level, abstract, generic knowledge is shared within the (emerging) community. At the local level, specific knowledge, skills, hands-on-experiences and practices are generated (Geels & Raven, 2006).

Extant literature shows five challenges and two dilemmas in creating a network for successful experimentation. The first challenge is to facilitate and create a broad and diverse network. Narrow and closed networks can be challenging because they do not include a variety of stakeholder perspectives which leads to limited learning possibilities. Particularly, user involvement is important for socio-technical experimentation (Weber et al., 1999). Second, a challenge is how to enable a deep network with relevant and committed actors. In a deep network stakeholders are able to mobilize commitment and resources within their organization (Schot & Geels, 2008; Weber et al., 1999). Lack of a deep network can impede experimentation because it affects access to necessary resources. A third challenge is to create a harmonious network and to navigate tensions between actors. Networks may not always be harmonious but strained. Internal tensions between stakeholders can pose challenges for experimentation. For example, governments' and technology developers' views may clash, which could damage the willingness to cooperate (Verbong et al., 2008). Navigating such tensions and

overcoming different views may lead to valuable outcomes. A fourth challenge is to generate public acceptance around the experiment. For instance, although sustainable mobility or cycling in general are widely supported, specific options can be contested. Trialing such options in an experiment can lead to protest and resistance (Verbong et al., 2008). A fifth challenge is to organize leadership and local coordination of the experiment (Seyfang et al., 2014). Limited leadership or management of the experiment hampers continuation of the experiment.

A network-related dilemma is engaging with 'regime' insiders (the status quo) versus outsiders. Including relative outsiders may broaden visions and allow for 'radical' ideas whereas vested interests could hinder innovation, even though working with incumbents enables access to resources and competences (Weber et al., 1999). The second dilemma is related to resources and concerns dependency vs autonomy. The level of 'protection' and access to resources (e.g. social, human, political, organizational and financial) is crucial as it helps to protect experimentation from too early rejection in mainstream markets. However, a balance must be struck between too much and too little protection: support and protection can be of crucial importance in order to give an experiment legitimacy and stability in the start-up phase. On the other hand, the reliance on external protection may weaken the development of autonomous learning processes (Hommels, Peters, & Bijker, 2007).

Similar types of challenges and dilemmas are identified in studies on transdisciplinary approaches, and in particular those focusing on urban experimentation. As transdisciplinary research involves collaboration between scientific disciplines and collaboration between science and society actors (Jahn et al., 2012), building a diverse network of engaged actors is key. However, insufficient legitimacy of actors involved, unbalanced problem ownership and limited capacity to engage in transdisciplinary research collaborations can be challenging (Hessels et al., 2018; Lang et al., 2012). For urban labs, also the mode of working of academics can undermine the ease of non-academics to participate (Culwick et al., 2019). In addition, Scholl et al., (2018) show that a challenge for urban labs is to have linkages with formal government structures to facilitate embedding lessons learned into practice.

5.2.3 Learning

Learning processes are important for experimentation as they enable the generation of knowledge about needs, problems and possibilities of the innovation. The aim of SNM is to learn more about the desirability of an innovation (in terms of technical and economic feasibility and environmental gains) (Kemp et al., 1998).[52]

Literature discusses four challenges and one dilemma related to learning. A dilemma is to enable broad learning, i.e. learning that is focused on aligning lessons about technical (technology, infrastructure) and social aspects (e.g. user context, markets, policy, regulation, societal impact) (Van der Laak et al. 2007), without watering down focus. In practice, learning in experiments if often focused too much on technological or economic aspects. On the other end of the dilemma, however, is the observation that when experiments are designed with too many learning ambitions in mind, this may hamper or delay choices and commitments in the experimentation process (Schot & Geels, 2008).

The first challenge is to facilitate reflexive learning i.e. learning that challenges deeper held values, believes and assumptions (Schot & Geels, 2008). Through such learning, fundamental conceptions about technology, users, demands and regulations are questioned and explored. It may lead to changes in cognitive frames, underlying assumptions and ways of looking at problems or solutions (Byrne, 2009) (Hoogma et al., 2002). Reflexivity requires trust and engagement trough interaction and dialogue. Reflexive learning is enabled by continuous evaluation of experiments and learning across experiments, but this is often challenging in practice, e.g. because of a lack of resources for monitoring, a lack of clear responsibilities, political need to demonstrate success, or a lack of reflexive capabilities.

A second challenge is to align learning across organizations, which might have different learning goals. Varying learning goals stand in the way of fruitful experimentation. For some stakeholders, learning might be a secondary rather than a primary goal. They rather make concrete achievements than learn about possibly unfeasible options (Heiskanen, Jalas, Rinkinen, & Tainio, 2015).

52. Hoogma (2002) identified five learning dimensions: technical development and user infrastructure, user context, societal and environmental impact, industrial development and policy and regulations (see Jain, 2017).

A third challenge is to facilitate learning across different experiments. Learning across different experiments helps foster sustainability transitions (Luederitz et al., 2017). However, in transferring and applying generic knowledge to specific contexts, local networks often need help and support to translate those lessons into their specific contexts. Learning from experiments – transforming outcomes into generic lessons – requires dedicated 'aggregation activities' (e.g. standardization, codification, model building, formulation of best practices) and circulation of knowledge to enable comparison between local practices (e.g. conferences, workshops, technical journals, proceedings, newsletters play a role here) (Geels & Raven, 2006). For learning to take place during and after the experiment, creating a store of knowledge and experiences. However, stakeholders can be reluctant to share data and insights across the network, for example due to a lack of trust or competition.

In line with the abovementioned challenges and dilemmas, studies on transdisciplinarity also stress the importance of reflexivity about learning and the role of researchers Jahn et al., (2012). In the context of urban experimentation, Scholl et al., (2018) found that a lack of clear and shared focus on learning about new forms of governance can be a key challenge, as well as, too much focus on operational issues rather than capturing lessons learned. Transdisciplinary approaches aim at enabling mutual learning between science and society. However, being an engaged researcher can be challenging as one has to maintain some critical distance (Wickson, Carew, & Russell, 2006). To be able to work with these potentially conflicting agendas, actors should 'nurture reflexive research habits'. For urban experimentation, this means that a key challenge is learning goals should be aligned and that the position of researchers may influence LLs.

Table 5-1: Challenges and dilemmas derived from the Strategic Niche Management literature

Process		Challenges and dilemmas identified in literature	Literature reference
Vision and expectations The articulation of expectations and the creation of visions is an important process in stablishing an experiment as it provides directions to learning processes, attracts attention and legitimates protection and nurturing.	Challenge	Create a vision and/or concrete expectations	Hatzl et al., (2016), Jain et al., (2017), Wolfram (2018), Elmustapha et al., (2018), Susur et al., (2019)
		Ensure robust visions and expectations	Weber et al., (1999), Weber (2003), Caniëls & Romijn (2008), Ceschin (2013), Xue et al., (2016), Naber et al., (2017), Bush et al., (2017), Imbert et al., (2019), Susur et al., (2019)
	Dilemma	Broad vs specific experiment	Kemp, Schot & Hoogma (1998), Weber et al., (1999)
		Flexible vs persistent attitude towards vision	Schot & Geels (2008), Hatzl, Seebauer, Fleiß, & Posch (2016), Turnheim & Geels (2019)
		Too high vs too low expectations	Verbong et al., (2008), Caniëls & Romijn (2008), Verbong et al., (2010), Seyfang & Haxeltine (2012), Heiskanen, Nissilä, et al., (2015)
Network, actors and resources Network building is important to create support for the new socio-technical innovation, facilitate stakeholder interaction and provide necessary resources.	Challenge	Building broad networks	Weber (1999), Weber (2003), Schot & Geels (2008), Verbong et al., (2008), Hoppe et al., (2015), Xue et al., (2016), Naber et al., (2017), Verbong et al., (2010)
		Enabling deep networks	Hatzl et al., (2016), Naber et al., (2017)
		Navigating network tensions	Verbong et al., (2008)
		Generating public acceptance and support	Verbong et al., (2008)
		Organizing leadership and/or local coordination	Seyfang et al., (2014), Hoppe et al., (2015), Bush et al., (2017), van der Grijp et al., (2019)
	Dilemma	Incumbents vs challengers	Weber et al., (1999)
		Dependency vs autonomy	Weber et al., (1999), Seyfang et al., (2014), Kemp et al. (1999)

Table 5-1: Continued

Process		Challenges and dilemmas identified in literature	Literature reference
Learning Broad learning, encompassing first order and reflexive learning processes.	Challenge	Facilitate reflexive learning	Weber et al., (1999), Wiskerke, (2003), Schot & Geels, (2008), Regeer, de Wildt-Liesveld, van Mierlo, & Bunders, (2016), Naber et al., (2017), Wolfram, (2018), Elmustapha et al., (2018)
	Challenge	Aligning learning goals across organizations	Heiskanen, Jalas, et al., (2015)
	Challenge	Learning across experiments	Seyfang et al., (2014), Heiskanen, Nissilä, et al., (2015) Luederitz, et al. (2017), Weber et al., (1999), Weber, (2003), Schot & Geels, (2008), Caniëls & Romijn, (2008), Verbong et al., (2008), Huijben & Verbong, (2013), Hatzl et al., (2016), Bush et al., (2017), Bush & Bale, (2019), Susur et al., (2019)
	Dilemma	Enabling broad learning	Caniëls & Romijn, (2008), Verbong et al., (2008), Schot & Geels, (2008), Verbong et al., (2010), Hatzl et al., (2016), Jain et al., (2017), van der Grijp et al., (2019)

5.3 Research design

This research is embedded in a transdisciplinary research project running from 2016 to 2020. [53] The aim of this project to explore the role of cycling innovation in enabling the transition towards sustainable mobility and livable urban regions. To this end, strategic urban experiments are set up in a transdisciplinary manner (te Brömmelstroet et al., 2020). Hence, setting up the living labs was one of the goals, to get better understanding of strategic urban experimentation in these different contexts. This provides a unique opportunity to observe challenges and dilemmas of strategic urban experimentation in practice, involving close collaboration between academics from different fields, cities, regions and innovators and an approach in which academic, local and experience-based knowledge in taken into account. Our overall research design can be characterized as exploratory research. We aim to determine particular aspects of a phenomenon, in our case tensions and dilemmas in living labs, where we have (some) control over behavioral

53. The co-creation process of LLs is the result of a successful grant application, driven by the different universities participating in this project. Hence, the authors of this research also initiated the project and encouraged the authorities to engage in and start LLs.

events (through co-creation of the labs), with a focus on contemporary events. As such, our case study strategy is a mix of what Yin (2003) argues is an 'experiment' and 'case study'. Because our cases are situated in the same national context, but within different local and regional context, we characterize our research strategy as a multiple-case study design, which allows us to contrast the findings on the basis of key concepts in our framework (the challenges and dilemmas).

5.3.1 Case study characterization

The cases of this study are four LLs, described in box 1.

The cases are situated in the Netherlands, where cycling rates are generally high, although different per city. In Amsterdam (821.752 inhabitants) the share of cycling in transport use is 36%; in Utrecht (334.176) it is 41%; Eindhoven (223.209) it is 33% and in Zwolle (123.861) it is 49%. (Kennisinstituut voor Mobiliteitsbeleid, 2019). Relative to their size and number of inhabitants, both Amsterdam and Utrecht have a high rate of cycling. Both cities have rich local cycling culture. In these cities, ambitions, policy plans and priorities related to cycling are not aimed at increasing cycling rates but more to improving the quality of cycling and tackling cycling related urban challenges. In Amsterdam, the municipality aims to create more space, both trough road infrastructure and by building more parking capacity. Utrecht aims maintain its position as a world class cycling city by improving accessibility and existing infrastructure. Eindhoven, historically more a car-oriented city, emphasis of cycling policy is also on stimulating cycling and improving accessibility and connection with the region. Zwolle has the highest cycling rates of the Netherlands (and world). The starting point of cycling policy plans are improving speed and comfort of the cycling infrastructure.

5.3.5 Data collection

For this study, a qualitative case study approach was carried out, following traditions in interpretative and qualitative research (Yin, 2003). The whole process of initiating, designing, establishing and implementing an LL was studied. Closely monitoring the sequence of events was possible as the authors of this research were involved in the organization of LLs. This engagement consisted of several activities, i.e. organizing four public kick-off events, initiating and coordinating local meetings with stakeholders (i.e. cities, regional governments, innovators), organizing project meetings in which research insights were shared and

Box 1: Cases of strategic urban experimentation: cycling innovation living labs

Living Lab 1: Exchange bikes in Amsterdam

This LL is situated at the train station of the Zuid-as business district, close to the city. 200 selected commuters from and to this train station received a free bike – out of a pool of 120 bikes. One group of people who travel to the train station by train can take a bike upon arrival at the train station and use it to travel to their final destination. The other group of people, who live close to the train station, use this bike from their homes to travel to the train station. In theory, this idea could drastically reduce (50%) parked bikes at train stations. Bike parking capacity at train stations is a pressing challenge in many Dutch cities, and mainly at train stations. Throughout the whole country, bike parking capacity at train stations is being expanded. However, often, these parking facilities will reach full capacity soon after they are delivered. Moreover, such publicly funded parking infrastructure is costly. Stakeholders involved in the LL are a bicycle producer providing the bikes, the national railway company (which also operates a nation-wide station-based bike sharing system), the rail infrastructure company (owner of the parking facility), the municipality of Amsterdam, two research institutes (a local university and university of applied sciences) and the regional transport authority who manages the project.

Living Lab 2: Free-floating bike sharing in Utrecht

This LL is about testing the potential of free-floating bike sharing for a period of two years. The municipality of Utrecht selected one bike sharing provider that has the sole right to provide this service to users in the city. The city's goal is to learn about the potential and implications of free-floating bike sharing, as a solution to address local urban challenges such as accessibility and bike parking. The city is also interested in learning from the LL as a method. Researchers of the local university and a university of applied sciences are involved in the LL to study parking conditions and to conduct a user survey. The LL is managed by the municipality.

Living Lab 3: Researching bicycle highways in Eindhoven

This LL involves a cooperation between the regional government (province of North Brabant), the municipality of Eindhoven and other principal cities of the province. The LL involves empirical research into bicycle highways as a new form of bicycle infrastructure and what design and governance principles are necessary both to develop a comprehensive network and to integrate this into the existing bicycle infrastructure. Unlike the cities of the other LLs, here the focus is more on offering attractive alternatives to driving rather than accommodating cycling growth. Another focus is on best practices for integrating feeder routes with bicycle highways. Between the major cities of the province of Brabant there is a network of bicycle highways.

Living Lab 4: Monitoring cycling infrastructure in Zwolle

This LL links to an existing infrastructural project that aims to upgrade a cycling road between a the city of Zwolle and the village of Dalfsen. In this LL, the regional government is involved as well as both municipalities that are linked through the cycling road. The focus of the living lab is particularly related to learning about processes of collaboration between different governmental stakeholders.*

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* *A second LL was developed around cycling lessons for immigrants. Because this LL was established later in the project, data collection did not cover this case.*

collaborating with cities to inform policy-making. This also means that the researchers have a two-fold role as participants in the LL and observers of the process. This double role will be reflected upon in the discussion section.

Empirical data was collected through interviews and participant observation in meetings during the period of October 2016 until 2020. The interviews were conducted in two rounds: February – March 2018 and May – August 2019. In total, 26 semi-structured stakeholder interviews were conducted, audio-recorded and transcribed. In the first round of interviews, questions were structured along key experimentation processes (i.e. visions, actors & resources, learning, context), but expressed verbally in a way that prevented the use of scholarly jargon. This provided a first general insight in how the LLs have been designed and developed from the start of the project. The second round of interviews – when the LLs were established – focused on progress, challenges, dilemma's and reflections about the LL process. Involved LL stakeholders in four cities were interviewed representing municipalities (n=10), provinces (n=5), universities (n=7), transport authority (n=2), intermediary (n=1) and the private sector (n=1). See appendix C and D for the overview of interviewees and the interview protocol respectively. Interviews per cases are referred to by a1-a6 (LL1), b1-b6 (LL2) c1-c7 (LL3), and e1-e6 (LL4).

The interviews were analyzed and structured with the help of coding software Nvivo. A hybrid approach of inductive and deductive coding was used (Fereday & Muir-Cochrane, 2006). With inductive coding, recurring themes in the data that are not directly linked to the conceptual framework are labeled. In the deductive coding approach we identified the three experimentation processes and related challenges and dilemmas (see Table 5-1), which were used as labels. Combining both approaches allowed for a focused analysis along the framework concepts while at the same time having an open attitude towards new, additional challenges and dilemmas outside the scope of our tentative framework.

5.4 Results

In this section the challenges and dilemmas of doing LL experimentation, derived from the analysis of four cases, are outlined. SNM literature provided a starting point, as 16 types of challenges and dilemmas were identified related to visions and expectations, networking and learning (to these is referred to in italics). For each of these processes we discuss the main insights in terms of known challenges and dilemmas from the literature that stand out in our analysis of the cases,

challenges and dilemmas that were not found in our analysis and potential new challenges and dilemmas, not covered by SNM literature.

5.4.1 Visions and expectations

A challenge that stood out was the creation of visions and expectations about specific LLs. These LLs have evolved against the background of an overarching transdisciplinary research project. A broad and robust vision was shared among all stakeholders participating in this project. This vision was that cycling positively contributes to cities and that cycling innovation should be stimulated and researched.[54] LLs were proposed as a method to experiment with cycling innovations in practice. The establishment of LLs was received with enthusiasm creating high promises – reflected through a variety of actors willing to join at the beginning of the project.[55] Even after three years of collaboration most stakeholders perceive it as fruitful because it helps them to address local challenges, create knowledge and build relationships with cycling researchers (c6, b4, d5). Expectations were high enough to attract stakeholders, but were not unrealistically high to lead to disappointments. Dealing with this reflects a flexible attitude towards the vision among stakeholders. However, ensuring robust expectations about local LLs was challenging in the beginning. Transforming an overarching vision, a variety of ideas and innovations, and diverse group of actors into four local LLs appeared challenging.

One reason for that relates to the ambiguous concept of 'cycling innovation' as it was interpreted in various ways. Different expectations existed about what should be tested in the LL (c4, c5, d1, d2). Stakeholders mostly envisioned testing a physical innovation. For example, in the LL in Eindhoven, a city representative expected a high-tech driven innovation: "*I think I was fixated on technological innovation because they were very tangible. There were cycling innovations such as*

54. Since the Netherlands already has very high cycling rates, though they are uneven across different areas, the reasons why different urban and regional authorities take interest in cycling innovation are diverse and relate to high intensity of cycling in some areas (which e.g. generates parking capacity issues), yet to be achieved potential of some cycling routes and some inflexibility in multimodal journeys (combining cycling with other modes of transport, primarily train, in commuting between cities)..

55. To get a grasp of types of cycling innovations, four local kick-off pitch events (one in each city) were organized with entrepreneurs and innovators pitching 'cycling innovations' to cities. The events attracted approximately 50 cycling innovations (varying from smart locks, to peer-to-peer bike sharing systems, to smart parking infrastructure) attuned to local urban challenges. See *https://www.smartcyclingfutures.nl/events/* for brief reports of these events.

BikeScout – a smart lighting system that warns cars for approaching cyclists at crossings – or apps. I expected these types of innovation would play a more important role" (c4). In contrast, some interviewees envisioned a social innovation such as a new way of governing cycling infrastructure projects (c6).

Selecting experiments for all LLs – and thereby turning a broad vision into concrete experiments with cycling innovation – appeared to be challenging. The cases show that local urban challenges and local contestation played an important role. LLs are challenge-led and thus the selection of an experiment in Amsterdam and Utrecht was directed by the need to address local challenges. In Amsterdam, optimal use of bike parking facilities as a key challenge for the improvement of the regional cycling system and accessibility. This led to an experiment aimed at testing a potential solution to this challenge. In Utrecht, accessibility, bike parking and abundance of bikes were identified as key challenges, resulting in an experiment that aims to test the potential of free-floating bike sharing (FFBS). In Eindhoven and Zwolle, linking the experiment to local urban challenges was more challenging. In these cases, the actors (municipalities, provinces and researchers) had difficulties in reaching consensus i.e. coming to specific questions related to the urban challenge, struggling to come to final decisions as to what to select for experimentation and translate this into new concrete experiments (c7, d6). A collective search process resulted in linking LLs to existing cycling related projects, rather than co-creating entirely new LL experiments.

Experiment selection was also influenced by local contestation. In Amsterdam, initially FFBS was considered for experimentation. But this innovation had become a contested and politically sensitive topic because of disruptive launching strategies and the impact of the bikes on public space.[56] Therefore, the municipality did not want a FFBS LL experiment in public space. Also, it was not willing to preference one company in an LL over many others interested (c4). Eventually, a less sensitive bike parking innovation was selected (not situated in public space but in a train station) (see box 1). This political sensitivity affected experiment selection in LL2. The fact that FFBS had become controversial in Amsterdam (FFBS was banned), made it an interesting opportunity to explore this cycling innovation in Utrecht. Especially because firms were looking to relocate this city after the ban

56. In October 2018, three months after their entry in the city, free-floating bike sharing firms were banned by the municipality of Amsterdam. Multiple firms introduced large numbers of bikes without formal consent onto the city streets leading to impact on public space and conflict with parking legislation (see van Waes et al., (2018, 2020) for elaborate case studies).

(b1, b4). In Utrecht, this political sensitivity was used to engage with FFBS firms and explore conditions under which FFBS can operate in line with city needs. Through a tender procedure one firm was selected (see box 1).

A new challenge, not explicitly discussed in SNM literature, that appeared was that – besides different interpretations of a cycling innovation experiment – also ambiguity existed among stakeholders in relation to the general concept of 'LLs' (What it can do? What it is about? Who will do what?) in the first part of the project (c, d1, d2). The concept was not entirely clear and open to different interpretations. Two defining dimensions were identified in the project[57]: 1) the creation of an *"experimental space"* — a physical location to trial socio-technical innovations in practice 2) The LL as a method or new way of working and organizing an innovation process and collaboration between universities and urban and regional authorities.

Part of this challenge was that roles and responsibilities were not clearly articulated from the start. Among all LLs unclear role expectations were recognized as a key challenge (a, b, c, d). In the LLs in Amsterdam, Eindhoven and Zwolle, it remained unclear for a long period who would do what. Roles were not clearly defined and actors eventually took up roles depending on their own interest and expertise. Some stakeholders expected that particular actors would take up a specific role: e.g. researchers expected that practitioners would take the lead in selecting an urban challenge, facilitate and/or take the lead in setting up the LLs; practitioners on the other hand assumed that researchers would have a proactive role given they were in the lead of the project proposal, provide applicable knowledge and clear-cut solutions to their problems and manage the local LL process. In addition, the role of researchers caused misunderstanding (also for themselves) because they took up multiple roles: initiator of LL meetings, building a network, sharing knowledge, critical observer and active LL stakeholder. In Amsterdam this led to frustration among practitioners as they felt they were being observed rather than provided with solutions to their problem: *"I sometimes felt a bit observed when I was arguing with the city or railway company. I was doing that on a table where also a couple of academics were thinking, oh, that, wow, interesting. It was almost like a camera observing how we were failing in our communication and everything. It felt a bit peculiar sometimes."* (a3).

57. This dual definition also translates into learning goals and expectations of stakeholders i.e. they aim to learn about the cycling innovation in practice and about the LL as a method.

5.4.2 Social network building, actors and resources

The most prominent challenge that stood out from the cases – and also identified from the literature – was creating broad networks. As described in the previous section, attracting a broad variety of interested actors was not a problem given the high promises of the project. Especially in the beginning, in each region broad networks of potentially relevant stakeholders were formed. A variety of stakeholders joined LL meetings, exploring whether they might want, or could play, a role in the LL. In this period, LLs meetings were held, without formal structures (no formal decision-making procedure or rules of the game). The LL was in this phase a platform where stakeholders could meet and discuss progress (e.g. roles, what to experiment with, which stakeholders to attract, etc.). After roughly two years, four solid and harmonious local networks were formed (see Box 1 for a description of different actors). Navigating network tensions within LLs was not an issue.

Although LL networks were formed, the early involvement of users – assumed important for a broad network for experimentation – on a local level appeared challenging. The relevance of involving users in an early stage did not come forward during the development stage, and consequently, direct user involvement remained very limited. Attempts to involve users were more indirect and on a project level, through cyclists representative groups such as Cyclists Union (Fietsersbond in Dutch) and Cycling Community (Fietscommunity in Dutch). The latter organization engaged with the research project in knowledge sharing (e.g. organizing workshops). However, limited user involvement was generally not seen as problematic in the early phase of setting up LLs by most actors. Some stakeholders see users indirectly represented through city actors (e6).

Another key challenge concerned enabling deep networks and mobilizing political and financial resources. For the LLs, this meant finding the right representatives within a municipal or regional authority, with decision-making power and/or access to financial resources for the establishment of LLs (b5). Financial resources for doing LLs were initially lacking in all regions. Part of the misunderstanding about role expectations described earlier, was misunderstanding about financial resources needed to set up and manage LLs. In the project proposal, it was not clarified who would have to provide these resources and no budget was allocated for setting up actual LLs (c5). This led to a temporary deadlock in the process of setting up LLs. As initiators of the whole project, researchers were expected by the practitioners to take up a more proactive role in setting up LLs (c5, d3).

However, no financial resources were available for actually doing LLs from the university-side. A potential here is that researchers can initiate LLs, but without financial resources they are dependent on public stakeholders, who are in turn dependent on local and regional political agendas.

Too much dependency on resources and external protection did not come forward as a key dilemma. LLs in Amsterdam and Utrecht show that financial and political support did play an important role in their development. Their networks proved important for generating public and political support. Both cases also show a local sense of urgency in solving urban mobility related challenges and the contribution of cycling innovations. In Utrecht this translated into high level support for bike sharing and urban experimentation, formalized in a policy letter (b1). This political support translated in these cases into financial support. Financial resources provided a solid breeding ground for the establishment of LL2. A budget (part of a national program to improve accessibility) spurred development as it was used to appoint a project manager (b1). In Amsterdam financial resources were mobilized that should address parking capacity, which is identified as a regional issue in an administrative agreement [58] (a8). In contrast, the municipality of Eindhoven dealt with budget cuts (new pilots were critically assessed, including LLs), which translated into limited human capacity affecting the local LL. The city spent more hours and budget on the LL than was budgeted beforehand (c4). Across all LLs generating public support for the experiments was not a clear challenge.

Organizing leadership was a challenge in all LLs. Limited leadership or coordination was perceived as a hampering factor in the set-up phase, as reflected by a practitioner: "*It's quite difficult to navigate in between the practical side and the academic side. Somebody taking the lead would be really helpful in future living labs. Both sides could really help each other much more. I think it has a lot of potential if you put these together. The academic world having the theoretical knowledge and us being practical and having less of this knowledge*." (a3). This insight improved understanding about the need for a dedicated LL project manager as this was recognized as a necessary strategy to continue LL development.

Appointing a LL manager was facilitated in two cases by the mobilization of financial resources (provided by governments). This led to immediate progress in

58. The agreement – 'Bestuursakkoord Fietsparkeren' – was signed by actors including Municipality, Regional Transport Authority, and railway and rail infrastructure companies.

Amsterdam and Utrecht as a dedicated manager responsible for the continuation of the experiment took the co-creation phase into a more traditional project form. In Amsterdam, this was a regional transport authority, not hindered by political tensions around FFBS experimentation unlike the municipality and in Utrecht, the municipality appointed a dedicated project manager. Stakeholders in these LLs experienced this as a positive and necessary contribution that provided clarity, direction and action to the LLs (a5, a,6, a7, b6, b7).

Engaging with 'regime' insiders and/or outsiders only occurred in LLs in Amsterdam and Utrecht in which the LL innovation could challenge vested interests. In Utrecht, a relative newcomer was selected to operate a FFBS in the city, even though the national railway company operates the largest (station-based) bike sharing system in the Netherlands. The LL in Amsterdam can be viewed as a more radical socio-technical experiment in which also incumbent actors (such as the national railway company and the rail infrastructure owner) are involved. Involving them was both challenging and necessary as they own and manage parking space needed for the placement of the bikes. But their involvement also influenced the experiment (a7). For example, it was not possible to use bikes of the existing (station-based) bike sharing system (operated by the railway company) for this experiment because it was worried that negative results of the experiment would affect their reputation. However, such interference did not pose a clear dilemma for experimentation.

5.4.3 Learning

The learning dilemma and challenges identified from literature all occurred in the LLs. Closely related were the dilemma to enable broad learning and the challenge of aligning learning goals across organizations as different learning goals and knowledge interests existed. For some the goal of LLs is about (first order) learning about practicalities of the innovation. Municipalities, practitioners, innovators and applied researchers are mainly interested in the practical implications of LLs (e.g. what is the impact of bike sharing on modal shift? What are user motivations?). Researchers and some municipalities also aim at reflexive learning i.e. learning about the broader problem, the LL process as an approach to organize urban innovations and learn from collaboration between practitioners and universities. These actors are mostly interested in more fundamental questions (e.g. what can we learn from the LL as a method of reflexive governance and for urban innovation?). The municipality of Utrecht endorses both goals: "*It would*

be nice that the innovation will become a success. And it would even be nicer that this urban living lab process has contributed to that. Although personally I would like that bike sharing system will be successful. However, professionally, I'd rather see that the process will teach us many new things such as what went wrong and how we can embed this process in in future policy within our organization." (b3).

A tension between learning goals is that for researchers it does not really matter whether LLs will be successful or fail, as they are primarily interested in drawing lessons. For practitioners, there is more at stake as they can be held accountable. "*For academics, failure also provides insight. Municipalities don't have that luxury situation.*" (c6). However, for some government actors, the LL approach enabled them to allow for failure (b4). Hence, tension between different interests created disruptions in the LL process.

An important challenge was to facilitate reflexive learning within all LLs, in particular in relation each other's backgrounds. What limits the learning potential is that stakeholders are grounded in different contexts representing different professional 'worlds', with different languages and professional jargon (English vs Dutch; abstract vs practical) different outputs (policy & concrete plans vs scientific articles) and timeframes (long vs short term). Misunderstanding of these different working environments was emphasized by one practitioner: "*One of my assumptions is that scientists have less affinity with the erratic and unruly reality we deal with in practice. We are hands-on and not just sitting behind a desk. We are the ones sitting at the table with our inhabitants, and have to prepare plans and decisions with our administrators. We have to deal with angry citizens. So these are different worlds*." (d2). Learning about different backgrounds and disciplines can be challenging, as shown in LLs in Eindhoven and Zwolle. Practitioners tend to struggle with learning from academics as they are working on more fundamental questions, less relevant to daily practices of local governments. This limited understanding was emphasized by a practitioner: *"I don't have an academic background and like me, most colleagues at our department have a more practical background so we don't know how the university works. When you distinguish fundamental and applied research, we don't know. So expectations don't match. I just think: I have some societal questions that I would like to get investigated. But researchers have their PhD projects, which have their own requirements. It took us two years to understand this"* (c1). Also different stakeholders use different professional jargon and may take for granted background knowledge that is not shared by others.

According to most stakeholders, more learning across LLs could have taken place, in particular about experimentation processes (a3, c2, d5). The cases show that all stakeholders were struggling in the startup phase. Sharing insights about what works and what did not could have contributed to local LL development. To facilitate this learning process, a number of workshops have been organized, prior to which interviews were held to obtain lessons about practicalities and experiences.

5.5 Discussion

5.5.1 Understanding challenges and dilemmas in strategic urban experimentation

Taking stock of the results, we suggest there is relevance of using a SNM-based framework enriched with insights from transdisciplinary research on living labs for understanding dilemmas and challenges in strategic urban experimentation. This is relevant as prominent LL literature does not discuss practical challenges and dilemmas (Bulkeley et al., 2016; Voytenko et al., 2016). In this section we interpret similarities and differences between literature and our findings from the four cases. Table 5-2 shows that most of the known challenges and dilemmas from literature also occurred across the four LLs.[59] The symbols in the table reflect our interpretation of the extent to which the challenge or dilemma occurred in that particular LL. We also observed a place-based dimension to strategic urban experimentation. As the LLs are situated in different urban environments, it became evident that these play an important role. Place-based aspects in relation to experimentation has been highlighted before in the literature on geography of transitions (e.g. Hansen & Coenen, 2015; van den Heiligenberg et al., 2017). As Table 5-2 shows differences between LLs, we also discuss potential reasons for these differences, grounded in an understanding of different place-based conditions.

We observe that creating a robust vision and expectations about the socio-technical innovation appeared to be challenging across all LLs. In contrast, none of the LLs faced the dilemma of flexible vs persistent attitudes towards LLs. No notable differences in challenges and dilemmas related to visions and expectations between LLs were identified.

59. The identified challenges are in line with Hossain et al (2019) who recognizes similar living lab challenges such as governance, efficiency of learning, temporality and scalability.

Overall, creating broad networks and enabling deep networks appeared to be challenging but was not a major issue. Also, LLs did not suffer under too much or too little protection (dependency vs autonomy). However, some notable differences appeared between LLs when zooming in. Creating broad networks, enabling deep networks and organizing leadership and coordination appeared to be less challenging in Amsterdam and Utrecht – cities that have a long cycling history – than in Eindhoven and Zwolle. An explanation, perhaps, is that in these mature cycling environments, there are already existing networks around cycling, which are historically better developed and better equipped to support strategic urban experimentation with cycling innovation. Both cities also have more pressing cycling related issues such as parking problems and the abundance of bikes, hence there is a sense of urgency to experiment with cycling innovations. This is translated in supportive political agendas and financial means for experimentations. Related to these strong local networks, results show that aligning learning goals between organizations in a LL was less challenging in cycling cities. A possible explanation is that pressing cycling related issues in these cities created a shared understanding and interest in tackling these problems which translates into a relatively easy alignment of learning goals.

This shows that strategic experimentation is entangled with local political agendas and resources. Supportive regional or urban visions can help stimulate experimentation (van den Heiligenberg et al., 2017). Part of what makes experimentation become strategic is when it gets linked to political agendas.[60] For example, agendas around cycling stimulation, improving accessibility and parking capacity at train stations have positively influenced LLs in Amsterdam and Utrecht. However, lack of such linkages negatively affects the capacity for strategic urban experimentation. For instance, in Eindhoven cycling is still marginal in terms of political priority, which means that a local agenda can be mobilized only to a limited extent.

A supportive environment for strategic urban experimentation also enabled building unconventional coalitions in which both innovators and incumbent actors collaborate. At the same time, a strong local cycling culture in these cities meant that experiments and innovations challenge the prevalent norms of private bike ownership could lead to limited support, but it did not. Although Zwolle today is also an ambitious cycling city, its ambition has only relatively recently become

60. In practice, getting commitment from partner organizations can be a timely but crucial, process as often agreement has to come from different levels within the organization.

more explicit and politically enacted. Also, there are no pressing cycling related issues as observed in Amsterdam or Utrecht. Hence, there are other policy priorities, such as speed and comfort of cyclists using the cycling infrastructure. At the other end of the spectrum there is Eindhoven, a city historically more car-oriented, at least relative to the other three cities. Here, cycling is less prominent as a political priority, which leads to limited resources to support cycling innovation experiments. Furthermore, similarities in challenges and dilemmas across different LLs may be partly influenced as they are connected through the overarching research project consisting of a network of academic researchers. This connection has influenced strategies to respond to challenges. For example, it allowed to recognize that a successful intervention in one living lab (appointing a project manager) could also be applied in other living labs.

5.5.2 General reflections about challenges and dilemmas

In addition to these similarities and differences across the cases, we discuss two new broader reflections about challenges and dilemmas as observed in the current literature and the results from our analysis.

Strategic urban experimentation processes
We observed a difference concerning articulating (and managing) robust expectations about processes of strategic urban experimentation. Whereas extant niche experimentation literature points at the importance of articulation of visions and robust expectations about the socio-technical innovation, the cases show that aligning visions and expectations about the concept of LL experimentation itself (e.g. its methods, roles, responsibilities, procedures) plays an equally important role.

Our findings suggest that different interpretations of what LLs should be and enable existed. Shared visions and expectations about the concept of LLs were created in the process of setting them up. It took approximately two years for LLs to become robust projects in which expectations, goals, roles and the approach became established among the stakeholders. This resonates with Verbong et al. (2008) who recognizes that experiments often start as platforms for interaction and establishing them is a process of muddling through, understanding each other and learning by doing rather than a clearly defined process with strict agreements. Research on transdisciplinarity highlights that lack of a clear and shared focus about new forms of governance (in our case LL experimentation) is a key challenge (Scholl et al., 2018).

Table 5-2: Challenges and dilemmas from SNM in LLs

			LL1	LL2	LL3	LL4
Vision and expectations	Challenge	Create a vision and/or concrete expectations	●	●	●	●
		Ensure robust visions and expectations	●	●	●	●
	Dilemma	Broad vs narrow experiment (selection)	●	●	●	●
		Flexible vs persistent attitude towards vision	-	-	-	-
		Too high vs too low expectations	❍	❍	❍	❍
Network, actors and resources	Challenge	Creating broad networks	❍	❍	❍	❍
		Enabling deep networks	❍	❍	●	●
		Navigating network tensions	-	-	-	❍
		Generating public support	❍	❍	-	-
		Organizing leadership and/or local coordination	❍	❍	●	●
	Dilemma	Engaging with 'regime' insiders vs outsiders	❍	❍	-	-
		Dependency vs autonomy	-	-	-	-
Learning	Challenge	Facilitating reflexive learning	●	●	●	●
		Aligning learning goals across organizations	❍	❍	●	●
		Learning across experiments	●	●	●	●
	Dilemma	Enabling broad learning	●	●	●	●

● *=strong,* ❍ *=occurred but no major issue, - =not occurred*

Throughout the start-up period, managing LLs was a challenge across all cases. A striking observation is that LLs in Amsterdam and Utrecht have evolved from a typical LL approach (i.e. co-creation, broad vision, open to a variety of perspectives, ideas and initiatives, high level of uncertainty) to a more traditionally structured project-based approach (i.e. clear defined goals, clear roles and responsibilities, certainty) which shaped a more effective collaboration among LL actors (e.g. LL2 evolved into a tender procedure for selecting a FFBS company). In a way, the outcome of the LL became embedded in existing organizational structures, and the more established the LL became, the less useful the open and co-creative character of LLs becomes. This development coincided with the appointment of LL project managers. Indeed, earlier research suggested that linkages with formal government structures and clear leadership are crucial aspects for LL development (Scholl et al., 2018; Voytenko et al., 2016).[61] This insight – transforming LLs into more a clear-cut projects facilitates embedding in organizational structures – also contributes to literature that recognizes the challenge of institutionalizing experimentation as a mode of governance in organizational structures (Sengers et al., 2019; Voytenko et al., 2016). From a place-based perspective, this observation can be understood, as that in Amsterdam and Utrecht there were existing organizational structures – a local network – conducive to LL experimentation. A question remains whether this creates a new dilemma of maintaining the innovative and transformative potential of a LL, while adapting to and embedding it into existing practices and institutions.

Stimulating transdisciplinary reflexivity

We want to highlight transdisciplinarity as a typical challenge that future SNM work could be further enriched with. From SNM we know that reflexive learning is important for experimentation. A key observation and dilemma concerns reflexivity in transdisciplinary research collaborations between universities and urban practitioners. Reflexivity means that actors turn a critical gaze upon themselves (Finlay & Gough, 2008). For example, the results of this living lab research demonstrates that potentially conflicting learning goals within such a research collaboration can impede fruitful learning and experimentation, and should therefore be reflected upon. In particular, we discuss here our own position and role in the living labs.

61. For most municipalities, LLs were also governance experiments, which has the ability to bring about change of formal governance structures (Bos & Brown, 2012).

The importance and need for reflexivity about the role of researchers is a key insight from the literature on transdisciplinary research (Jahn et al., 2012; Lang et al., 2012). Transdisciplinary research requires scholars to reflect on their role as researchers, their research focus and methodology and their relation to academia and society (Knaggård et al., 2018). When participating in transdisciplinary research, researchers are not just knowledge makers, but facilitators of change, and hence consciously or not, they are changing their own roles, identities and values in the process (Pereira et al., 2019). Likewise, research suggests that transitions' researchers can have different roles: reflective scientist, process facilitator, knowledge broker, change agent, and self-reflexive actor which refers to being reflexive about one's positionality and normativity, and to seeing oneself as part of the dynamics that one seeks to change (Wittmayer & Schäpke, 2014).

Researchers committed to not only describing transformation processes but also to initiating them – such as strategic urban experimentation in LLs – face the engagement vs distance dilemma (Köhler et al., 2019).[62] The dilemma is how to be an engaged participant while also be able to take some distance to critically observe. Positionality – the stance of the researcher in relation to the object of study – is therefore key to reflect upon (Coghlan & Brydon-Miller, 2014). The position adopted by the researcher affects every phase of the research process: from problem definition to research design to how other are invited to participate. To work with the engaged researchers dilemma Wickson et al., (2006) suggest they should nurture reflexive research habits.

Being engaged in strategic urban experimentation, we suggest that our position as researchers has influenced the research process and the development of LLs, which in turn have influenced research outcomes. We took up and navigated between different roles (e.g. initiating the research project, setting up local LL experiments, facilitating learning across LLs, examining its progress and sharing insights). Being thus both observers and participants, we have continuously faced the engagement-distance dilemma. To what extent should we intervene in the course of events? [63]

62. This dilemma relates to a broader debate about the relation between science and society. A key question is how researchers can respond to societal challenges. According to Kueffer et al. (2012) researchers face three challenges: the complexity challenge (i.e. how to combine various disciplines, also from outside academia), the impartiality challenge (i.e. how to ensure research serves common interests when knowledge is used in decision-making) and the salience challenge (how to produce useful knowledge for decision makers or practitioners).

63. On a more mundane level that can translate into a question such as whether one should focus

5.6 Conclusion

In this chapter, we asked the question: what are challenges and dilemmas in doing strategic urban experimentation? To this end, we systematically reviewed SNM literature to develop a tentative framework of challenges and dilemmas, enriched with recent insights from transdisciplinary research on living labs. This framework was tested with challenges and dilemmas from four empirical LL cases concerned with cycling innovation. We unpacked place-based dimensions and provide an additional set of explanatory arguments of why the cases unfolded as they did in terms of challenges and dilemmas. As such, this framework has proved useful as a sense-making and analytical device for exploring challenges and dilemmas in strategic experimentation. Future studies could use the framework for similar analysis in other domains or geographies. Future studies could also explore the usefulness of this framework beyond analytical purposes by using it to design the (governance of) strategic experimentation. Finally, the framework was designed to make sense of challenges and dilemmas at the level of local experiments. As such, future work could explore challenges and dilemmas at the level of 'global niches' (Geels and Raven, 2006), including challenges and dilemmas related to empowering niches (Smith and Raven, 2012). A key new challenge observed concerns articulating and managing expectations about processes of strategic urban experimentation itself, rather than only about the socio-technical innovation. LLs started as open processes but along the way turned into more closed projects. Managing this process involves balancing between embedding LLs in existing structures while maintaining openness to new ideas. We also found that engaging in strategic urban experimentation brings up dilemmas for researchers since besides being observers and producers of knowledge they have also become facilitators of change in collaboration with practitioners. Further research could focus on systematically investigating strategies to deal with the identified challenges and dilemmas and the broader impact and upscaling dynamics of strategic urban experimentation in living labs. While this study has made use of recent insights from transdisciplinary research on living labs, there is considerable scope for a broader and more systematic discussion of how transdisciplinary approaches can enrich the field of sustainability transitions more widely in future work.

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on listening during a meeting or actively interact and shape the conversation. A partial solution to that dilemma would be to split roles with some researchers taking notes and observing everyone while others participating more actively.

5.7 Appendix

A: Literature review

A literature search was carried out to identify relevant articles that discuss Strategic Niche Management and experimentation processes. This search encompassed the following steps. In the first step key words were defined and used to search for matching articles with these words in the titles, abstract or key word section. The following query was used in Scopus: TITLE-ABS-KEY (*"strategic AND niche AND management"* AND (learn* OR network* OR expectations* OR vision*)) AND (LIMIT-TO (DOCTYPE , *"ar"*)). This led to a first result of 132 articles (august 14th 2019). This set was further narrowed down by reading the abstracts. When the articles show a meaningful relationship with SNM literature and its processes, it was selected as a contribution to the literature review. This selection procedure resulted in 53 articles. This set of articles was coded in Nvivo with the aim of identifying challenges and dilemmas of experimentation. Hence, aspects were labeled as a challenge or dilemmas related to visions and expectations, actors and network building or learning (resulting in six different labels). Reading and coding the articles, the ones that did not show a meaningful relationship with the aim of our research were excluded from the analysis. Eventually 29 articles were selected for the analysis. The three experimentation processes were labelled and categorized as a challenge or dilemma, based on the definition provided in footnote 50.

B: Operationalization table

	Challenges and dilemmas	Signifying terms / key words in data (examples what to look for)
Visions & expectations	Create a vision and/or concrete expectations	Mentions of broad and/or concrete visions and expectations Stakeholder goals of participating in LLs
	Ensure robust visions and expectations	Varying visions and expectations of the project and LLs Different understandings/interpretations of LL and socio-technical innovations
	Broad vs narrow vision and experiment (selection)	LL definitions among stakeholders
	Flexible vs persistent attitude towards vision	Changing responses to LL developments
	Too high vs too low expectations	Varying expectations at different phases of LL development
Network	Creating broad networks	Involvement of a variety of stakeholders and perspective (e.g. governments, companies/innovators, universities, users etc.)
	Enabling deep networks	Involvement of stakeholders and ability to mobilize resources (e.g. political, financial)
	Navigating network tensions	Conflicts within LLs
	Generating public acceptance and support	Limited support about LLs how it is received among the broader public
	Organizing leadership and/or local coordination	Role and presence of a local manager or coordinator of LLs
	Engaging with 'regime' insiders vs outsiders	Involvement of incumbent actors (e.g. public transport companies) or outsiders (e.g. innovators/entrepreneurs)
Learning	Facilitating reflexive learning	Reflexive learning processes taking places
	Aligning learning goals across organizations	Mentions of learning goals of different stakeholders
	Learning across experiments	Processes of learning between LLs
	Enabling broad learning	Different learning aspects: technical (about the innovation) and social (about broader conceptions of the innovation and experimentation in general)

C: Overview of interviewees

LL	Round	Interviewee	Ref.	Date
Amsterdam	1	Municipality	a1	26-2-2018
		Municipality	a2	20-3-2018
		Regional Transport Authority	a3	21-2-2018
		University – Urban Planning Department	a4	27-2-2018
	2	Municipality – project manager bike parking	a5	19-7-2019
		Regional Transport Authority	a6	3-7-2019
		University – Urban Planning Department	a7	21-5-2019
		Consultant – temporary project manager	a8	27-5-2019
Eindhoven	1	Municipality – cycling policy maker	e1	27-8-2018
		Province – policy maker	e2	27-8-2018
		University – Innovation Sciences Department & Urban Planning Department	e3	26-3-2018
	2	Municipality – cycling policy maker	e4	16-8-2019
		Province – policy maker	e5	16-8-2019
		University – Innovation Sciences Department	e6	12-8-2019
		University – Phd Candidate	e7	6-8-2019
Utrecht	1	Municipality – project leader cycling program	b1	1-3-2018
		Municipality – project manager living lab	b2	1-3-2018
		Province – policy maker	b3	2-3-2018
	2	Municipality – project manager living lab	b4	14-5-2019
		University – Innovation Studies Department	b5	4-6-2016
		Bike sharing firm – local project manager	b6	5-6-2019
Zwolle	1	Municipality A	d1	5-3-2018
		Municipality B	d2	5-3-2018
		Province – department of	d3	5-3-2018
	2	University of applied sciences – researcher	d4	19-8-2019
		Municipality B – project leader	d5	7-8-2019
		Province – department of	d6	7-8-2019

6

Conclusion & Discussion

Despite its opportunities, platform innovation has an impact beyond urban mobility transitions, creating new governance dilemmas. Urban authorities face difficult decisions because platform innovation promotes particular public interests but also undermines others. To better navigate such challenges, new forms of governance and collaboration between local governments and private actors are needed.

In an increasingly urban and mobile world, digital platform enabled innovations have emerged as potential drivers for urban transitions. Through a case study of free-floating bike sharing, this dissertation set out to answer the question: How does the emergence of platform enabled bike sharing interact with urban mobility transitions? The interplay between platform enabled bike sharing and transition dynamics is studied through institutional, business model and urban experimentation lenses, in accordance with the first three objectives of this research. In the Discussion section, the wider implications for research and governance of platform innovation in urban mobility transitions are discussed, including recommendations. This final chapter starts with first summarizing the main findings of each chapter.

6.1 Summary of main findings

Chapter 2 assesses the future upscaling potential of different bike sharing business models that co-exist in the Netherlands. The emergence of bike sharing systems can be understood as part of an unfolding urban mobility transition. A typology was developed distinguishing four different business models (i.e. two-way station-based, one-way station-based, two-way free-floating and one-way free-floating) in the Dutch bike sharing landscape. This typology highlights differences between traditional bike sharing models that are station-based (two-way station-based and one-way station-based bike sharing systems) and new business models (two-way free-floating[64] and one-way free-floating bike sharing systems) that are station-less. The emergent one-way free-floating (or dockless) bike sharing business model is the main empirical subject of this dissertation, hence the main findings of this model are further elaborated upon. The free-floating bike sharing business model is characterized by a customer value proposition that allows users to take and drop a bike anywhere in a city without the use of physical parking infrastructure and a revenue model based on pay-per-ride or increasingly also subscription based. The combination of digital platform technology, a smartphone and GPS enables locating and unlocking a bike without the use of physical docking stations for parking. In contrast to the traditional models, users enjoy increased flexibility.

To assess the upscaling potential a prospective transitions framework was developed. By looking at co-evolving dynamics of increasing returns to adoption of an

64. Also known as *"peer-to-peer"* bike sharing.

innovation, industry structure and the role of institutions the upscaling potential of the different models was assessed. The study finds that the free-floating bike sharing business model has upscaling potential because both providers and users benefit from increasing returns to adoption, more than the traditional bike sharing models. As the number of adopters grow, producers see cost per unit decline. From the demand side, users enjoy spatial network effects as more bikes on the street makes it easier for users to find and unlock one in their vicinity. Hence, the platform becomes more attractive when more people use it. The costs of switching to this system are also low as it only requires downloading a smartphone application. From the supply side, providers also benefit from increasing returns. In contrast, traditional bike sharing systems face physical challenges in upscaling, as these are dependent on parking infrastructure which is costly and spacious (which explains their dependency on public funding).

Furthermore, the analysis suggests that future prospects of free-floating bike sharing systems not only depend on business model characteristics, but also on the types of firms adopting and supporting it. Experience of firms in related fields and local industry embeddedness helps them to adapt to local institutions. Also their size plays a role, as larger firms have more access to resources and are better equipped to invest in launching new services at initially low prices. The results show that free-floating bike sharing companies were founded by startups. However, they soon attracted substantial investments of venture capital investors and large technology companies. These actors have limited background in the urban mobility field as their core business is in e-commerce, social media, mobile and digital payments and ride hailing. Nevertheless, their financial resources enabled to reach critical masses needed for realizing increasing returns for producers and users. Hence, although the free-floating bike sharing industry mainly consists of entrants with no specific experience in transport, their promise motivates the backing of strong private investors, with no further dependency on public funding.

The analysis shows that free-floating bike sharing companies have solved a classical business model challenge that traditional bike sharing companies face: getting access to resources for large scale investments in infrastructure which do not directly increase profits but are required for successful and wide-spread adoption of a service. Because they are enabled by a digital platform, free-floating bike sharing systems can scale with relatively limited resources and independent from dedicated parking infrastructure, in contrast to traditional systems. On top

of that, the private investors financially backing these startups allow to launch with large numbers of bikes and compete at very low prices.

However, a major challenge for upscaling of free-floating bike sharing is to address institutional conflicts. The case study demonstrates that in particular the free--floating aspect – many bikes parked throughout the city – conflicted in Dutch cities with existing urban institutions around the use of public space and parking regulations. Also existing local practices and habits such as bike ownership may prevent this form of bike sharing from upscaling. In the end, there may not be a big demand for increased flexibility, the value proposed by this new bike sharing system. In contrast, traditional systems – such as the two-way station-based system that has been around for a while – are institutionally better embedded in existing urban mobility regimes, integrated in intermodal mobility, widely used, publicly accepted, supported by authorities, without conflicts with formal institutions. Hence, further development of free-floating bike sharing systems depends on entrepreneurial skills such as reconfiguring rules and cultures to embed this novel model in existing urban mobility systems. Conflicts between urban authorities and companies show that his institutional alignment is currently missing.

Building upon the institutional challenges identified in the previous chapter, Chapter 3 focuses on entrepreneurial strategies to embed free-floating bike sharing systems in local spatial and institutional contexts. There is much to be learned about how place-specific institutional strategies are related to the local circumstances in different cities. To this end, a framework is built combining literatures on the geography of transitions and institutional strategies to investigate the recursive relations between institutional strategies and place-specific conditions through which sustainable innovations may emerge differently across places. In this study, strategies aimed at creating, maintaining or changing regulatory, normative and cultural-cognitive institutions by seven companies are examined in the cities of Amsterdam and Shanghai. In this way, the institutionalization process is reconstructed. Both cities responded differently to the introduction of free-floating bike sharing: in Shanghai it addressed urban problems (such as congestion, the last mile problem, illegal autorickshaws and air quality) and was socially supported whereas in Amsterdam, it was banned soon after introduction. Regulatory institutional settings can be influenced by lobby or advocacy strategies. Strategies that focus on normative settings include creating identities, challenging prevalent norms and altering traditional meanings. Cultural-cognitive settings can be influenced by creating new knowledge, associating new practices

with existing ones, mimicking successful models for own legitimacy or developing new meaning systems.

The study finds that these types of strategies are strongly influenced by local spatial and institutional settings. Physical place specific elements such as infrastructures and urban mobility challenges played a role. In Shanghai, a good match of free-floating bike sharing with urban challenges enabled collaborations with urban governments to build cycling infrastructure. Although such infrastructure is amply available in Amsterdam, there was no clear link with local urban problems.

Taking the institutional perspective, the initial lack of regulations enabled rapid growth of free-floating bike sharing in both cities. After launching, and because of dependency on infrastructure for cycling and parking, companies advocated regulation and lobbied for pilot projects for free-floating bike sharing in collaboration with urban authorities. This was only successful in Shanghai, where official partnerships were established.

Different prevalent norms about local practices around urban mobility shaped the strategies of free-floating bike sharing companies. In Shanghai – a car-city that aims to stimulate cycling – companies challenge car use. In Amsterdam, current cycling rates have already led to parking problems and bike ownership was challenged. To convince and attract users to bike sharing, companies in Shanghai constructed images of free-floating bike sharing as a fashionable, high tech, convenient and eco-friendly innovation, invented in China. By drawing on the social position of users and framing bike sharing as new status symbol companies attempted to attract users.

Cultural-cognitive institutions were also influenced to help ease adoption of free-floating bike sharing. Companies engage in research collaborations with established institutes and share data to create knowledge about bike sharing. Also, rather than urban transport companies, they frame themselves as tech companies and make associations with other well-known platform-businesses such as Uber, Airbnb and Didi. By doing so they aim to build legitimacy and create trust among (potential) users. Although this positively influences adoption in Shanghai, in Amsterdam this association raises concerns (e.g. data privacy) as these tech platforms not always have had a positive reputation among citizens. The concept of free-floating bike sharing, with odd and unconventional bike designs, promoted by foreign startups, only accessible through app, taking up

public space, conflicts with certain norms and values of a strong and institutionalized local cycling culture. This culture is grounded in the idea that cycling involves privately owned bikes. The study shows that issues of power such as support and resistance against free-floating bike sharing played an important role. In Shanghai, companies strategically aligned with incumbent digital players and authorities. In Amsterdam, authorities took the side of communities that successfully complained how free-floating bike sharing reinforced cycling related problems. Hence, different contexts shape different issues.

Furthermore, in comparing different cities, the study shows that the local degree of cycling institutionalization affects institutional strategies. In Shanghai, a setting where cycling is less institutionalized it appeared to be easier to create conditions and institutions necessary for FFBS (such as infrastructure and regulations). In Amsterdam, a setting where cycling is highly embedded and institutionalized, companies aiming to promote free-floating bike sharing face and struggle with existing institutions such as bike ownership and a strong cycling culture that is antagonistic to this new form of bike sharing.

Finally, the study suggests how dynamics at different scales – not only different places – influence institutional strategies locally. Companies not only respond to local conditions but also to institutional developments, constraints and opportunities at the national level to institutionalize their venture at a local level. In Shanghai this was seen in relation to the national social-credit system. In the Netherlands, companies strategically anticipated the national ambition to develop an interoperability standard that aims to integrate different bike sharing services – active across different cities – into a single user standard interface. Also negative frames (e.g. photo's reflecting negative outcomes and experiences of bike sharing from Chinese cities) traveled globally and influenced local institutional strategies.

Chapter 4 focuses on the unforeseen outcomes and negative impacts of the free-floating bike sharing business model and how to manage these. Addressing such issues is important as ignoring these leads to setbacks in positive urban mobility transitions. The chapter presents a case study of seven free-floating bike sharing companies in three Dutch cities i.e. Amsterdam, Rotterdam and Utrecht. A framework is built to study socio-ethical aspects of business models by combining literature on business model and Responsible Innovation. The framework considers the purpose, process and outcome dimensions of business model innovation. Purpose considers motivations for business model innovation. Processes focuses

on how the business model innovation process unfolds looking at anticipation, inclusivity, reflexivity, and responsiveness dimensions of companies. Outcome focuses on the business model launched.

The study finds how socio-ethical factors play an important role in the success or failure of business model innovation. Almost all free-floating bike sharing companies, and also municipalities, were initially unable to anticipate impacts. Some companies were able to exercise inclusivity and responsiveness and adjust their business models whereas other could or would not. They were inflexible in incorporating local needs and conditions. To avoid negative consequences and to enhance sustainable business models, the findings suggests that responsible innovation principles should be applied to business model innovation processes.

Additionally, the study demonstrates two distinct types of companies that deploy business models with different underlying purposes, influencing processes and strategies of responsible innovation and outcomes differently. On the one hand there are companies that operate following a (top-down) platform based logic that is reliant on large market share that lead to aggressive business model implementation strategies. These companies seek additional sources of value creation and associate themselves more with well-known platform-based businesses. Free-floating bike sharing companies supported by incumbent tech players suggest additional sources of value creation, beyond providing bike sharing as a service. Additional value can be created around data collection, digital payments, advertising and integration with broader digital platforms (acquiring users to integrate in other platforms mobility, e-commerce, social media or digital payment platforms). Hence, this study exposes that there may be additional motivations behind seemingly innocent and responsible innovations such as bike sharing. The fact that platform innovation has made it relatively easy to set up a bike sharing system – without being hindered by regulatory frameworks – combined with additional sources of value creation has led to a highly competitive market with different startups supported by different investors and tech firms. The fierce competition to reach market share has led to a race to the bottom. Backed by investors, companies could (artificially) charge low fees for a ride. At the same time, the bikes were low cost with a short life span, limited to no maintenance and a poor redistribution service. This led to clogging up public space and waste production. Acquiring new customers seemed a bigger priority than sustaining a bike sharing system. Hence, the combination of radical scaling strategies, reliance on scale, the way they were run (limited collaboration with authorities) and

a poor product (bike sharing), suggests that their primary ambition was not to provide a sustainable solution to mobility challenges, but rather to establish and operate a platform business model that facilitates interactions between users and the platform as this creates additional private economic value through data collection, advertisements and integration with other services.

On the other hand, the study shows companies that operate a business model that is accompanied with more collaborative implementation strategies. These are more locally embedded (often smaller) companies with a more local origin and a community-oriented approach that are more focused on the local challenges. These provide a service that is more attuned to local contexts, with a bike that matches the experience of users and with a business model less reliant on platform dynamics.

Chapter 5 presents a governance perspective by looking into urban living lab experimentation with cycling innovations, including platform enabled cycling. Strategic urban experimentation in living labs is seen a way of learning from innovation in real-life settings in collaboration with users, city authorities, companies and universities. In order to improve understanding of how strategic urban experimentation works in practice this study analyses how they unfold and evolve, what kind of challenges emerge and how these are navigated. Therefore, this study identified challenges and dilemmas of doing strategic urban experimentation. Based on a Strategic Niche Management literature review a framework was developed to identify challenges and dilemmas of urban experimentation. This framework was used to identify challenges and dilemmas based on a three-year monitoring and analysis of four living lab cases concerned with cycling innovation in four cities in the Netherlands (i.e. Amsterdam, Utrecht, Eindhoven and Zwolle). Besides a free-floating bike sharing living lab, experiments were set up around innovative cycling concepts such as 'exchange bikes', bicycle highways and cycling lessons for immigrants.

The study provides insights about strategic urban experimentations processes. A key challenge concerns articulating and managing expectations about processes of strategic urban experimentation itself, rather than managing prospects about the socio-technical innovation subject to experimentation. This entails aligning ideas and expectations about living lab experimentation, methods, roles, responsibilities and procedures. A striking observation is that some urban experiments started as open processes but along the way turned into more closed projects.

The experiments in Amsterdam and Utrecht evolved from a typical living lab approach (i.e. co-creation, broad vision, open to a variety of perspectives, ideas and initiatives, accepting high level of uncertainty) to a more traditionally structured project-based approach (i.e. clear defined goals, clear roles and responsibilities, certainty) which shaped a more effective collaboration among actors, which was instrumental in undertaking experimental action. In a way the outcome of living labs became embedded in existing organizational structures, following more conventional governmental logics, which was needed in order to move forward. However, a key challenge of managing this process involves balancing between embedding urban experimentation in existing structures while maintaining openness to new ideas.

Furthermore, place-based dimensions of urban experimentation are unpacked which explain why the cases unfolded as they did in terms of challenges and dilemmas. For example, in (relatively) more mature cycling environments (such as Amsterdam and Utrecht) existing networks around cycling are historically better developed and equipped to support strategic urban experimentation with cycling innovation. Also, a supportive political environment for strategic urban experimentation enabled building unconventional coalitions in which both innovators and incumbent actors could collaborate.

The study also found that engaging in strategic urban experimentation brings up dilemmas for researchers since besides being observers and producers of knowledge they have also become facilitators of change in collaboration with practitioners. In practice this meant that researchers had to navigate between different roles (e.g. initiating the research project, setting up local living lab experiments, facilitating learning across living labs, examining its progress and sharing insights).

6.2 Main conclusions

The central proposition of this dissertation was that platform enabled innovations such as free-floating bike sharing, change urban mobility transition dynamics. To better understand this, I studied three elements that are important aspects of transition dynamics: business models, institutional dynamics and experimentation. In answering the main research question – **How does the emergence of platform enabled bike sharing interact with urban mobility transitions?** – this dissertation draws conclusions about the mutual relationships between platform enabled bike sharing and business models, institutional

dynamics and experimentation. Table 6-1 provides an overview of the interplay of these concepts with urban mobility transitions. These will be discussed in more detail below.

Table 6-1: Interplay of business models, institutional dynamics and experimentation with urban mobility transitions

Lens	Interplay with urban mobility transitions
Business models	• Spatial network effects – enabled through digital means – accelerate local urban mobility transitions as business models are not dependent on new physical infrastructure. • Digital business models unfold rapidly and simultaneously across different places in the world, influencing local urban mobility systems • New revenue model based on value creation from data attracts commercial interests but also serve public interests and contribute to urban mobility transitions • Platform enabled bike sharing brings digital technology incumbents as new actors to the centre of urban mobility transitions • Unethical business model and implementation strategies of digital platform innovators negatively influence the acceptability and desirability of urban mobility transitions
Institutional dynamics	• Platform enabled bike sharing often not aligned with existing local urban institutions (such as regulations, norms and cultures) that shape urban mobility systems • By creating new and influencing existing institutions to their own benefit, digital platform innovators influence the direction of urban mobility transitions and change the public-private balance in regulating urban mobility transitions
Experimentation	• Unconventional and experimental implementation strategies of digital platform innovators challenge the deliberate and democratic evaluation of the societal desirability of innovation, creating tensions between providers and public stakeholders in urban mobility transitions • Urban authorities have agency and steer the direction of platform innovation in urban mobility transitions by governing through living lab experimentation, which helps navigate challenges (such as conflicts with stakeholders and institutions)

6.2.1 Creation of new business models

Business model innovation is an important aspect of transition dynamics. This dissertation explores how platform enabled bike sharing changes the dynamics of urban mobility transitions through new business models. A business model perspective improved understanding of how platform enabled bike sharing systems create, deliver and capture value and how these innovations are brought to the market. Chapters 2 and 4 demonstrate how these platforms radically transformed the value proposition, the value network, the revenue model and market implementation strategies of traditional bike sharing models.

The first way in which platform enabled bike sharing influences urban transition dynamics is through spatial network effects both for users and producers. This influences the pace of transitions, because network effects are enabled through digital means rather than physical means. These network effects enable local scaling, facilitated rapid growth, influencing local urban mobility transitions. In addition, the diffusion of platform enabled bike sharing is made easier through a business model that removed inefficient and costly elements such as physical parking infrastructure. This lies at the core of the value proposition of platform enabled bike sharing, as compared to traditional bike sharing systems, platform enabled bike sharing offers flexibility and increased accessibility to shared bikes because it is based on a dense network of bikes widely available instead of a limited number bikes available at fixed locations.

The second way in which platform enabled bike sharing influences urban mobility transitions is that global diffusion is easier because the business model is less dependent on physical infrastructure. Chapter 3 demonstrates that the digital nature of the business model allowed for relatively easy replication of bike sharing systems across cities in the world. After being invented and implemented in Chinese cities, the business model was quickly transferred to other cities in Asia, Europe and North America. Costs for expanding to foreign markets are greatly reduced compared to traditional companies because they are not dependent on physical infrastructure (i.e. just put bikes on streets and make users download an app). This also means that a single digital platform-based business model influences local transition dynamics simultaneously in different areas, accelerating the uptake of sustainable innovations across national geographical borders. This draws attention to the role of digitization in changing transition dynamics, suggested as an important direction for transitions research (Köhler et al., 2019; Kolk & Ciulli, 2020).

Digital platform enabled business models transcend national contexts and facilitate the global travel of innovations, influencing local urban transition dynamics.

The third way in which platform enabled bike sharing influences urban mobility transitions is through the revenue model based on value creation from data generation that has attracted private interests but at the same time also could serve public interest. Chapters 2 and 4 exposed that platform enabled bike sharing generates additional sources of value creation such as user data and the integration in other services. It is demonstrated that a new business model around bike sharing unlocked new sources of value creation, besides making a profit from pay-per-ride fees and subscriptions. These new sources of value creation are not only valuable for commercial purposes, as data generated can be valuable for public purposes as well. Urban authorities benefit from data, as it allows to learn from and govern platform enabled urban innovation i.e. data driven insights provide valuable input for policy-making. For example, in non-cycling environments – without dedicated cycling infrastructure – user data could provide insight in popular cycling routes taken by users, that could eventually be transformed into dedicated cycling lanes and bike parking areas.

The fourth way platform enabled bike sharing influences urban mobility transitions is through the creation of new value networks that consist of strategic partnerships with incumbent tech companies. As concluded above, unlocking of new sources of value creation has attracted commercial interests in the form of supporting powerful actors from the 'tech-sector', which were not active players in urban mobility before.[65] Hence, this dissertation shows that platform enabled innovations bring new actors to the centre of urban mobility transitions. Chapter 4 unveils that the creation of these new private coalitions in the urban mobility field demonstrate other interests than primarily providing a bike sharing service. Rather, they have an interest in users accounts and user data for commercial purposes. This is untransparent and poses risks to data privacy because 'unknown' tech players are able to track individual mobility movements through a bike sharing platform aiming to collect and monetize user information. This brings about the risk of public urban agendas – often focused on stimulating sustainable urban mobility – becoming jeopardized and under control of powerful private interests.

65. Value networks of traditional bike sharing companies generally consist of strategic partnerships with city authorities that partly subsidize the service and/or marketing companies.

Fifth, platform enabled bike sharing business models can have implications for the acceptability and desirability of urban mobility transitions. Chapter 4 demonstrates how business models brought about negative and undesirable consequences, leading to negative setbacks in urban mobility transitions (e.g. in Amsterdam bike sharing experiments were postponed as it conflicted with urban institutions). Platform enabled bike sharing companies show unconventional – non-inclusive – approaches to how business models are implemented and brought to the market: launching in cities without formal consent and legitimize through users, a common approach among platform-based businesses such as Airbnb and Uber.[66] The involvement of powerful actors with substantial financial resources made rapid scaling and reaching critical mass possible (high volumes are critical as marginal returns are low). In turn, this brought about fierce competition to attract as much customers as possible to achieve market dominance. In these 'winner takes all' dynamics, companies tend to develop into monopolies and a perverse effect of the hyper competition is that some, in their endeavor to achieve market dominance, failed to provide a sustainable and reliable bike sharing service. To benefit from spatial network effects large numbers of bikes were put on streets, available to users at artificially low rates, leading to an oversupply. This overcapacity caused that many bikes were left unused, clogging up public space and instigating vandalism. At the same time, these bikes were often cheaply produced and of low quality leading to massive waste production as companies were not taking responsibility for adequate maintenance. In other words, large amounts of cash were burnt to attract users without making profits from bike sharing trips. Chapters 4 and 5 show there is also room for more collaborative approaches to implement new business models. In contrast, companies with local origin were more focused on local challenges, more attuned to local experiences, with a qualitative bike that matches practice of users, highlighting a more collaborative and mission driven logic, focused on providing a reliable and sustainable bike sharing service. These companies benefited from incorporating local stakeholder perspectives and user needs, and from being able to adjust these needs and produce more locally relevant and socially desirable and ethically acceptable business models. Nevertheless, shedding light on unsustainable effects of innovation and transitions is important as this topic has been neglected in the field of transitions studies but influences the acceptability and desirability of urban mobility transitions.

66. The idea behind this strategy is to attract users in a short period of time and thereby show the platform meets a particular demand and contributes to solving urban problems, making it more difficult for governments to ban or regulate it strictly.

6.2.2 Challenging urban institutional dynamics

Institutional change is a second important aspect of transition dynamics. In this dissertation, the institutional perspective provided understanding in how and why the development of platform enabled bike sharing unfolded the way it did. Chapters 2 and 3 demonstrate how platform enabled bike sharing has challenged and was challenged by local urban institutions in several ways. Here I explore two aspects of the interplay between platform enabled bike sharing and institutional change, and how this is relevant to urban mobility transitions.
The first way how platform enabled bike sharing influences institutional changes in urban mobility transitions is because these new business models often does not align well with local urban institutions such as regulations, norms and cultures. Platform enabled bike sharing conflicted with regulations for parking and providing commercial services in public space. Also alignment with informal institutions can be challenging. Chapter 2 and 3 show how local norms, practices and a strong cycling culture were unsupportive to platform enabled bike sharing in Amsterdam – a mature cycling environment – leading to a ban. The concept of platform enabled bike sharing, with odd and unconventional bike designs, promoted by foreign startups, only accessible with a smartphone, taking up public space, conflicted with certain prevalent norms and values of a strong and institutionalized local cycling culture grounded in the idea that cycling involves privately owned bikes.

Second, platform enabled bike sharing innovators influence institutional changes in urban mobility transitions. Taking the institutional perspective, it becomes clear that platform enabled innovations do not rely on a smart configuration of business model components only, but institutional alignment is at least as important. Chapter 3 shows that platform enabled bike sharing businesses acted as institutional entrepreneurs aiming to reconfigure institutions to their benefit. They exercised agency to strategically shape the necessary institutional conditions, and achieve institutional alignment. The study shows that such institutional strategies – to institutionalize platform enabled bike sharing – are adapted based on local spatial and institutional settings. Companies use different institutional strategies as they respond to local institutions such as regulations, prevalent norms around urban mobility and existing cultures and practices, physical place specific elements such as infrastructures and urban mobility challenges and issues of power such as support and resistance. This means that the incumbent structures and dominant institutions that need to be overcome or changed differ per city.

In particular, regulatory institutions were targeted for changes by entrepreneurs by lobbying for regulations, pilots and formal collaborations with governments in an attempt to generate legitimacy. To do so, experts, locals with political experience or legal consultants were hired.

Companies also attempted to change broader informal institutions. They use various strategies to gain public legitimacy, such as claiming that platform enabled bike sharing would help solve urban problems stemming from cycling or car mobility. They also create new knowledge about the impact of bike sharing by sharing data and engaging in research collaborations.[67] Another strategy by major companies is to strategically position and frame themselves as tech companies (instead of urban transport companies) and make associations with other well--known platform-businesses. By doing so they claim existing regulatory frameworks do not apply, in order to legitimize their unconventional strategies and continue business. A strategy is also to attract new users by creating new identities around platform enabled bike sharing and framing it as a status-symbol.

Additionally, platform enabled bike sharing influences institutional changes in urban mobility transitions by the creation of new private institutions. Chapter 4 shows that platform enabled bike sharing companies have created their own new regulatory institutions and new meaning systems. They have mechanisms in place for governing and regulating interactions between users and the platform through penalty and rating systems. Credits can be awarded to influence or stimulate desirable user behavior. Such systems can in turn be integrated in wider social media and credit systems. Another example is inducing desirable parking behavior through geo-fencing. However, these types of measures are outside of public control. Hence, the creation of private institutions and self-regulatory measures changes the public-private balance in regulating urban mobility transitions. To conclude, by creating new and changing formal and informal institutions, platform enabled bike sharing companies influence the long-term direction of urban transitions.

67. This dissertation shows that the strategies of platform enabled bike sharing companies are similar to the substantial efforts of large technology companies ('big tech') in lobbying to influence regulations at the EU level. They hire former government officials, consultants and lawyers to represent their interests in this process and establish research collaborations to publish 'industry friendly research' (Satariano & Stevis-Gridneff, 2020).

6.2.3 Changing urban experimentation dynamics

From an experimentation perspective, it can be concluded that platform enabled bike sharing changed urban mobility transition dynamics in two ways. The first way concerns how the unconventional and experimental implementation strategies taken by platform enabled bike sharing businesses influence urban mobility transitions dynamics. Such rapid introduction of platform enabled bike sharing in cities is a different type of experimentation than the more formal and consensual approach suggested by existing transition frameworks such as strategic niche management. Without formal consent and prior assessment companies launched overnight by introducing bikes into cities and waited to see what happened. While rapid experimentation can be considered an important asset in transitions (e.g. it enables fast learning), the findings of this research suggest that it also creates a challenge to maintaining democratic quality of the experimental process because it is not inclusive. In particular, the pace of such 'experimental' approaches does not align well with the deliberate and public evaluation of the desirability of innovation and the possibility to regulate in case of negative impacts or risks. Chapter 4 demonstrates that launching without prior assessment of externalities and public interest and leaving democratic deliberation and public debate ex-post affairs has brought about controversy and tensions between the providers and public stakeholders such as urban authorities and citizens.

This brings us to the second way how platform enabled bike sharing influences experimentation dynamics. Navigating tensions and conflicts was done by anticipating and proactively engaging with experimentation, as demonstrated by how some urban authorities responded to platform enabled bike sharing. This demonstrates room for agency among authorities to decide upon the future of platform enabled bike sharing. This agency has taken shape in the form of governance by experimentation. Chapter 5 shows how urban living lab experimentation – in the city of Utrecht – has been a way to navigate platform enabled bike sharing in urban mobility transitions, by functioning both as a mode of governance and as a research method for learning about platform enabled bike sharing in a real-world environment. In this living lab, public and private actors and researchers collaborated. An experiment was set up – to test platform enabled bike sharing – with a focus on safeguarding public values and interests. The living lab functioned as a platform for deliberation and negotiation. To avoid and address conflicts, the living lab provided a space to explore

and address critical questions about platform enabled bike sharing and discuss the conditions under which it can contribute to urban mobility transitions. With regards to platform enabled bike sharing, stakeholders made agreements about scaling, sharing data and insights about usage and agreements and handling of complaints. In this way, the living lab provided a platform to build long term relationships and trust. The living lab also functioned as an intermediary between innovation and policy. It was a place where proposals for institutional changes were prepared and discussed. For example, in Utrecht, local parking regulations were temporarily adapted to facilitate platform enabled bike sharing. Through this process of learning by doing in a real-world environment, experimentation provided a way of embedding and institutionalizing platform enabled innovation in the local setting.

6.3 Discussion

This section discusses the implications for governance and research in urban mobility transitions. By zooming out on the particular case of platform enabled bike sharing, also more general implications for governance and research on platform innovation are discussed.

6.3.1 Implications for governance

The rapid emergence of platform enabled bike sharing has given rise to a range of opportunities for cities working towards sustainable urban mobility. In particular for cities that aim to stimulate cycling, platform enabled bike sharing provides an attractive alternative that was promoted to benefit health, increase accessibility and provide clean urban mobility, without the need for extensive public funding. The ability of platform enabled bike sharing to drive urban mobility transitions is very much dependent on the context in which it is implemented. Whether platform enabled bike sharing can be a substitute for unsustainable urban mobility – and thereby supporting a modal shift to more sustainable mobility – is highly dependent on the local urban mobility regime. In Chinese cities (incl. Shanghai), evidence suggests that platform enabled bike sharing is mainly used to connect to public transport (i.e. bus and metro) and that these trips replace walking, bus and car trips (i.e. private car, taxi and motorbikes) (Jiang et al., 2020). For the Dutch context – where cycling dominates urban mobility systems – evidence shows that platform enabled bike sharing mainly replaces walking, cycling (with a private bike) and public transport trips (Farla, 2019; Ma et al., 2020; Van Waes et al.,

2018).[68] In this situation, it does not contribute to a significant modal shift to more sustainable urban mobility. Significant sustainability benefits do occur when a modal shift from cars to bikes takes place. The case of platform enabled bike sharing shows that a new business model has facilitated easy access to a new form of sustainable urban mobility and thereby exposes large new groups of people in society to cycling, which is cheap, healthy and clean. Hence, platform enabled bike sharing by itself may not always produce a major modal shift, but it does contribute to "*normalizing*" and promoting cycling in contexts where cycling is marginal (Médard de Chardon, 2019; Ricci, 2015). This means platform enabled bike sharing creates momentum for broader change, paves the way for increased support for investments in cycling and cycling infrastructure and thereby drives urban mobility transitions.

At the same time, despite these opportunities, this dissertation made clear that platform enabled bike sharing – due to the nature of the business model – has an impact beyond urban mobility transitions, creating new governance dilemmas. In line with other studies, this dissertation has shown that the platform enabled bike sharing business model created wider ethical and social issues and conflicts with public interests: gathering data by companies led to privacy concerns (Spinney & Lin, 2018); putting large numbers of bikes on streets raised questions about nuisance and use of public space by private companies (Petzer et al., 2020); fierce competition among companies, solely focusing on attracting users and striving for market dominance, led to a race to the bottom and massive waste production (Curtis & Mont, 2020); companies focusing operation in profitable areas, thus benefitting the already privileged (Médard de Chardon, 2019); and integrating in bigger platforms can lead to power concentrations or even monopolies which can be problematic when one bike sharing service gets priority over similar other services, leading to unfair competition in urban mobility transitions (e.g. Lime bikes available through the Google Maps platform whereas others bike sharing services are not). Hence, the introduction of digital platform technology in urban mobility raises fundamental issues. This means

68. Besides a sustainability argument there are also financial reasons to invest in bike sharing in the Netherlands. The national government heavily invests together with cities in expensive bike parking infrastructure, mainly around train stations, to stimulate public transport use and reduce parking pressure. Investing in a large scale bike sharing system may have similar potential to solve these urban mobility challenges. This can be done for example by improving the existing station-based bike sharing system with key business model elements of platform enabled bike sharing systems such as a different pricing structure (e.g. pay per ride instead of pay per day) and smart-locks.

urban authorities face difficult decisions because platform enabled bike sharing promotes particular public interests but also undermines other public values. This dilemma relates to a broader critique on the platform economy and confirms the image that has emerged of how digital platforms are putting public values under pressure while benefitting from the positive image of 'sharing' (Frenken et al., 2017; van Dijck, 2020).

As the influence of digital platform innovation on urban mobility transitions and society at large will increase, so does the demand for regulation and governance. This should also be viewed against the backdrop of governments that recently started restricting technology companies more broadly (European Commission, 2020). Over the last decades digital technology companies have grown into large – 'big tech' – conglomerates, partly because they were not hindered by regulations. This was obviously, as the case of platform enabled bike sharing also demonstrates, not without consequences.[69] This dissertation argues that the involvement of such new digital technology incumbents can lead to unsustainable outcomes in the form of irresponsible innovation in (urban mobility) transitions. It is therefore important to take impacts on public interests seriously. But for governments it is difficult to grasp and govern the impact of innovations such as platform enabled bike sharing. That is because regulatory developments mostly do not evolve as quickly as innovation does. Regulating promising but disruptive innovation entails a balancing act in which timing is important: regulating too early or too strictly may frustrate innovation and hinder growth, but regulating too late or too lightly could lead to irresponsible innovation dynamics. In particular, governing digital innovations such as platforms is challenging because, in contrast to innovations in mature sectors, they are not subject to formal assessment before they enter the market. In more mature and (and non-digital) sectors, innovations such as new toys, medicines, food or a new type of aircraft engine are subject to detailed scientific analysis, extensive testing and normative deliberation before they can be brought to the market (Frenken & Pelzer, 2020). For these innovations, a multitude of formal rules and guidelines are in place to prevent negative impacts on society. But due to their novelty and digital nature, platforms innovations can ignore such rules more easily and just launch their service into a market (i.e. which often simply involves downloading an app) without prior formal

69. In an attempt to comply with regulations platforms deploy measures (such as credit-rating systems or geo-fenced parking to induce desirable parking behaviour in the case of platform enabled bike sharing) but, as this research has shown, governments cannot rely on private self-regulation for safeguarding public interests.

assessment or engagement with public stakeholders. Another reason governing platform innovation is complex is because government intervention mostly occurs at a local level – after impacts have occurred – while platforms operate globally as transnational companies. The case of platform enabled bike sharing showed how different municipalities responded ad hoc resulting in either fighting (banning) or collaborating with private platform businesses. Hence, the key governance challenge for urban governments is balancing public and private interests at a local level while platforms serve private shareholder interests in a global playing field. This means that the extent to which platform innovation positively contributes to urban (mobility) transitions – and to preventing irresponsible innovation – is dependent on how local public and private actors collaborate, addressing its more fundamental challenges.

Thus, to achieve this and to better navigate challenges of platform innovation, new forms of governance and collaboration between local governments and private actors are needed. From a public perspective, governing platform innovation should focus on promoting positive effects and preventing or mitigating negative effects (Frenken et al., 2017). Taking up the notion of responsible innovation (Stilgoe et al., 2013; Von Schomberg, 2013), governing platform innovation entails local governments and platforms becoming mutually responsive to each other by taking into account the acceptability and desirability, which allows societal (and urban) embedding of platform innovation. Below three recommendations are discussed that support this.

1. **Skills and capacity building to anticipate and manage impacts of platform innovation**
   The first recommendation is to build local capacity to anticipate and manage platform innovation. Although this research showed there is great enthusiasm among urban governments to engage with innovators and researchers, it also demonstrates there are various practical challenges in doing living lab experimentation (see Chapter 5). Additionally, the different ad hoc responses to platform innovation demonstrate that currently most cities are not yet adequately equipped to navigate challenges of platform innovation.[70] Policy makers at the local level are confronted first with platform innovation but they – in some cities more than other – may not have the right capacity

70. This limited ability to effectively respond to platform innovation is not only demonstrated by the case of platform enabled bike sharing, but also by other urban platforms such as accommodation sharing and taxi rides (i.e. Airbnb and Uber).

or capabilities to anticipate its impact. This research shows that by engaging with researchers in living labs, cities can get access to such skills and relevant knowledge, however only temporarily. In governing platform innovation it is therefore recommended for local governments to move beyond ad-hoc approaches and strategically build capacity to better navigate challenges of platform innovation in the future. Just as platform innovators strategically invest in knowledge and expertise (such as legal skills and political experience) to influence institutional settings to their benefit, urban governments could invest in capacity that helps to anticipate and manage challenges of platform innovation. This means investing in skills and knowledge at a local level, similar to the expertise of the planning and assessment agencies that is available to national governments (such as the Dutch Rathenau Institute for Technology Assessment and the Netherlands Environmental Assessment Agency).

2. Governing platform innovation through experimentation
   The second recommendation is urban living lab experimentation as an appropriate approach for governing platform innovation. Living labs stimulate systematic and social learning in an early stage about opportunities and problems while testing it in a real-world environment. In line with other studies, this research shows that such an approach takes tensions, conflicts and contestation as a productive starting point for dialogue, informal assessment and research into the effects of platform innovation. (Rip, 1986; Torrens et al., 2019). So, besides an environment for cocreating experiment to test innovation, this research suggests living labs as a starting point for articulating common objectives of platforms and local governments such as achieving sustainable urban mobility while safeguarding public interests.

   However, despite the value of living lab experimentation as a governance approach, this dissertation has shed light on some challenges. A key challenge is to transform temporary experiments into permanent solutions. It is therefore important for urban living labs to have linkages with formal government structures (Scholl et al., 2018). Although literature recognizes the challenge of embedding or institutionalizing experimentation as a mode of governance into organizational structures of cities (e.g. Sengers et al., 2019; Voytenko et al., 2016), it does not provide practical insights on how to do so. This research contributes by showing how more permanent embedding of the living lab approach within municipalities can be realized. Chapter 5 illustrates how living labs evolved into traditionally structured project-based approaches with clearly defined

goals, roles and responsibilities, which better suited the ways of working within municipalities. Hence, transforming open living labs into more closed projects facilitates better embedding in existing organizational structures.

Furthermore, this dissertation also draws attention to how urban living lab experimentation – as a mode of research – is not a neutral process. The first way is that 'living labs' are performative, influencing experimentation dynamics. Chapter 5 showed that for a municipality, the 'license to fail in a living lab' was helpful in experimenting with platform enabled bike sharing. The living lab created a safe learning space to engage with urban innovation and the possibility of 'failing' (i.e. the possible outcome of the experiment that platform enabled bike sharing would not be a success in the city) as an outcome would be an acceptable outcome. Relatedly, early engagement with a particular innovation in a living lab by local governments and researchers legitimizes the innovation, thereby contributing to local institutionalization during the experimentation process. This explains, as shown in Chapter 3, why entrepreneurs advocated urban experiments for platform enabled bike sharing: early engagement with municipalities and researchers and creating new insights influences public acceptance. Hence, in this case (i.e. Utrecht, the Netherlands), urban living lab experimentation contributed to the institutionalization of and public support for platform enabled bike sharing.

The second way urban living lab experimentation was not neutral relates to the role of researchers. As Chapter 5 discusses, transitions researchers are increasingly committed to not only describe transformation processes but also to initiate them. In having this double role, they face the engagement--distance dilemma: to be an engaged participant while also being able to take critical distance (Köhler et al., 2019). To work with this dilemma nurturing reflexive research habits is helpful.[71] For example, the position of the researcher in relation to the object of study is key to reflect upon (Coghlan & Brydon-Miller, 2014; Wickson et al., 2006). That is important because being a living lab researcher means navigating between different roles (e.g. initiating the research project, setting up experiments, facilitating learning, examining progress and sharing knowledge) which influences the research process, development of living labs and research outcomes.

71. On a more mundane level that can translate into a question such as whether one should focus on listening and observing during a meeting or intervene and actively interact and shape the conversation.

3. **Sharing data to learn from and regulate platform innovation**
   The third recommendation for local governments is to establish agreements on data use with platforms. This is an important precondition for both learning about (and being able to experiment) and regulating platform innovation. Corroborating earlier studies, this research shows that for positively contributing to urban transitions it is for urban authorities important to collaborate and engage with providers of platform innovation (Cohen & Kietzmann, 2014; Ma et al., 2018; Voytenko Palgan et al., 2021). In fact, local governments need to collaborate with platforms as much as platforms need the support of local governments (Cohen & Sundararajan, 2015; Ranchordás & Goanta, 2020). Data plays an important role in this collaboration as it allows to learn and in turn regulate effectively. Insights about use and misuse enable assessing impacts of platform innovation and thus support evidence based policy making. Also, when regulations are in place, access to data allows public authorities to check whether platforms comply with these rules. Hence, platforms are in the position to empower government decision making by providing access to useful information. To facilitate this, it is recommended for local governments to get access to relevant and objectifiable data about platform use as a precondition for being allowed to operate in that particular city. Such an agreement could be an outcome of living lab deliberation. Similarly, to safeguard data privacy, local governments could demand transparency about if and how the platform uses data for other purposes.

6.3.2 Limitations and future research

In this section I reflect on several limitations of this research which also opens up directions for new research. The first limitation of this dissertation is about the spatial generalizability of the findings of the underlying studies. The geography of the cases is mainly based on developments around bike sharing and urban experimentation in the Netherlands. However, Chapter 3 does provide insights beyond the Netherlands as it includes a case study in Shanghai, China. Additionally, in terms of cycling innovations such as platform enabled bike sharing, the Netherlands is also an exceptional and unique case, as it stands out compared to most other countries when it comes to having an extensive cycling infrastructure and rich culture. In the Netherlands, cycling is a dominant mode in urban mobility systems, which brings "*challenges*" and "*problems*" some cities would be jealous about, like too many cyclists on a bike path or too many bikes parked at train stations. This suggests that the conclusions are not directly applicable

to other contexts and raises the question what the findings of this dissertation mean for cities outside the Netherlands. For example, in less mature cycling environments where car mobility dominates, it is likely that cycling innovations – as also touched upon in the Shanghai case in Chapter 3 – face different types of resistance and institutional challenges. Thus, this opens up the opportunity for future research to focus on studying platform enabled urban mobility innovations in different contexts, with different urban mobility regimes. To support broadening the scope of this research, the research design can be used as a starting point. The three core conceptual elements of this dissertation – business models, institutional dynamics and experimentation – do provide a more general analytical framework. This framework could serve as a heuristic device and allows for comparative research to test generalizability.

The second limitation is a strict focus on free-floating bike sharing as an example of platform enabled innovation in the urban mobility domain. This research has shown that the emergence of platform enabled bike sharing is a very context--specific development. This raises the question whether the conclusions also hold for other emergent platform enabled urban mobility innovations such as sharing systems for e-scooters and e-mopeds. Thus, the generalizability of the findings about platform enabled urban mobility innovations can be validated and enriched through studying other emergent cases in this domain. Broadening the scope to other cases in the urban mobility domain is relevant as the rapid rise of these other modes resembles common features with platform enabled bike sharing. For example, the growth of e-scooter sharing systems is also accompanied with irresponsible innovation dynamics such as a short life cycle, waste production, limited government interaction and parking problems. (Hollingsworth et al., 2019; Russel, 2018). An additional motivation to study electric powered individual urban mobility modes is that they have a longer range than normal bikes. By being able to travel longer distances, such vehicles are better equipped to replace trips by cars. This means they could have a higher potential to contribute to a shift to sustainable urban mobility. Additionally, as touched upon in Chapter 3, another promising development within the mobility domain is mobility as a service, that aims to connect all the (shared) mobility services to enhance accessibility. Furthermore, research could dive into the effect of different revenue models. For example, the uptake of bikes and electric powered bikes has been greatly influenced by a subscription-based revenue model. As the costs of electric powered bikes are substantial for most people, a subscription model can enable the use of these bikes to a larger group of people.

The third limitation of this research is the focus on platform innovation within the urban mobility domain. It is evident that the emergence of platform innovation not only influences urban mobility transition dynamics. Platform enabled innovations have also emerged in other domains such as energy, transportation and agriculture (Kolk & Ciulli, 2020). Thus, future research could further explore the interplay between platform innovation and transition dynamics in other domains.

A fourth avenue for future research is to further mobilize insights from literature on transdisciplinary and action research. The transitions field has extensively focused on researching experiments (including living labs) and processes of experimentation. However, it has not been studied as a methodology to govern transitions, which is relevant as transitions researchers increasingly also aspire to enact transitions. This dissertation has investigated living labs as a governance approach and doing transitions research in living labs is quite novel. While this research has made use of recent insights from transdisciplinary research on living labs, there is considerable scope for a broader and more systematic discussion of how transdisciplinary approaches can enrich the field of sustainability transitions more widely in future work.

A fifth promising avenue for research is further unpacking of the role and implications of digitization in (urban) transition processes (e.g. Kolk & Ciulli, (2020)). This research has shown that digital platforms influence the direction and pace of transitions, but not always in a sustainable way. Furthermore, they have potential to radically transform existing practices. For example, managing a platform enabled bike sharing system is essentially based on software and algorithms and as a consequence requires minimal human involvement. Digital technologies allow for automating activities that previously would require manual labor (e.g.: dynamic pricing algorithm to stimulate redistribution, self-regulatory systems to induce desirable parking behavior such as geo-fences and credit rating systems), making innovations more autonomous. Technological advancements such as artificial intelligence may even speed up this process. Transitions research has only engaged with these developments to a limited extent. Therefore, further investigation should unpack the interplay of digital innovations and transitions.

Finally, building on the core concepts of this dissertation – business models, institutions and experimentation – the study of platform innovation has shown there is scope for further research on the relationship of these concepts with transition dynamics. With regards to business models, this dissertation has opened up the

debate about the unsustainable outcomes of new digital business models in transitions. Future research could further explore how responsible business model innovation can be stimulated. With regards to experimentation, an important topic for further research – and as also touched upon in this dissertation – is the question of how to institutionalize forms of experimentation (such as living labs) into existing organizational structures to stimulate innovation and yield broader impact. In addition, given the urgency of sustainability challenges, rapid diffusion of sustainable innovation and rapid experimentation to learn about what works and what does not work in practice, may be a promising approach in achieving sustainable transitions. In this context, further research could focus on what can be learned from rapid scaling strategies deployed by platform innovators.

7

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8

Appendices

8.1 Public engagement contributions

Written contributions in popular media:

- Fiets is ideale anderhalvemeter-mobiliteit en biedt garanties voor de toekomst.
  Elsevier Weekblad. 2 jun 2020. https://www.ewmagazine.nl/opinie/opinie/2020/06/fiets-is-ideale-anderhalvemeter-mobiliteit-en-biedt-garanties--voor-de-toekomst-759675/
- Geef deelfiets de ruimte.
  NRC Handelsblad. 31 juli 2017. https://www.nrc.nl/nieuws/2017/07/31/geef-deelfiets-de-ruimte-12307002-a1568370

Interview contributions in newspapers, magazines, radio or television:

- Zij zijn de reden dat je overal fietsen met blauwe banden ziet.
  Het Financieele Dagblad. 13/03/20
- Eerlijk zullen we alles delen?
  Flow Magazine. Vol 3. 2020
- Swappers en delers.
  Uitkrant. 5/11/18.
- Een Netflix voor fietsen.
  De Standaard. 22/10/18.
- The emergence of bike sharing systems in cities.
  Sharing Cities Magazine. 1/11/17.
- Wat moeten we met de Chinese deelfietsen?
  Vogelvrije Fietser. 21/10/17.
- Amsterdam gaat deelfietsen ruimen: 'Grote kans dat we failliet gaan'
  RTL Nieuws. 3/10/17.
- Gaan deelfietsen de weerstand overwinnen?
  NRC Handelsblad. 30/09/17.
- Overheid moet leidend zijn bij deelfietsen.
  BNR Nieuwsradio. 16/09/17.
- Deelfietsen zijn big business, en Amsterdam is het beloofde land.
  Het Parool. 2/08/17.
- Utrechtse onderzoeker: "Deelfiets oplossing voor volle stalling".
  RTV Utrecht. 1/08/17.
- Deel- en huurfietsen in Amsterdam.
  Nieuwsuur. 31/07/17.

Presentations

- Bike sharing: hype or hope
  21 april 2018, Urban China, Shanghai
- Deelfietsgebruik in Amsterdam
  2 February 2018, Bijeenkomst kopgroep
- Gemeentelijk deelfietsenberaad georganiseerd door CROW Fietsberaad, *Utrecht*
- Deelfiets: hype of hoop?
  30 November 2017, Fietscommunity, Utrecht
- Gooi de deelfiets niet weg
  23 November 2017, Inspiratiedag Tour de Force, Ede-Wageningen
- Leren van de deelfiets
  21 September 2017, Nationaal Fietscongres, Tilburg
- Het deelfietsdilemma
  19 September 2017, Pakhuis de Zwijger Amsterdam
- Public interests in the platform economy
  7 July 2017, Embassy Kingdom of the Netherlands, Berlin

Policy briefs

- Fietsinnovatie: leve het living lab!, Smart Cycling Futures *(co-author)*
- Deelfietsen voor een duurzame stad, Smart Cycling Futures *(co-author)*

8.2 Summary

Platform innovation in urban mobility transitions

In an increasingly more urban and mobile world, platform enabled innovations have emerged as potential drivers for urban transitions. This dissertation focuses on free-floating bike sharing as an example case that has seen an impressive global growth in recent years, facilitated by digital platform technologies. The proposition of this research is that such platform enabled innovations change urban mobility transition dynamics. To better understand this, three important aspects of transition dynamics are studied: business models, institutional dynamics and experimentation. To this end, this research set out to answer the question: How does the emergence of platform enabled bike sharing interact with urban mobility transitions? This qualitative research mainly focuses on the development of platform enabled bike sharing in Dutch cities, but also provides insights from Shanghai, China. The thesis is written in the context of a transdisciplinary research collaboration aimed at investigating the role of cycling innovations in urban transitions. As such, additional reflections are provided about governing platform innovation through living lab experimentation.

The main conclusion is that platform innovation gives rise to new business models, challenges urban institutions and changes urban experimentation dynamics. First, this thesis find that new business models accelerate local urban mobility transitions, because digital platforms accelerate spatial network effects and enable fast global diffusion. This is because such platforms are not dependent on new physical infrastructure. Platform innovation also brings new actors (digital technology incumbents and startups) into urban mobility transitions. These businesses change the narrative in urban mobility transitions by focusing more on the role of value creation from data. This thesis argues that this can lead to undesirable outcomes in the form of irresponsible innovation in urban mobility transitions. Second, this thesis demonstrates that platform innovation challenges urban institutions, because digital platforms lack alignment with existing regulations, norms and cultures. By creating new or influencing prevalent institutional settings to their own benefit, digital platform entrepreneurs influence the direction of urban mobility transitions. Third, in relation to urban experimentation, this thesis observes that the rapid implementation strategies of platform innovators challenge the deliberate and democratic evaluation of its societal desirability, creating tensions between providers and public stakeholders in urban mobility transitions.

The research suggests urban living lab experimentation as a promising form of governance and collaboration between public and private actors, as well as researchers, to better navigate challenges of platform innovation in urban mobility transitions, but also identifies key challenges for doing urban experimentation.

8.3 Samenvatting

Platform innovatie in stedelijke mobiliteitstransities

De opkomst van digitale platform innovatie is potentieel een drijvende kracht in de transitie naar duurzame stedelijke mobiliteit. Zo geven platformen toegang tot gedeelde mobiliteitsopties zoals auto's, scooters of fietsen en stimuleren daarmee efficiënter gebruik en duurzamere mobiliteit. Dit onderzoek richt zich op een nieuw type deelfietssysteem, uitgevonden in 2015 in China, dat in de afgelopen jaren wereldwijd sterk is gegroeid, mede gefaciliteerd door digitale platform technologie. Met dit systeem hebben gebruikers middels een smartphoneapp toegang tot een fijnmazig netwerk van deelfietsen die vrij verspreid staan door een stad. De rol van deze nieuwe vorm van deelfietsen in de transitie naar duurzame mobiliteit wordt zowel geprezen als bekritiseerd. Om de invloed van dit soort platform innovaties op de stedelijke transitiedynamiek beter te begrijpen worden drie belangrijke aspecten onderzocht: business modellen, de rol van instituties en experimenteren. De onderzoeksvraag luidt: Hoe interacteert de opkomst van platform gedreven deelfiets systemen met stedelijke mobiliteitstransities? Dit kwalitatieve onderzoek richt zich met name op de ontwikkeling van platform gedreven deelfietssystemen in Nederlandse steden, maar biedt ook inzichten uit Shanghai, China. Het onderzoek is uitgevoerd binnen de context van een transdisciplinaire onderzoekssamenwerking dat als doel heeft de rol van fietsinnovatie in stedelijke transities te onderzoeken. Als onderdeel hiervan zijn stedelijke experimenten – waaronder een deelfiets living lab – in samenwerking met gemeenten, innovatoren en onderzoekers opgezet. Zodoende geeft dit onderzoek ook aanbevelingen over nut en noodzaak van het besturen van platform innovatie door middel van experimenteren in de praktijk.

In Hoofdstuk 2 wordt de schaalbaarheid van verschillende deelfiets business modellen in Nederland onderzocht aan de hand van drie factoren: toenemende schaalopbrengsten, industrie samenstelling en de rol van instituties. In het deelfietslandschap kan onderscheid worden gemaakt tussen innovatieve platform gedreven business modellen (opgericht door startups) en traditionele deelfiets business modellen die gebruik maken van fysieke parkeerinfrastructuur zoals dockingstations. Het platform gedreven model is het meest schaalbaar vanwege het zogeheten netwerk effect, voor zowel de aanbiedende bedrijven als de gebruikers. Voor aanbieders nemen de kosten namelijk af naar gelang het aantal gebruikers groeit. Aan de vraagkant profiteren gebruikers van een ruimtelijk

netwerk effect aangezien meer deelfietsen op straat het systeem aantrekkelijker maakt. Bovendien is het voor gebruikers relatief makkelijk om over te stappen naar dit systeem aangezien het enkel vraagt om het downloaden van een app. Aanbiedende bedrijven kunnen relatief makkelijk opschalen omdat dit model voor groei niet afhankelijk is van fysieke infrastructuur. Het opschalingspotentieel van platform gedreven deelfietssystemen wordt ook beïnvloed doordat de startups veelal financieel en strategisch ondersteund worden gevestigde digitale technologie bedrijven. Dit geeft toegang tot groeikapitaal wat wordt ingezet om in korte tijd met de verspreiding van grote aantallen deelfietsen zoveel mogelijk gebruikers aan zich te binden. Instituties spelen ook belangrijke rol in de toekomst van platform gedreven deelfietsen. In korte tijd plaatsten verschillende bedrijven duizenden deelfietsen zonder formele toestemming van lokale overheden. Mede door het gebrek aan duidelijke regels konden de bedrijven snel groeien. Maar om verdere wildgroei en overlast te voorkomen staken steden als Amsterdam daar al gauw een stokje voor. Deze mobiliteitsinnovatie conflicteerde met formele instituties zoals regels omtrent parkeren en het aanbieden van commerciële diensten in de publieke ruimte. Ook botste het met gebruiken in de lokale fietscultuur, zoals een hoog fietsbezit. Het draagvlak voor deelfietsinnovatie in de fietshoofdstad van de wereld was hierdoor niet groot.

In Hoofdstuk 3 worden strategieën onderzocht die ondernemers inzetten om lokale stedelijke instituties in hun eigen voordeel te beïnvloeden en zodoende draagvlak te creëren voor platform gedreven deelfietsen. Hiervoor is gekeken naar bedrijven in Amsterdam en Shanghai. Bedrijven hanteren verschillende strategieën, die afhankelijk blijken van de lokale ruimtelijke en institutionele setting. Zo wordt de nieuwe deelfiets gepromoot als een gezond, duurzaam en betaalbare oplossing voor lokale stedelijke problemen zoals overvolle fietsenstallingen (in Amsterdam) of filedruk, verkeersopstoppingen en illegale taxidiensten (in Shanghai). Om formeel voet aan de grond te krijgen in steden pogen bedrijven lokaal beleidsontwikkeling te beïnvloeden door te lobbyen voor specifieke regelgeving en stedelijke experimenten. Onderdeel van deze strategie is het inschakelen van lokale experts met politieke en beleidservaring. Daarnaast gaan bedrijven samenwerkingen aan met steden en onderzoekers om zo nieuwe kennis te creëren over de impact van deelfietsen, wat mogelijk kan dienen als input voor beleidsvorming. Onderling werken bedrijven samen aan gemeenschappelijke deelfietsstandaarden. Bedrijven beïnvloeden ook bredere aspecten. Zo proberen bedrijven in Shanghai een lokale fietscultuur te creëren, onder meer door bij te dragen aan de ontwikkeling van infrastructuur. Daarnaast trekken bedrijven

gebruikers aan door de deelfiets te promoten als een nieuw status symbool en associëren ze het met bekende digitale platforms om zo legitimiteit onder gebruikers te genereren. Gelijkenissen met dit soort bedrijven hadden in Amsterdam minder effect omdat platforms zoals Uber en Airbnb niet geheel oncontroversieel zijn. Dat buitenlandse startups de al drukke binnenstad gebruiken voor commerciële deelfietsdiensten zorgde voor lokaal verzet aangezien dit haaks op de lokale fietscultuur staat waarin fietsbezit een belangrijke rol speelt.

Hoofdstuk 4 laat zien dat platform innovaties ook onvoorziene en ongewenste effecten kunnen veroorzaken zoals overlast, lage kwaliteit deelfietsdienst, gebrekkige samenwerking met lokale autoriteiten en zorgen over data privacy. Dit negeren kan zorgen voor tegenslagen in positieve transities naar duurzame stedelijke mobiliteit. Hiertoe wordt, vanuit een verantwoord innoveren perspectief, de impact van business model innovatie en strategieën van deelfietsbedrijven en gemeentes in Amsterdam, Utrecht en Rotterdam onder de loep genomen. Deze steden reageerden verschillend op de introductie van de nieuwe deelfiets, van verbod tot experimenteren in een living lab. Het onderzoek laat zien dat sociale en ethische factoren een belangrijke rol spelen in het succes of falen van business model innovatie. De analyse legt twee verschillende typen bedrijven bloot. Aan de ene kant zijn er bedrijven die snel marktaandeel proberen te verwerven door zonder afstemming met lokale autoriteiten grote aantallen deelfietsen tegen kunstmatig lage prijzen aan te bieden. De focus op snel en grootschalig lanceren leidt tot hevige competitie en gaat uiteindelijk ten koste van een kwalitatieve deelfietsdienst en aandacht voor lokale belangen. Daarnaast ziet dit type aanbieder kansen in dataverzameling en is de deelfietsendienst vaak geïntegreerd in of onderdeel van grotere technologie bedrijven of digitale platforms die ook e-commerce, sociale media, online betalingen, taxi of maaltijddiensten aanbieden. Aan de andere kant zijn er ook aanbieders die meer focussen op samenwerkingen met lokale stedelijke autoriteiten en aandacht hebben voor publieke belangen. Ze maken afspraken over een gecontroleerde uitrol van deelfietsen en het delen van data voor onderzoek en beleidsdoeleinden. Deze bedrijven handelen responsief door bedrijfsstrategie en business model aan te passen aan lokale omstandigheden.

In Hoofdstuk 5 worden uitdagingen en dilemma's van strategisch stedelijk experimenteren met fietsinnovatie in living labs onderzocht. Aan de hand van strategisch niche management literatuur worden praktische uitdagingen en dilemma's met betrekking tot visies en verwachtingen, het bouwen van netwerken en

leerprocessen van living labs geïdentificeerd in vier Nederlandse steden (i.e. Amsterdam, Utrecht, Eindhoven en Zwolle). Living labs bieden een platform voor open innovatie waarin verschillende stakeholders – zoals beleidsmakers, innovators en onderzoekers – gezamenlijk beloftevolle innovaties – zoals platform gedreven deelfietsen – in een praktijkomgeving testen. Experimenteren in living labs kan daarnaast ook worden gezien als een bestuurlijke aanpak om al doende te leren over de kansen en problemen van innovatie en indien nodig de ontwikkeling van deze innovatie bij te sturen. Een belangrijke uitdaging van strategisch stedelijk experimenteren in living labs is het managen van verwachtingen over het experimenteerproces in plaats van verwachtingen over de innovatie zelf. Gezamenlijk experimenteren brengt namelijk verschillende disciplines en ervaringen bij elkaar. Om het leerproces te bevorderen vraagt dat om het duidelijke afstemming van ideeën, belangen, rollen, werkwijzen, verantwoordelijkheden en procedures. Het aanstellen van een toegewijde projectleider blijkt bij te dragen aan het inbedden van de living lab aanpak in bestaande organisatiestructuren van overheden. Tot slot laat de studie zien dat living lab onderzoekers grote invloed hebben op het ontwerp, verloop en uitkomst van experimenten. Het schakelen tussen de rol van objectieve onderzoeker en aanjager van innovatie vraagt om reflectie.

In antwoord op de onderzoeksvraag hoe platform innovatie interacteert met stedelijke mobiliteitstransities is de algehele conclusie dat platform innovatie leidt tot 1) nieuwe business modellen, 2) het uitdagen van stedelijke instituties en 3) veranderende experimenteerdynamieken.

- Nieuwe platform gedreven business modellen versnellen stedelijke mobiliteitstransities vanwege ruimtelijke netwerk effecten. Platformen hebben schaalvoordelen en zijn niet kapitaal intensief. Dit maakt snelle en mondiale verspreiding van innovatieve diensten mogelijk, met name omdat platformen niet afhankelijk zijn van investeringen in nieuwe fysieke infrastructuur. Platform innovaties brengen ook gevestigde technologiebedrijven en startups naar de voorgrond van mobiliteitstransities. Een belangrijke motivatie hiervoor zijn potentiele verdiensten uit gebruikersdata (data die bovendien ook publieke doelen kan dienen). De nieuwe business modellen kunnen echter ook leiden tot niet-duurzame effecten, wat van invloed is op de aanvaardbaarheid en wenselijkheid van mobiliteitstransiteis.
- Platform innovatie zorgt voor frictie met stedelijke instituties omdat afstemming vaak mist met bestaande regelgeving, normen of lokale culturen. Dit

is van invloed op het draagvlak voor platform innovatie. Door het creëren van nieuwe instituties of het beïnvloeden van bestaande instituties in hun eigen voordeel veranderen platform innovators de richting van stedelijke mobiliteitstransities.

- De snelle lancering van platform innovatie staat op gespannen voet met de meer weloverwogen en democratische evaluatie van de sociale wenselijkheid. Dit zorgt voor spanningen tussen private aanbieders van platforminnovatie en publieke stakeholders in stedelijke mobiliteitstransities.

Tot slot wijst dit onderzoek op een belangrijke bestuurlijke uitdaging omdat platform innovatie bepaalde publieke belangen behartigt (zoals duurzame mobiliteit) maar tegelijkertijd ook andere publieke waarden ondermijnt (zoals overlast of dataprivacy). Bovendien blijkt dat steden nog niet goed uitgerust zijn om te kunnen anticiperen op de impact van platform innovatie. Om uitdagingen van platform innovatie in de toekomst beter het hoofd te bieden – en een positieve bijdrage aan stedelijke transities te garanderen – zijn daarom nieuwe vormen van bestuur en samenwerking tussen lokale overheden en platformen nodig. Dit onderzoek beveelt strategische stedelijke experimenten in living labs aan als passende bestuurlijke aanpak waarin belanghebbenden gezamenlijk leren over kansen en problemen van platform innovatie.

8.4 Curriculum Vitae

Arnoud van Waes focuses in his work on understanding and initiating processes of sustainable innovation. He has a background in Mechanical Engineering and obtained a MSc degree in Innovation Sciences from Eindhoven University of Technology, the Netherlands. During his studies he did an engineering internship at a hydropower plant in Nicaragua, worked as a sustainability consultant at a startup in Amsterdam and did a research exchange at Aalborg University Copenhagen, Denmark. After completing his MSc degree he worked as a project manager and Technology Assessment researcher at the Rathenau Institute in The Hague, the Netherlands. There he was involved in research and policy advice on renewable energy, circular economy, digital platforms, robotization & automation and agri-food. He continued his interest in sustainable innovation with a doctoral research project and joined the Innovation Studies group at Copernicus Institute of Sustainable Development, Utrecht University, the Netherlands. His PhD research was embedded in the transdisciplinary research project Smarty Cycling Futures and focused on platform innovation in urban mobility transitions. He conducted fieldwork in China as a visiting research fellow at Fudan University in Shanghai and the International Business School at Xi'an Jiaotong-Liverpool University in Suzhou. During his time in Utrecht, he was also involved in teaching Sustainable Entrepreneurship at the Utrecht University School of Economics. In addition, he attended and presented his work at different international academic conferences on sustainability transitions and business model innovation, as well as more practitioner oriented events and workshops on urban mobility and cycling innovation in the Netherlands. Furthermore, he was closely involved in setting up and managing urban living lab experiments in major Dutch cities. His work has been published in academic journals, advisory reports and popular media. He currently works as a Senior Consultant at TwynstraGudde on innovations in energy and mobility transitions.

8.5 List of publications

- Van Waes, A. (2017). Geef deelfiets de ruimte. **NRC Handelsblad.** *https://www.nrc.nl/nieuws/2017/07/31/geef-deelfiets-de-ruimte-12307002-a1568370*

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- Frenken, K., van Waes, A., Pelzer, P., Smink, M., & van Est, R. (2019). Safeguarding Public Interests in the Platform Economy. **Policy and Internet.** *https://doi.org/10.1002/poi3.217*

- Van Waes, A., Farla, J., & Raven, R. (2020). Why do companies' institutional strategies differ across cities? A cross-case analysis of bike sharing in Shanghai & Amsterdam. **Environmental Innovation and Societal Transitions, 36 (October 2019), 151–163.** *https://doi.org/10.1016/j.eist.2020.06.002*

- Te Brömmelstroet, M., Nikolaeva, A., Nello-Deakin, S., van Waes, A., Farla, J., Popkema, M., van Wesemael, P., Liu, G., Raven, R., de Vor, F., & Bruno, M. (2020). Researching cycling innovations: The contested nature of understanding and shaping smart cycling futures. **Transportation Research Interdisciplinary Perspectives, 8, 100247.** *https://doi.org/10.1016/j.trip.2020.100247*

- Long, T. & van Waes, A. (2021). When bike sharing business models go bad: incorporating responsibility into business model innovation. **Journal of Cleaner production, 297, 126679 .** *https://doi.org/10.1016/j.jclepro.2021.126679*

- Van Waes, A., Nikolaeva, A. & Raven, R. (2021). Challenges and dilemmas of strategic urban experimentation. An analysis of four cycling innovation living labs. **Technological Forecasting and Social Change.** *(second review)*

notes

Platform innovation in urban mobility transitions

Platform innovation has emerged as a potential accelerator for urban mobility transitions. This book explores the opportunities and challenges of platform innovation by investigating the rise and fall of dockless bike sharing: a story of a seemingly promising urban mobility innovation, disruptive global growth and also undesirable outcomes. Drawing on scientific scrutiny and real-life experimentation, this book brings together insights from the global cycling capital Amsterdam and the bike sharing capital Shanghai. This new phenomenon demonstrates how platform innovation gives rise to new business models, challenging regulations and prevalent practices. Platform innovation has brought major technology companies to the centre of urban mobility transitions, conflicting with public interests beyond sustainable urban mobility. To navigate challenges of platform innovation in urban mobility transitions, this book provides business and governance strategies.

Arnoud van Waes is a researcher and consultant focusing on sustainable innovations in mobility and energy transitions