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THE SHARING ECONOMY IN TRANSITIONS: LEGITIMATION DYNAMICS IN THE URBAN MOBILITY CONTEXT IN FORTALEZA, BRAZIL

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To my wife, Aline, and our son, Fernando Henrique. As everything has always been… As everything will always be… For you.

During the final stages of this work, humanity was challenged by a menacing virus. To all professionals who have been working on the front line to save lives, I dedicate my most sincere deference.

"I am not a tree hugger! Sometimes we hear like this: 'Oh, you have a car? That's no longer a thing of the future, man! The future is having nothing!' No, man, sorry. For me, the future is for you to have everything. The future is about you have the subway, have a train, bus, bike... even a car! All the options at your disposal."

(Excerpt of interview with Bicicletar user B11)

ABSTRACT

Despite the growing literature on the sharing economy, legitimacy issues in this specific field are still little studied, while the debate on its controversial results grows. In this sense, the objective of the thesis was to understand the legitimation process of innovations performing in the context of the sharing economy from the perspective of the different actors involved. We orchestrated the main literature on the business model approach, legitimacy theory, and transitions perspective then put the sharing economy into the structure. From this literature review, we proposed that sharing economy ventures are based on innovative business models building up internal momentum and adding stability in technological niches while interacting with institutionalized rules of the incumbent socio-technical regime. Such rules could represent a set of legitimacy requirements that new business models have to meet, transform or replace in order to emerge and stabilize. An integrative theoretical framework was proposed that provided guidelines for empirical work, since the contents and meanings of its relationships and constructs – that is, legitimacy mechanisms – were not yet known. Based on a qualitative, interpretivist approach, and adopting a discovery-oriented research posture, a multiple case study was conducted in the context of urban mobility in Fortaleza, Brazil. Three cases were selected: an electric car sharing system (Vamo Fortaleza) and two bicycle sharing systems (Bicicletar and Bicicleta Integrada). For reliability purposes, data were collected from a variety of sources, such as documents, observations and in-depth interviews with users, policymakers and partner companies' managers. Regarding the theoretical contributions of the research, our findings confirmed or advanced the current literature in that (i) business models are valuable tools to deal with legitimation challenges since some actors managed their components to meet the legitimacy requirements that innovations needed to stabilize; (ii) public sector actors use business models as managerial tools to accelerate urban transitions to sustainability; (iii) landscape developments are not homogeneous, but an arrangement of heterogeneous forces influencing both developing niche innovations and the dimensions of the socio-technical regime; (iv) with regard to niche-regime interactions, new business models can undertake a symbiotic ("fit-and-conform") strategy with one or more dimensions of the incumbent regime while maintaining a disruptive ("stretch-and-transform") position relative to others; and (v) the interplayed approach of business models and legitimacy theory from the transitions perspective can give analysts the ability to capture dynamics from both strategic and institutional views of legitimacy. On the empirical contributions, the content analysis also

showed that (vi) due to the interaction between diverse interests and expectations of different groups of actors, sponsored business models in the sharing economy can achieve only a balanced legitimacy, that is, an equilibrium degree from which any gain in legitimacy for one group will necessarily be extracted from another; (vii) the main determinants of balanced legitimacy of sharing-based business models were: the interests of each group of actors, network logic, complementary infrastructure, maintenance issues, station balancing process, and system reliability; (viii) policymakers are very influential actors for urban transitions, as they have directly engaged in regulatory matters, technological and business model innovations, infrastructure efforts, educational policies and awareness campaigns aimed at transforming habits and ultimately the culture for more sustainable urban mobility. We also discussed implications and limitations of the study and proposed an agenda for future research.

RESUMO

A despeito da crescente literatura sobre a economia do compartilhamento, questões de legitimidade neste campo específico ainda são pouco estudados, enquanto cresce o debate sobre seus controversos resultados. Neste sentido, o objetivo da tese foi compreender o processo de legitimação de inovações desempenhadas no contexto da economia do compartilhamento a partir da perspectiva dos diferentes atores envolvidos. Combinou-se a principal literatura sobre a abordagem de modelos de negócio, teoria da legitimidade e perspectiva de transições, e colocou-se a economia do compartilhamento neste contexto. A partir desta revisão de literatura, propôs-se que estas iniciativas são baseadas em inovações em modelos de negócio, construindo momentum interno e ganhando estabilidade nos nichos tecnológicos enquanto interagem com regras institucionalizadas do regime sociotécnico incumbente. Tais regras poderiam representar um conjunto de requisitos de legitimidade que os novos modelos de negócio precisam atender, transformar ou substituir para emergir e se estabelecer. Propôs-se um *framework* teórico integrativo que forneceu diretrizes para o trabalho empírico, uma vez que os conteúdos e significados das relações e construtos nele presentes – ou seja, mecanismos de legitimação – ainda não eram conhecidos. A partir de uma abordagem qualitativa-interpretativista, e adotando uma postura de pesquisa orientada à descoberta, foi realizado um estudo de múltiplos casos no contexto da mobilidade urbana em Fortaleza, Brasil. Três casos foram selecionados: um sistema de compartilhamento de carros elétricos (Vamo Fortaleza) e dois sistemas de compartilhamento de bicicletas (Bicicletar e Bicicleta Integrada). Para fins de confiabilidade, os dados foram coletados de diversas fontes, como documentos, observações e entrevistas em profundidade junto a usuários e gestores públicos e de empresas parceiras. Em relação às contribuições teóricas da pesquisa, os resultados confirmaram ou avançaram a literatura atual em que (i) modelos de negócio são valiosas ferramentas para lidar com desafios de legitimação, pois os atores gerenciaram seus componentes de modo a atender os requisitos de legitimidade que as inovações precisavam para se estabilizar; (ii) atores do setor público se valem de modelos de negócio como ferramentas gerenciais no sentido de acelerar transições urbanas para a sustentabilidade; (iii) desenvolvimentos de landscape não são homogêneos, mas um arranjo de forças heterogêneas a influenciar tanto inovações em desenvolvimento no nicho quanto as dimensões do regime sociotécnico; (iv) sobre interações nicho-regime, novos modelos de negócio podem empreender uma estratégia simbiótica ("fit-and-conform") com uma ou mais dimensões do

regime incumbente enquanto mantém uma posição disruptiva ("stretch-and-transform") em relação a outras; e (v) a abordagem combinada de modelos de negócio e teoria da legitimidade na perspectiva de transições consegue dar a analistas a capacidade de capturar dinâmicas de ambas as perspectivas de legitimidade, estratégica e institucional. Sobre as contribuições empíricas, a análise de conteúdo mostrou ainda que (vi) devido à interação entre diversos interesses e expectativas de diferentes grupos de atores, modelos de negócio patrocinados na economia do compartilhamento podem alcançar apenas uma legitimidade de equilíbrio, isto é, um grau a partir do qual todo ganho em legitimidade para um grupo será necessariamente extraído de outro; (vii) os principais determinantes de legitimidade (de equilíbrio) foram: os interesses de cada grupo de atores, lógica de rede, infraestruturas complementares, aspectos de manutenção, processo de balanceamento de estações, e confiabilidade do sistema; (viii) gestores públicos são atores muito influentes para transições urbanas, uma vez que eles se engajaram diretamente em questões regulatórias, inovações tecnológicas e de modelos de negócio, esforços na área de infraestrutura, políticas educativas e campanhas de conscientização com o objetivo de transformar hábitos e, em última análise, a cultura para uma mobilidade urbana mais sustentável. As limitações do estudo foram discutidas e uma agenda para futuras pesquisas foi proposta.

Palavras-chave: Modelos de negócio; Inovação; Legitimidade; Transições; Sustentabilidade; Setor público; Políticas públicas.

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LIST OF ABBREVIATIONS

AMC	Municipal Traffic and Citizenship Body
BRT	Bus Rapid Transit
BU	Bilhete Único (Individual Pass Card)
CHESF	São Francisco Hydroelectric Company
ETUFOR	Fortaleza Urban Transport Company
GPS	Global Positioning System
IBGE	Brazilian Institute of Geography and Statistics
ICMP	Integrated Cycling Master Plan
IFCE	Federal Institute of Education, Science, and Technology of Ceará
IPECE	Institute of Research and Economic Strategy of Ceará
LRV	Light Rail Vehicle
NTU	National Association of Urban Transport Companies
MLP	Multi-level Perspective
PAITT	Immediate Actions Plan for Transport and Transit
RFID	Radio Frequency Identification
SCSP	Municipal Department of Conservation and Public Services
SEINF	Municipal Department of Infrastructure
SEUMA	Municipal Department of Urbanism and Environment
SITFOR	Fortaleza Transport Integrated System
TGA	Traffic-Generating Area
UECE	State University of Ceará
UFC	Federal University of Ceará

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1 INTRODUCTION

In recent years, much has been discussed about the new business models based on the sharing economy (or collaborative economy, peer-to-peer economy, collaborative consumption, access-based consumption, among other denominations identified in the literature) and their impacts on the various fields of application (CHENG, 2016; DYAL-CHAND, 2015; RICHTER *et al.*, 2017).

The rise of innovations in the context of the sharing economy has led to significant changes in several sectors or industries, such as tourism and hospitality (TUSSYADIAH, 2016; ZERVAS; PROSERPIO; BYERS, 2017), agriculture and food production (UKOLOV *et al.*, 2016), financial services (PISCICELLI; COOPER; FISHER, 2015), fashion industry (JOHNSON; MUN; CHAE, 2016), urban mobility and transportation (TEUBNER; FLATH, 2015; VALENTE; PATRUS; CÓRDOVA GUIMARÃES, 2019), and so on.

Research has intended to understand the phenomenon from behavioral lenses, by investigating the influence of the personal values (DAVIDSON; HABIBI; LAROCHE, 2018; LIMA *et al.*, 2018) and motivations (AMARO; ANDREU; HUANG, 2019; MAHADEVAN, 2018) on the consumer willingness to engage in sharing-based consumption practices. The relationship between sustainable consumption, sharing economy and the environment has also settled an important research field (AUGENSTEIN; BACHMANN, 2018; COHEN; MUÑOZ, 2016; LIGHT; MISKELLY, 2015), although the debate on whether − or not − the sharing economy fosters sustainability is intensifying (BONCIU; BÂLGĂR, 2016; MARTIN, 2016; SALVIA; PISCICELLI, 2018).

Finally, several studies regarding the legal and regulatory perspectives have shed some light on the dynamics of the institutionalization process of new business models based on the sharing economy (DYAL-CHAND, 2015; PFEFFER-GILLETT, 2016; SINCLAIR, 2016). Despite all these recent advances in research in the sharing economy context, the legitimation processes of these ventures still require more attention, given its relevance for new ventures in general (KAGANER; PAWLOWSKI; WILEY-PATTON, 2010; KARLSSON; MIDDLETON, 2015) or new business models in particular (LEE; HIATT; LOUNSBURY, 2017; MIKHALKINA; CABANTOUS, 2015). Except for the regulatory issues, legitimacy in the sharing economy is still very little studied, especially when observing the relationships among different perspectives arising from the wide range of actors involved.

According to Suchman (1995, p. 574), legitimacy is "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions." In this sense, it could be often achieved through the process of conforming to the institutionalized preferences in a given social context (DEEPHOUSE, 1996).

As there exist some risky entry conditions that any new ventures usually have to deal with (e.g., identifying market opportunities, obtaining financial resources, recruiting and training employees), firms performing innovative business models will also face some legitimacy deficits (ALDRICH; FIOL, 1994; KARLSSON; MIDDLETON, 2015; LOUNSBURY; GLYNN, 2001), since their strategies and actions may be in disagreement with established principles and rules and accepted institutional standards (SCOTT, 2014, original 1995).

In addition, as legitimacy can directly influence the firm's growth and/or survival (ALDRICH; FIOL, 1994; SANTOS; EISENHARDT, 2005; TORNIKOSKI; NEWBERT, 2007; VAN OERS; BOON; MOORS, 2018), concerns about the legitimacy of innovation become a crucial point to the organizational strategy, leading companies to adopt behaviors aligned to the established restrictions (FLEURY; CALIXTO, 2016; HARGADON; DOUGLAS, 2001; RINDOVA; BARRY; KETCHEN, 2009), and/or influence institutions, communities and other stakeholders in order to obtain legitimacy (DOWLING; PFEFFER, 1975; ZIMMERMAN; ZEITZ, 2002).

Thus, we consider that firms or activities performing "sharing arrangements" are subject to these conditions, since they shift from a traditional sell-and-ownership model to a "sharing-and-exchange" one (BELK, 2014a).

Although innovations can occur in four different domains – products, processes, marketing and organizational (OECD; EUROSTAT, 2005) – innovations in business models are assumed to be transversal to them (DEMIL; LECOCQ, 2010), as they represent a set of relevant activities of a company that allow the creation of value and wealth (e.g., design, manufacturing, marketing, sales, distribution), and evolve according to the ecosystem in which the company operates (RONG; PATTON; CHEN, 2018).

Firms can innovate in their business models by making radical or incremental changes in the value proposition, supply chain practices and target market definition (DÁVILA; EPSTEIN; SHELTON, 2007), as well as in revenue-generating mechanisms to value creation and strategies to obtain competitive advantage (CHESBROUGH, 2007). Such innovations often require changes in some institutional established patterns (DE LEEUW;

GÖSSLING, 2016), that is, institutional innovations (RAFFAELLI; GLYNN, 2015) that firms have to keep aligned with.

Therefore, we assume that the sharing economy-based initiatives might be seen as business model innovations. As such, they have to overcome a variety of legitimacy gaps to emerge from the niches where they are being developed and become widespread practices.

The multi-level perspective on technological transitions (GEELS, 2002, 2005) could help to explain these dynamic processes of emergence of innovations from niches to socio-technical regimes. This conceptual framework comes from a neo-Schumpeterian, historical-evolutionary approach for Economics (and innovation, in particular), which has gained prominence since the late 1970s (FREEMAN, 1979, 1995; LUNDVALL, 1988; NELSON; WINTER, 1977). This tradition criticizes the excessive focus on transaction costs and the restrictive efficiency-allocation logic and emphasizes the historical cycles of organizational experimentation and learning and the dynamic trajectories of consolidation of novelties (HANUSCH; PYKA, 2007).

Drawing upon these principles, the multi-level perspective on technological transitions analyses the processes of emergence and diffusion of innovations by addressing dynamic interactions among different institutional forces interacting at three levels: niches, socio-technical regimes, and landscapes (GEELS, 2002, 2004, 2018a; MARKARD; TRUFFER, 2008). This research strand seeks to understand how niche developments (i.e., early-stage innovations) should be managed and how the processes of reconfiguration (transition) of the current socio-technical systems (regimes) occurs (GEELS; SCHOT, 2007; KERN, 2012).

Other frameworks than the multi-level perspective might also be useful in investigating emergence and diffusion, such as strategic niche management (KEMP, 1994; RAVEN; VAN DEN BOSCH; WETERINGS, 2010; SCHOT, 1998), transitions management (LOORBACH, 2010; ROTMANS; KEMP; VAN ASSELT, 2001; ROTMANS; LOORBACH, 2010), and technological innovation systems (BERGEK *et al*., 2008; BERGEK; JACOBSSON; SANDÉN, 2008; MARKARD; TRUFFER, 2008).

In this research, however, we decided for the multi-level perspective framework. Our motivation for this lies in some reasons (based on Chang *et al*. (2017) and Markard, Raven and Truffer (2012)): (i) strategic niche management framework focus mainly on niche-internal processes towards emergence and niche-regime interactions, often overlooking external, cultural-institutional context; (ii) transitions management perspective, in turn, is predominantly governance-oriented, emphasizing the role played by public management and

politics in managing transitions, but leaving aside potential contributions coming from businesses and organizational strategies for transitions; (iii) finally, technological innovation systems approach highlights institutional arrangements of sectoral and national systems of innovations to inform guidelines for policy making purposes, without focusing on transitions to sustainability. In our view, therefore, the multi-level perspective framework offers a more comprehensive toolkit to properly address the phenomenon under analysis.

A number of studies have addressed the emergence and diffusion of innovations from the multi-level perspective on transitions (LEPOUTRE; OGUNTOYE, 2018; RAVEN, 2004; SEYFANG; LONGHURST, 2013; VAN DEN ENDE; KEMP, 1999). They investigate the clash between social forces that attempt to maintain the stability of the current regime and those ones that enable or facilitate the change (HARGADON; DOUGLAS, 2001; MYLAN *et al.*, 2019).

This thesis aims to discuss the legitimation process of new ventures performing business models under the sharing economy umbrella, through orchestrating assumptions from the legitimacy theory with some contributions and insights from the multi-level perspective on technological transitions and the business model innovation approach. We thus assume an inter-ontology crossover as meta-theoretical position (GEELS, 2009, 2010, 2020), so that we would be able to effectively combine long-term evolutionary patterns with institutional dynamics.

One argues that this theoretical-conceptual triad seems to provide the appropriate background to explore the phenomenon under investigation, indicate empirical research tracks, and drive comparative theoretical analyses for building a theory capable of explaining such a phenomenon.

1.1 Research problem and objectives

The studies that supported the research theme led to the identification and delimitation of the following research problem:

> *How does the legitimation process of sharing economy innovations performing in the urban mobility context occur?*

From the theoretical-conceptual triad addressed in the research (business model innovation, legitimacy theory, and multi-level perspective on socio-technical transitions), the main objective of this thesis is to understand the legitimation process of sharing economy

innovations performing in the urban mobility context, from the perspective of the different actors involved.

In order to achieve the main objective, some specific objectives were established, as follows:

1. Characterize the socio-technical levels of the urban mobility transition to sustainability;

2. Analyze the nature of relationships between the landscape, regime, and technological niche levels towards transition;

3. Identify the mechanisms and interactions through which the legitimation process of the sharing economy innovations takes place, from the perspective of different actors, namely, users, sharing companies – operator and sponsors – and policymakers;

4. Investigate what role business models play in the legitimation process of the sharing economy;

5. Advance the theoretical and empirical domains on the legitimation of the sharing economy, building on business model innovation approach, legitimacy theory, and multi-level perspective on socio-technical transitions.

1.2 Justification and relevance of the research

Sharing economy is an emerging topic of growing interest in the academic, market, and public policy spheres (LIMA; CARLOS FILHO, 2019). Initiatives based on this business model have brought transformations to a variety of sectors (TÄUSCHER; KIETZMANN, 2017), and led to several clashes arising from its interactions with the current institutional systems (MORGAN; KUCH, 2015).

Such transformations have a controversial nature (FRENKEN; SCHOR, 2017; RICHARDSON, 2015): while many see them as a way to achieve more sustainable forms of production and consumption and promote social inclusion and a more equitable economy (CRAMER; KRUEGER, 2016; HAMARI; SJÖKLINT; UKKONEN, 2016; MI; COFFMAN, 2019), the debate about this innovative business models' ability to deliver such promises increases (ACQUIER; DAUDIGEOS; PINKSE, 2017; MURILLO; BUCKLAND; VAL, 2017; SCHOR, 2017).

On that subject, critical approaches to the sharing economy have become recurrent. They argue that it is a painful manifestation of neoliberalism (MARTIN, 2016) attending to a capitalist agenda (CAMMAERTS, 2011) and highlight its misalignment with legal and regulatory standards (MILLER, 2016; RANCHORDÁS, 2015; RICHARD; CLEVELAND, 2016). Criticisms also underline its potential ability to undermine consumer protection and promote unfair competition (HENTEN; WINDEKILDE, 2016) and inequalities in both an economic (SCHOR, 2017) and a social (FRENKEN, 2017; GANT, 2016) senses. Additionally, sharing economy would stimuli discriminatory practices (COCKAYNE, 2016; SCHOR *et al.*, 2016) and incentive the relaxation of worker protections and labor conditions (GANAPATI; REDDICK, 2018; NERINCKX, 2016).

It should be noted that such a debate ultimately surrounds the legitimation processes of these new business models, considering the vast and complex range of meanings and perspectives to which the term "legitimacy" can give rise (JOHNSON; DOWD; RIDGEWAY, 2006; SUCHMAN, 1995). For instance, in an insightful, integrative work, Deephouse and Suchman (2008) address the knowledge accumulated over three decades about institutional legitimacy and discuss its dimensions, sources, antecedents, and consequences, as well as the process through which the legitimation occurs. While "dimensions" refers to the types or categories of legitimacy (ALDRICH; FIOL, 1994; SCOTT, 2014; SUCHMAN, 1995), "sources", "antecedents", and "consequences" may refer to organizational incentives to attain it and the characteristics from these dynamic process.

Transitions studies have paid little attention to the emergence of new organizational forms and markets for sustainability, which requires analyzes of legitimation processes between the socio-technical levels (BOON; EDLER; ROBINSON, 2020). Therefore, from the multi-level perspective on technological transitions, companies performing innovative business models (sharing-based activities, for instance) would have to pursuit sources of legitimacy to reach a fittest alignment with the socio-technical standards, in a multidirectional, dynamic niche-regime interaction.

Unexpectedly, very little research has addressed the legitimacy phenomenon in the sharing economy context (see Mair and Reischauer (2017) for an exception). Most of these studies have considered only the legal-regulatory dimension of legitimacy, as mentioned before. They focused on how to *regulate* − rather than *legitimate* − the sharing economy (DYAL-CHAND, 2015; KATZ, 2015; MILLER, 2016), without even mentioning the term legitimacy or paying attention to this phenomenon and its complexity and multidimensionality.

Besides, virtually no studies have placed the sharing economy into the multi-level perspective on technological transitions to sustainability (e.g., MARTIN, 2016; MARTIN; UPHAM; BUDD, 2015; MORADI; VAGNONI, 2018; PRAYAG; OZANNE, 2018), despite the sharing economy's sustainable appeal (CURTIS; LEHNER, 2019; MI; COFFMAN, 2019). However, none of them focused on the legitimation process, which is why legitimacy in the sharing economy remains ill-understood.

Geopolitics is also a relevant issue for this research. Transitions literature has been focusing predominantly on the developed world (WIECZOREK, 2018), especially on European nations, given the provenience of the mainstream researchers and institutions (MARKARD; RAVEN; TRUFFER, 2012). Nonetheless, a growing number of studies have investigated transitions dynamics in the context of developing countries (HANSEN *et al*., 2018), where ill-functioning institutions reproduce social exclusion, poverty, corruption, and market imperfection (RAMOS-MEJÍA; FRANCO-GARCIA; JAUREGUI-BECKER, 2018). Within this cohort, however, Brazil seems to have still little prominence in the number of studies compared to Africa and Asia (WIECZOREK, 2018).

The locus of analysis of the dynamics of transitions matters. While most studies apply national or global approaches to the detriment of regional or urban ones (MARKARD; RAVEN; TRUFFER, 2012), there should be various place-specific factors that directly affect transitions, such as urban and regional visions shaping decision making processes in local political contexts, and informal localized institutions (values, norms, and practices) influencing legitimation practices (HANSEN; COENEN, 2015).

As Coenen, Benneworth and Truffer (2012, p. 976) asserted, cities could be seen as "major nodes in wider networks of actors that may simultaneously develop their local resources and access and influence resources at different spatial scales." Cities can act as transitions managers and provide protected spaces for experimentation and learning in a wide range of initiatives, such as energy-efficient housing, renewable energies, sustainable urban mobility, and so on (TORRENS *et al*., 2019; TRUFFER; COENEN, 2012). Also, by adopting a city-level perspective, we can capture social relations, roles, responsibilities, and intrinsic motivations of actors engaged in transition processes (HÖLSCHER *et al*., 2019).

From the discussions above, our motivations to undertake this research lay in five foremost aspects. First, to the best of our knowledge, there are still no empirical contributions to support the theoretical assumptions we made in this research, stemmed from the theoretical-conceptual triad adopted. In this respect, empirical efforts are assumed to be capable of avoiding a merely stylized theoretical arrangement.

Second, sharing economy is experiencing rapid growth worldwide, with a large amount of criticisms. Given this controversial, paradoxical nature (ACQUIER; DAUDIGEOS; PINKSE, 2017), it is still unclear whether its advantages (promises) surplus the risks and adverse externalities. Indeed, even such negative consequences are not well-known in the long run (FRENKEN; SCHOR, 2017).

Third, the Eurocentric bias of transitions research (MARKARD; RAVEN; TRUFFER, 2012) unveils opportunities for studies in the developing world. From a spatial point of view, investigating the dynamics of transitions in a specific urban context allows us to focus on local processes and institutions that a global approach might not reach (fourth). Regarding this issue, this thesis responds to the call for research addressing local or urban analyses of transitions, especially in Brazil, where the field seems like nascent.

Finally, there is a recognized theoretical and empirical gap for the phenomenon in this specific field. Legitimation processes in general lack empirical research (DEEPHOUSE; SUCHMAN, 2008), and those related to the sharing economy context in particular are almost inexistent, as previously underlined. So, an emerging theory to explain the phenomenon seems well-timed.

The quest for a substantive theory is assumed to be applicable whenever existing formal theories fail in explaining or are not appropriate to predict a particular phenomenon, in a substantive area or context. Research efforts therefore are necessary in order to propose a more suitable theory, the basis upon which grounded (based on data) formal theory is generated (GLASER; STRAUSS, 1965).

Thus, there is an opportunity for studies aimed at understanding the multidimensional construct of legitimacy and its dynamics, from the perspective of each actor involved in (or impacted by) existing sharing-based initiatives. This is the gap that this thesis intends to supplant, in line with a novel research agenda that seeks to relate constructs and frameworks from both management studies (e.g., legitimacy, business models) and transitions theory (BOON; EDLER; ROBINSON, 2020; KÖHLER *et al*., 2019).

1.3 Research context

As urban populations expand, cities need to overcome increasing pressure undermining the infrastructure, economic, and ecological systems (CERUTTI *et al*., 2019; COHEN; MUÑOZ, 2016). On the other hand, the rise of a collaborative economy based on sharing activities and ubiquitous information and communication technologies has brought

several challenges for the public sector, in order to strike a balance between supporting the innovative potential of the sharing initiatives in utilize idle assets and mitigate their eventual negative consequences (GANAPATI; REDDICK, 2018).

In particular, the transport sector encompasses a set of challenges to society such as air pollution, greenhouse gases, CO_2 emissions (MORADI; VAGNONI, 2018; PEREIRA; SILVA, 2018), mainly in countries and cities that struggle with rapid population growth and increasing density, as well as the need for reduce inner-city traffic and congestion (COHEN; KIETZMANN, 2014).

In Brazil, the deterioration of the commuting quality in the cities observed in the last decades has encouraged the development of innovative public policies in urban mobility (MEIRA; ANDRADE; LIMA, 2017; PERO; STEFANELLI, 2015). Such developments led researchers to evaluate their impacts on the productivity of the workers (HADDAD; VIEIRA, 2015) and plan new urban mobility systems in light of sustainability principles (MARTINS; VASCONCELOS; SALLES, 2017), as well as social, cultural, economic and health aspects (NETTO; RAMOS, 2017).

In this context, several new business models have emerged and experienced fast diffusion in Brazil and worldwide under the sharing economy concept, such as car sharing systems (ILLGEN; HÖCK, 2018; PRIETO; BALTAS; STAN, 2017; VALENTE; PATRUS; CÓRDOVA GUIMARÃES, 2019), bike sharing platforms (ARRUDA *et al*., 2016; SANTOS, 2018; VAN WAES *et al*., 2018), ride sharing services (COHEN; KIETZMANN, 2014; LEE *et al*., 2018; SHAHEEN; CHAN; GAYNOR, 2016), and electric scooter sharing systems (AGUILERA-GARCÍA; GOMEZ; SOBRINO, 2020; HARDT; BOGENBERGER, 2019).

The aforementioned debatable nature of the sharing economy is also perceived in this field in particular. Some studies have positioned sharing initiatives as a way to achieve more sustainable urban mobility systems (BULLOCK; BRERETON; BAILEY, 2017; MORADI; VAGNONI, 2018; YANG *et al*., 2018), capable of reducing inequalities (CRAMER; KRUEGER, 2016), democratizing access to a number of services and facilities (RANCHORDÁS, 2015), and balancing safety and social inclusion (SINCLAIR, 2016) if performing under appropriate conditions.

Nevertheless, sharing practices in the urban mobility context have also been criticized insofar as discussions about aspects such as safety, conflicts with the traditional users and companies, infrastructure issues, and misconduct by service providers have raised. For instance, traditional taxicab companies have accused ride sharing services – like Uber and its local competitors – of practicing unfair competition, consumer fraud, and deceptive

business practices (POSEN, 2015). Furthermore, customers have alleged incidents of driver misconduct, including driver negligence and sexual harassment (PFEFFER-GILLETT, 2016).

Bike sharing systems often lack sufficient dedicated bicycle infrastructures such as exclusive bike lanes and docking stations density. There is also safety issues related to a perceived lack of car drivers' awareness and perceived risk of collision with motor vehicles (FISHMAN; WASHINGTON; HAWORTH, 2013; SANTOS, 2018). Additionally, municipalities and bike sharing operators need to explore mechanisms to support the provision of service in lower density peripheries (COHEN; KIETZMANN, 2014). Some of these factors are assumed to be critical for the success of bicycle sharing systems (MÉDARD DE CHARDON; CARUSO; THOMAS, 2017).

In turn, car sharing schemes still face barriers such as lack of familiarity with the concept, fear of sharing among users, insurance issues, and vehicle availability (BALLÚS-ARMET *et al.*, 2014; SHAHEEN; MALLERY; KINGSLEY, 2012), although these factors may vary according to the service modality. Finally, scooter sharing programs have been associated with increasing number of accidents with users and pedestrians (AIZPURU *et al.*, 2019; SIKKA *et al.*, 2019).

It is argued that such challenges in the context of urban mobility underpin the sharing economy's struggle for legitimacy, in its various dimensions, such as culture, user practices, infrastructure, technology, policy and regulatory issues. Although the societal functions of transport and urban mobility are one of the main strands of transition studies (e.g., BERMÚDEZ RODRÍGUEZ, 2018; COELHO; ABREU, 2019; GEELS, 2012, 2018b; MARLETTO, 2014; SPREI, 2018), such studies do not take sharing economy-based new ventures and their legitimation dynamics as research objects.

Thus, this research addresses the legitimation process of sharing-based business models in the context of urban mobility in transition. The spatial context of the study is the city of Fortaleza, Brazil, where local government actors have engaged in public-private partnerships to run sponsored bike sharing and car sharing systems. The research interests are on the systems' business models themselves, rather than those of sponsors or other participant companies.

1.4 Research structure

Besides this introduction and the references section, the thesis is structured in the following sections: in the second chapter, we discuss the theoretical support of the research,

by addressing the business model approach, the multi-level perspective on socio-technical transitions, and legitimacy theory in specific sections for each one. In addition, we dedicated another section to orchestrate this theoretical triad and connect their main constructs in accordance with the aims of the research. This theoretical underpinning chapter ends with a section addressing the sharing economy from the business model approach and the transitions perspective, followed by a closing discussion about legitimacy in that context.

We dedicated the chapter 3 to epistemological considerations, as well as an explanation of the methodological design. Here, we address our ontological stance, the research approach and design and strategies. The characterization of the cases studied, the data sources and *corpora*, data collection and analysis techniques, and the participants' profile are also discussed here.

Early results are presented and discussed in two subsequent parts. In the fourth chapter, we engage in a descriptive approach and present a characterization of the landscape and socio-technical regime levels. Chapter 5, in turn, provides a detailed description of the business models investigated, with the research cases being considered niche developments. For the purposes of such a descriptive approach, we rely on the participants' perceptions about the sharing initiatives, as well as the analysis of the information obtained from observations and documentary sources. In this way, we were able to capture the nature of relationships between the landscape, regime, and technological niche levels.

Still in chapter 5, after each case description (business models), we develop a more inductive approach focusing on the dynamics of interactions between socio-technical levels and actors to identify the mechanisms – drivers and barriers – through which the legitimation process of the sharing economy occurs. Deductive work has also undertaken here, with the aim of proposing relationships between variables from the research data. In particular, the role played by business models in the transition journey was also examined.

We further discuss all these findings in the sixth chapter, in light of the research specific objectives, and make a comparison with the visited literature, pointing out similar and conflicting aspects. Furthermore, we highlight the research advances for this literature and propose a draft of a substantive theory for the phenomenon, by enunciating presuppositions or hypotheses that emerged from the data.

In chapter 6, in turn, we present the research concluding remarks. It contains discussions about conceptual implications for existing literature and contributions to management in the sharing economy field; research limitations are discussed, and some recommendations for future works are suggested.

Appendices bring up the rear containing the data collection protocols (documents, observations and in-depth semi-structured interview), as well as the fieldwork records, with additional photographic records to those in the body of the text.

2 THEORETICAL UNDERPINNING

In this chapter, we orchestrate three theoretical-conceptual literatures that underpin the thesis. Empirical studies addressing the theme are also visited and discussed. Besides, one section is dedicated to addressing the sharing economy as the field of empirical efforts of the research.

2.1 Business model innovation

The academic literature is prominent in technological innovation. However, new technologies often need to be combined with innovations in business models to enable the customer value capture: a change in technology rarely does not simultaneously yield improvements or adaptations – occasionally radical ones – in business models or processes (DÁVILA; EPSTEIN; SHELTON, 2007; TEECE, 2010). That is, an appropriate business model can "translate technical success into commercial success." (SAKO, 2012, p. 24)

It should be noticed that the economic value of technological innovation will remain latent until it is marketed through some business model. The same technology applied in different ways will yield different returns, which denotes the relevance of the business models (CHESBROUGH, 2010; SHAW; ALLEN, 2018).

Before addressing innovation in business models, it is necessary to comprehend the concept of business model itself. The term "business models" has become widely used by practitioners and scholars, and its ubiquity and variety of uses suggest that they are of great importance to the business and academic fields (BADEN-FULLER; MORGAN, 2010). Such a concept has often been misinterpreted and confused with other constructs from organizational theories such as strategy, business concept, or business process modeling (DASILVA; TRKMAN, 2014).

The Casadesus-Masanell and Ricart's (2010) definition may help to reduce the overlap between the concepts of strategy and business model. These authors state that the term business model "refers to the logic of the firm, the way it operates and how it creates value for its stakeholders", whereas strategy "refers to the choice of the business model through which the firm will compete in the marketplace" (p. 196).

According to Chesbrough (2007), business models define how an organization creates, markets, and delivers value to customers, as well as captures value from them in

return. Though quite understandable, this definition does not provide insight into all the elements that constitute a business model.

In this regard, Wirtz *et al*. (2016) suggest that a business model is an aggregated representation of the main activities of a firm that describes the architecture of value creation, i.e., how information, products or services are generated, as well as the strategic, customer and market components, in order to sustain the competitive advantage. On that subject, Johnson, Christensen and Kagermann (2008) define four interlocking building blocks of a business model, as depicted in Figure 1:

Figure 1 – Business models building blocks
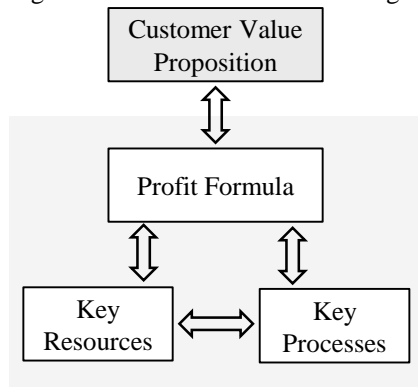
Source: The author, adapted from Johnson, Christensen and Kagermann (2008)

Customer value proposition refers to a fundamental, preferably distinctive way to create value for customers, that is, solve a significant problem. Profit formula, in turn, is the mechanisms by which a firm creates value for itself while delivering value to the market, i.e., delivering its value proposition to its targeted customers. To do this, companies need to employ a set of key resources, assets required to build the value proposition and make it tangible and deliverable (e.g., people, technologies, financial assets, products, facilities, channels). Finally, key processes refer to the operational and managerial routines and procedures that support firms in providing value to the market and capturing value in return (e.g., planning, research and development, manufacturing, outsourcing, sales, customer service, contract management).

In a seminal paper, Amit and Zott (2001) drew on theoretical contributions from diverse literature (e.g., value chain analysis, strategic networks, resource-based view of the firm, and transaction cost economics) and proposed a very comprehensive definition to business models which consider content, structure, and governance transactions to create value. According to the authors,

> *Transaction content* refers to the goods or information that are being exchanged, and to the resources and capabilities that are required to enable the exchange. *Transaction structure* refers to the parties that participate in the exchange and the ways in which these parties are linked (…) and the adopted exchange mechanism for enabling transactions (…). Finally, *transaction governance* refers to the ways in which flows of information, resources, and goods are controlled by the relevant parties (…) and to the incentives for the participants in transactions (AMIT; ZOTT, 2001, p. 511, emphases in the original).

Thus, business models may be interpreted as an arrangement of specific resources and capabilities (e.g., technologies, exclusive processes, influential brands, patents) and transactions with other market actors in order to create value (DASILVA; TRKMAN, 2014). In line with these authors, Amit and Zott (2015) describe business models as a system of interdependent activities performed by a focal firm and others actors in the value chain (vendors, end customers, etc.), by combining their human, physical, and capital resources through mechanisms linking these activities to each other.

As we can see, business models combine both transactional and resource-based views of the firm as "boundary-spanning systems of transactions and activities" (AMIT; ZOTT, 2015, p. 332), a conceptual approach that has been explored by several studies (CONNER; PRAHALAD, 1996; EUN; LEE; WU, 2006; MCIVOR, 2009; RONG; PATTON; CHEN, 2018). This broader conceptual approach considers the effective role of the interactions among the several actors in the value chain, as well as the influence of external factors that could lead to changes in the business model.

Given this dynamic, evolutionary facet, there is a need to comprehend the role of innovation in this specific field. As expected, innovation is one of the vital research foci in the business model literature (WIRTZ *et al.*, 2016).

From a broader angle, innovation is "the attempt to try out new or improved products, processes or ways to do things." (FAGERBERG; SRHOLEC; VERSPAGEN, 2010, p. 834) According to the Oslo Manual (OECD; EUROSTAT, 2005), there are four types of innovation: product innovation, process innovation, marketing innovation, and organizational innovation. In turn, novel business models might stem from adequate arrangements of these elements, since they can yield slack of resources that could be used in developing new products, improving processes efficiency, or exploring new markets (DEMIL; LECOCQ, 2010).

Business model innovations are new ways to organize business to create and capture value for its stakeholders, through finding novel, different manners to generate revenues and define value propositions for customers, suppliers, and partners (CASADESUS-MASANELL; ZHU, 2013). Foss and Saebi (2016, p. 21) refer to business model innovation as "(…) a managerial process of search in the space of combinations of BM [business models] components (and their underlying activities)." Therefore, innovations in business models could entail changes in the whole value chain and could be a pathway to obtain competitive advantages, especially if such an innovative model is sufficiently distinguished and difficult to be replicated by incumbent companies and new entrants (TEECE, 2010).

"Distinguished" and "difficult to be replicated" (as well as "legitimate", "appropriate") are perceptions exogenous to the focal firm, that is, views from other actors in the institutional environment in which it performs, such as suppliers, customers, government agencies, and competitors, either entrants or incumbents. When a company introduces an innovative business model, this institutional environment is not expected to be inert, so that shifts in established patterns may occur (DE LEEUW; GÖSSLING, 2016), either to prevent or to conform to it.

Furthermore, as business models innovations can play a role in opening up new markets (THOMPSON; MACMILLAN, 2010), competitive settings may also run through transformations. For example, incumbents can learn about new business models from entrants and incorporate these innovations. Hence, innovators need to make a decision between revealing their ideas – i.e., running its new business model – or, instead, hiding them by adopting a traditional logic of value (CASADESUS-MASANELL; ZHU, 2013).

This dilemma represents a quest for legitimacy that new organizational forms (hence, new business models as well) undertake (TORNIKOSKI; NEWBERT, 2007). Drawing upon the content, structure, and governance framework (AMIT; ZOTT, 2001), Snihur and Zott (2013) point out that legitimation efforts (e.g., fostering the diffusion of knowledge and understanding about their innovation) can raise the specter of imitation by competitors and undermine the competitive advantage. Thus, firms could increase legitimacy with customers and partners insofar they limit the likelihood of imitation through strategically designing the content, structure, and governance of their business models.

Alignment with customers' expectations and partners' requirements can assist the institutionalization of the business model that has not yet thrived. Experimentation, learning, and adaptation thus are the norm (PISANO; PIRONTI; RIEPLE, 2015; TEECE, 2010). New business models undergo a fine tuning process of voluntary and emergent incremental

changes (DEMIL; LECOCQ, 2010) in order to achieve alignment with the norms, culture, laws, and users preferences; ultimately, to be legitimate, appropriate, as mentioned above.

Legitimacy could also come from the engagement in collaborations with partners from the public sector, which often occurs through alliances or public-private partnerships. The next section puts the business model approach into the public sector perspective and gives a brief overview of its origins and development in this specific domain.

2.1.1 Business models in the public sector

Although the expression "business models" has its roots in the for profit organizations field, recent literature, mainly that linked to public entrepreneurship and public sector innovation, has claimed that business models for both public and private sectors share the same foundations, yet may differ in aspects like scope and design (NAJMAEI; SADEGHINEJAD, 2016).

The entrepreneurial function of the public sector has been discussed for a long time (e.g., RAMAMURTI, 1986; ROBERTS, 1992). Much of the debate has taken place within the realm of the different traditions of economic thought and their related conceptions of the role of the State (BOYETT, 1996; QUINN; COURTNEY, 2016), accompanying the rise of the so-called internal markets, or "quasi-markets", in the mid-1980s (LE GRAND, 1991).

The phenomenon of quasi-markets refers to the fundamental transformation in the public sector arena through which public service organizations began to operate as quasi-firms, being pressured to marketing their services, reducing costs and raising quality, yet under the governmental regulatory power (FERLIE, 1992). In that scenario, public entrepreneurship emerges as a key means to create, develop, implement, and consolidate innovations in the public sector (BARTLETT; DIBBEN, 2002).

Relying on Schumpeter's thought, Roberts (1992, p. 56) also highlights the role of innovation and defines public entrepreneurship as "the generation of a novel or innovative idea and the design and implementation of the innovative idea into public sector practice." Thus, public entrepreneurship involves a set of tasks and processes by which governments and public administrators innovate to improve the performance of their operations in the provision of public goods and services and raise citizens' quality of life (LEWANDOWSKI, 2017).

Among other factors, public entrepreneurship differs from private entrepreneurship typically by the weaker competitive forces, the poorer definition and measurement of objectives and performance, and the way value created is privately appropriated (KLEIN *et al*., 2010). Despite this, one argues that public sector organizations need to be entrepreneurial as much as any business does (DRUCKER, 1985, as cited in ROBERTS, 1992). As a consequence, it is assumed that not only for profit organizations should employ business models.

In fact, innovation and business models are presumed to be pertinent to public sector organizations performing in quasi-market environments, though they need adaptations due to the political dimension inherent in such contexts (OSBORNE; BROWN, 2005). Since business models play a role in bringing to surface the latent value of innovations (TEECE, 2010), as we have previously discussed, they thus are critical to improve performance of delivering public services.

There are different ways in which policymakers can develop business models to create value for society from the more efficient use of public resources and the use of more sustainable technologies (BOLTON; HANNON, 2016). In view of this, several studies have attempted to pose the business model – and business model innovation – literature in the public sector field. Some of these works refer nominally to "business models" (e.g., EDRALIN *et al*., 2018; MARTINS; MOTA; MARINI, 2019; MICHELI *et al*., 2012; OSBORNE *et al*., 2014; PUGALIS *et al*., 2016), while others refer to "policy mix", "public policies", "governance", or other expressions that will ultimately lead to changes in the way public sector delivers services to citizens (e.g., EHNERT *et al*., 2018; JOHNSTONE; NEWELL, 2018; ROGGE; REICHARDT, 2016). Furthermore, public authorities can play an indirect but influential role in private innovation by both supporting the adoption of specific technologies and processes (JOHNSON; SILVEIRA, 2014; QUITZAU; HOFFMANN; ELLE, 2012) or preventing other ones (GEELS; VERHEES, 2011), leading to changes in the companies' business models.

Lewandowski (2018) addressed the role of public sector business models in circular economy schemes, given its contribution to several areas and aims of public policy. This author makes some caveats regarding the profit formula and customer value proposition building blocks. Unlike private business models, profit formula in public business models is often duty-oriented, instead of profit-oriented, and embeds hidden intangible capitals like symbolic, power, and social one. As customers are citizens, value propositions are tailored to

match many target groups' needs and are delivered through services obligatory and even imposed on citizens.

In the urban context, public policies often cross over the lines of the public domain, which blurs the boundaries between private, public, and third sector organizations (OSBORNE *et al.*, 2014). New business models have emerged therein as a pathway to the public sector to better engage with private sector partners and foster public innovation by benefiting from sharing intellectual capital and skills (MICHELI *et al.*, 2012).

Considerable literature – both theoretical and empirical – has been dedicated to this theme. For example, Ranerup, Zinner and Hedman (2016) analyzed 14 public services platforms in Sweden, from four different sectors: healthcare, elder care, education, and public pensions. The authors identified the business models core components of the digital platforms and grouped them in two categories. Some platforms are representatives of a traditional view, performed mainly by public agencies, and focused on providing neutral information and enabling comparisons for informed choices. In contrast, others seem to represent an emerging view, in which private agencies and public-private partnerships organizations promote their services, support dialogues and feedbacks from users, besides those features of the traditional view.

Still in the context of digitalization of public services delivering, Mattsson and Andersson (2019) compared private business models with what they termed "public service provision model" to explain how tensions between public and private business models and actors can drive adaptations of the private partner's business model (in this case, a start-up firm hired to support innovations related to digital transformation in Sweden education system). Regardless of the origin of theses tensions – e.g., the organizational level of interaction with the public actors (national, municipal, school), the incompatibility of existing technologies and the firm value offerings – it is of interest to note the use of business models notion in a public system and its implications for partnerships with private actors.

Edralin *et al.* (2018) employed the business model framework to study four government training institutes in the Philippines and examine how they create, deliver, and capture value. From the cross-case analysis, they proposed a new, improved business model structure for public training institutes which is said to be capable of overcoming resource constraints by leveraging off collaboration and partnerships with private organizations.

By orchestrating insights from public governance and business model studies, Martins, Mota and Marini (2019) analyzed the role of cooperation arrangements of the public sector and private organizations to create public value. They suggest that business models

may contribute to improving public governance in terms of communication, innovation, and efficiency.

Dahan *et al.* (2010) argue that collaborations between firms and public authorities – even non-government organizations – provide opportunities for the former to address new markets with innovations that would be less successful than they would without the partnerships. These arrangements "bring different resources and capabilities, and different strengths and areas of expertise: in combination, these allow public-private partnerships to co-imagine and co-create complex systems of value delivery that would probably otherwise be inconceivable." (p. 335)

Digital platforms could be the keystone for such partnerships. A study by Joo, Seo and Lee (2016) suggests that digital platforms can work as innovative business models in the public sector, by integrating different actors like service providers, service integrators, users, and public agencies. According to the authors, platform business models are aimed at supporting public service innovation and improving citizen services performance and governance.

Maybe one of the most innovative platform-based business models involving public-private partnerships is mobility as a service (MaaS). It is a nascent, promising concept that emerged in the sharing economy era, aimed at restructuring the mobility value chain by integrating all the offerings of providers and supplying them to users as a single service (JITTRAPIROM *et al*., 2018; MATYAS; KAMARGIANNI, 2019). A recent research by Smith, Sochor and Karlsson (2019) investigated the case of MaaS in Sweden and identified barriers and challenges that discourage organizational actors (e.g., integrators, service providers, and operators) to engage in these business models. Fear of losing control and being dominated by other actors, the difficulty to create public awareness of MaaS, high economic risks and marketing costs, and potential mismatching of private side and public policy requirements are some of these factors, which in the final analysis point to legitimacy challenges.

Finally, Ganapati and Reddick (2018) claim that governments should not only play a regulatory role in the sharing economy business models. As users, public agencies could also directly engage in such models by adapting internal procurement processes focused on renting, and partnering with sharing platforms to complement and supplement public services delivering. Moreover, public sector should participate because the diversity of solutions – not only in mobility marketplace, but also in other industries – is expected to keep

growing and new technological options will certainly become available (WESTERVELT; SCHANK; HUANG, 2017).

As observed, studies with the business model innovation concept in the public sector are numerous, and partnerships between public and private actors to generate or save revenue and create social value have become common (PUGALIS *et al*., 2016). Actors experimenting and improving new processes, technologies, and value propositions in niche environments place business model innovation under a dynamic, trial-and-error learning viewpoint (SOSNA; TREVINYO-RODRÍGUEZ; VELAMURI, 2010), given the unpredictable nature of embryonic innovations.

From this outlook, either from private or public sectors, the multi-level perspective on technological transitions seems to be able to furnish a finer-grained understanding about the phenomenon, since institutionalized rules, artifacts, networks and habits (i.e. "systems", "regimes") tend to be resistant to change (WALRAVE *et al*., 2018).

2.2 Multi-level perspective on socio-technical transitions

In the previous section, we argued that a novel technology, in and of itself, is not able to create value for the firm (TEECE, 2010). We then discussed the dynamic, adaptive nature of the business models and their important role in transforming the latent value of technological innovations into real economic value (CHESBROUGH, 2010).

Now we discuss how innovation, either technological or in a business model, can emerge and become widely diffused. By analyzing the set of social and institutional factors that influence this process, some contributions may be useful in order to achieve the thesis objectives.

According to the sociological perspective of technology, no technological artifact, *per se*, is capable of bringing any benefit or fulfilling any functions in society, unless in association with human agency, social structures, organizations and institutions (GEELS, 2002). Thus, a range of social groups and institutions are taken on board in order to drive technical trajectories, as depicted in Figure 2.

Figure 2 – Multi-actor network in socio-technical regimes
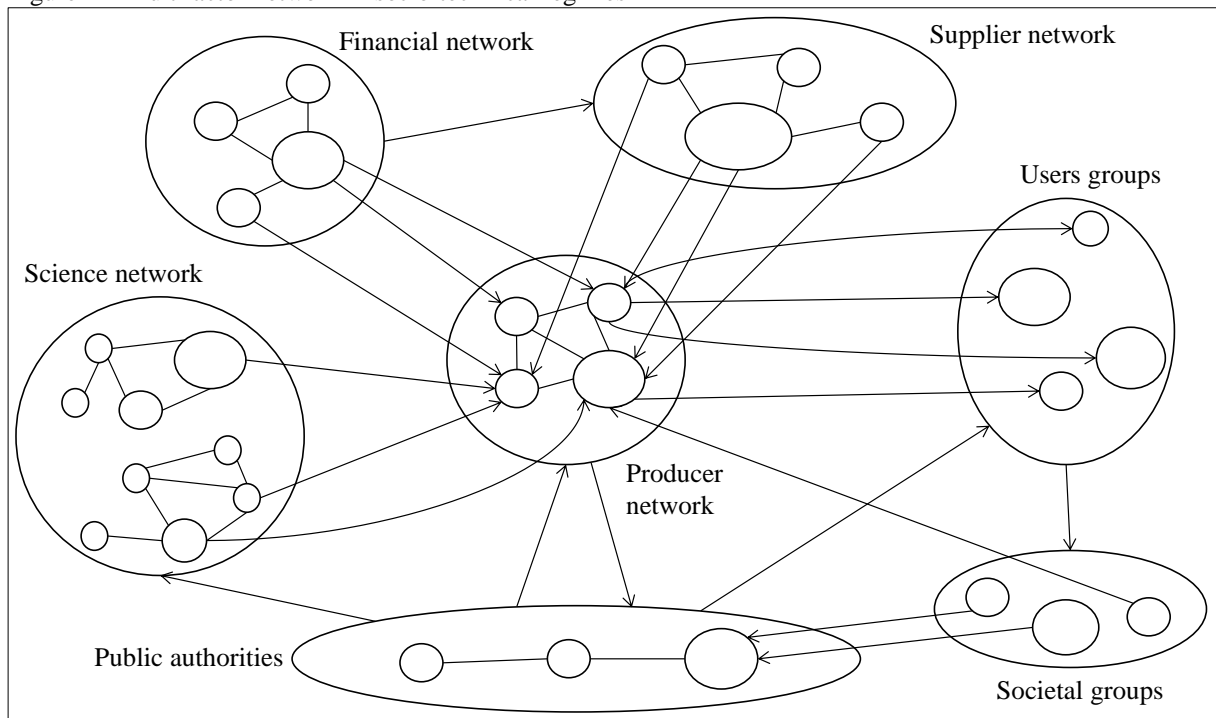
Source: The author, adapted from Geels (2002).

Financial networks refer to venture capital investors, capital banks, and insurance firms that take risks by providing financial support to producers in order to develop and market products, services, and solutions that meet users' needs. In turn, producers are operationally supported by suppliers and complementors, whose outputs (materials, components, and machinery) are essential for sustaining operations. Important support could also come from science and technology networks that are part of the innovation system. Societal groups influence producer networks by pushing for practices that are in line with accepted standards and shared beliefs. Public authorities establish general principles, laws and rules to regulate the innovation system (e.g., public universities and research institutes) and markets (production and consumption). On the other hand, the public sector is often under pressure from companies and societal groups seeking to satisfy their interests.

These elements settle a socio-technical configuration – or regime – that represents the current institutional, competitive, societal, and cultural conditions under which firms play their strategies and make their decisions (SCHOT, 1998; SCHOT; HOOGMA; ELZEN, 1994). Geels (2002, p. 1257) defines technological transitions as "major technological transformations in the way societal functions such as transportation, communication, housing, feeding, are fulfilled." They comprises long-term change in societal subsystems through co-evolutionary institutional processes in the technological, economic, and socio-cultural domains (HOLTZ; BRUGNACH; PAHL-WOSTL, 2008).

Transitions do not only yield technological changes but also changes in industrial networks, regulation, competition environments, infrastructure, user practices, and symbolic meanings. In other words, they reveal a process of reconfigurations in the current socio-technical regime (GEELS, 2002).

The transitions framework emerges from the evolutionary (neo-Schumpeterian) economics. Unlike the transaction costs paradigm (COASE, 1937; WILLIAMSON, 1975, 1981), which centers on the efficient resource allocation, the evolutionary approach focuses on the processes of experimentation and learning (i.e. uncertainty) that form the basis for innovative activities (FREEMAN, 1995; LUNDVALL, 1988; NELSON; WINTER, 1977). Concerning the driving forces of economic development, Hanusch and Pyka (2007, p. 276) argue that "innovation competition takes the place of price competition as the coordinating mechanism of interest", since prices are basic to the adjustment to limiting conditions, whereas innovations, on the other hand, are responsible for overcoming them.

Besides the evolutionary economics (technological trajectories, regimes, niches), the multi-level perspective brings advances for innovation studies by drawing upon insights also from the sociology of technology (innovations are socially constructed through interactions between a variety of actors) and the institutional theory (a set of regulatory and cultural factors constraining or enabling action) (GEELS, 2012). Therefore, the multi-level perspective on technological (later, socio-technical) transitions framework sheds light on the processes of rise and diffusion of innovations by assessing the dynamic interactions among social, cultural, technological, political – ultimately, institutional – forces clashing one another at three levels: niches (micro level), socio-technical regimes (*meso* level), and landscapes (macro level) (GEELS, 2002, 2018a, 2018b; KEMP; SCHOT; HOOGMA, 1998; MARKARD; TRUFFER, 2008).

Extensive literature addresses how the transition to a new socio-technical regime occurs, and what factors drive this shift, as we can see, for example, in the evolution from horse-drawn carriages to automobiles (GEELS, 2005); in the transition from candles and oil lamps to gas lamps and incandescent lamps (SCHOT, 1998); from sailing ships to steamships (GEELS, 2002); in the rise of electric vehicles sector (SCHOT; HOOGMA; ELZEN, 1994); the shift from the computing based on punch card machinery to digital computer (VAN DEN ENDE; KEMP, 1999); in the biogas development in Denmark and the Netherlands (GEELS; RAVEN, 2006; RAVEN; GEELS, 2010); and in transitions to low-carbon energy systems (BENTO; FONTES, 2018; CHERP *et al.*, 2018; GEELS, 2018a; MCMEEKIN; GEELS; HODSON, 2019).

From this perspective, before emerging and flourishing, novel technologies are first developed in technological niches (KEMP; SCHOT; HOOGMA, 1998; SCHOT; HOOGMA; ELZEN, 1994; SEYFANG; LONGHURST, 2013), wherein they face challenging market conditions: the short-term costs tend to be high, since they have not yet benefited from economies of scale and experience curves; in addition, they often require special skills, new infrastructure, and a range of institutional shifts, as new organizational arrangements, regulatory changes, realignment with cultural and value systems, among others (KEMP, 1994; KEMP; SCHOT; HOOGMA, 1998; SMITH; RAVEN, 2012).

On the other hand, niches are important because they provide protected zones for experimentation and learning processes regarding technological issues, user preferences, regulatory concerns, and public policies, since it is possible to deviate from the rules of the existing regime (GEELS, 2004; MARTIN; UPHAM; BUDD, 2015; RAVEN; VAN DEN BOSCH; WETERINGS, 2010; SMITH; RAVEN, 2012).

Landscapes, in turn, consist of a set of deep structural macro-level factors that "do not mechanically impact niches and regimes, but need to be perceived and translated by actors to exert influence." (GEELS; SCHOT, 2007, p. 404) These factors can be of three types depending on the pace at which they change (VAN DRIEL; SCHOT, 2005): (i) rapid exogenous shocks, such as wars, migration crises, pandemics, financial collapses, and political upheavals; (ii) long-term changes, such as environmental concerns, shifts in societal values, demographical changes, macroeconomic patterns, urbanization, and macro-political trends; and (iii) factors that do not change or that change only slowly, such as geographical conditions, infrastructures, and material organization of cities.

All of these broader contextual developments have some impact on innovation processes without being influenced by the outcome of these processes in the short or medium term (MARKARD; TRUFFER, 2008). They influence the socio-technical regime, but regime actors have little or no influence on them (GEELS, 2018a; RAVEN; VAN DEN BOSCH; WETERINGS, 2010).

Due to the recognized lack of criteria for framing and defining socio-technical regimes, Holtz, Brugnach and Pahl-Wostl (2008) proposed five guiding characteristics that are useful for this purpose and thus facilitate understanding and management of transitions: (i) regimes have *purposes* closely reletad to specific societal functions; (ii) its elements hold strong *coherence* in that they are closely interrelated; (iii) regimes have dynamic *stability*; (iv) because the multiple interaction of actors, *non-guidance*, emergent behavior is the norm, rather than coordination or central control; and (v) regimes are said to have *autonomy* in the

sense that they develop mainly from internal processes. Figure 3 shows this dynamic multi-level perspective for the socio-technical transitions.

Figure 3 – A dynamic multi-level perspective (MLP) on technological transitions
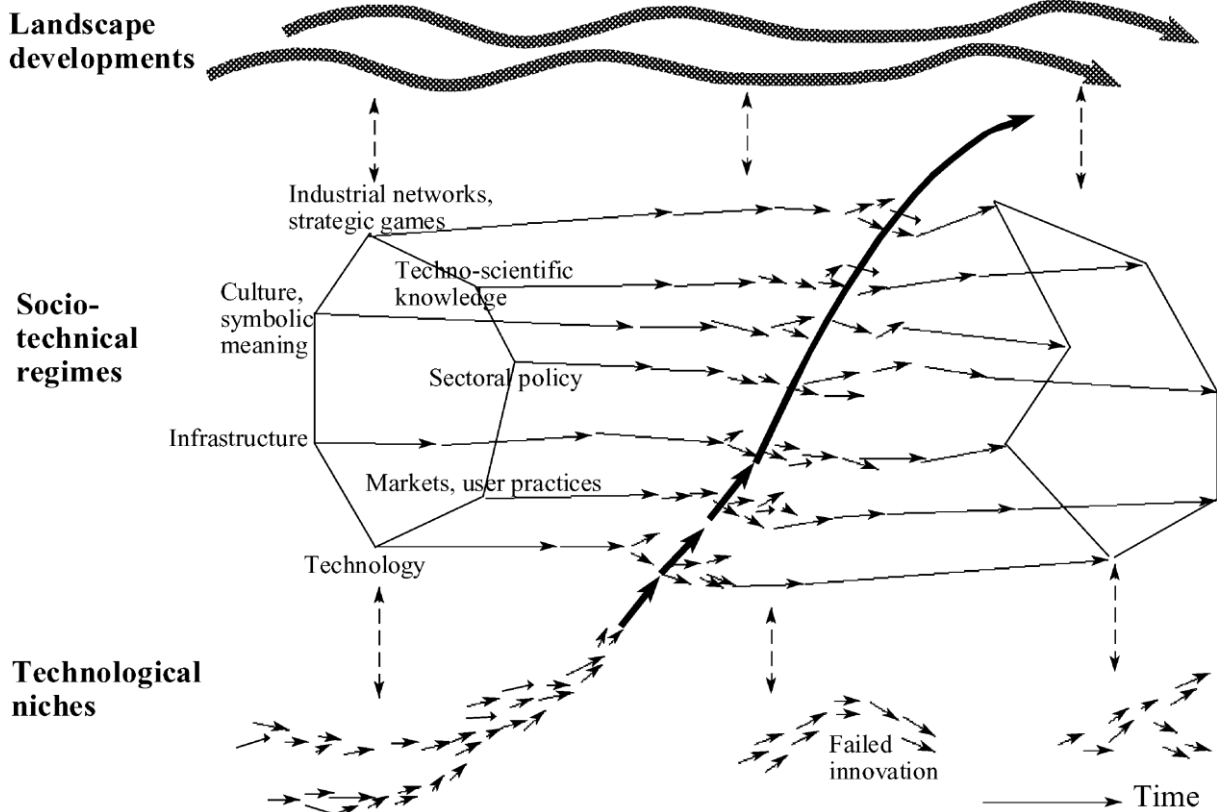
Source: Geels (2002).

A consistent, comprehensive definition for regimes was proposed by Smith, Voß and Grin (2010, p. 441), for whom "socio-technical regimes are structures constituted from a co-evolutionary accumulation and alignment of knowledge, investments, objects, infrastructures, values, and norms that span the production-consumption divide."

The strength of a regime can be assessed by the degree of institutionalization of its constituent elements (FUENFSCHILLING; TRUFFER, 2014). Transitions do not come about effortlessly, as they are hampered by strong lock-in mechanisms in existing systems (CHANG *et al.*, 2017; MARKARD; RAVEN; TRUFFER, 2012), such as economies of scale and scope, technological interrelatedness, network externalities, learning effects, differentiation of power, and collective action (KLITKOU *et al.*, 2015).

Thus, the more structured the regime, the more resistant to changes it is, meaning that in highly institutionalized regimes, its dimensions – i.e., institutional forces – act as barriers to innovations coming up from niches. Structuration, stability, and institutionalization

are at the center of the discussions about transitions dynamics and trajectories, which next section will address.

2.2.1 *Dynamics and pathways of socio-technical transitions*

Criticisms of the MLP framework have emerged since its initial proposition. They have predominantly focused on the lack of discussions about agency and the rules guiding the network of actors, the absence of political and power concerns in influencing niche-regime interactions, and the neglect of the role played by the degree of structuration on such interactions and the different kinds of transitions pathways (GENUS; COLES, 2008; SMITH; STIRLING; BERKHOUT, 2005; SMITH; VOß; GRIN, 2010).

Later developments of the Geels' (2002) framework has gaining relevance and deepened the understanding of the interaction dynamics between the niche, regime and landscape levels (EDMONDSON; KERN; ROGGE, 2019; HESS, 2016; INGRAM, 2018; MYLAN *et al*., 2019; SMINK *et al*., 2015). They have taken in consideration the role played by the landscape developments in opening up the regime and creating opportunities for novelties, and highlighted the differences in the degree of structuration of activities and rules at the micro, *meso* and macro level (FUENFSCHILLING; TRUFFER, 2014; GEELS; SCHOT, 2007). Figure 4 illustrates how these advances were embedded into the MLP framework.

Figure 4 – An adapted framework for multi-level perspective on transitions
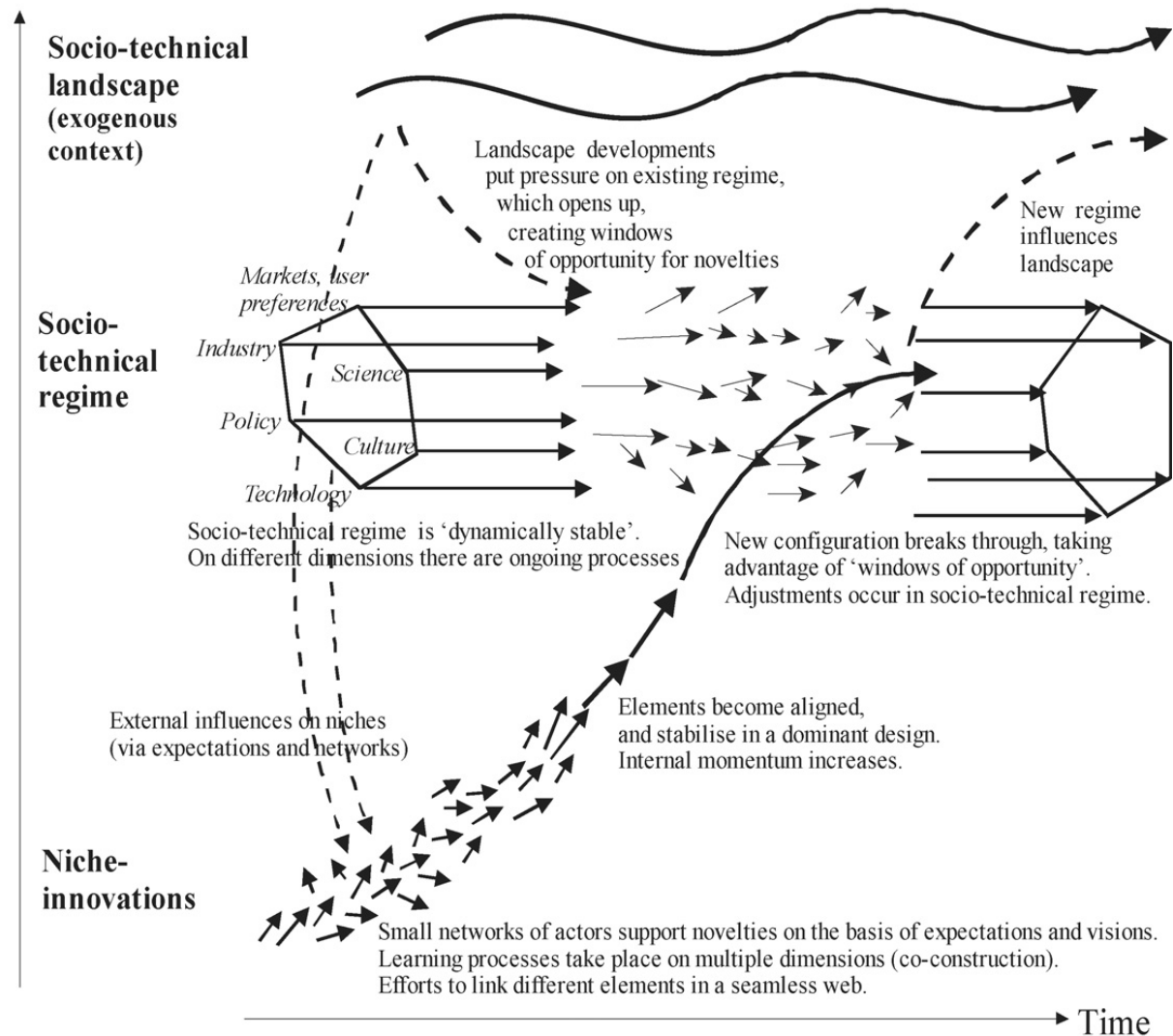
Source: Geels and Schot (2007, p. 401).

Through the *Y*-axis in the picture, Geels and Schot (2007) argue that technological niches and socio-technical regimes are similar types of structures, but differ mainly in size and degree of stability. Niches and regimes may be seen as organizational fields (in the institutional sense, as employed, e.g., by DiMaggio and Powell (1983)), in which groups of relevant actors interact. In regimes, these communities are larger and stable, and the rules that coordinate action are well established, structured, i.e., deeply legitimized. In the niches, communities are smaller and unstable, as well as the rules that coordinate action, since they still are under construction. Pressures coming from both niches (e.g., radically new technologies, early stage innovations) and landscape might destabilize the current regime and

create windows of opportunities for a new, reconfigured socio-technical system, based on niche innovations.

Because of such dynamic stability, innovations within regimes tend to be mostly incremental (GEELS, 2012), through ongoing, long-term improvements on different regime dimensions (BIDMON; KNAB, 2018). On the other hand, innovations emerging from niches can be either incremental or disruptive: whereas the former are more likely to "fit-and-conform" to mainstream socio-technical institutions and practices, the latter may "stretch-and-transform" the incumbent regime, although they could alternatively benefit from existing rules as well (SMITH; RAVEN, 2012).

Still from Figure 4, the dashed arrows coming down from the landscape and regime levels to the niche show that dynamics and communities in this level are influenced by regime and landscape developments. Even when radical niche developments become effective in performing a social function, they will not automatically reconfigure the current regime, which will only be possible if macro level pressures (landscape) previously destabilize it (CHERP *et al.*, 2018). Moreover, this reinforces the importance of investigating regime-to-niche activities rather than only focus on niche-to-regime ones, which currently dominates the literature (MYLAN *et al.*, 2019; TURNHEIM; GEELS, 2019).

In this sense, transitions can take on different trajectories, implying different dynamics in terms of institutions, technologies, and actors. Thus, investigating the trajectories by which transitions occur and the forces exogenous to the regime which also influence its reconfiguration is an important issue.

We want to refer to the nature of external broader developments (landscapes) in terms of speed, amplitude, frequency, and scope (SUAREZ; OLIVA, 2005), the nature of niche innovation influence on the regime, whether rival (competitive) or symbiotic (cooperative), and the timing of interactions, i.e. the state of niche developments at the moment the landscape pressure occurs (GEELS; SCHOT, 2007).

Based on these elements, Geels and Schot (2007) – and later, Geels *et al.* (2016) – proposed a typology for different pathways to transitions, according to Table 1. The authors also drew on Smith and Raven's (2012) patterns of transitions – "fit-and-conform" and "stretch-and-transform" – in order to better explore the institutional dynamics throughout the transitions processes.

Table 1 – Typology of transition pathways

Transition pathway	Landscape pressure nature	Niche innovation state, nature	Transition dynamics		
			Actors	Technologies	Institutions
Technological Substitution	Divergent (intense, large, or specific shock)	Fully developed, competitive or symbiotic	Clashes between better-performing new firms and incumbents "Foreign", outsider new entrants replace incumbents	Radical innovation substitutes incumbent technology Radical innovation substitutes incumbent technology	Limited institutional change (niche innovations fit-and-conform to the regime) Larger institutional change (niche innovations stretch-and-transform the regime)
Transformation	Divergent (moderate, disruptive)	Not sufficiently developed, symbiotic or competitive	Incumbents incrementally adjust search routines and procedures Incumbents substantially reorient to new technology or business model or, even more deeply, to new rules and norms	Incremental improvements in existing technologies performance and new knowledge integration Gradual reorientation towards new technologies from diversification to technical substitution	Limited institutional change (niche innovations fit-and-conform to the regime) Larger institutional change (niche innovations stretch-and-transform the regime)
Reconfiguration	Divergent	Fully developed, symbiotic	New alliances – rather than substitution – between incumbents and new entrants	From incremental improvements by add-ons or component replacements to combinations between new and existing technologies, to changes in user practices, perceptions, and search heuristics	From limited institutional change (niche innovations fit-and-conform to the regime) to larger institutional change (niche innovations stretch-and-transform the regime)
Dealignment and realignment	Divergent (large, sudden)	Not sufficiently developed	Incumbents collapse as landscape pressures create opportunities for new entrants; actors lose faith and then engage in search, learning and struggles to establish new rules and institutions	Multiple embryonic innovations rise and compete with each other, one of which gradually becomes as dominant as legitimate.	Larger institutional change (external shocks disrupt rooted rules and replace them after prolonged uncertainty; many niche innovations try to benefit from destabilization)

Source: The author, based on Geels and Schot (2007), Geels *et al.* (2016), and Smith and Raven (2012).

Building on the original MLP framework's hierarchical architecture, Figure 5 schematically illustrates the four transitions pathways discussed above and helps to explain their dynamics.

Figure 5 – Transitions pathways
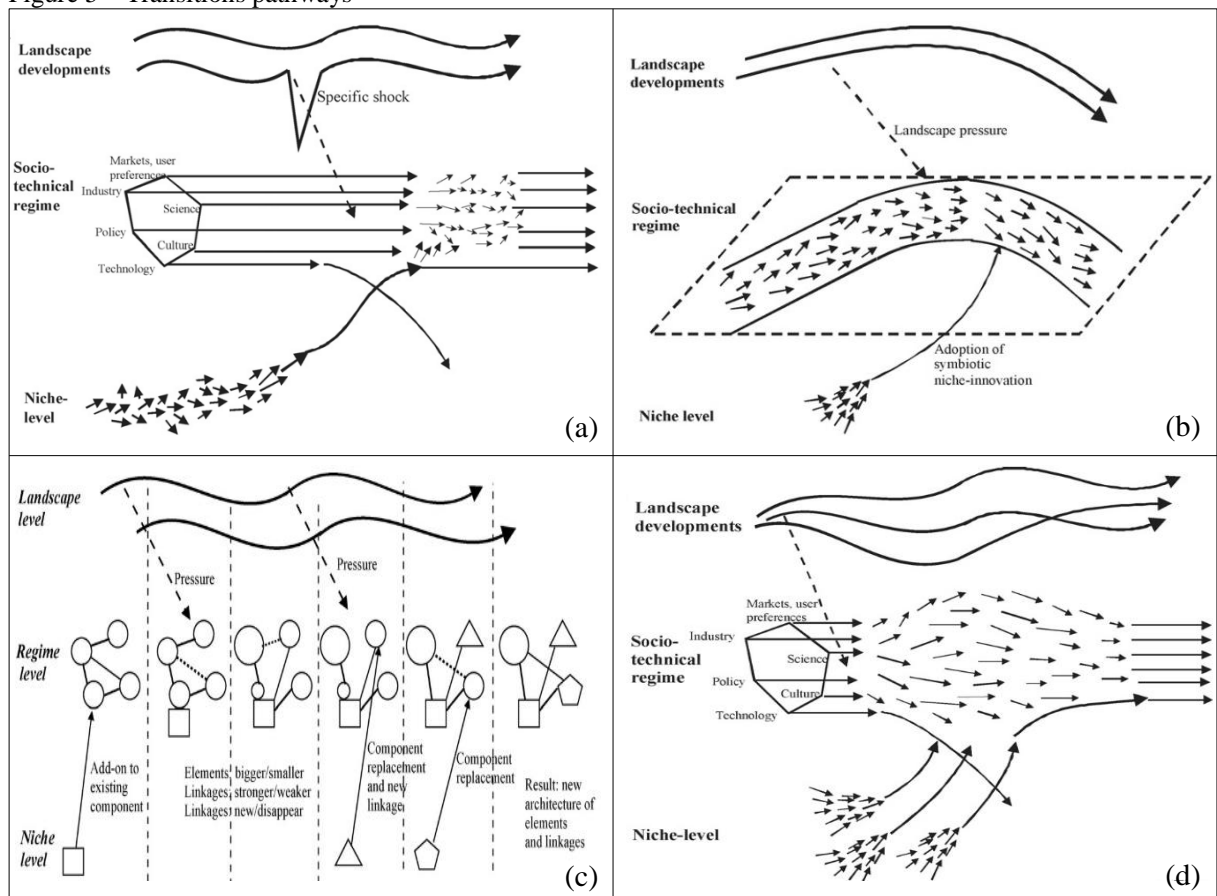
Note: (a), (b), (c) and (d) respectively represent Technological substitution, Transformation, Reconfiguration, and Dealignment and realignment pathways.
Source: The author, adapted from Geels and Schot (2007).

Significant differences and similarities between the transition pathways can be observed from Table 1 and Figure 5. For instance, substitution and transformation trajectories are preceded by disruptive external forces from the landscape level destabilizing the regime in a medium term transition process. However, they differ in the state of the niche development: technological substitutions require stable, somewhat structured niche innovations in order to replace existing technologies by fit-and-conform or stretch-and-transform patterns. In turn, transformation pathway occurs mainly through adjustments by regime actors in the context of landscape pressure, as niche innovations still have not gained momentum and stability to scale up (in this regard, Geels *et al.* (2016) point out that incumbent actors may also reorient

towards niche innovations). Therefore, radical innovations do not necessarily require significant transformations in the whole regime, rather only at the technological dimension, and may adjust to other existing institutional patterns (SMITH; RAVEN, 2012).

Reconfiguration and dealignment and realignment trajectories also differ in the same aspect, but typically take longer. Besides that, in the reconfiguration pathway, niche and regime actors synergistically combine to transform the system's architecture in the long term, whereas in the dealignment and realignment trajectories, unstructured niche developments compete with one another to benefit from the institutional vacuum resulting from a large external shock.

Furthermore, whenever niche developments are still embryonic and unstable, the way regime actors translate and interpret landscape pressures will become more significant. Under such pressures, the actions by incumbent actors and their stance with regard to niche innovations will determine the transition.

All four pathways consider that landscape developments will count for the regime shifting (divergent forces). This is probably because authors recognize *change* as the essence of transition processes, so that their trajectories only could be triggered by destabilizing pressures. Notwithstanding, some more recent empirical studies have argued that landscape forces can exert both changing and stabilizing pressures simultaneously (GEELS, 2012, 2018b; KUNGL; GEELS, 2018).

More recent studies have sought "a more fluid understanding of shifts *between* pathways as transitions unfold, which depends less on external landscape change (…) and more on endogenous enactment." (GEELS *et al*., 2016, p. 900, emphasis in the original) They start from the assumption that transitions are not deterministic, singular processes, but ones in which multiple niche developments and regime adaptations co-evolve leading ultimately to the whole-system reconfiguration (GEELS, 2018b, 2019; MCMEEKIN; GEELS; HODSON, 2019).

From these discussions, one can notice the relevance of actors' behavior and interactions for socio-technical transitions. Indeed, theoretical advances have brought illumination to discussion about agency and relationship between networks of actors (DE HAAN; ROTMANS, 2018; FISCHER; NEWIG, 2016; GEELS, 2010; GEELS; SCHOT, 2007; WITTMAYER *et al*., 2017), the role played by different intermediary actors and organizations in supporting or hindering transitions processes (HARGREAVES *et al*., 2013; KIVIMAA *et al*., 2019; MOSS, 2009), and power and political economy issues influencing

niche-regime interactions (AVELINO; ROTMANS, 2009; GEELS, 2014; KERN, 2012, 2015; MEADOWCROFT, 2009, 2011; ROBERTS; GEELS, 2019a, 2019b).

Human action is the cornerstone underpinning all the aforementioned advances, and it is useful at giving a better understanding of how socio-technical regimes work. Actor behavior is constrained by cognitive, normative and regulative rules at the collective level of a regime (GEELS, 2004, 2012), so that individual action cannot easily change this regime (RIP; KEMP, 1998). Niche-regime interactions are ultimately interactions between actors within and between these levels, as incumbent actors can influence niche developments (INGRAM, 2018; TURNHEIM; GEELS, 2019). As collective action is consequential for new markets formation (LEE; STRUBEN; BINGHAM, 2018), it is necessary to analyze the mechanisms through which such interactions occur.

In this sense, the Holm's (1995, p. 398) question sounds quite illustrative: "How can actors change institutions if their actions, intentions, and rationality are all conditioned by the very institution they wish to change?" The author argues that the answer comes from considering institutions as interconnected, multi-level systems in which each action-level simultaneously is a guideline for action and a product of action.

Geels (2004) proposes an analytic distinction between socio-technical system, institutions (rules) and actors, as depicted in Figure 6.

Figure 6 – Three interrelated dimensions of the sociology of technology
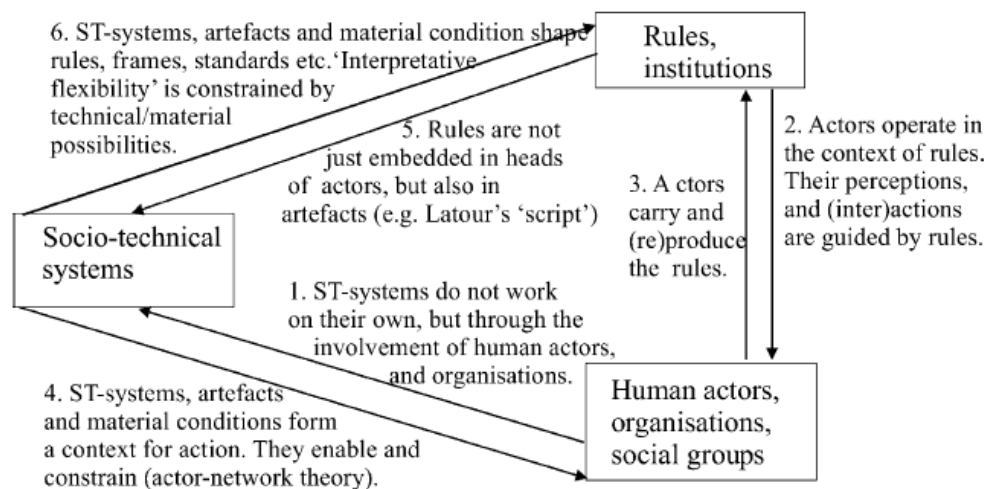
Source: Geels (2004, p. 903).

Socio-technical systems represent the context of the action of social groups and organizations (paths 1 and 4). Through their artifacts, they shape the rules and institutions, which conversely are embedded in artifacts as well (paths 5 and 6). Actors' perceptions and

actions are guided by rules they own (re)produce (paths 2 and 3). Thus, stability in a given regime is a function of how its rules and institutions influence – and are perceived by – actors interacting with artifacts and material networks (GEELS, 2004).

Such a set of rules, i.e. the "coherent arrangements of beliefs, norms, values and practices that stem from dominant societal institutions" (FUENFSCHILLING; TRUFFER, 2014, p. 774), represents the deep structural drivers that coordinate and guide actors' perception (GEELS, 2012) by constraining or enabling their actions (GEELS; SCHOT, 2007), ultimately preventing or assisting the transition.

Since the term "transition" is referred here as a shift from one socio-technical regime configuration to another, a co-evolution of technical, economic, political and behavioral transformations is a *sine qua non* condition (BIDMON; KNAB, 2018; EDMONDSON; KERN; ROGGE, 2019; GEELS, 2004; VAN DEN ENDE; KEMP, 1999), culminating in what was termed a techno-institutional complex (UNRUH, 2002). Raven and Geels (2010) refer to socio-cognitive evolution to address such changes in social network interactions and expectations, beliefs, and perceptions.

In the words of Rip and Kemp (1998, p. 365),

> "What coevolution continues to indicate, now at the level of regimes and sociotechnical transformations, is that overall changes result from several interacting developments together, rather than from a point source of change forcing itself upon the rest of the world."

From an institutional logics perspective (THORNTON; OCASIO, 2008), there must be a co-evolutionary process through which changes in both the organizational and societal levels evolve and become further institutionalized (HAVEMAN; RAO, 1997). Otherwise, mismatching institutional logics are expected to constitute a severe hurdle to successful transition (SMINK *et al.*, 2015).

Social groups at the organizational and societal levels could be seen as sub-regimes within the socio-technical regime, whereas institutions, as the rules that coordinate their relations. In this way, a socio-technical regime does not encompass the entirety of the broader, relatively autonomous regimes, but only the actors and rules which are closely aligned to each other (GEELS, 2004), sharing and reinforcing the same underpinning institutional logics (MCMEEKIN; GEELS; HODSON, 2019). Figure 7 gives a representation of that description.

Figure 7 – "Sub-regimes" in the socio-technical regime
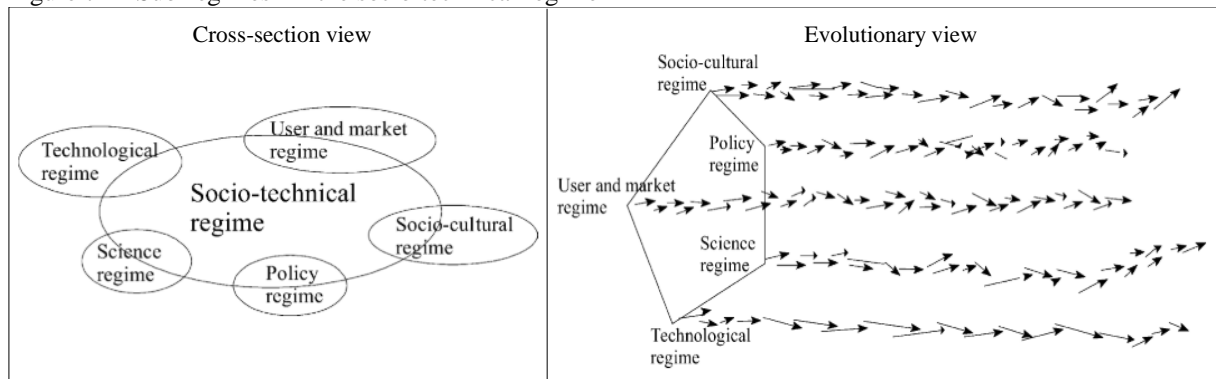
Source: The author, adapted from Geels (2004, p. 905 [Fig. 5] and p. 912 [Fig. 7]).

The cross-section view illustrates how the socio-technical regime can capture and encapsulate those parts (sub-regimes) of each regime that share common established practices and rules within them. Therefore, these rules are linked both within and between sub-regimes so that they compound a specific socio-technical regime.

In turn, the evolutionary view (on the right in Figure 7) shows the evolving nature of each broader regime – e.g., culture, science, technology – of whose entirety some parts will integrate a socio-technical regime. The stability of a socio-technical regime is thus dependent upon the degree of structuration of the interactions between actors, technologies and the institutional rules (GEELS *et al.*, 2016; GEELS; SCHOT, 2007) within and between sub-regimes.

At this point, transitions dynamics meet the institutional legitimacy concept, as institutions are assumed to be the context for social structures and formal (regulative), normative and cognitive rules that guides action (GEELS, 2004, 2005). As one expects, the processes of diffusion and institutionalization parallel the dynamics of legitimation (JOHNSON; DOWD; RIDGEWAY, 2006; LAWRENCE; WINN; JENNINGS, 2001), since ultimately the organizational emergence can be understood as a quest for legitimacy (TORNIKOSKI; NEWBERT, 2007).

Therefore, it is fundamental to appreciate the concept of institutional legitimacy, as follows in the next section.

2.3 Legitimacy from the institutional lenses

Before bringing the legitimacy theory into the context, it is useful briefly to present the reasons that led us to adopt this construct to the detriment of others previously mentioned.

Preceding discussions about the multi-level perspective for dynamics of socio-technical transitions have highlighted the importance of constructs such as stability, institutionalization, and structuration to comprehend the interactions between niche, regime and landscape and their actors and institutions. The underlying idea has been that the more structured the regime, the more institutionalized and stable it is, and the greater its resistance to change. In other words, the regime resilience – or persistence – is a function of the degree of institutionalization (therefore structuration) of its elements and characteristics (FUENFSCHILLING; TRUFFER, 2014).

Vast institutional literature supports such an assumption, as we can see in the studies by Meyer and Rowan (1977), Zucker (1977), DiMaggio and Powell (1983), Holm (1995), Tolbert and Zucker (1983, 1996). In common, all of them start from the Berger and Luckmann's (1991, original 1966) classic contribution on the social construction of reality, according to which institutions are socially constructed so that they reflect their general institutional environment (MEYER; ROWAN, 1977).

As "institutionalization" is a process of increasing "structuration", both concepts are said to have strongly related meanings. Ultimately that indicates they are interchangeable constructs (BARLEY; TOLBERT, 1997). According to Zucker (1977, p. 728), institutionalization is "the process by which individual actors transmit what is socially defined as real and, at the same time, at any point in the process the meaning of an act can be defined as more or less a taken-for-granted part of this social reality."

Here, we would like to put forward another construct, namely legitimacy. As Carroll and Buchholtz (2008, p. 122, emphasis in the original) state,

> (…) whereas legitimacy is a condition, **legitimation** is a dynamic process by which business seeks to perpetuate its acceptance. The dynamic process aspect should be emphasized, because society's norms and values change, and business must change if its legitimacy is to continue.

In this same vein, Scott (2014) criticizes the view of legitimacy as a mere resource that organizations extract from the institutional environment (social exchange approach) and argues in favor of a robust institutional perspective according to which

(…) legitimacy is not a commodity to be possessed or exchanged but a *condition* reflecting perceived consonance with relevant rules and laws or normative values, or alignment with cultural-cognitive frameworks (…), suggesting that it is not a specific resource, but a *fundamental condition* of social existence. (SCOTT, 2014, p. 72, our emphases)

As a condition, legitimacy is thereby a result of a process. Zucker's definition for institutionalization seems to encompass both the Carroll and Buchholtz's concept of legitimation and the Scott's concept of legitimacy. Indeed, Deephouse and Suchman (2008, p. 58) assert that "legitimation is closely related to diffusion and institutionalization", and such a "process" nature is claimed by numerous studies (BERGEK; JACOBSSON; SANDÉN, 2008; GREENWOOD; HININGS; SUDDABY, 2002; JOHNSON; DOWD; RIDGEWAY, 2006; LAWRENCE; WINN; JENNINGS, 2001).

However, it is possible for an organization to be deeply institutionalized but not entirely legitimate, depending on the social systems of interest (DEEPHOUSE; SUCHMAN, 2008). Jepperson (1991), for instance, refers to some illegitimate elements becoming institutionalized, such as organized crime, political corruption, and bribery.

Also, in several developing countries, public services are far institutionalized while often lack social support due to perceived corruption or poor quality (BERKOVICH, 2016; HAQUE, 1998; ROTHSTEIN, 2015). For those reasons, we argue that legitimation, instead of institutionalization or structuration, is a more useful, comprehensive construct, and finer aligned with the purposes of this thesis.

The Weberian approach of legitimacy postulates that legitimation occurs through a collective construction of reality in which the elements (social objects) of the social order are perceived as aligned with the system of values, beliefs, and norms that individuals recognize are broadly communal, even if they do not personally share them (JOHNSON; DOWD; RIDGEWAY, 2006). From the institutional approach, such factors represent a set of powerful rules – i.e., myths – that shapes the organizational behavior – decisions, structures, programs, policies – in their pursuit for legitimacy (MEYER; ROWAN, 1977). As an organization is part of an entire, broader field, the whole belief system is understood to shape a collective process of culturally-driven structuration (DIMAGGIO; POWELL, 1983).

According to the strategic approach of legitimacy, in addition to economically viable and legally supported behaviors, organizations must perform behaviors – managerial

actions – that are socially and culturally consistent with the norms, expectations, and values of the social system in which they are inserted (CARROLL; BUCHHOLTZ, 2008; DOWLING; PFEFFER, 1975).

This conception was widespread in the organizational literature, in which the "elements of the social order" above referred may be interpreted as organizations and institutions. As Deephouse and Suchman (2008) point out, many sources of legitimacy could be organizations themselves (e.g., government agencies, media companies, suppliers, partners), denoting that the granting of legitimacy is as amenable to organizational analysis as is the pursuit. In this respect, legitimacy can also be achieved from several institutional sources such as industry's standards, practices, technologies, and past actions of industry members (ZIMMERMAN; ZEITZ, 2002).

When a new organizational form emerges (e.g., new business models), its legitimacy is low, as its rarity and degree of novelty indicate that it must search for resources and demand to support it. That is why legitimacy is considered to be a vital resource for business growth and survival (MARKARD; WIRTH; TRUFFER, 2016; SANTOS; EISENHARDT, 2005; TOLBERT; ZUCKER, 1983; TORNIKOSKI; NEWBERT, 2007; VAN OERS; BOON; MOORS, 2018), as well as the formation of new industries (ALDRICH; FIOL, 1994; BERGEK; JACOBSSON; SANDÉN, 2008). As this novel organizational form diffuses one has a growing legitimacy, which denotes some success in obtaining such resources (ALDRICH; FIOL, 1994; JOHNSON; DOWD; RIDGEWAY, 2006) and support from the wider public (GEELS; VERHEES, 2011; POLLOCK; RINDOVA, 2003).

On the other hand, literature has also pointed out that the loss of legitimacy may lead to deinstitutionalization of established, taken-for-granted organizational forms or practices (CHAUDHRY; RUBERY, 2019; DAVIS; DIEKMANN; TINSLEY, 1994; OLIVER, 1992). In this process, windows of opportunities are opened for the emergence of new players seeking legitimacy to become institutionalized (GREENWOOD; HININGS; SUDDABY, 2002; HIATT; SINE; TOLBERT, 2009).

Aldrich and Fiol (1994) argue that entirely new organizational forms lack recognition and credibility in the social context in which they begin their activities, which may magnify several constrictions to which new ventures are subject (e.g., access to capital). The authors suggest two dimensions of legitimacy: (i) cognitive, that is related to the level of knowledge about the new activity and its practices and resources that are assumed critical to succeed; and (ii) sociopolitical, the extent to which the general community, government

officials, stakeholders, and opinion leaders accept a new organizational form as aligned with existing standards, norms and laws.

In turn, Scott (2014) suggests a three-dimensional view of organizational legitimacy. Regulative legitimacy stems from actors who exert some sort of power over organizations – like government regulatory agencies – and define the boundaries of what is legally acceptable through requirements and sanctions. Normative legitimacy flows from actors who define what is morally desirable rather than legally required – like professional associations, unions – that define referential standards and values for a given community. Finally, cultural-cognitive legitimacy comes from comparable, widespread organizational actors, thereby providing templates for organizational structures and actions. As argued by Hargadon and Douglas (2001), an innovation's value depends on how well the public comprehends what the new idea is and how to respond to it.

In a seminal work, Suchman (1995) proposes three types of legitimacy: pragmatic legitimacy, that is based on self-interest of an organization's most immediate audiences, with regard to the social, economic and political impacts of organizational action on the community; moral legitimacy, based on normative approval, i.e., depends on what is perceived as morally right; and cognitive legitimacy, based on comprehensibility and societal taken-for-grantedness.

For its part, according to the author, pragmatic legitimacy unfolds into three types: exchange legitimacy, since there may be a utilitarian exchange between audiences and the organization, driven by the favorable nature of the impacts of the organizational actions; influence legitimacy, when constituents support the organization because they recognize that it is engaged with their most important interests, which demonstrates ongoing commitment to their well-being; and dispositional legitimacy, as audiences often react as though organizations were individuals (possessed of goals and personalities), they tend to confer legitimacy on those companies of "good character" ("honest", "decent", "trustworthy").

Suchman's (1995) moral legitimacy is assumed unfolded in four types: consequential, that is, evaluations of outputs and consequences of the company operations (e.g., adverse side-effects of its production process, or perceived poor quality level in its outcomes can decrease moral legitimacy); procedural legitimacy, as organizations can obtain legitimacy by adopting socially accepted processes, techniques, and procedures; structural legitimacy, that is, audiences accord legitimacy to organizations whose structural characteristics convey the image that it operates in an adequate manner, in line with

collectively valued purposes; and personal legitimacy, that rests on the personality traits of individual organizational leaders (charisma, allure, charm, talent).

Lastly, Suchman (1995) asserts that cognitive legitimacy is a two-factor construct: the first factor is the comprehensibility, i.e., legitimacy stems mainly from the availability of recognized cultural models that can explain the organization and its activities, making them plausible and predictable; the second, taken-for-grantedness, indicates the extent to which an organization is seen as irreplaceable (inevitability), and the continuity of its operation as necessary (permanence), that is, "alternatives becomes unthinkable (…) and the legitimated entity becomes unassailable by *construction*." (SUCHMAN, 1995, p. 583, emphasis in the original)

Drawing upon these three conceptions of organizational legitimacy, we confront their core ideas in each construct in order to identify similarities and complementarities. Table 2 presents the comparison conducted.

Table 2 – Dimensions of organizational legitimacy

Authors	Dimensions (or types)		
Scott (2014)	Cultural-Cognitive	Normative	Regulative
Aldrich and Fiol (1994)	Cognitive	Sociopolitical	
Suchman (1995)	Cognitive	Moral	Pragmatic

Source: The author.

It should be noted that in the three approaches discussed above, in accordance with Navis and Glynn (2010), legitimacy results both from actors within the category or sector, through strategies and symbolic behaviors undertaken by companies, and actors external to the category, interested audiences who assess – and may confer – its credibility and appropriateness.

Drawing upon the Suchman's (1995) work, the essay by Zimmerman and Zeitz (2002) offers a useful schema with four different strategies for new ventures to acquire legitimacy: conformance with the environment, selection of the environment, manipulation of the environment, and creation of the environment. Table 3 describes such strategies and gives some enlightenment about the organizational behavior towards legitimacy.

Table 3 – Characteristics of legitimation strategies

Strategy	Behavior towards legitimacy	Strategic position	Characteristics
Conformance	Legitimation occurs through full	Follow the rules	Legitimacy seekers have little or no

Strategy	Behavior towards legitimacy	Strategic position	Characteristics
	alignment with the demands and expectations of the existing social structure, without questioning or changing.		power and resources to challenge the taken-for-granted and well-established rules, norms, and models of the social structure.
Selection	Legitimacy is achieved by choosing an environment that is consistent with and most advantageous to the legitimacy seeker.	Select a favorable environment	New ventures have the resources to select the existing rules, norms, and models that are consistent with it so that some degree of conformity is possible.
Manipulation	Legitimation becomes possible by changing the rules, norms, values, practices, and regulations.	Change the rules	Companies opportunistically attempt to influence institutions in order to achieve consistency with the environment.
Creation	Legitimacy is obtained by creating new norms, rules, models, practices, and even government regulations.	Create the rules	Legitimacy seekers act as a pioneer and establish the basis of legitimacy.

Source: The author, based on Zimmerman and Zeitz (2002).

As discussed above, legitimacy is a condition achieved through a variety of manners that combine coordinated collective actions with institutional (re)arrangements to adapt to the environment where a firm performing a new business model operates or intends to explore. Such behaviors show the struggle of innovations to overcome, at least to some extent, the set of barriers of (or gaps in) legitimacy to become widespread, legitimate.

During this process, the current socio-technical system experiences adaptations and transformations, i.e., reconfiguration pathways (see section 2.2). We advocate that the reconfiguration of the system for the emergence of a new business model and its quest for legitimacy are ultimately two lenses through which one can observe the same phenomenon. Such a phenomenon can vary in terms of who are the dominant actors and how capable they are of imposing the reproduction or change of rules and institutions (GEELS *et al.*, 2016).

In the next section, we state our first deductive assumption in this thesis and address the strategies and dynamics inherent to legitimation processes by putting business model innovations into the transitions perspective.

2.4 Connecting business model approach, transitions perspective, and legitimacy theory

> "When innovations meet institutions, two social forces collide, one accounting for the stability of social systems and the other for change." (HARGADON; DOUGLAS, 2001, p. 476)

Some studies have aimed to understand the process of emergence of new market categories (KHAIRE; WADHWANI, 2010; LEE; HIATT; LOUNSBURY, 2017; NAVIS; GLYNN, 2010; SANTOS; EISENHARDT, 2009), which can be defined as "business environments in an early stage of formation" (SANTOS; EISENHARDT, 2009, p. 644). Because of this, they usually face a lack of resources and clear, consistent identities (NAVIS; GLYNN, 2010), which hinders their legitimating process, as identity is a driver for legitimacy (GLYNN, 2008; GLYNN; ABZUG, 2002; NAVIS; GLYNN, 2011).

Like any innovation, those related to new market categories as well as new business models manifest a paradoxical characteristic: on the one hand they bring into the market a novel, distinct solution to meet current or latent demands; on the other this newness may present nonconformities with established social, normative, institutional or legal standards, which reveals some legitimacy deficit (ALDRICH; FIOL, 1994) and vulnerabilities that the company will have to deal with to thrive (NAVIS; GLYNN, 2011).

Up to this point, we have argued that legitimacy requirements are in the heart of the process of emergence and spreading of technological innovations (BUNDUCHI, 2017; KAGANER; PAWLOWSKI; WILEY-PATTON, 2010; MARKARD; WIRTH; TRUFFER, 2016), novel business models (AMIT; ZOTT, 2015; KARLSSON; MIDDLETON, 2015; MIKHALKINA; CABANTOUS, 2015; ZIMMERMAN; ZEITZ, 2002) or new market categories (KHAIRE; WADHWANI, 2010; LEE; HIATT; LOUNSBURY, 2017; NAVIS; GLYNN, 2010; TORNIKOSKI; NEWBERT, 2007). Therefore, in our view, legitimacy is a crucial resource to enable new business models to cross the niche boundaries and rise to the socio-technical regime. However, the structural – competitive and institutional – conditions in the current regime provide it with relative stability and could work as barriers to innovation emergence (GEELS, 2002; GEELS; SCHOT, 2007).

Our first core argument is that the characteristics of the current socio-technical regime might represent a set of (and probably a gap in) legitimacy requirements that innovations (e.g., new business model) would have to fulfill, transform, or substitute to succeed. By "characteristics" we mean the arrangement of actors, technologies and institutional patterns and rules within a regime as well as the interactions with one another. The multi-level perspective for socio-technical transitions (GEELS, 2002, 2004; GEELS; SCHOT, 2007; KÖHLER *et al.*, 2019; RAVEN; GEELS, 2010) supports this proposition.

In a given socio-technical regime, the dimensions of legitimacy will tend to remain in a dynamically steady state until pressures arising from both technological niches and landscape developments can disturb this relative *equilibrium*. Accordingly, each

legitimacy dimension is viewed as a deeply rooted lock-in mechanism to be in some way, and to some extent, unlocked. Stated another way, "as long as the regime remains stable, niche innovations have little chance to diffuse more widely." (GEELS, 2005, p. 451)

An integrative meta-analysis undertaken by Panetti *et al.* (2018) identified seven causal drivers of transitions, namely, technology diffusion in mainstream markets and ideas; market formation; changes at the landscape level and regime instability; articulation of visions and expectations and social desirability; availability of complementary technologies; socio-technical alignment; and system lack of internal adaptive capabilities. These drivers might indicate potential avenues whereby to overcome legitimacy gaps and reconfigure the regime, enabling the selection and spread of a new business model.

In this sense, we tried to collate the sub-regimes of the socio-technical regime as proposed by Geels (2002, 2005) in the MLP framework (see Figure 3 and Figure 4) with the dimensions of legitimacy. We rely on Suchman's (1995) typology for legitimacy and present these relations in Table 4, focusing on how the legitimacy gap – for each dimension, whenever possible – could be fulfilled, leading to changes in the regime level.

Table 4 – Linking legitimacy and socio-technical regime dimensions

Regime dimensions (GEELS, 2002)	Legitimacy dimensions (SUCHMAN, 1995)	Legitimacy-seeking behavior vignettes
Industrial networks	Pragmatic	Utilitarian exchanges could occur between companies with complementary assets or competencies; when two or more companies hold relationships with one another (e.g., buyers, suppliers, financial backers), they are conferring legitimacy on each other, so that their innovative business models may gain traction.
	Cognitive	Unstable networks of actors in the niche level will be recognized as necessary when their novel business models meet collective industrial expectations in the regime and can improve the incumbent production practices, routines, and techniques.
Culture, symbolic meanings	Pragmatic	Innovative firms could interact with their audiences through new consumer experiences, engaging with their consumers' interests and well-being, and creating symbolic ties with them.
	Moral	Normative approval is attained when symbolic meanings created by companies in the niche level are in line with norms, beliefs, and values of the social system.
	Cognitive	Innovative firms will emerge to the regime when their business models become culturally recognized, as a distinct category in the users' minds; such an identity needs to meet the users' values and beliefs system.
Infrastructure	Pragmatic	This dimension refers to private or public structural conditions under which regime evolves over time; if infrastructure is public, emerging technologies will often depend on the public sector (sectoral policy dimension), and innovators may lobby the policymakers to intervene by favorable regulations and subsidies; if private, it can pressure niche-innovations by demanding investments in relationship-specific assets or

Regime dimensions (GEELS, 2002)	Legitimacy dimensions (SUCHMAN, 1995)	Legitimacy-seeking behavior vignettes
		complementarities which improve its performance and value.
	Cognitive	Niche actors may engage in shaping the infrastructure holder's expectations, either public or private agent, that the emerging innovation is advantageous, respectively in terms of welfare or private benefits; in both cases, there will be incentives for infrastructure adjustments.
Technology	Pragmatic	When incumbent technologies represent barriers to innovation, new ventures could change the way services are delivered and products manufactured and consumed; on the other hand, if existing technologies are necessary, innovators need to complement them by improving their performance.
	Moral	New technological developments must be in conformity with socially accepted values and beliefs, which could vary over time and according to region.
	Cognitive	As well as industrial networks, new technologies and business models need to be recognized as proper standards to solve users' or producers' day-to-day problems, either by complementing or replacing incumbent technologies.
Markets, user practices	Pragmatic	Existing user practices are influenced by new technologies, which could reduce transaction costs, improve the consumer experience, and increase adoption.
	Moral	Consumption practices and preferences are influenced by the norms, beliefs, and values of the social context; niche innovators need to provide better performing solutions by employing socially accepted processes and techniques, and preferably be led by charismatic leaders.
	Cognitive	When novelties meet users' problems, they may become preferred solutions, and standardized choices in the consumption behavior; innovative firms could also engage in media communications to spread a favorable narrative and mark a clear, distinct position in the market and consumers' minds.
Scientific knowledge	Pragmatic	Based on scientific knowledge, novelties are designed and developed in niches, and then geared to solve problems in the existing regimes; the higher the adjustment with the problem, the higher the probability of the innovation filling the legitimacy gap and emerging to the regime level.
	Moral	Science has its "own moral" (e.g., respect for patents, property rights); when the support of institutions within the innovation system is indispensable, new technologies developed in niches must follow such moral standards to gain support and flourish.
Sectoral policy	Pragmatic	As the quest for alignment with current sectoral rules and regulations might undermine the innovative potential of a new business model or technology, legitimacy, in this case, might come from the pressure imposed by other legitimacy dimensions (i.e. as a consequence of): higher user adoption rates, or the expansion of companies' partnerships or other arrangements.
	Cognitive	As barriers to emerging niche innovations, current laws and regulations may often be misaligned with consumer needs or preferences, but aligned with the interests of incumbent firms; thus, consumers tend to recognize and support innovative business models and technologies that challenge sectoral policies and standards that go against their interests.

Source: The author.

Although this effort has not been exhaustive, the mini-vignettes briefly described actions supporting the processes of transformation within the socio-technical regime and elimination of legitimacy gaps. As with any environmental change, such a transformation can take place in varying ways, depending primarily on how fully institutionalized, deeply entrenched the regime rules are (FUENFSCHILLING; TRUFFER, 2014).

"Regime rules" refers, as we have argued so far, to several important factors influencing this transition process, such as the presence of power and political pressures (HESS, 2016; ROBERTS; GEELS, 2019a, 2019b), the different knowledge systems between niche and mainstream regime (INGRAM, 2018), the institutional logics, i.e. rules, norms, and belief systems guiding action (SMINK *et al.*, 2015), and the mechanisms of coordination of interaction between actors (DE HAAN; ROTMANS, 2018; WITTMAYER *et al.*, 2017).

Building on these relationships between the dimensions of legitimacy and the characteristics of the socio-technical regime, we advance the multi-level perspective on socio-technical transitions framework by proposing a complementary innovative model. Through it, we intend to better illustrate the interactions among emerging innovations, current institutional forces, and legitimacy issues, as depicted in Figure 8.

Figure 8 – Legitimacy dynamics in the multi-level perspective
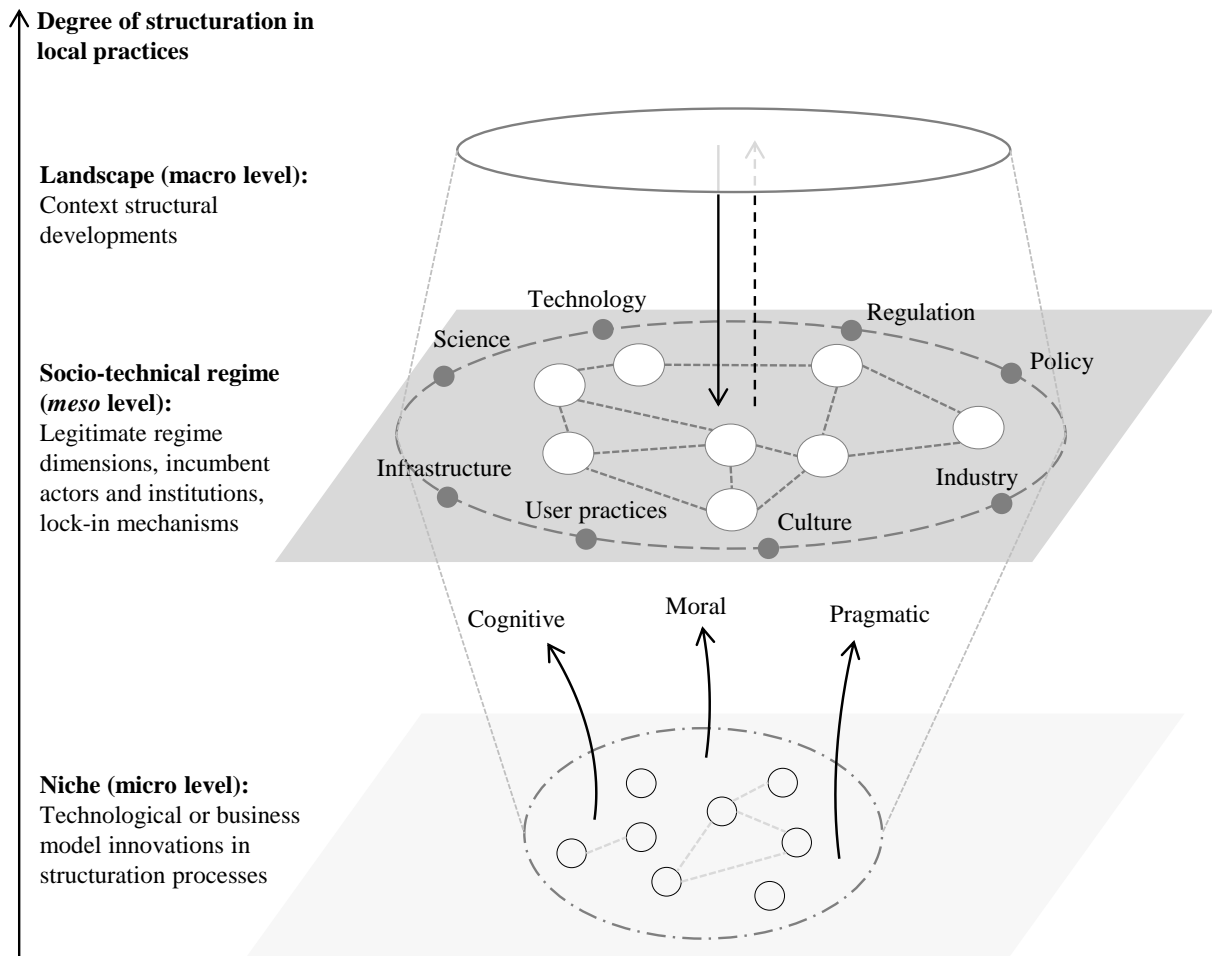
Source: The author, building on Geels (2002).

The dashed line around the socio-technical regime indicates its dynamically stable condition, that is, although it tends to remain constant, ongoing and long-term developments occur within it. Besides, this stability may also be disturbed by a suitable arrangement of pressures coming from both the broader landscape and technological niches. Such pressures are represented by arrows respectively above and below the regime.

Figure 8 further shows the institutional forces working both within and between the socio-technical regime and niche levels. The points on the edge of the regime symbolize its dimensions, i.e., sub-regimes. There are actors, rules, and institutions associated with each of them (for purposes of better visualization and understanding, we chose not to depict sub-regimes as circles at the edge of the regime). The dashed lines linking the actors to each other indicate the current degree of structuration within the regime. In our view, such an arrangement, consisting of sub-regimes and their respective actors and institutions connected, represents a set of legitimacy requirements that technological innovation and novel business models need to fulfill or adapt to scale up from niches and break through the regime. They act

as lock-in mechanisms, institutional forces that give regime stability and shield it from external pressures from both landscapes and niches.

Niche level instability is shown in some ways. In addition to the lighter gray plane, the relationships between actors are weaker because institutions (rules) are not still fully established. Unlike those in the regime, niche actors do not share language, knowledge bases (cognitive legitimacy), beliefs (moral) and expectations (pragmatic). Since legitimacy is critical for structuration, niche innovations build up internal momentum insofar as the legitimation work succeeds.

Cognitive, moral and pragmatic legitimation efforts are represented by upward, niche-to-regime arrows. Thereby, regime dimensions might be related up to the three types of legitimacy, in a dynamic, non-deterministic relationship. As discussed in Table 4, whereas for some dimensions (e.g., user practices, technology and culture) it is easy to find out the association with all types of legitimacy, for others, on the other hand, such connections are not so clear. This is the case, for instance, of infrastructure and sectoral policy sub-regimes, for which not all sources of legitimacy would be applicable. Even though the attempts of drawing such associations have taken a heuristic approach, we argue that accurate analysis for a real, complex context will vary from system to system, depending on the interactions between its real actors, technologies, and institutions (as will be presented later in chapters 4 to 6, which reports and discuss the empirical findings of this research).

It is not expected that different types of innovations – technological or business models ones – struggling to emerge into diverse socio-technical regime should be related to all sources of legitimation. For instance, niche innovations capable of improving performance of incumbent products, services, or processes in the regime level are unlikely to suffer from lacks in moral legitimacy, given their merely incremental nature. In these cases, new ventures may focus on gaining – even sustaining – pragmatic and cognitive legitimacy, by emphasizing the usefulness of their new product or business model and promoting informative marketing campaigns. At the other extreme, disruptive innovations can transform competitive conditions, shift user preferences, and even challenge regulatory and cultural standards, which will require costly legitimation efforts in the three legitimacy dimensions. Following the Zimmerman and Zeitz's (2002) and Smith and Raven's (2012) taxonomies, in the first case, the most likely legitimation strategies will be conformance and selection, through a "fit-and-conform" approach; in the latter, a "stretch-and-transform" approach through manipulation and creation strategies. Table 5 illustrates these connections.

Table 5 – Legitimation approaches and strategies

	Approaches	
	Fit-and-conform	Stretch-and-transform
Strategies	▪ <u>Conformance</u>: "Follow the rules." ▪ <u>Selection</u>: "Select a favorable environment."	▪ <u>Manipulation</u>: "Change the rules." ▪ <u>Creation</u>: "Create the rules."

Source: The author, based on Zimmerman and Zeitz (2002) and Smith and Raven (2012).

Research has addressed the importance of business models in enabling the potential value of new technologies (CHESBROUGH, 2010) and creating new markets (AMIT; ZOTT, 2015; NAVIS; GLYNN, 2010; THOMPSON; MACMILLAN, 2010). The abovementioned strategies will play an essential role for new business models, as their emergence, legitimation, and diffusion will be dependent upon experimentation and learning routines towards the alignment with regime rules and norms (DEMIL; LECOCQ, 2010; PISANO; PIRONTI; RIEPLE, 2015). As appropriate spaces for trial-and-error learning endeavors, niches enable a discovery-driven approach and bring the opportunity to discover and exploit new business models (MCGRATH, 2010; SOSNA; TREVINYO-RODRÍGUEZ; VELAMURI, 2010). On that subject, an assessment of how new business models may drive and fashion broader transition processes thus requires an investigation of their potential (mis)alignments with the institutional context (VAN WAES *et al.*, 2018) in order to achieve satisfactory legitimacy (SNIHUR; ZOTT, 2013).

From a co-evolutionary perspective on the industry emergence (i.e., shaped by an interplay of technology, institutions, and industry structure), the research by van Waes *et al.* (2018) examined the upscaling potential of different innovative bike sharing business models in the Netherlands and how institutional patterns in the industry, technology, regulations, and culture influence these prospects. Assuming that business model innovations can help to overcome barriers to the diffusion of sustainable technologies, the authors found that spatial network effects are critical to diffusion, which in turn is critical to profitability, especially for station-based schemes. Free floating models, on the other hand, struggle to consolidate and scale-up, as they are not yet embedded among the public and in local legislation alike.

Huijben, Verbong and Podoynitsyna (2016) analyzed the regulatory background of solar photovoltaic energy niche arrangements in the Netherlands and Belgium and how different types of niche business model interact with the mainstream selection environment (i.e., regulatory regime) – either through a fit-and-conform strategy or a stretch-and-transform one – in order to diffuse. Their findings show that regulatory niche shielding strategies positively impacts the business models profit equation, which works as an incentive

mechanism for attracting new entrepreneurs and investors. Besides, niche organizations managers use a set of different fit-like and stretch-like strategies while adapting their customer interactions and value propositions to survive. Sometimes they adopt illegal but morally legitimate, protected business models that cross regulatory boundaries in order to provoke discussion and expand existing rules.

By orchestrating business models and transitions in the particular context of the Brazilian healthcare industry, Lopes *et al.* (2019a) developed a multi-level perspective-based theoretical framework for analyzing the several internal and external elements and actors that dynamically interact towards transitions. In a later study, Lopes *et al.* (2019b) undertook an empirical inquiry about how to promote healthcare sustainable supply chains. Based on in-depth interviews with specialists from different Brazilian private hospitals, the authors argue that the range of actors with different needs and expectations interfere in the hospital business models' sustainability enablers and the whole supply chain wherein each of them operates, which prevents the transition to a broader sustainable supply chain.

Bolton and Hannon (2016) inserted the public sector in the game and discussed how local UK authorities design innovative business models drew on sustainable technologies. By investigating the cases of two niche energy service companies operating under a decentralized energy supply business model, their findings highlight the key role of reforms in the political, market and regulatory subregimes in supporting business model innovations in order to leave niches and spread.

Business model innovations are also said to function as key drivers in accelerating sustainability transitions while struggling with their incumbent counterparts oriented to perpetuate lock-ins. Still in the context of power systems, Wainstein and Bumpus (2016) discussed how niche actors in the distributed energy business are scaling-up through innovative business models that do not require upfront costs from customers, and how renewable energy sources in liberalized electricity markets have led to the erosion of wholesale prices and challenged incumbents in the traditional centralized energy model.

A similar conception of the role of business models in transitions is observed in a study by Bidmon and Knab (2018), who seem to have succeeded in trying to connect business model theory and socio-technical transitions framework. For these authors, business models can play three important roles in transition dynamics, as follows in Table 6.

Table 6 – Business models' roles in socio-technical transitions

Business models as...	Role description	Impact on transition dynamics

Business models as...	Role description	Impact on transition dynamics
... part of the current socio-technical regime	Barrier: Incumbent business models as barriers to socio-technical transitions.	Existing business models function as lock-in mechanisms, shielding and reinforcing the regime and stabilizing its logic against niche developments.
... intermediates between niche and socio-technical regime	Driver: Novel or existing business models as drivers to socio-technical transitions pushed by new technological artifacts.	Incumbent or new business models encapsulate emerging technology innovation and support both its stabilization and breakthrough from niche to regime level.
... non-technological niche innovation	Driver: New business models as drivers of socio-technical transitions.	Novel business models emerging from niches challenge the dominant regime logic and build up a substantial part of a new regime since its boundary-spanning nature requires co-innovations of various actors.

Source: The author, based on Bidmon and Knab (2018).

Given the interdependence between a focal company and other actors in the value chain (AMIT; ZOTT, 2015), the boundary-spanning nature of business models can play a dual role in transitions. On the one hand, by coordinating competencies (resources, technologies, processes) from a focal firm and its partners, existing business models work as lock-in mechanisms across the value chain, adding stability to the regime while inhibiting the diffusion of still illegitimate niche innovations. On the other hand, as niche innovations struggle to gain stability and endogenous momentum, existing or novel business models act as vehicles influencing the whole value chain and enabling legitimacy seekers to break through to regime.

In such a way, business model innovations are capable of both shaping the institutional environment (DE LEEUW; GÖSSLING, 2016), by changing the cognitive, normative and regulative rules that govern the interactions, or shielding the regime by conserving the existing rules (BIDMON; KNAB, 2018).

Building on the insightful contributions by Bidmon and Knab's (2018), Smith and Raven (2012), and Zimmerman and Zeitz (2002), we summarize by arguing that when innovative niche business models have a competitive, divergent relationship with the incumbent regime, they will engage in a stretch-and-transform approach "against" it by selecting between two legitimation strategies, namely manipulation ("change the rules") and creation ("create the rules"). In these cases, legitimacy gaps tend to be severe in the three dimensions – pragmatic, moral and cognitive – and encompass a larger number of socio-technical sub-regimes.

Otherwise, when a new business model has a symbiotic, cooperative relationship with the regime, it will undertake a fit-and-conform approach, choosing between selection ("select a favorable environment") and conformance ("follow the rules") legitimation

strategies. In addition, a smaller number of sub-regimes would be impacted, and the moral dimension of legitimacy will tend not to be harmed. Some adaptations in the existing cognitive structures in the regime are likely to be necessary, but only in an incremental way. Furthermore, aspects related to pragmatic legitimacy, especially those of a regulatory nature will need to be evaluated, although any adjustments required may only be marginal. Figure 9 inserts business models innovations in the multi-level perspective from a legitimacy approach.

Figure 9 – Business model innovations legitimacy in the multi-level perspective
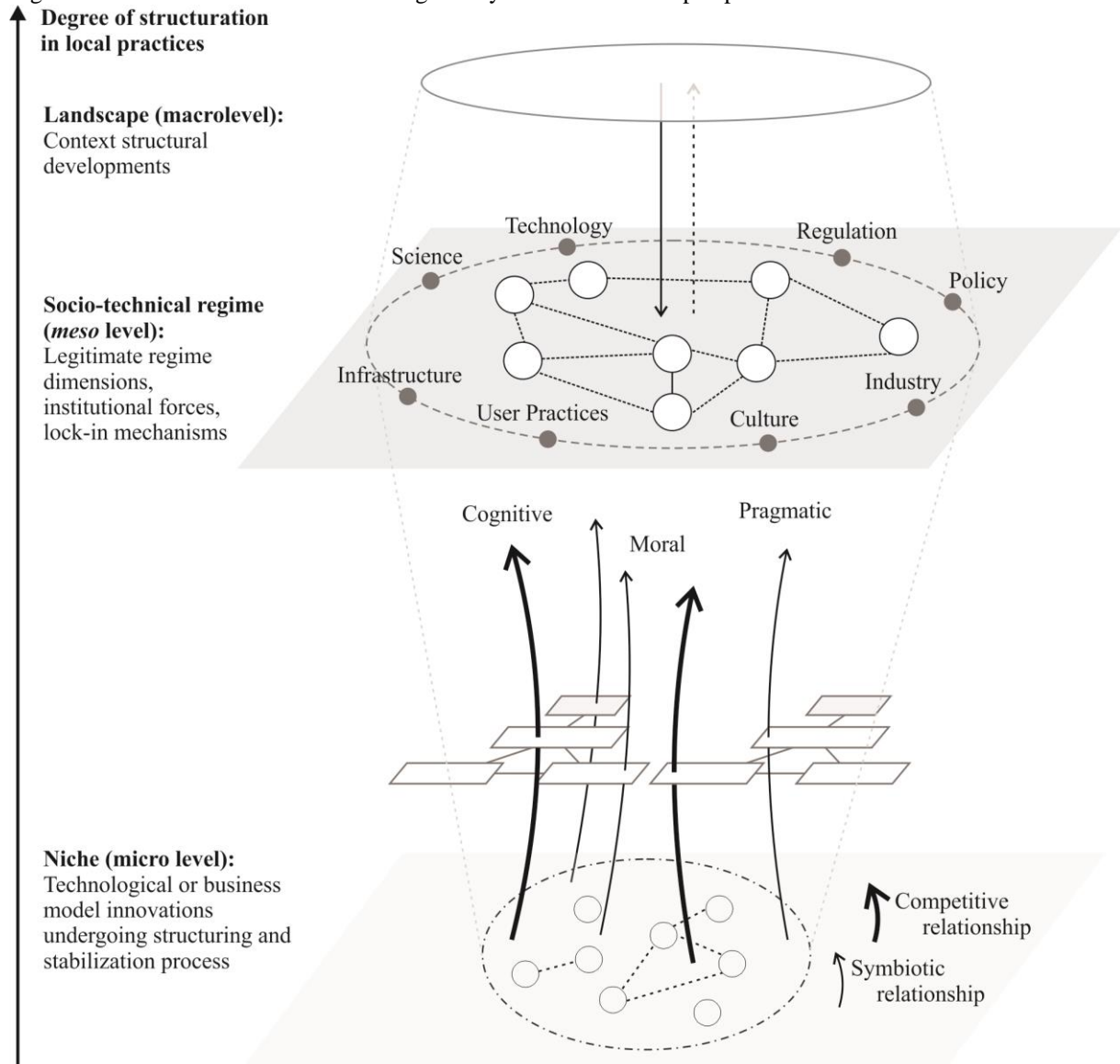
Source: The author, building on Wainstein and Bumpus (2016) and our Figure 8.

By putting the business model innovation literature into transitions perspective, we undertook a legitimacy approach and proposed an integrative framework (see Figure 8) encompassing dimensions of legitimacy and characteristics of socio-technical (sub-)regimes in order to understand the multi-level interactions and its dynamics. This framework is

considered a starting point to guide the empirical efforts of the research, as the mechanisms underlying its relationships are still unknown.

Firstly, one intends to capture the perception of the research subjects concerning each of the legitimacy dimensions. Then, the objective is to propose a substantive theory for the process of legitimation in the sharing economy context. Before that, we need to discuss the concept of the sharing economy and put it into the perspectives of transitions and business models.

2.5 Sharing economy

In the last few years, the sharing economy has gained increasing attention among practitioners and academics (TÄUSCHER; KIETZMANN, 2017), in part due to the success some sharing business models companies have been able to achieve (PARENTE; GELEILATE; RONG, 2018).

It is still unclear whether the sharing economy is merely a perfunctory trend in consumer behavior and business models, or we are experiencing an inexorable change in the way products and services are acquired, distributed and consumed (KATHAN; MATZLER; VEIDER, 2016). However, the emergence of several different new market categories based on sharing models (e.g., peer-to-peer accommodation, car sharing, ride sharing, bike sharing, time banking, scooter sharing, among others) seems to suggest that it is not only an ephemeral fashion.

We now address the origin and some definitions for the sharing economy. Then, we discuss the phenomenon from the lenses of business model innovation, institutional approach for legitimacy, and multi-level perspective on technological transitions. Such an effort will establish the guidelines for the empirical scope of the research.

2.5.1 Origin and definition

"Sharing" is a phenomenon as old as the humankind itself (BELK, 2014b; CODAGNONE; MARTENS, 2016). It can be seen as the most fundamental manifestation of economic behavior based on human biological behavior, flourishing under adaptations to hunting and becoming an influential force for solidarity between communities (PRICE, 1975).

As a phenomenon of the business and consumer practices world, the pioneering use of the term "sharing" seems to go back to an prominent essay by Yochai Benkler (2004),

in which the author draws upon the carpool and distributed computing industries to picture sharing as a modality of production and outline its consequences to some public policy debates.

Since then, the sharing economy has increased with the age of the internet (BELK, 2014b) and related technologies that facilitated connectivity (KATHAN; MATZLER; VEIDER, 2016) and boosted up sharing models to a large scale (COHEN; KIETZMANN, 2014). It brought together several similar categories identified in the literature, such as collaborative consumption (BOTSMAN; ROGERS, 2010, 2011; LAAMANEN; WAHLEN; CAMPANA, 2015; LAMBERTON, 2016); on-demand economy (COCKAYNE, 2016), peer-to-peer economy (WEBER, 2016), platform economy (NERINCKX, 2016; SCHOR; ATTWOOD-CHARLES, 2017), or gig economy (FRIEDMAN, 2014); peer-to-peer markets (EINAV; FARRONATO; LEVIN, 2016); the mesh (GANSKY, 2010); access-based consumption (BARDHI; ECKHARDT, 2012); connected consumption (DUBOIS; SCHOR; CARFAGNA, 2014; WHITHAM; CLARKE, 2016); commercial sharing systems (LAMBERTON; ROSE, 2012), and so on.

This comprehensive variety suggests that there is still no consensus on what modalities or categories are comprised in the scope of the sharing economy (CODAGNONE; MARTENS, 2016), although the expression "has become a catch-all label with strong normative underpinnings." (ACQUIER; DAUDIGEOS; PINKSE, 2017, p. 1) In this regard, some studies have attempted to propose an appropriate taxonomy (BELK, 2014a; CONSTANTIOU; MARTON; TUUNAINEN, 2017; DE RIVERA *et al.*, 2017; LAMBERTON, 2016; MUÑOZ; COHEN, 2017; SCARABOTO, 2015) or better define the conceptual boundaries of the phenomenon (ACQUIER; DAUDIGEOS; PINKSE, 2017; FRENKEN, 2017; GERHARD; SILVA JÚNIOR; CÂMARA, 2019; HABIBI; DAVIDSON; LAROCHE, 2017; KENNEDY, 2016; PUSCHMANN; ALT, 2016).

Despite this plethora of expressions, they all hold in common the essence of the phenomenon under investigation: interactions through which people sell, buy, rent, lend or share underutilized material goods, services or less tangible assets (money, time, for instance) to one another, usually – but not necessarily – supported by information technology platforms, setting up new business models (GANSKY, 2010; KATHAN; MATZLER; VEIDER, 2016) or emerging market categories (MIKHALKINA; CABANTOUS, 2015; NAVIS; GLYNN, 2010).

2.5.2 *Sharing as a business model innovation*

Previous discussions support the proposition of our second basic argument. In our view, sharing economy activities are based on new, innovative business models and might be understood as a nascent or emerging market category. The words of Rashmi Dyal-Chand are illustrative and reveal the core of this discussion: "Is Airbnb a hotel, a rental agency, or a provider of a software product? Is Uber an employer, a taxicab company, or a software developer?" (2015, p. 244)

When referring to "new business models" and "emerging market categories", we are advocating that sharing businesses transform, to some extent, the current competitive conditions of the industry in which they operate. They take advantage of transactions cost reductions while connecting people for mutual benefit (KIESLING, 2018).

For instance, through the "sharing" business model, people can access "taxi services" (e.g., Uber, Lyft), accommodations for tourism and leisure (Airbnb, Couchsurfing), private cars (Car2go, Zipcar), or bicycles (Wheelz, RelayRides), to name only companies that have been working on a large scale (MALHOTRA; VAN ALSTYNE, 2014). All these cases, to name but a few, corroborate our second argument, which is in line with some recent studies that had put the phenomenon in the business model innovation perspective (CHOI *et al.*, 2014; GUTTENTAG, 2015; HABIBI; DAVIDSON; LAROCHE, 2017; MIKHALKINA; CABANTOUS, 2015; MUÑOZ; COHEN, 2017; RICHTER *et al.*, 2017; TÄUSCHER; KIETZMANN, 2017).

According to Lamberton and Rose (2012), commercial sharing systems are business models through which customers have the opportunity to enjoy product benefits without ownership whenever they realize that the benefits of sharing outweigh its costs. They drew on the rivalry *vs.* exclusivity dyad from the public goods seminal literature (HARDIN, 1968; OSTROM, 2003) and proposed a valuable framework to classify sharing systems, as illustrated in Figure 10.

Figure 10 – Typology of sharing systems

	Higher Rivalry	
Lower exclusivity	<u>Open Commercial goods sharing</u> Access to the sharing system is open for those who can pay an entry fee (there are no other limits on who may participate); one consumer's use of a shared good makes it unavailable for another consumer to use (e.g., bike sharing, car sharing, fractional ownership).	<u>Closed Commercial goods sharing</u> Access to the sharing system is restricted to people with status, relationships to other sharers, or donation ability; one consumer's use of a shared good makes it unavailable for another consumer to use (e.g., health cooperatives, cell phone sharing plans, frequent-flyer-mile sharing plans).
Lower exclusivity	<u>Public goods sharing</u> Access to the sharing system is generally open to anyone, goods are generally non-depletable; one user's consumption does not rule out another's simultaneous consumption (e.g., public parks and roads, world wide web, open-source software).	<u>Access/Club goods sharing</u> Access to the sharing system is restricted to people with status, relationships to other sharers, or donation ability; the underlying good is difficult to deplete, either because membership is limited to a sustainable number or due to the nature of the good (e.g., private clubs, book clubs, investment clubs).
	Lower Rivalry	

*(Right side margin label: **Higher exclusivity**)*

Source: The author, adapted from Lamberton and Rose (2012).

"Rivalry" indicates the degree to which customers compete for a limited supply of the shared product. "Exclusivity" refers in turn to what degree the access to the product can be controlled and restricted to a group of consumers. Since these dimensions are not dichotomous but continuous, sharing business models could engage in a variety of arrangements, from public to commercial (rivalry), from open to closed ones (exclusivity).

Kumar, Lahiri and Dogan (2018, p. 148) point out that a sharing economy business model "consists of a firm, or service enabler, which acts as an intermediary between the suppliers of a good or service (service provider) and customers who demand those underutilized goods and services." They propose a simple and enlightening generic scheme to represent sharing business models, which is shown in Figure 11.

Figure 11 – Sharing economy business model
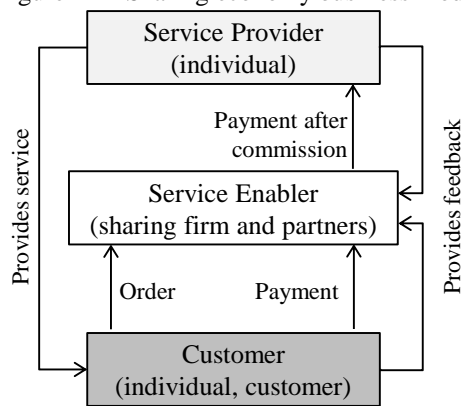
Source: The author, adapted from Kumar, Lahiri and Dogan (2018).

Because this underlying process predicts two-side payment transactions (from customer to service enabler, and then from service enabler to service provider), this framework is restricted to Lamberton and Rose's (2012) so-called commercial sharing systems (higher rivalry), and cannot be applied to public initiatives at large, not even public-private partnerships-based ones. Thus, adaptations seem to be necessary in order to contemplate schemes promoted by the public sector, either alone or in partnership with the private sector.

Constantiou, Marton and Tuunainen (2017) corroborate Lamberton and Rose (2012) and argue that sharing business models could differ in terms of the degree of control over participants and the intensity of rivalry among them. Each model delivers different value propositions, resulting from different organizational mechanisms of coordination. As argued by Kathan, Matzler and Veider (2016), such innovative value propositions can affect the strategies of the incumbent companies in several ways, namely, their value propositions itself, revenue streams and profit formula, and critical resources and processes management.

Dreyer *et al.* (2017) developed a model of three-way interactions among institutional context, business model innovation, and stakeholder values and empirically confirmed the significant influence the socioeconomic and institutional conditions exert on the stakeholder values. Ultimately, such conditions shape the stakeholders' perceptions about the sharing businesses, leading to a need for adaptation and permanent alignment with the institutional context in which they perform in order to gain or sustain legitimacy.

Potential misalignments between the characteristics of the business model and established institutional rules (e.g., user practices, regulatory issues, incumbent processes) may represent a set of barriers to the sharing economy-based ventures so that they cannot

emerge from the niches in which they are being developed (TÄUSCHER; KIETZMANN, 2017).

These findings bring the characteristics of the institutional context into the center of the discussion and lead us to analyze the sharing economy phenomenon from the multi-level perspective on socio-technical transitions.

2.5.3 Putting the sharing economy into transitions perspective

Linking our second argument – that sharing economy-based firms or activities perform innovative business models as an emerging market category – with the dynamics of multi-level perspective on technological transition previously discussed (see section 2.2), we state our third core assumption in this research. We advocate that the sharing economy and its close cousins might be seen as niche developments, combining innovations in technology and business model, building up internal momentum while interacting with the incumbent institutional forces to scale up through the current socio-technical regime.

Sharing economy practices and business models are said to be misaligned with current social and institutional patterns. As asserted by Morgan and Kuch (2015), it is a manifestation of the radical transactionalism, that is,

> (…) the creative redeployment of legal techniques and practices relating to risk management, organisational form and the allocation of contractual and property rights, in order to further the purpose of internalising social and ecological values into the heart of economic exchange (MORGAN; KUCH, 2015, p. 565).

Since sharing economy is deemed a controversial, paradoxical umbrella construct that encompasses a diversity of for-profit and non-profit activities (ACQUIER; DAUDIGEOS; PINKSE, 2017; RICHARDSON, 2015), vast literature has been intensively criticizing some aspects from its innovative business model, as their long-term impacts are likely to remain blurred (FRENKEN; SCHOR, 2017).

Criticisms are predominantly related to regulatory standards (GUTTENTAG, 2015; RANCHORDÁS, 2015; RICHARD; CLEVELAND, 2016), inequality implications (GANT, 2016; SCHOR, 2017; SCHOR *et al*., 2016), and labor conditions (GANAPATI; REDDICK, 2018), but not only that. Such disapprovals could represent the tensions that

sharing economy need to overcome to establish in a new, reconfigured socio-technical regime.

Despite all these tensions, it is unexpected that virtually no studies in the literature have examined the sharing economy from the multi-level perspective on socio-technical transitions. More accurately, only seven studies seem to have done so before (AUGENSTEIN; BACHMANN, 2018; MARTIN, 2016; MARTIN; UPHAM; BUDD, 2015; MORADI; VAGNONI, 2018; PRAYAG; OZANNE, 2018; SALVIA; PISCICELLI, 2018; VAN WAES *et al.*, 2018). However, four of them addressed the sharing economy from the sustainability transitions paradigm, a specific, pioneering application of the multi-level perspective framework that has gained prominence in the last years (GEELS, 2010; LOORBACH, 2010; MARKARD; RAVEN; TRUFFER, 2012; SMITH; VOß; GRIN, 2010).

Those studies by Prayag and Ozanne (2018) and Moradi and Vagnoni (2018) were the only ones to position the sharing economy in a broader approach of transitions. Nevertheless, none of these studies have focused on legitimation processes and its dynamics (even then, the word *legitimacy* and close variations do not appear at all), which is why such issues remain poorly understood in the context of the sharing economy.

In turn, the study by van Waes *et al.* (2018) seems to be the only closer predecessor of the research reported here. However, while it adopts the same theoretical assumptions (legitimacy, transitions, and business model innovation), there are slight variations in methodological assumptions and more considerable differences concerning the research objectives and context.

Therefore, in line with these studies, we argue that the sharing economy might be yet a niche development, a field in which a set of interrelated resources and technologies (e.g., sharing platforms, internet, smartphones, infrastructure) are handled or used by several different actors (e.g., users, providers, owners, etc.), based on somewhat elusive or ill-established rules of action coordination (CHANG *et al.*, 2017; RAVEN; VAN DEN BOSCH; WETERINGS, 2010; SMITH; RAVEN, 2012).

Figure 12 is aimed at putting the sharing economy in a transitions perspective. We adapted the framework by Martin (2016) which centered at four prevailing sharing activities, namely, accommodation sharing platforms, car and ride sharing platforms, peer-to-peer employment markets, and peer-to-peer platforms for sharing and circulating resources.

Figure 12 – Sharing economy multi-level perspective
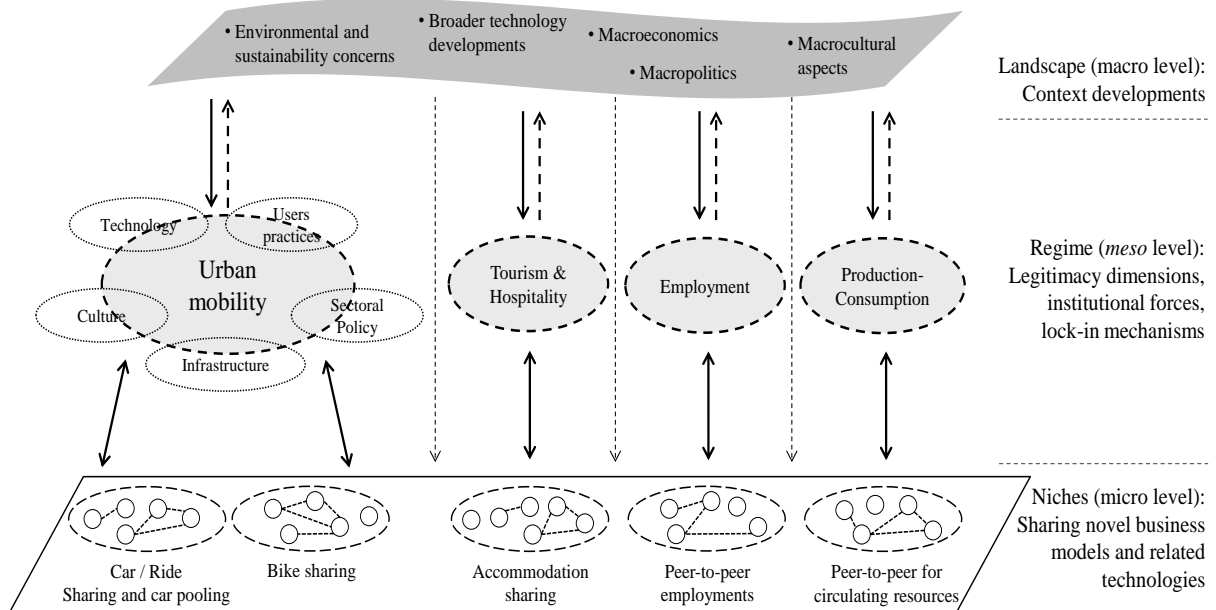
Note: Urban mobility regime is of greater interest of this research; for that reason, it was highlighted, and its sub-regimes were depicted; nonetheless, such sub-regimes should also be considered as existing within the other sharing regimes.
Source: The author, based on Martin (2016).

In line with our third assumption, the framework shows that sharing economy is a still stabilizing niche development as actors begin to organize themselves and share structures, language, expectations, knowledge, and cultural meanings. The lines delimiting regimes are thicker than those delimiting the niches, indicating the differences in the degree of stability and structuration between them. Although some actors are still "out of the game", innovative business models and technologies start to gain traction (some actors are linked to each other at the niche level) insofar their two-way interactions with regime's actors, technologies and institutions deepen through (more) symbiotic relationships (than divergent ones) which are capable of releasing lock-in mechanisms and reconfigure the regime.

As niches develop, they exert pressure on the socio-technical regime, whose configuration (e.g., well-established rules, current competition settings, incumbent organizational arrangements and business models, technologies in use, and current regulation) acts as a barrier, mitigating those pressures from the niche. Pressures also seem to come from the broader socio-technical landscape, in the form of more comprehensive factors such as economic crisis, social and environmental concerns, cultural changes, and advances in information and communication technologies.

Thus, in order to understand the rise of business models based on the sharing economy, it is necessary to analyze legitimacy issues in light of the transitions perspective, to which next section is devoted.

2.5.4 Legitimacy in the sharing economy: linking transitions perspective and business model innovation

Sharing economy has brought several challenges both for the public sector (GANAPATI; REDDICK, 2018) and for incumbent companies (HENTEN; WINDEKILDE, 2016). Concerns with the dynamics of the sharing economy and how it manifests and evolves across various economic systems are closely related to legitimacy issues (MAIR; REISCHAUER, 2017).

Putting together our three basic assumptions in a comprehensive sentence, we argue that sharing economy ventures are based on innovative business models (second assumption) building up internal momentum and adding stability in technological niches while interacting with the institutional forces from the current socio-technical regime (third), which represent legitimacy requirements they have to fulfill, transform, or substitute (first) in order to emerge and establish. The most illustrative way to represent that summarizing proposition is perhaps to refer to (and investigate) some cases by addressing the tensions that such novelties face in launching to markets.

The direct economic effects of the sharing economy are undeniably positive (FRENKEN; SCHOR, 2017) and create large welfare surplus, as evidenced by the significant volume of transactions (FRENKEN, 2017). However, critical research seems to show that there is a flagrant tension between the sharing economy manifesto – promises of social and environmental progress – and some of its impacts on markets, governments, workers, consumers, and the environment (MURILLO; BUCKLAND; VAL, 2017).

Authors have argued that sharing economy could be a new form of neoliberalism (MARTIN, 2016), that reproduce, at least to some extent, the capitalist agenda (CAMMAERTS, 2011), and could exacerbate inequality in some ways (SCHOR; ATTWOOD-CHARLES, 2017). For instance, sharing business models challenge labor unions and create a class of independent workers who do not benefit from labor protection (GANAPATI; REDDICK, 2018; MALHOTRA; VAN ALSTYNE, 2014).

Some platforms could also shift income to more affluent households, crowding out lower-educated workers who traditionally did jobs such as driving, cleaning, and household tasks (SCHOR, 2017). In addition, such platforms reproduce class inequalities through person-to-person discrimination practices (SCHOR *et al.*, 2016) and digital peer review via punitive rating systems (COCKAYNE, 2016) in micro-level interactions.

Peer-to-peer accommodation platforms (e.g., Airbnb) generate a negative externality, as they could spur income inequality in two ways: first, in neighborhoods where home sharing is a common practice, rents for a regular apartment may go up, which harms lower-income residents (FRENKEN, 2017); second, the increasing conversion of housing into tourism accommodation leads to gentrification, a process of collective out displacement of residents (GANT, 2016).

Finally, but not least, regulatory issues are now at the center of the debate (SINCLAIR, 2016), since sharing businesses are often accused of tax evasion, by taking advantage of loopholes to avoid rules and taxes (GUTTENTAG, 2015; KATHAN; MATZLER; VEIDER, 2016; RICHARD; CLEVELAND, 2016) as well as of violating state or local government laws (MILLER, 2016). Besides concerns regarding health, public safety, and limited liability of sharing practices (PFEFFER-GILLETT, 2016), incumbent companies have claimed that "the sharing economy is opening the door to unfair competition." (RANCHORDÁS, 2015, p. 413)

In this context, several studies have underlined the need for new regulatory institutional arrangements for regulating the sharing economy as a whole (DYAL-CHAND, 2015; KATZ, 2015; MILLER, 2016; POSEN, 2015). As argued by Cortez (2014), innovations that disrupt existing products, business models, firms, or entire industries often disrupt the existing regulatory schemes, demanding regulatory disruptions in turn.

On the other hand, a new business model becomes a prototypical exemplar for a new market category as the legitimation process is evolving to be successful (LEE; HIATT; LOUNSBURY, 2017; NAVIS *et al*., 2012; NAVIS; GLYNN, 2010). In the sharing economy context, some ventures in peer-to-peer accommodation seem to be a landmark of this process.

Marton, Constantiou and Lagoudakos (2017) investigated the case of the CouchSurfing platform, which like Airbnb, operates in the accommodations sharing sector. In the beginning, the company operated under a non-profit model, meeting the interests of its users (pragmatic legitimacy). This can also be understood as an attempt to create socially acceptable expectations, like openness, cultural exchange, and a sense of community (moral legitimacy). Furthermore, the company disseminated communications to reinforce these values and embed a distinct meaning for its business model (cognitive legitimacy).

By analyzing the case of Airbnb, Mikhalkina and Cabantous (2015) investigated how its innovative business models became prototypical exemplars for sharing economy-based firms. The authors emphasized the role of business media and its influence on the cognitive process that underpins the emergence of Airbnb as an iconic, recognized business

model, by using analogies to existing, alternative categories (cognitive legitimacy). In doing so, Airbnb has created a single, stylized meaning for consumer experiences in the hospitality and accommodation industry (pragmatic legitimacy), aligned with consumer expectations (moral legitimacy).

Furthermore, companies in that field may engage in campaigns to enhance moral and pragmatic legitimacy as research has found the positive effect of the entry of sharing economy on the employment rates in the tourism industry (FANG; YE; LAW, 2016). In this way, they expect to weaken the regime's resistance, mainly those from the policymakers involved in economic and regulatory matters. Thus, tensions related to short-term rental regulations (GUTTENTAG, 2015), tax collection (FRENKEN, 2017; SINCLAIR, 2016) and consumer protection (DYAL-CHAND, 2015) could lessen a little. Indeed, some jurisdictions have brought forward regulatory measures towards to regulate services like Airbnb (GANAPATI; REDDICK, 2018; MILLER, 2016), which could be deemed a middle between "conformance" and "transformation" strategies of legitimation.

In both cases, companies benefited from the formation of networks (linking demanders and suppliers), the successful construction of symbolic meanings, an adequate infrastructure, and a good fit between solution and problem, in terms of services offered and users' needs. On the other hand, they were (actually, still are) in conflict with some existing standards, especially those defended by incumbent actors, effectively supported by the current sectoral policies and rules. In this sense, incumbent firms may react to competition from sharing economy platforms through acquisitions, collaboration, or definitively engaging in competition. However, as ventures in the sharing economy domain may take advantage of the increasing fluidity of traditional organizational boundaries, breaking institutional rules becomes easier (MARTON; CONSTANTIOU; LAGOUDAKOS, 2017).

Figure 13 inserts the sharing economy legitimacy in the transitions perspective, focusing on the urban mobility regime wherein the research was conducted. We adapted the view of the sharing economy from the multi-level perspective (as in Figure 12) by incorporating elements from the the multi-level perspective framework for business model innovations legitimacy (see Figure 9) previously presented.

Figure 13 – Sharing economy business models in the urban mobility context: a legitimacy framework
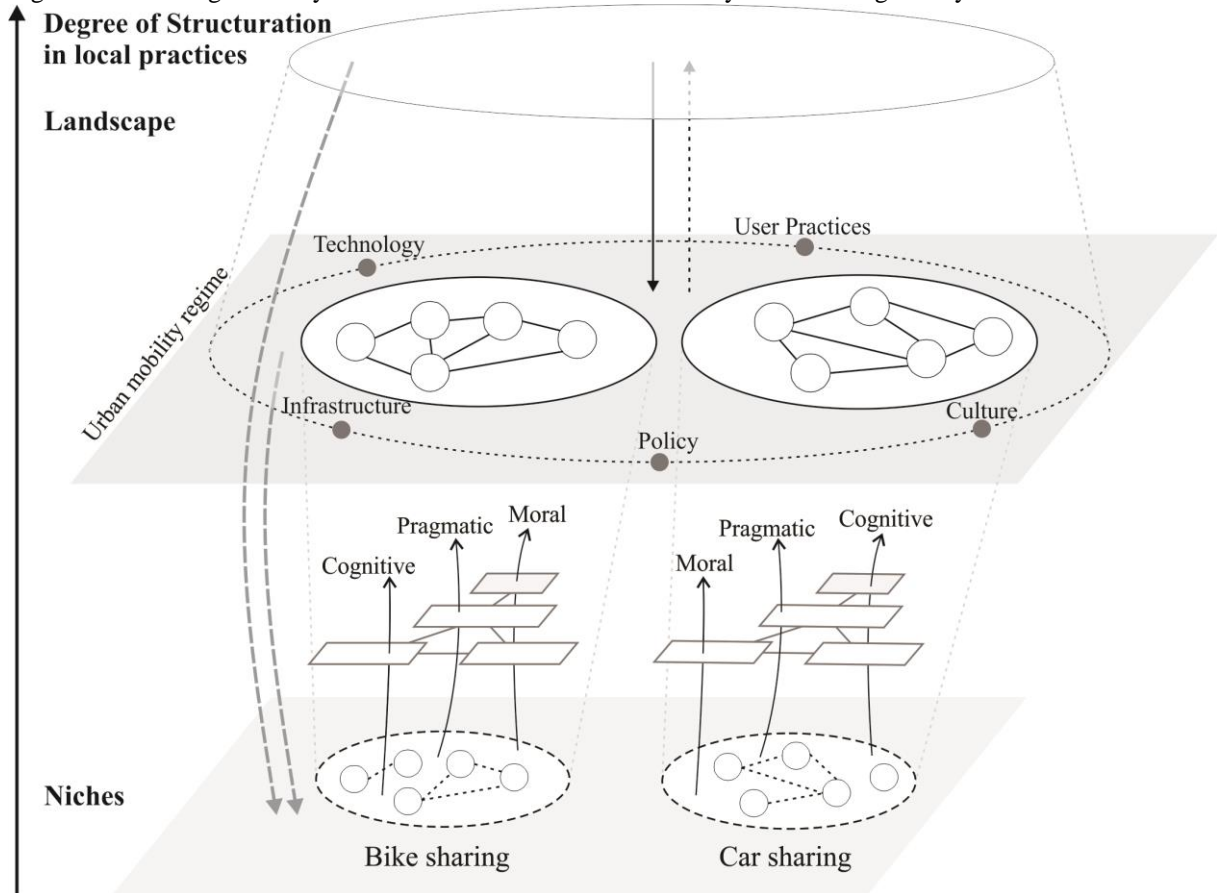
Source: The author, based on Geels (2002) and Geels and Schot (2007).

Accordingly to the context of the research, some of the main actors, technologies, and roles will be described for each socio-technical level from the empirical data. To simplify the approach to the field, industrial networks, scientific knowledge, and government regulations sub-regimes were considered to be in redundancy with technology, infrastructure, and sectoral policy ones. In addition, the relationships presented in Figure 13 do not represent aprioristic hypotheses to be tested. In fact, in the context of the sharing economy legitimacy, very little is known so far about the content and meanings underlying each of the relationship and constructs in the model.

Such a framework is therefore useful in that it provides guidelines to the empirical work, explicitly those concerning what should be observed (interactions), who should be addressed (actors), what actors perceive as being legitimacy dimensions and dynamics (rules, institutions), and how such dynamics drive action. To the best of our ability, we intended to understand the actors, interactions, and institutions by holding a heuristic, discovery-oriented research position in order to observe the phenomenon and allow the emergence of a grounded

theory that could explain it, rather than testing aprioristic assumptions. The next chapter is dedicated to discussing the methodological design and epistemological issues of the study.

3 METHOD

The relevance of discussing methodological issues lies in to guarantee epistemological alignment among research problem, objectives, theoretical support, and method, which provides more clarity to the analysis of the results (COOPER; SCHINDLER, 2011). In order to achieve the objectives proposed, the following methodological aspects are presented in this chapter: the research aim and questions, paradigmatic and methodological approaches, research design, strategy and case presentation, procedures for data gathering and analysis.

3.1 Research aim and questions

The research problem ("*How does the legitimation process of sharing economy innovations performing in the urban mobility context occur?*") led to the proposition of the main research objective, that is to understand the legitimation process of sharing economy innovations performing in the urban mobility context, from the perspective of the different actors involved. In line with the specific objectives proposed, some research questions will need to be addressed:

1. How are the socio-technical levels of the urban mobility transition characterized?
2. What is the nature of the relationships between the landscape, regime, and technological niche levels towards the transition?
3. What are the mechanisms and interactions through which the legitimation process of the sharing economy innovations takes place, from the perspective of different actors, namely, users, sharing companies – operator and sponsors – and policymakers?
4. What role do business models play in the legitimation process of the sharing economy?
5. How could the literature on business model innovation, multi-level perspective on socio-technical transitions and legitimacy theory explain the legitimation of the sharing economy?

In accordance with the theoretical background and the research aim and questions the methodological approach is discussed as presented below.

3.2 Paradigmatic and methodological foundations

Burrel and Morgan (1979) drew upon four sets of philosophical assumptions about the nature of social sciences, related to ontology, epistemology, human nature, and methodology. Based on a twofold criterion, they proposed four sociological paradigms from which the knowledge of the social world might be apprehended as being objective or subjective, or perceived in terms of regulation (order) or radical change (conflict), as depicted in Figure 14.

Figure 14 – Sociological paradigms
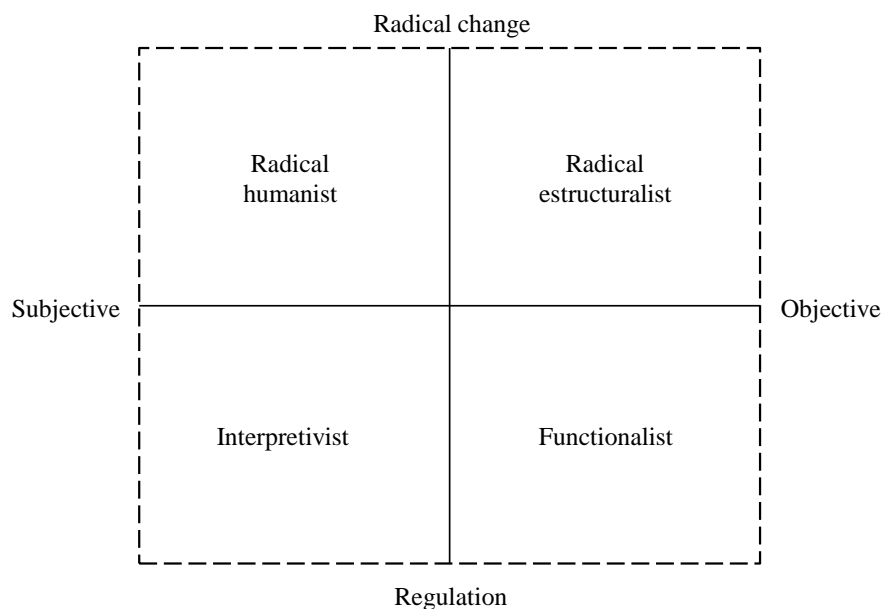
Source: The author, adapted from Burrel and Morgan (1979).

In a sentence, these sociological paradigms represent "(...) four views of the social world based upon different meta-theoretical assumptions with regard to the nature of science and of society" (BURREL; MORGAN, 1979, p. 24), although later developments have argued in favor of the permeability between paradigms in the field of social sciences (GIOIA; PITRE, 1990; LEWIS; GRIMES, 1999).

As the research aimed to identify and understand the mechanisms influencing the process of legitimation of business model innovations – specifically in the sharing economy context – from the perspective of the different actors, the investigation was conducted under the interpretivist paradigm principles. According to these principles, the researcher is concerned with understanding the nature of the social world at the level of subjective experiences, by capturing the research subjects' perceptions (SILVA; ROMAN NETO, 2010).

In this research, we argue that legitimacy is a social phenomenon (DEEPHOUSE; SUCHMAN, 2008; DOWLING; PFEFFER, 1975; JOHNSON; DOWD; RIDGEWAY, 2006; MEYER; ROWAN, 1977) that can shape the process of emergence of technological and/or business model innovations (ALDRICH; FIOL, 1994; GEELS; SCHOT, 2007; HARGADON; DOUGLAS, 2001; TORNIKOSKI; NEWBERT, 2007).

Since the choice of a methodological approach depends on the nature of the phenomenon to be explored and the research objectives (CRESWELL, 2010), the exploratory-qualitative approach is assumed to be more appropriate to this study, given (i) the eminently social nature of legitimation processes, (ii) the subjective perceptions to be captured and interpreted, and (iii) the still somewhat incipient literature on legitimacy in the sharing economy field. This interpretivist position considers that the social world is a pattern of symbolic relationships and meanings stemmed from the human action and interaction; reality is a social construction, even a projection of the human imagination (CUNLIFFE, 2011; MORGAN; SMIRCICH, 1980). Therefore, such a methodological choice is a necessary pathway for a more in-depth comprehension of the legitimating factors of sharing economy-based business models, which is in line with the research objectives.

3.2.1 Business models in transitions: ontological considerations

An interpretive methodological stance is seen as reasonable for empirical efforts on legitimacy theory, given the nature of the phenomenon, as we discussed above. In addition, the "process" ontology of legitimacy dynamics (BERGEK; JACOBSSON; SANDÉN, 2008; CARROLL; BUCHHOLTZ, 2008; JOHNSON; DOWD; RIDGEWAY, 2006) is quite well matched to the time-spanning orientation (GEELS, 2012) and the outcomes explained as a result of timing and conjunctures of event-chains, aspects that make the multi-level perspective a process theory (GEELS; SCHOT, 2010).

Articulating the business model approach and the transitions theory, however, requires further discussions. In this sense, Köhler *et al.* (2019) warn about ontological incompatibility when applying and adapting concepts, constructs and models from management studies to transitions-related research questions. As a relatively young field, transitions research is still developing its ontological and epistemological foundations, which give rise to important methodological challenges (ZOLFAGHARIAN *et al.*, 2019).

Indeed, the multi-level perspective on socio-technical transitions has a ground on the sociology of technology, a constructivist foundation that positions the human agency and

social structures as engines for value creation from innovations (GEELS, 2002). This framework emphasizes reinforcing developments, co-evolution, and alignments stemmed from both trial-and-error learning processes in niches and incremental improvements in regimes (GEELS, 2012). Hence, the transitions' heuristic, inductive characteristic becomes salient and makes it suitable to interpretive traditions of research (GEELS, 2011), even constrained to them (GENUS; COLES, 2008).

On the other hand, it is claimed that the literature on business models is mainly positivistic, especially the studies from the analytical approach of strategy. Such a business model tradition first developed under the rational choice ontology (e.g., Porter's positioning school and Ansoff's planning school), in which managerial action is a deliberate, rationally bounded process of analysis and choice aimed at maximizing performance in a given relatively steady institutional environment (GEELS, 2010).

Furthermore, when the research unit of analysis is the business model itself, or the research object is its elaboration or adaptation, pure- or near-positivistic approaches are likely to be more adequate, for example through experimental or design-based methods (BADEN-FULLER; MORGAN, 2010; OSTERWALDER; PIGNEUR; TUCCI, 2005; SIEDHOFF, 2019). In these cases, models are in the room precisely for verification and test procedures, i.e., methodological routines subordinated to the positivist ontology.

Whereas long-term trajectories and cumulative knowledge developments are overlooked by analytical positivist studies, the evolutionary ontology seems to embed those characteristics in such a way that business model innovations can be investigated from a trial-and-error learning, discovery-driven approach (MCGRATH, 2010). For instance, Niosi and McKelvey (2018) analyzed the relationship between business model innovations in the innovation cascades and how they have impacted science-based industries in general and biotechnology sector in particular. In turn, Schaltegger, Lüdeke-Freund and Hansen (2016) undertook a co-evolutionary analysis of how business model innovations developed by both niche pioneers and mass market players evolve and contribute to making markets more sustainable.

These studies are exemplars of what Geels (2010) termed "inter-ontology crossovers" meta-theoretical position, according to which "theories aim for inter-play, not synthesis, between a few ontologies; crossovers may be possible when ontological assumptions are not too different." (p. 503) As socio-technical transitions are multi-dimensional phenomena, studying them from different ontologies can be more productive than being limited to the existing disciplines from a single ontology (GEELS, 2009, 2020). Of

greater interest for this thesis, we rely on Geels' (2010) argument that the most consistent and promising crossover in transitions studies is the evolutionary ontology, which gives multi-level perspective the ability to combine long-term patterns and trajectories with interpretive interest in institutional dynamics, social interactions, and structure-agency tensions.

While innovations are said to come from heuristic and discovery logics, studying them from an interpretivist angle is also to be quite appropriate. As with any innovation, new business models – like those under the sharing economy umbrella – are equally subject to the dynamics of experimenting and learning (SOSNA; TREVINYO-RODRÍGUEZ; VELAMURI, 2010) as well as of structuring, legitimation, and diffusion (JOHNSON; DOWD; RIDGEWAY, 2006; LAWRENCE; WINN; JENNINGS, 2001), both in space and in time (SOVACOOL, 2016).

Attempts to bridge the multi-level perspective with other ontological traditions have already been underway. For instance, Sorrel (2018) and Svensson and Nikoleris (2018) claim for critical realist approaches as a remedy to ontological weaknesses of MLP framework. In presenting a state of the art of transitions research from the five most influential journals in the field, Zolfagharian *et al.* (2019) bring a thoughtful methodological panorama of how transition problems are addressed. Though their results show an (expected) asymmetry, with more than 80% of the 217 studies drawing on qualitative methods, on the other hand it is clear the rising opportunity for quantitative, even causal methods. The authors also present several examples of transitions research conducted under paradigms other than the commonplace interpretive one, such as positivism and critical realism.

Some studies have operationalized business models-related concepts and frameworks under the multi-level perspective on transitions. A non-exhaustive list includes those by Bolton and Hannon (2016), Huijben, Verbong and Podoynitsyna (2016), Wainstein and Bumpus (2016), Bidmon and Knab (2018), van Waes *et al.* (2018), and Lopes *et al.* (2019b, 2019a) (for details, see the section 2.4 wherein they were further discussed).

In an insightful study, Sarasini and Linder (2018) argue that transition theory and its frameworks lack concepts and constructs of a theory of the firm. The authors combined business model perspective with transitions assumptions to propose some lines of inquiry aimed at examining the dynamics of business model innovation in the context of sustainability transitions. Indeed, "in the course of such a transition", as Farla *et al.* (2012, p. 991, our emphasis) stated, "(radically) new products, services, *business models* and organizations emerge, partly complementing, partly substituting existing ones."

Thus, here we argue that there is no ontological irreconcilability in investigating the legitimation process of innovations in business models (sharing-based initiatives) from the multi-level perspective on socio-technical transitions. Furthermore, we claim that the inter-ontology position we embrace here is proper to research attempting of bridging "foundational oppositions", especially when interested in building theories (GIOIA; PITRE, 1990; LEWIS; GRIMES, 1999).

All that said, we argue in addition that our attempt to investigate transitions by using business models frameworks meets, at least to some extent (in a conceptual level), a recent agenda that calls for the modeling of societal transitions through both prospective (e.g., HAXELTINE *et al*., 2008; MARLETTO, 2014) and predictive, even mathematical approaches (e.g., EPPRECHT *et al*., 2014; KÖHLER *et al*., 2018; MERCURE *et al*., 2016; ROGGE; PFLUGER; GEELS, 2020). Since the models are explicit and clear, they can give researchers a less ambiguous and more interlinked understanding of the phenomenon (HOLTZ *et al*., 2015; PAPACHRISTOS, 2019), even though this is a challenging task whose literature is still developing (MCDOWALL; GEELS, 2017; TURNHEIM *et al*., 2015).

3.3 Research design and strategies

In the following sections, specific methodological issues are discussed, namely, methodology, strategy, phases, activities, and scope for each phase, delimitation of the study, methods for data collection and analysis, and criteria for evaluation of substantive theory. In the end, we present a matrix that relates the research objectives to data collection and analysis methods, as well as to data sources.

3.3.1 Methodology: Why Grounded Theory?

Drawing on the Burrel and Morgan's (1979) subjective-objective dimension, Morgan and Smircich (1980) proposed a typology for methodological positions based on epistemological, ontological and human nature considerations, as presented in Figure 15.

Figure 15 – Basic assumptions of objectivism and subjectivism in Social Sciences

	Subjectivist approaches		**Objectivist approaches**
Ontological assumptions	Reality as a social construction or a projection of human imagination	←-----→	Reality as a concrete process or structure
Human nature assumptions	Man as pure spirit, social constructor, and symbol creator	←-----→	Man as an adaptor, a responder to the social environment
Epistemological stance	To obtain phenomenological insights, to understand how social reality is created	←-----→	To study systems, process, change, and to construct a positivist science
Research methods	Exploration of pure subjectivity, phenomenology, hermeneutics	←-----→	Historical analysis, lab experiments, surveys

Source: The author, adapted from Morgan and Smircich (1980).

In light of the research problem (a "how-type" question), the objective and research questions, the phenomenon of interest (the "social process" of legitimation, as discussed in section 2.3) and the previous discussions, the study assumed a subjectivist ontological and methodological position. Such an option led to the adoption of methods subordinated to the phenomenological, interpretivist approach, precisely, the grounded theory.

Grounded theory is a suitable method for capturing the complexity of social phenomena in terms of their underlying dynamics and patterns, without bothering to test or verify *ex-ante* theories (DOUGHERTY, 2017). It furnishes systematic procedures for gathering and analyzing the data to generate and validate substantive theories about social phenomena under investigation (CHARMAZ, 1996; CORBIN; STRAUSS, 1990). "Substantive theory" refers to the set of propositions that emerged from the data – rather than from existing theories – and attempts to explain a particular phenomenon for which there is as yet no formal explanatory theory or, if any, it is unsatisfactory (GLASER; STRAUSS, 1965, [1967] 2006).

This study adopted the methodological procedures and canons systematized by Corbin and Strauss (1990), as follows in Table 7:

Table 7 – Grounded theory procedures and canons

Procedures and canons	Description
Data collection and analysis must be interrelated processes	The analysis begins as soon as the first data is collected because it is used to guide the next interview and observations. In addition, the systematic and sequential efforts of data collection and analysis enable to increase the validity and credibility of the research

Concepts are the basic units of analysis	Theorists work with conceptualizations of data – or labeling phenomena with concepts – rather than actual data *per se*. By comparing incidents and naming phenomena with the same term, a theorist can accumulate the basic units for theory
Categories must be developed and related	Categories are higher in level and more abstract than the concepts they represent and are generated through the same analytic process of making comparisons to highlight similarities and differences that are used to produce lower-level concepts
Sampling in grounded theory proceeds on theoretical grounds	Samples proceeds in terms of concepts, their properties, dimensions, and variations, which are related to the incidents observed *in loco*. In grounded theory, representativeness of concepts, not of persons, is crucial. The aim is not to generalize findings to a broader population *per se*, but build a theory that explains the phenomenon in the substantive area.
The analysis makes use of constant comparisons	As an incident is noted, it should be compared against other incidents for similarities and differences. The resulting concepts or categories are labeled as such, and over time, they are compared and grouped as previously described. Successive comparisons increase the validity of the results and the quality of substantive theory.
Patterns and variations must be accounted for	The data must be examined for regularity. Finding patterns or regularities helps to give order to the dater and assist with integration.
The process must be built into the theory	Process analysis could mean breaking a phenomenon down into stages, phases, or steps. It may also denote purposeful action that is not necessarily progressive, but changes in response to prevailing conditions observed.
Writing theoretical memos is an integral part of doing grounded theory	The use of memos enables the researcher readily to deal with all the categories, properties, hypotheses, and generative questions that evolve from the analytical process. Writing memos should begin with the first coding sessions and continues to the end of the research.
Hypotheses about relationships among categories should be developed and verified as much as possible during the research process	As hypotheses about relationships among categories are developed, they should be taken back into the field for checking out and revision as needed. Hypotheses are revised continuously during the research until they hold true for all of the evidence concerning the phenomena under study, as gathered in repeated interviews, observations, or documents.
A grounded theorist need not work alone	Opening up one's analysis to the scrutiny of others helps guard against bias. Discussions with other researchers often lead to new insights and increased theoretical sensitivity as well. Occasional or on-going discussion groups provide an excellent support.
Broader structural conditions must be analyzed, however microscopic the research	Broader structural conditions (e.g., economic variables, cultural values, political trends, social movements, and so on) could affect the phenomenon, and the researcher must show specific linkages between such conditions and potential or actual consequences.

Source: The author, based on Corbin and Strauss (1990).

From these discussions, one recursive characteristic of the grounded theory is remarkable: the researcher uses analysis of the previously collected data to drive his subsequent immersion in the field, in a circular process between data collection and analysis (CORBIN; STRAUSS, 1990).

3.3.2 Strategy: theory building from case studies

A case study is a research strategy widely used in social sciences in general and in organizational studies in particular. As empirical investigations of a particular contemporary phenomenon within its real-life context, case studies may be motivated by conceptual issues arising from existing theories, as well as by questions that propose to elaborate a theory from the data collected from one or more cases (GODOY, 2010).

Some authors have contributed to establishing a more positivist tradition of case studies, such as Robert K. Yin and Kathleen M. Eisenhardt (GODOY, 2010)[1]. They underline the need for some validity, reliability and generalizability criteria (e.g., well-structured research protocols) as well as encourage confirmatory approaches (YAZAN, 2015). Other authors, such as Sharan B. Merriam and Robert E. Stake, advocate a more phenomenological commitment, which is concerned with the complexity of the reality being investigated and how the research subjects interpret such a reality (YAZAN, 2015). These are the so-called "qualitative case studies" (MERRIAM, 1998; STAKE, 1995), which we have adopted in this research.

Despite their differences in procedures and epistemological assumptions, both approaches admit the adoption of case studies as strategies for building theories, as can be observed in some studies (e.g., EISENHARDT, 1989; EISENHARDT; GRAEBNER, 2007; PANDIT, 1996). In this regard, theory building from cases approach seems to have its roots in a combination of both phenomenological (inductive) and positivistic (deductive) traditions (GEHMAN et al., 2018).

Concerning case selection, it should consider theoretical – rather than statistical – reasons, such as the potential contribution to the emergence of a substantive theory (CORBIN; STRAUSS, 1990; EISENHARDT, 1989). The next section presents the cases addressed in this research.

3.3.3 The case: urban mobility initiatives in the City of Fortaleza, Brazil

Fortaleza is a large metropolis located in Northeast Brazil. With more than 2.6 million of inhabitants, the capital of the state of Ceará is the fifth largest Brazilian city in

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[1] In a symposium in 2016, Kathleen Eisenhardt would state not to consider herself as a pure positivist researcher (details can be found in the paper by Gehman et al. (2018), which she co-authored).

population, and the tenth one in gross domestic product (GDP), according to the Brazilian Institute of Geography and Statistics (IBGE, 2018).

In the last few years, several public policies were planned and incorporated into the Fortaleza 2040, the long-term municipal director plan, containing several axes of action, such as municipal governance; social, territorial and economic equity; culture and knowledge development; environmental quality; economic dynamism; and urban mobility (FORTALEZA, 2016a). The latter is of greater interest for the purposes of this thesis.

According to the plan, in the words of the mayor of Fortaleza, its main objectives are "transform Fortaleza into a more accessible, fair and welcoming city; increase the offer of opportunities supported by the organized network of connections between public and private spaces in the city; and achieve efficient control of economic growth." (FORTALEZA, 2016a, p. 15, own translation)

In the specific context of urban mobility (FORTALEZA, 2016b), one of the premises of the Fortaleza 2040 plan is to give priority to the cycling and walking, the vitality of the public space – with communally shared uses – and other forms of active transportation (p. 132), through by the integration between traditional bus lines, bus rapid transit (BRT) and bus lanes, light rail vehicles (LRVs), subway, bicycles, private vehicles, rental car systems and other transportation options (p. 300).

The city of Fortaleza has received national (e.g., Transporte Ativo (FORTALEZA, 2018)) and international (e.g., Sustainable Transport Award (ITDP, 2018)) recognition for its urban mobility policies and projects, some of which are strictly related to the sharing economy, as discussed below.

3.3.3.1 Bicicletar

Bicicletar is a public bike sharing system designed to offer citizens a sustainable and non-polluting transportation option. It is operated through a partnership among the municipal government, the sponsor Unimed Fortaleza, an important Brazilian healthcare provider, and the operator Serttel, one of the largest information technology companies operating in the urban mobility sector in Brazil and Latin America. The system consists of smart, solar-powered stations distributed at strategic points in the city, where registered users can take a bicycle, use it on their short-haul routes and return it to the same station or another one (BICICLETAR, 2018a).

The project has grown rapidly since the startup in December 2014 (O POVO, 2015), and surpassed the mark of 2,250,000 trips in 2018 (BICICLETAR, 2018b). Figure 16 depicts the map of the distribution of docking stations of Bibicletar throughout the city.

Figure 16 – Map of the Bicicletar station network

Source: The author, adapted from Bicicletar (2018c).

3.3.3.2 Bicicleta Integrada

Slightly similar to the Bicicletar, the Bicicleta Integrada project aims at offering the citizens a free and healthier mobility transportation that is integrated with the public transport system (BICICLETA INTEGRADA, 2018a). While the Bicicletar program is used for more recreational purposes and shorter routes, the Bicicleta Integrada allows the user taking the bicycle for up to 14 hours, helping them to go longer distances and perform their day-to-day tasks, only returning the bicycle next working day, if necessary. For this utilitarian purpose, the Bicicleta Integrada provides a bicycle station associated with each of the bus terminals in the city, totaling seven stations across the city, as can be observed in Figure 17.

Figure 17 – Map of the Bicicleta Integrada station network

Station in operation   No docks available   Station offline

Under implementation or maintenance process   No bikes available
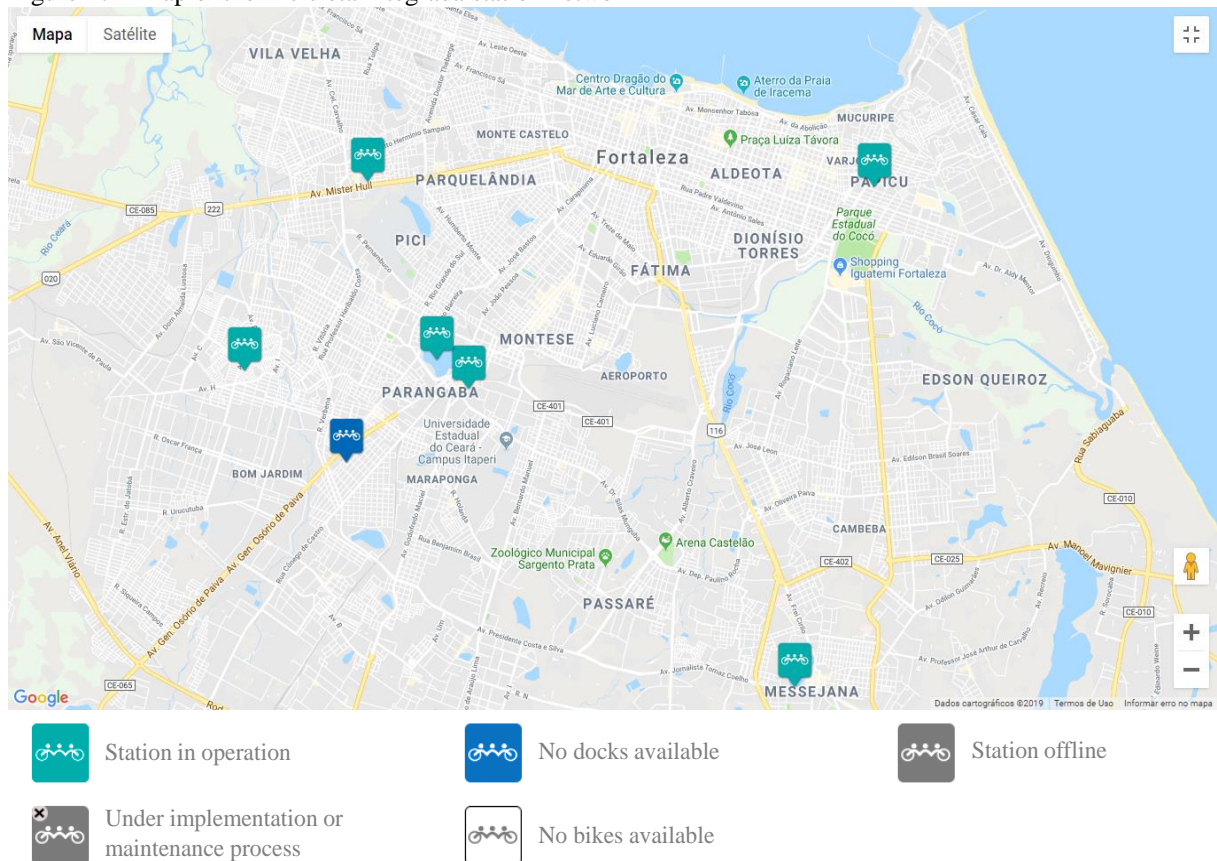
Source: The author, adapted from Bicicleta Integrada (2018b).

As well as Bicicletar, this project is also operated by Serttel, in partnership with some sponsoring companies: Marquise, an important regional player operating in the construction industry, Shopping RioMar Kennedy, one of the largest shopping centers in the city, and Extra, one of the largest Brazilian companies in the consumer goods retail sector. Some other partners from different sectors have previously supported the project, such as a large business conglomerate from Ceará which operates in several industries and is present in various regions of Brazil (BICICLETA INTEGRADA, 2018c).

3.3.3.3 Vamo Fortaleza

Acronym for "Veículo Alternativo para MObilidade" (or Alternative Vehicle for Mobility), "vamo" is a linguistic expression of regional culture and a conversational form that usually replaces the term "vamos!", which in turn means "let's go!", in English. It is the latest sharing-based urban mobility project implemented by the Fortaleza government. As with Bicicletar and Bicicleta Integrada, the car sharing system is operated by Serttel. HAP Vida, the largest healthcare services provider in the North and Northeast of Brazil is the sponsor.

According to Vamo Fortaleza (2018), this is a more intelligent and sustainable way of getting around the city, promoting sustainable urban mobility through a network of electric car sharing. Figure 18 presents the distribution of docking stations of Vamo Fortaleza car sharing system around the city. Then, Table 8 presents the cases and corresponding institutional actors.

Figure 18 – Map of the Vamo Fortaleza station network

Station in operation   No vehicles available

Station offline   No docks available
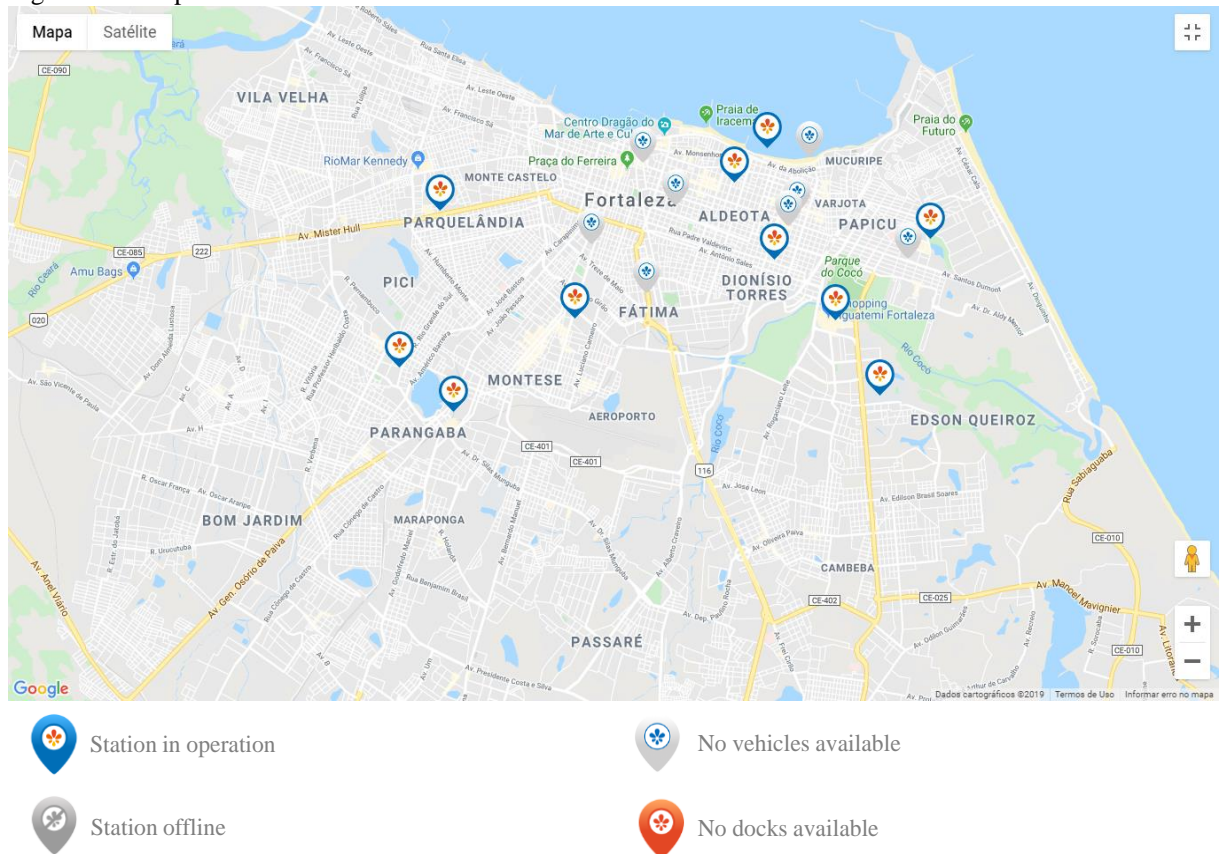
Source: The author, adapted from Vamo Fortaleza (2019).

Table 8 – Cases and actors

Case	Partnership leader	Operator	Current sponsors	Former sponsors
Bicicletar	Municipal government	Serttel	Unimed Fortaleza	-
Bicicleta Integrada	Municipal government	Serttel	Marquise and Shopping RioMar Kennedy	Indaiá, Unifor, and Extra
Vamo Fortaleza	Municipal government	Serttel	HAP Vida	-

Source: The author, based on Bicicletar (2018c), Bicicleta Integrada (2018c), and Vamo Fortaleza (2018).

As can be observed, the research strategy employed was the multiple case studies. The legitimation process of these sharing economy-based urban mobility initiatives was addressed from the multi-level perspective on socio-technical transitions, from the business model innovation lenses, and from the institutional approach for legitimacy.

3.3.4 *Phases and activities*

The research design was inspired by the scripts proposed by Eisenhardt (1989) and Pandit (1996) for building theories from exploratory case studies. Table 9 details the phases and their activities and objectives.

Table 9 – Research phases and activities

Phases	Activities	Objectives
Getting started	Definition of the research question Search for possible a priori constructs Neither theory nor hypotheses	Focusing research efforts Providing better grounding of construct measures Retaining theoretical flexibility
Scoping and delimitation	Identification of the object Theoretical sampling (case selection) Identification of the limits of the phenomenon	Constraining extraneous variation and sharpening external validity Focusing efforts on theoretically useful cases Establishing the substantive area
Crafting instruments and protocols	Multiple data collection methods	Strengthening grounding of theory by triangulation of evidence
Entering the field	Overlap data collection and early analyses Flexible and opportunistic data collection methods	Revealing helpful adjustments to subsequent data collection Allowing investigators for taking advantage of emergent themes
Analyzing data (both within-case and cross-case)	Identification of concepts and categories and their relationships Theoretical sampling (case and unit of analysis selection) Recursive, circular process of data collection and analysis Shaping valid and reliable propositions	Gaining familiarity with data and preliminary theory generation Forcing investigators to look beyond initial impressions and see evidence through multiple lenses Achieving theoretical saturation (i.e., when marginal improvement becomes insignificant) and build internal validity Confirming, extending, and sharpening theory
Evaluating the appropriateness of the substantive theory	Comparison with conflicting literature Comparison with similar literature	Builds internal validity, raises the theoretical level and sharpens the construct definitions Sharpens generalizability, improves construct definition, and raises theoretical level
Ending the research	Preparation of the research report	Exposes the results and limitations, and submits the emerging theory to the evaluation of other researchers.

Source: The author, based on Eisenhardt (1989) and Pandit (1996).

The phases listed above are not necessarily presented in sequential order, in view of the recursive overlap between data collection and analysis. Some procedures were adopted in order to achieve the theory-method fit (GEHMAN *et al.*, 2018): triangulation of evidence from a variety of sources is the starting point regarding this specific purpose; in addition, the recursive process of data collection and analysis may promote the discovery of emerging

themes not yet identified in both conflicting and similar literature, as well as meeting reliability concerns; finally, from the research question and object (sharing economy legitimation process), the substantive area (urban mobility) and the cases, data collection protocols were prepared to guide the fieldwork (interviews and observation protocols were updated during data collection routines to consider emerging categories in succeeding data collection). Figure 19 presents a comprehensive schema for the thesis design. The next sections detail the data collection and analysis procedures.

Figure 19 – Research design
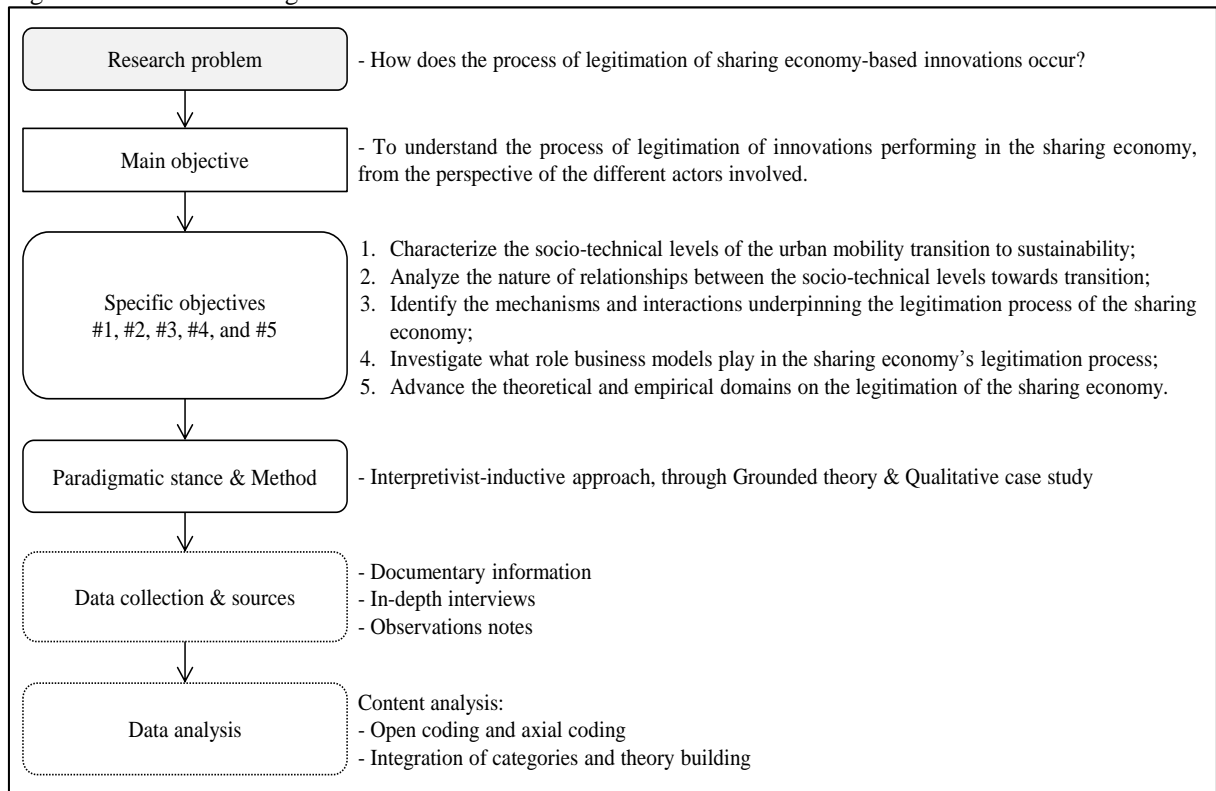
Source: The author.

3.3.5   Data collection and participants

In accordance with the research objectives, both primary and secondary data were collected through a number of methods and from several sources, in order to capture the perspectives of all actors involved in the phenomenon and to allow data triangulation to ensure the reliability and validity of the results.

Firstly, secondary data sources were addressed to support the construction of interviews and observation protocols. Documentary information about the three cases available on reports, websites, press releases, bills, laws, and regulations were analyzed

through document analysis and then compared with literature. Table 10 presents the collection of documents analyzed in the first stage of the empirical work.

Table 10 – Documentary information *corpus*

#	Title	Type	Source	Date accessed
1	Program for Expanding the Bicycle Path Network	Official website	https://mobilidade.fortaleza.ce.gov.br/menu-programas/malha-ciclovi%C3%A1ria.html	2019-08-10
2	Ciclofaixa de Lazer Program	Official website	https://mobilidade.fortaleza.ce.gov.br/menu-programas/ciclofaixa-de-lazer.html	2019-08-10
3	Bicicletar Program	Official website	https://mobilidade.fortaleza.ce.gov.br/menu-programas/programa-iii.html	2019-08-10
4	Bicicleta Integrada Program	Official website	https://mobilidade.fortaleza.ce.gov.br/menu-programas/bicicletas-integradas.html	2019-08-10
5	Bicicletar Platform	Platform	http://www.bicicletar.com.br/home.aspx	2019-08-11
6	Bicicleta Integrada Platform	Platform	http://www.bicicletaintegrada.com/home.aspx	2019-08-11
7	Integrated Cycling Master Plan	Public policy	https://mobilidade.fortaleza.ce.gov.br/images/pdf/PDCI_FORTALEZA.pdf	2019-08-12
8	Vamo Fortaleza Program	Official website	https://mobilidade.fortaleza.ce.gov.br/menu-programas/programa-ii.html	2019-08-10
9	Vamo Fortaleza Platform	Platform	http://www.vamofortaleza.com/	2019-08-11
10	Cycling Transport Policy (Law No. 10,303 from December 23, 2014)	Public policy	https://diariooficial.fortaleza.ce.gov.br/download-diario.php?objectId=workspace://SpacesStore/ce1eadd0-1b03-4efa-a0a7-c90fb58910fd;1.1&numero=15431	2019-08-18
11	Regular and Complementary Transport	Official website	https://mobilidade.fortaleza.ce.gov.br/transporte/%C3%B4nibus-e-vans.html	2020-02-09
12	Catalog of services: mobility	Official website	https://catalogodeservicos.fortaleza.ce.gov.br/categoria/mobilidade?csrt=13693901045033985364	2020-02-09
13	2010 Fortaleza Public Transport Yearbook	Report	https://www.mobilize.org.br/midias/pesquisas/anuario-de-transportes-publicos-de-fortaleza.pdf	2020-04-30
14	Annual Report NTU: 2018-2019	Report	https://www.ntu.org.br/novo/upload/Publicacao/Pub637020043450950070.pdf	2020-05-02
15	Fortaleza private motor vehicle fleet	Statistical data	https://cidades.ibge.gov.br/brasil/ce/fortaleza/pesquisa/22/28120	2020-05-02

Source: The author.

We engaged in non-participant, direct observations while users of the bike sharing and car sharing systems used the services and interacted with the actors and dimensions of the urban mobility socio-technical regime. Whenever possible, informal conversations were held with users, when they were invited to participate in formal in-depth interviews.

Additionally, participant observations were carried out to better capture the legitimacy dimensions in the sharing economy field. The usefulness of participant observation in the discovery of substantive theories is well-known (BECKER, 1958). In this regard, the researcher registered on the platform of each sharing system, downloaded the respective applications and tested their usability (complexity of the registration procedure, pass

purchase, station condition check, availability of bicycles or vehicles, among other use routines). Due to the difficulty of identifying car sharing system users, the researcher also used such a service directly. Table 11 briefly presents information on the observations made.

Table 11 – Summary of observations

Seq	Sharing system	Station ID	Station name	Date	Length (min.)
1	Bicicleta Integrada	1	Parangaba bus terminal	Sep 17, 2019, 11:05 am	123
2	Bicicleta Integrada	6	Lagoa bus terminal	Sep 18, 2019, 05:52 pm	120
3	Bicicleta Integrada	4	Messejana bus terminal	Sep 19, 2019, 03:01 pm	100
4	Bicicleta Integrada	2	Papicu bus terminal	Sep 26, 2019, 10:29 am	90
5	Bicicletar	43	Campus do Pici	Sep 23, 2019, 01:48 pm	90
6	Bicicletar	44	Igreja Redonda	Sep 23, 2019, 03:29 pm	80
7	Bicicletar	66	Francisco Matos	Sep 24, 2019, 02:56 pm	90
8	Bicicletar	50	Igreja de Nazaré	Sep 25, 2019, 08:25 am	90
9	Bicicletar	33	Shopping Benfica	Sep 25, 2019, 03:15 pm	100
10	Bicicletar	31	Papicu bus terminal	Sep 26, 2019, 10:27 am	90
11	Vamo	1	Igreja de Nazaré	Sep 25, 2019, 08:25 am	90
12	Vamo	3	Luiza Távora Square	Oct 23, 2019, 09:34 am	60

Source: The author, from the research data.

Both observational and documentary data allowed the identification of the initial constructs and analytical categories regarding legitimating actions and dimensions of sharing economy-based urban mobility initiatives. Moreover, along with the categories extracted from the literature review, such data were also essential to guide the construction of the interview scripts used for primary data collection with participants.

Through in-depth semi-structured interviews, the research addressed four different groups of actors, namely, users of the urban mobility sharing services, sponsoring companies, operator firm, and policymakers. This variety of respondents is assumed to be exhaustive to encompass the range of legitimacy dimensions of the socio-technical regime (i.e., infrastructure, technology, user practices, culture/symbolic meanings, and sectoral policy) and the niche-regime-landscape interactions, as discussed in the theoretical underpinning (see chapter 2).

Users can provide insights for an emerging substantive theory since they directly experience the reality of the phenomenon in their daily lives. They can bring valuable information regarding their practices, motivations, sociocultural influences, and symbolic meanings they perceive, as well as the barriers that hamper their experience.

Managers of the organizations and partners running those sharing systems (sponsoring and operator companies) can contribute to the research with their perceptions

about infrastructural and technological aspects, as well as strategical and political issues. Policymakers (municipal government) were also invited to participate in the research, as they are responsible for the creation, implementation, and evaluation of public policies in the context of urban mobility. As leaders of the sharing initiatives of the research interest, they define technical requirements and design public calls for hiring companies to run the sharing projects. Policymakers can also bring insights regarding landscape influences in the cultural, economic, environmental, and political domains.

Table 12 presents the possible relationships between the thesis' theoretical bases and the research respondents in terms of the potential contribution they can bring about legitimacy dimensions – pragmatic, cognitive or moral – and the building blocks of business models.

Table 12 – Legitimacy dimensions, business models characteristics, and research participants contribution

Theoretical basis	Sharing users	Sponsors	Operator	Policymakers
Business model innovation	- Value proposition - Key processes	- Value proposition - Profit formula	- Value proposition - Key resources - Key processes - Profit formula	- Value proposition - Key resources - Key processes - Profit formula
Regime - User practices	- Pragmatic - Moral - Cognitive	- Pragmatic - Moral - Cognitive	- Pragmatic - Cognitive	- Pragmatic - Cognitive
Regime - Technology	- Pragmatic - Moral - Cognitive	- Pragmatic - Moral - Cognitive	- Pragmatic - Cognitive	- Pragmatic - Cognitive
Regime - Culture	- Moral - Cognitive	- Moral - Cognitive	- Moral - Cognitive	- Moral - Cognitive
Regime - Infrastructure	- Pragmatic - Cognitive	- Pragmatic - Cognitive	- Pragmatic - Cognitive	- Pragmatic - Cognitive
Regime - Sectoral policy	- Pragmatic - Moral - Cognitive	- Pragmatic - Moral - Cognitive	- Pragmatic - Moral	- Pragmatic - Cognitive

Source: The author.

A preliminary version of each semi-structured interview protocol was pre-tested with at least the first respondent from each group. Some questions thus were included while others were rewritten in order to prevent misinterpretations in the interviews. As data collection and analysis are interrelated processes, the concepts and categories previously emerged were considered for subsequent interviews and observations.

Despite the small number of participants from the operator, sponsors, and the municipal government, the depth of the interviews and the data triangulation process ensured the robustness of the analysis. Moreover, one considers that the previous analysis of fieldwork

diaries and documentary data, as well as the interviews with users, may have mitigated any potential risk to the validity of the findings.

To balance the profile of respondents – those within the user group – two conditions for participation in the research were established: maximum age of 45 years[2] and have completed high school. Such conditions are in line with the fact that the sharing economy platforms and services are disproportionately used by people within this group (BLOOMBERG NEWS, 2015), and minimize the likelihood of respondents unable to communicate information appropriately. Table 13 shows the characteristics of the subjects interviewed in the research and information about each interview.

Table 13 – Research participants profile

ID	Group	Age	Gender	Occupation	Marital status	Level of education	Time (yrs)[a]	Date (all in 2019)	Location	Length (min.)
B1	Bicicletar user	25	M	University student	Single	High School	< 1	Sep 27, 11:40 am	UECE, Campus Itaperi	62
B2	Bicicletar user	32	F	Food engineer	Single	Higher education	4	Oct 02, 08:00 pm	Google Hangouts	44
B3	Bicicletar user	40	M	Warehouse manager	Single	Higher education	2	Oct 03, 02:30 pm	Padaria Costa Mendes	38
B4	Bicicletar user	37	F	Sales Promoter	Divorced	Higher education	4	Oct 08, 12:20 pm	Restaurante Brasil Colonial	24
B5	Bicicletar user	27	M	University professor	Single	Higher education	3	Oct 09, 09:25 am	UFC, FEAAC	31
B6	Bicicletar user	40	M	Telecommunications technician	Married	Higher education	4	Oct 10, 05:20 pm	CHESF	34
B7	Bicicletar user	25	M	Teacher and University student	Single	High School	< 1	Oct 11, 05:25 pm	UECE, Campus Fátima	33
B8	Bicicletar user	25	F	University student	Single	High School	< 1	Oct 11, 06:05 pm	UECE, Campus Fátima	32
B9	Bicicletar user	33	F	Food engineer	Single	Higher education	4	Oct 12, 11:55 am	Google Hangouts	48
B10	Bicicletar user	36	M	Architect	Married	Higher education	2	Oct 16, 10:30 am	IFCE, Campus Fortaleza	32
B11	Bicicletar user	41	M	Sales manager and entrepreneur	Married	Higher education	3	Oct 17, 03:55 pm	Family's business office	39
B12	Bicicletar user	39	F	Chemistry technician	Married	Higher education	4	Oct 23, 09:15 pm	Google Hangouts	46
V1	Vamo User	43	F	Business manager	Single	Higher education	1	Nov 05, 07:20 pm	Skype	36
V2	Vamo User	26	F	Marketing analyst	Single	Higher education	1	Nov 12, 06:35 pm	Skype	34
V3	Vamo User	67	M	Retired bank employee	Single	Higher education	3	Nov 13, 11:35 am	E-mail	n/a
V4	Vamo User	41	M	Sales manager	Married	Higher education	2	Nov 14, 09:40 am	BS Design Corporate Towers	23
O1	Partner (Operator)	*	M	Operations manager	*	*	< 1	Oct 30, 02:05 pm	Serttel office (Fortaleza)	46
S1	Partner (Sponsor)	*	F	Marketing director	*	*	**	Nov 12, 04:25 pm	E-mail	n/a

[2] As the results will show, only one user (from Vamo car sharing system) did not meet this criterion. We decided to keep him in the study because of the difficulty of addressing Vamo users and the relevance of his data (he is one of the most frequent users, according to information from the city administration).

ID	Group	Age	Gender	Occupation	Marital status	Level of education	Time (yrs)[a]	Date (all in 2019)	Location	Length (min.)
S2	Partner (Sponsor)	*	F	Communication and Marketing manager	*	*	**	Dec 06, 5:55 pm	E-mail	n/a
S3	Partner (Sponsor)	*	F	Marketing analyst	*	*	3	Dec 10, 09:20 am	Phone	32
P1	Policy maker	*	M	Municipal government	*	*	5	Oct 31, 10:50 am	SCSP	48
P2	Policy maker	*	M	Municipal government	*	*	2	Nov 01, 03:00 pm	SCSP	40
P3	Policy maker	*	F	Municipal government	*	*	5	Nov 06, 09:15 am	Point Bistrô	50

Notes: [a] Time as a user, or time in current occupation for participants other than users; [*] Information not requested from these participant; [**] Information not provided by the participant;
Source: The author, from the research data.

Thus, we constructed three different *corpora* for upcoming analysis and comparison: a *corpus* of documentary information, a *corpus* of observations notes, and a *corpus* of transcribed interviews. Such a composition meets the criteria of internal homogeneity and relevance of the research data (BAUER; AARTS, 2008). Moreover, the identification of legitimation dynamics in all dimensions of the socio-technical regime requires mixed methods of data collection so that some methods may be more effective than others in this regard, as presented in Table 14.

Table 14 – Data collection methods and theoretical bases

Theoretical basis	Documents	Observations	In-depth interviews
Business model innovation	Official websites and platforms	Availability of bike/car and docks, customer service, user experience, complexity, usability, mobile app	Perceived benefits, system's role in the user's daily life, system features, business strategy, target audience
Regime - User practices	Official websites and platforms	Habits and goals, behaviors, knowledge about processes, technology, and routines	Habits and goals, users perceptions and experience, barriers, interactions with other actors
Regime - Technology	Official websites and platforms, municipal master plans and strategic plans	User experience, complexity, usability, docking stations, mobile app	Knowledge about technology, system features, technology's role in the user's daily life
Regime - Culture	Municipal master plans and strategic plans, public policies and regulations	Behaviors, symbolic meanings of "sharing", underlying influences	Normative influence, symbolic meanings of "sharing", alignment with values and worldview
Regime - Infrastructure	Municipal master plans and strategic plans, public policies and regulations	Availability, maintenance, customer service, the role played by partners and sponsors	Perceptions of the current sharing infrastructure, integration with the public transport system,
Regime - Sectoral policy	Municipal master plans and strategic plans, public policies and regulations	Policymakers interactions, public hearings, meetings, marketing campaigns	Perception of the role played by the public authority

Source: The author.

Different data collection methods can complement each other to ensure a more appropriate approach to the research object. While each method alone is insufficient to capture the legitimation dynamics in each regime dimension, an arrangement combining the three methods is assumed to be effective.

The process of primary data collection took place from mid-September 2019 to early February 2020. *In loco* direct observations lasted from 60 to 123 mins., with an average of 94 mins. Participant observations, in turn, spanned the whole period, and focused on the intensive use of the application, attempts to contact support, and use of the sharing system itself.

A total of 23 interviews were conducted. At the request of the respective respondents, three out of the 23 interviews (one user and two managers of sponsoring companies) were conducted via e-mail rather than face-to-face or online ones. The literature points out some e-mail interviews' disadvantages, such as more time consuming for respondents, the potential for short, concise answers, and the disability to capture social cues that contribute to a full understanding of the participant's experience (HAWKINS, 2018; RATISLAVOVÁ; RATISLAV, 2014). On the other hand, they allow access to individuals

often difficult or impossible to reach or interview face-to-face and allow participants to take part in the interviews in a familiar environment, intimately constructing their own experiences without the presence of the interviewer (MEHO, 2006).

Interviews lasted from 23 to 62 mins., with an average of 39 mins.. All interviews were recorded with the informant's express authorization and then transcribed for later data analyses. Appendices A1 to A3 show the final versions of the documentary, observation, and interview protocols, respectively. Respondents signed a consent form authorizing their voluntary participation in the research, as shown in Appendix A4.

3.3.6 Data analysis

Here we present two aspects related to data analysis, namely, techniques and processes. Different techniques for data analysis were employed, taking into account the various types of data collection sources. Content analysis was the most widely used technique, in view of the large amount of data obtained through in-depth interviews with the various research subjects, and content from reports, press releases, websites, bills, and laws as well. Through this technique, it is possible to make "replicable and valid inferences from texts (…) to the context of their use." (KRIPPENDORFF, 2004, p. 18)

The content analysis represents a way to interpret the content of a text by adopting systematic norms to extract the thematic meanings, allowing the researcher to identify, arrange and organize the different units in a superficial structure to reach the structure underlying any text or event (BARDIN, 2011; CHIZZOTTI, 2011). In spite of not being a consensus, content analysis is often considered a semi-qualitative technique (ALVES; BLIKSTEIN, 2010) that strictly aims to quantify, objectify, and identify thematic categories in a text (BARDIN, 2011), turning a blind eye to its deeper structures and the social context in which it was uttered (FINNA; JOHNSTONE, 2015).

In addition, document analysis will be undertaken on information contained in the reports or websites, as well as laws and regulations, with the aim of triangulating data from different sources and identify legitimating efforts or political reactions. Document analysis is a systematic approach to reviewing or evaluating both printed and electronic documents in order to elicit meaning or improve empirical knowledge (BOWEN, 2009). Because document analysis also holds some methodological intersections with content analysis, it can be seen as a type of it (KOHLBACHER, 2006). For other authors (e.g., Labuschagne (2003)), content

analysis is a general method to assess and evaluate data from transcripts of interviews, documents, or observation notes.

Regarding the process of analysis, both within-case and cross-case analyses were deployed to identify concepts and categories and their relationships, as well as ensure internal validity. Table 15 presents the different methods for the triangulation of evidence.

Table 15 – Evidence for cross-case and within-case analyses

	Cases	Within-case analysis		
		Documents [*]	Observations [*, **]	Interviews [*, ***, ****]
Cross-case analysis	Bicicletar (bike sharing scheme)	6	6 stations (540 min)	12 users 2 policymakers 1 operator 1 sponsor
	Bicicleta Integrada (bike sharing scheme)	5	4 stations (433 min)	2 policymakers 1 operator 1 sponsor
	Vamo (car sharing scheme)	2	2 stations (150 min)	4 users 3 policymakers 1 operator 1 sponsor

Notes: [*] The amount of evidence was capable of achieving theoretical saturation; [**] Observations included informal conversations with users, which we did not consider as formal interviews; [***] The operator manager interviewed was the same for all three cases; [****] One out of the three policymakers declined to respond about bike sharing initiatives.
Source: The author.

As previously mentioned, the content analysis and coding process encompassed some interrelated works. First, the documentary information was coded into early categories or concepts. Along with the literature review, these categories then guided the construction of observation and interview protocols. Observations and interviews took place alternately accounting for adequate theoretical sampling. In such a way, data from some collections were analyzed to allow the emergence of new categories to be considered in subsequent collections.

To assist in the analysis of qualitative data we followed a combined interactive model merging guidelines proposed by Miles and Huberman (1994) and Corbin and Strauss (1990). Such a model defines a cyclical process based on three concurrent flows of analysis activities, as displayed in Figure 20.

Figure 20 – Interactive model for qualitative data analysis
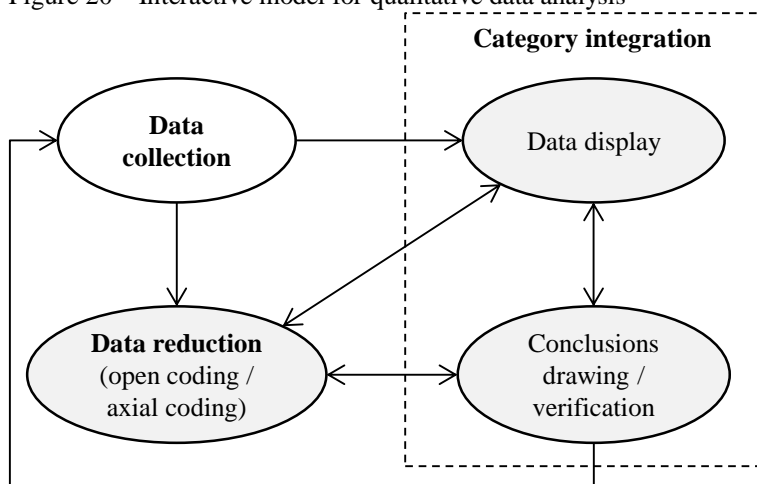
Source: The author, adapted from Miles and Huberman (1994) and Corbin and Strauss (1990).

In the analysis domain, the first activity is data reduction, referring to select, simplify, and transform (code) the data obtained from several sources in such a way that conclusions can be drawn for upcoming verification. The coding of data from each *corpus* – documentary, observations notes, and transcribed interviews – followed the Corbin and Straus' (1990) open coding and axial coding procedures.

Open coding and axial coding occur almost simultaneously since as emerging categories are created from data, the relationships between them naturally arise. "As analysts work with data, their minds automatically make connections because, after all, the connections come from the data." (CORBIN; STRAUSS, 2008, p. 198) Through the interpretive open coding process the data were broken down analytically. As categories and concepts emerged (open coding), they were whenever possible associated with both an axis related to the dimensions of the socio-technical regime – or landscape and niche levels – and an axis inherent to the types of legitimacy ((bi)axial coding). Category associations with each other were also possible throughout the axial coding process.

The data display stream concerns the information organization by using visual mechanisms that strength the researcher's analytical and creative power. In this thesis, we used matrices that, in turn, supported preliminary model vignettes linking emerging categories and variables. The conclusion drawing and verification phase represents the process by which the qualitative analyst, holding an open, skeptic posture regarding emerging meanings, patterns, and propositions, compares them with the primary data or submit them to the scrutiny of colleagues for testing the plausibility and validity of the results.

Miles and Huberman's data display and conclusions drawing are considered to be parts of the Corbin and Straus' selective coding, also called category integration. In this stage

of the analysis, the researcher is interested in unifying more relevant categories around a core category that synthesizes the phenomenon under investigation.

This cyclical, interactive model thus aligns with the recursion between data collection and analysis recommended by Eisenhardt (1989) and Pandit (1996), as we discussed in Table 9, and is critical to dealing with validity concerns. Such an approach sounds adequate to meet the purpose of discovering a well-fitted substantive theory. Table 16 shows a methodological design matrix relating the research objectives and questions to the data collection and analysis methods employed to achieve them.

Table 16 – Methodological design matrix

Research Objective	Research Question	Data collection	Source	Data analysis
(1) Characterize the socio-technical levels of the urban mobility transition to sustainability.	(1) How are the socio-technical levels of the urban mobility transition characterized?			
(2) Analyze the nature of relationships between the landscape, regime, and technological niche levels towards transition.	(2) What is the nature of the relationships between the landscape, regime, and technological niche levels towards the transition?	In-depth semi-structured interviews	Research subjects	Content analysis
(3) Identify the mechanisms and interactions through which the legitimation process of the sharing economy innovations takes place, from the perspective of different actors, namely, users, sharing companies – operator and sponsors – and policymakers.	(3) What are the mechanisms and interactions through which the legitimation process of the sharing economy innovations takes place, from the perspective of different actors, namely, users, sharing companies – operator and sponsors – and policymakers?	Non-participant observations

Participant observations | Notes from non-participant observations

Notes from participant observations | Content analysis from notes

Content analysis from notes |
| (4) Investigate what role business models play in the legitimation process of the sharing economy. | (4) What role do business models play in the legitimation process of the sharing economy? | | | |
| (5) Advance the theoretical and | (5) How could the literature on | | | |

Research Objective	Research Question	Data collection	Source	Data analysis
empirical domains on the legitimation of the sharing economy, building on business model innovation approach, legitimacy theory, and multi-level perspective on socio-technical transitions.	business model innovation, multi-level perspective on socio-technical transitions and legitimacy theory explain the legitimation of the sharing economy?	Document collection	Documentary	Content analysis

Source: The author.

3.4 Methodological synthesis

Based on the previous discussions, Table 17 summarizes the research epistemological and methodological design and characteristics.

Table 17 – Epistemological and methodological characteristics

Dimension	Characteristics of the research
Epistemological	Paradigm: Interpretivist; Research object: Legitimation process of the sharing economy; Research question: How does the process of legitimation of sharing economy-based innovations occur? Research objective: Understand the process of legitimation of innovations performing in the sharing economy, from the perspective of the different actors involved: users, sharing companies and partners, and regulators or policymakers;
Theoretical	Theoretical position: Constructivist approach; Background theories: Multi-level perspective on technological transitions, Legitimacy theory, Business model innovation, and Sharing economy;
Methodological	Research logic: Inductive (findings like constructs and their properties are derived from the data about the particular reality: sharing economy initiatives in urban mobility context); and deductive (hypotheses about relationships between constructs emerge from analytical, interpretative work); Methodological approach: Grounded theory;
Technical	Strategy: Multiple case study for theory building; Cases: Three sharing economy-based urban mobility services (Fortaleza, Northeast Brazil); Data collection: In-depth semi-structured interviews, observations, and documents; Data analysis: Content analysis and document analysis.

Source: The author.

The study is therefore subordinated to the interpretivist paradigm, since it addresses the research object with the aim of capturing – and interpreting – subjective

perceptions of the participants regarding the phenomenon observed. The research object itself does not exist in concrete reality, but can be identified from the data, through both inductive (discovery of concepts) and deductive (proposition of relationships between them) analysis. This effort will be carried out through a Grounded Theory approach, by using a multiple case study design.

The next chapters are dedicated to the presentation and discussion of the research findings, based on the methodological procedures described here. Throughout chapters 4 and 5, all emerging categories and conclusions presented are supported by representative evidence. That is, they were obtained from various evidences of the same *corpus* (e.g., excerpts of interviews) or the triangulation of different corpora (documents, observations, and interviews). We start by characterizing the socio-technical levels of landscape and regime.

4 CHARACTERIZING SOCIO-TECHNICAL LANDSCAPE AND REGIME LEVELS

In this chapter we analyze the research results from the different sources and data *corpora*, focusing on sketching up two socio-technical levels: landscape and regime. Defining the boundaries, actors, and institutions of the socio-technical levels is a deliberative task, which is also somewhat discretionary. To manage this, we rely on Holtz, Brugnach and Pahl-Wostl's (2008) framing characteristics of a socio-technical regime in order to guide our descriptive purposes. Although these authors have not addressed the case for landscape, we consider that its boundaries could be drawn from a complementarity heuristic based on both its conceptual definitions and research data.

Throughout this section, by adopting a discovery-oriented stance, we will build on Figure 13 to construct the interactions within and between socio-technical levels from the research findings. Characterizing the sociotechnical levels allows us to analyze how those interactions occur, and thus indicate the form in which those legitimation dynamics take place.

In an incremental, cumulative approach, we sketch vignettes from the data that, along with respective explanations, represent the phenomenon under investigation. We first discuss aspects related to landscape forces. Because the landscape developments and regime characteristics are assumed to be the same for the three cases analyzed, we decided to present and discuss them before the specific analysis of each case.

4.1 Landscape characterization

According to the multi-level perspective on transitions, landscapes are deeply structured external forces that influence both the process of reconfiguration in socio-technical regimes and dynamic interactions between niche and regime levels. Depending on the nature, pace, and intensity of this influence, such a reconfiguration process may assume different trajectories.

The results provide evidence of the influence of global cultural and political factors, local geography and demographic characteristics, as well as of how some urban developments have created opportunities for selecting the sharing schemes investigated. The following discussions will firstly focus on the actors' perception of high-order external aspects that could, in our view, configure landscape developments acting on the current

regime of urban mobility. As much as possible, we strengthened the evidence with information from documentary and observational sources.

4.1.1 Cultural influence

Research data have shown robust evidence of how global cultural aspects have influenced urban mobility systems around the world in the direction of making them a more sustainable societal function. From an individual perspective, cultural changes in lifestyle and consumption practices have been contributing to this broader transformation. Consequently, from an organizational view, both companies and the public sector need to understand this shift and act towards meeting new user preferences.

4.1.1.1 Changes in lifestyle and consumption patterns

In recent years, changes in lifestyle, with considerably more attention being devoted to the practice of physical activities, health care, and environmental concerns, have brought profound repercussions on the behavior of individuals as both citizens and consumers. Regarding urban mobility, such landscape developments directly influence consumer behavior and practices, public policies, and company strategies as well. This is supported, to a greater or lesser extent, by the testimonies of virtually all research participants as well as some document fragments.

There seems to be a **cultural shift towards active and sustainable urban mobility practices** so that users' preferences and practices have been seen as shifting from traditional, polluting habits to healthier and more sustainable ones. User B2, for instance, said: "(…) people have been using shared bicycles for some time. I think maybe it's a change of habit that maybe, who knows, may change the culture, right? I don't think it's a fad, I think it really is a change in habits." This perception is the same as that of several users, who report that they have watched an increase in the number of adopters of mobility by both shared and own bicycles.

> I think we have really had a paradigm change regarding mobility. In accepting a healthy alternative, of movement, right. Kind of a liberation. Some people I can already see that they are more willing. They either do it or say they would like to do it. (User B12)

For Bicicletar's sponsor, the shift to a more active urban mobility is a requirement for a healthier and more sustainable society. In her words,

> We want [shared] use to grow, because in a little while it won't be sustainable any more for everyone to have car, everyone emitting the same amount of carbon they emit today. (...) we grow more aware over time and those initiatives can add much to this prospect of a more sustainable society where people move around more and live healthier, who explore the city in different ways. (Sponsor S3)

More and more **people around the world are increasingly concerned with issues related to health improvement** and are engaging in new behaviors and habits that meet this appeal. Some of the research participants see the Bicicletar, Bicicleta Integrada, and Vamo Fortaleza initiatives as fully aligned with these concerns. As the operator O1 argues,

> (…) nowadays we are in a wellbeing phase, taking care of our body, right? Everyone is focused on health issues, right? (...) So, like, if we had the real possibility of pedaling more, I would pedal, and I think you would too.

Bicicletar user B6 states that he started to use shared bicycles to take care of his health through the practice of physical activity: "In the beginning I started, I started getting it to do exercise you know, because I was too sedentary. So I would get off [the bus] at some specific point, grab a bicycle from Bicicletar and go to my house." This was the same motivation expressed by user B7, which suggests the structuring of a mentality focused on health and well-being.

> I went up to my friend one day and said: "Carol, let's start using Bicicletar?" So she said "Sure, find out how you use it so we can use it!" So we started talking... she said it's also a question of health, that we are kind of sedentary, right? And I don't have time to be doing a sport, because my daily routine is tight.

Adopting the electric car sharing system also requires changing mindsets and habits. Although Vamo Fortaleza is not an alternative for active mobility – therefore, it does not directly contribute to a user's health – its popularization will undoubtedly contribute to the increase of the aggregate health level of all citizens by reducing pollution emissions. The representative of the company sponsoring Vamo Fortaleza points out:

> We need to change habits to have changes in ourselves, and thus, in society. Awareness on not polluting the environment, mainly with traditional cars, is one way, Also, knowing that the city that I take care of, invest in and value today, will be better for the coming generations. (Sponsor S1)

This change in mindset occurs not only in health care and environmental concerns. There is another structural behavioral change underway, specifically in the field of consumption: the **sharing rather than owning phenomenon**, that is, people have increasingly chosen to share rather than buy and own a good. One user of Vamo Fortaleza states: "I think that the tendency in the world today is for you to really share a good." (User V4).

User B3 corroborates this point. He considers that the Bicicletar program is subordinated to a broader cultural change related to sharing: "Bicicletar is moving in a direction that is growing all the time, shared mobility, social change, this whole business of cultural change itself… like how electric scooters are coming on the scene, it's a new product."

Another user of shared cars deepens her analysis by emphasizing how the propensity to share – instead of owning – is almost natural for younger generations.

> It's a new mentality. So much that you look at the young people, they no longer have that culture of owning things... even we inherited a little of that, right, that owning things, having assets provides security. Young people aren't concerned with that anymore. (...) Because you have Airbnb and such, you see this business of shared cars, you see, look, today there is even a shared clothes thing! People are sharing things in every way possible... (User V1)

Indeed, several respondents consider this process to be a **generational change that tends to favor the expansion of sharing schemes**. From her example, user B9 has noticed a change of mindset that confronts the traditional logic that considers owning a car as a symbol of status and power.

> I myself am from the millennial generation, I know many of my friends want to have a car or already have one, but I have always been a bit of an outlier. (…) I really have no desire for a car. I don't think having a car is a status symbol, and I can already see a bunch of people who feel the same way. The coming generations

already have this concern with the environment, with health. Having a car is really expensive. (User B9)

That generation ... than bunch actually close to age 40, are at the heart of the discussion today, which is really this cost of transportation thing... "Do I really want to pick of the tab for all this? And what will be the impact on other costs that I would like to have, in fact?" Costs with travel or costs with whatever... (...) we think we are helping a bit in reversing this culture of owning an auto[mobile]. (Policymaker P2)

Policymaker P2's words corroborate those of user B9, but in addition bring to the debate a utilitarian, pragmatic perspective. For him, the current adult generation has been to call into question the overall costs associated with owning a car and how they impact other possibly desirable costs. Operator O1 ended this generational discussion about cultural change: "There will be conflicts. These are new values, new tendencies that will not be changed in one, two or three years. They will be changed in 20, 25 years. Maybe our kids here feel this more than we do, right? We aren't old, we're young, but... [laughter]."

However, these lifestyle changes have been confronted by **cultural path dependence forces** that act as lock-ins: local urban mobility practices have been guided mainly by the logic of the automobile. In this way, the dominant, deeply rooted behavior in this societal function is based on a "one car, one person" rule, that is, individual mobility using a private car. Some fragments of interviews with users point to this characteristic: "(...) I think even here in Fortaleza, in Ceará, the focus is very much on the car driver. Cities are not thought out as being for cyclists. I think that gets in the way." (User B5) "So you move around the city and you see the number of cars with just one person in each car. It's lots of cars for few people, you know?" (User B6)

The factors discussed above illustrate how changes in lifestyles can have implications for various societal functions. In the next section, we discuss these repercussions, emphasizing the cultural developments at the landscape level in the sphere of public policies for urban mobility.

4.1.2 Macropolitical influence

Not only to deal with this cultural change but also to encourage it, several governments have engaged in the sustainable agenda in general and in sustainability policies

in the context of urban mobility in particular. By doing so, political actors reinforce those changes in lifestyle and consumption as well as promote the broader transition.

4.1.2.1 *A global trend towards sustainable urban mobility policies*

For some of the participants, there is a global trend towards sustainable urban mobility, especially in very populous cities, so that **efforts by governments towards environmentally-friendly urban mobility** have increasingly been seen around the world. All of the groups of participants expressed this perception, as seen in the examples below.

> We see this happening in other places around the world. It's a trend, this reduction in cars. Even trading combustion-engine cars for electric ones. There are several countries in Europe that are trying to start that. In Germany, if I'm not mistaken, by 2030 they are trying to avoid every type of combustion car. They will start selling only electrics, And bicycles are also a consequence of that. (User B5)

> Paris is a city that measures the quality of its air kind of every day, and when levels are critically low, they allow other options, provide free access to public transportation. So it is an issue that more and more cities are tackling because it isn't just the question of emitting CO2, of the greenhouse effect (...). It's quality of life in itself. Maybe in Brazil that is not so strong yet, but it has certainly begun and will only get stronger. (Policymaker P2)

As policymaker P2 observes, not only at the country level but also at the city-level, governments seem to participate in these discussions actively and develop urban mobility public policies. Such a perception is in line with the thought of the operator's manager, who argues that the global sustainability agenda creates opportunities for sharing projects in the context of urban mobility.

> This attachment to non-pollution, global warming, reducing pollution, Paris Accord. All this background brings an appeal not to use fossil fuels, You end up joining in on all those trends that are worldwide trends, and that brings the opportunity for this type of project, get it? (Operator O1)

Thus, **several countries and cultures** are seen as **supporting bike sharing or similar schemes** in order to meet this sustainability agenda. User B1 mentions the European

case: "Europe itself is already buying into the bicycle system, regardless of what city. There is the example of Amsterdam, which is the most iconic, where you see bicycles everywhere, you hardly see a car."

> Down in Rio I actually used the new thing, the scooter, which is also shared. I thought it was the best, I loved the experience! I remember I went to Chile and there they had scooters and bicycles too. So, like, I think that Fortaleza is moving... I think we are sort of taking baby steps, but we are on the right path. User B9)

Sharing schemes thus emerge as a global trend in the urban mobility context, which is in the speeches of all the policymakers interviewed. Policymaker P1's words are an example:

> That was a trend, right, it was natural. When we started thinking of solutions for urban mobility, we looked for practices, obviously outside of Fortaleza, outside of Brazil, in fact. And that trend for sharing is a global trend. (…) Close by to us we have cities that have had success with this, Europe is very strong in this, right... Bogotá is close to here. (Policymaker P1)

Referring to sharing arrangements in general, and in agreement with the abovementioned views, the operator company's participant asserted: "This is what I think; these processes are going to be expanded naturally, right? That is a natural trend. It's not a fad." (Operator O1)

This global trend of governments working to make urban mobility regimes more sustainable is, however, counterbalanced by lock-in elements that underpin incumbent regimes. We refer here to the **technological path dependence**, i.e., the fossil fuel-based urban mobility patterns that still are deeply structured in local practices around the world, especially in developing countries like Brazil. The considerable increase in the fleet of private combustion vehicles in Fortaleza – actually Brazil – in recent years (Doc #15) shows the persistence of the prevailing technology.

4.1.3   Urban developments

The expansion of cities challenges the capacity of their subsystems such as health assistance, water and energy supply, urban mobility, public spaces, among others. The

demand for new mobility modes increases as this growth often occurs towards neighboring municipalities so that new users are expected to join the urban mobility system. We found evidence that sharing economy business models meets the challenges and opportunities stemming from the metropolization and the urbanization phenomena.

4.1.3.1   Metropolization process

The metropolization process occurs when a city experiences growth towards peripheral areas and neighboring municipalities. Fortaleza has experienced this process, expanding its integration with surrounding municipalities, not only in geographical terms but also regarding social dynamics.

Metropolization encourages trade between municipalities and leads to an increase in the flow of people, materials, goods, and information. Because of that, **there is a greater demand for alternative mobility modes integrating the municipalities in the region**.

> One may identify strong displacements between the western and southern parts of the city moving towards the densified center, mostly because of work issues (...). Fortaleza has been experiencing the metropolization phenomenon (...). From 1970 to 2010, we can see a considerable increase in the relation between the population living in the Fortaleza Metropolitan Region and the total population for Ceará from 23% to 43%, approximately. (Doc #7)

Some of the bike sharing users interviewed – specifically, B1, B7, B8, and B9 – declared themselves to be residents of neighboring municipalities (e.g., Caucaia, Maracanaú). In their interviews, they stated that they use the Bicicletar system in part of their routine commutes, due to the need to commute to Fortaleza for working or studying.

> I use it every day. In fact, from Monday to Thursday, which are the days I go to university. I use it to go, I get off the bus at Av. Bezerra de Menezes, since I'm coming from Caucaia, then I get off there at [Av.] Bezerra [de Menezes], then I get the bicycle there and return it at the UECE station [State University of Ceará]. And to go back as well. I get it [the bike] here and leave it at the first bus stop where the buses to Caucaia pass. (User B7)

As the bicycle is not the most suitable vehicle for very long distances, for this route, they use the intercity bus system, switching to the bike sharing system as soon as they

have reached a station with bikes available within the municipality of Fortaleza. In doing so, users with this profile reveal **the need to integrate the intercity bus system with the bicycle sharing system**.

4.1.3.2 Urbanization dynamics

The accelerated growth of urban centers has brought several problems related to congestion, depletion of urban infrastructure, air pollution, health risks, and social exclusion. Policymaker P1 emphasizes these aspects, placing them in the context of Fortaleza, and points out actions taken by the municipal government.

> We saw several studies showing that 60% of the atmospheric pollution, of pollutant gas emission, comes from the transportation system. We also saw that infarcts and heart attacks are closely linked to sedentary lifestyles. So encouraging this active transport also helps with that issue. [As for] traffic accidents, the link is obvious, right? So the more you reduce motorized transportation and focus on active transportation you are working towards that. (Policymaker P1)

On the other hand, **high population density is associated with an increasing demand for commuting**, which in turn reinforces the issues pointed out above. One document analyzed points out how population growth impacts the urban mobility system.

> Fortaleza is one of the most populous cities in Brazil. It also has the highest population density [among the six largest capitals], with its population concentrated in the 15-64 age bracket, where citizens are part of the active population and need to work and get to work. In that context, improving conditions and means of transportation is crucial, (...) as well as providing alternative means for commuting. (Doc #7)

According to the research data, bicycle and electric car sharing systems appear as potential solutions for dealing with the challenges arising from urbanization processes. Sharing schemes would contribute towards reducing CO2 emissions and improving the quality of life for citizens.

> Bicycle use by citizens would lead both to a reduction of atmospheric pollutants by motorized vehicles and a reduction in municipal traffic, with a view to improving quality of life for citizens. (Doc #7)

> The main benefit from this system [of sharing electric cars] is that it encourages clean and renewable energies and does not emit pollutant gases and noise pollution. (Doc #8)

For some users of bike sharing or car sharing systems, **sharing-based business models could mitigate the misallocation of urban mobility resources**. Some excerpts indicate at least two ways in which such a misallocation is manifested. As user V4 mentions, "We see lots of cars with one person inside. And sometimes they are going to the same place!"

> For example: you are going to work in your car. You will leave your car there, and it will stay there unmoving for eight hours until you get off work. In other words, there might be another person who could need to use the car for four hours, for example. People will buy fewer cars, for example, if there is a well-done sharing system available. (User B5)

In the words of policymaker P1, below, he connects the challenges of municipal management in the field of public policies on urban mobility with the problems arising from urbanization processes. He further related them to global forces (e.g., reduction of inequalities, social inclusion, and sustainable development) that led to public sector engagement in urban mobility sharing initiatives.

> So we saw that there were solutions that directly or indirectly impacted the main causes of death in the city. Here I am talking only about health... Besides the benefits of reducing congestion, and even social inclusion (...). It is an easy solution that encourages sharing, provides more transportation options, and also favors all those benefits I talked about. (Policymaker P1)

The action of the city government in this context considers that **sharing-based business models are drivers for sustainable urban mobility**, so that, in the long run, such arrangements can contribute to the mitigation of problems in urban metropolises as with the

Fortaleza experience. In this sense, bike sharing programs "promote the humanization of the urban environment and social responsibility among the people." (Doc #5)

In general, all respondents confirm the view that the sharing economy can provide an answer to these global challenges. For example, the respondent linked to the sponsoring company of the Bicicleta Integrada system states:

> Without a doubt, the encouragement of that practice by the public sector, with investment in bicycle paths, as well as by private initiatives brings many advantages. The citizen does physical activity and saves on fuel. The city will have better mobility, with fewer vehicles circulating. The atmosphere gets relief because of the emission of fewer polluting gases. (Sponsor S2)

Referring to Bicicletar, user B4 considers that the program contributes to reducing environmental pollution and improving health: "(…) I think that reducing car use is even good for our health. So this will help in two ways: you will reduce traffic, pollution, and will help your health." For user B11, **bike sharing systems play an emancipatory and citizenship role** insofar as they are another alternative for urban mobility out of so many that should be available to the population.

> I think it is another mode within a set of options that should exist. I am completely in favor of cars. But I am also completely in favor of car sharing, I am also completely in favor of Uber, of bicycles, of bicycle sharing, of buses, of scooters... (User B11)

> (…) Regarding benefits to the community, we can highlight the reduction of traffic congestion, reduction of air and noise pollution, improvements in public health, increasing social interaction as a result of safer streets, and an increased flow of tourists. (Doc #7)

Users of the Vamo Fortaleza car sharing system also confirm the perception that business models based on the sharing economy meet the challenges imposed by urbanization.

> Sharing really does lead to optimizing resources, so I see that as a positive point. I am one of those who rides a bicycle, rents cars, I have an electric scooter, got it? So that means I'm in favor of mobility, multimodal mobility and optimized spaces, right? (User V1)

Urbanization processes are seen as causing demographic and social changes as well, such as population growth and changes in the patterns of income distribution across different regions of the city. Indeed, landscape demographic forces were also found in the research data, as we will discuss below.

4.1.4   Demographic factors

Demographic forces may influence business models based on the sharing economy. In this context, socioeconomic inequalities and changes in the size of Brazilian households emerged from the research data as important landscape developments. Inequalities pressure policymakers at the three levels – federal, state, and local – to equalize opportunities for access to quality public services. Additionally, different household patterns are associated with different preference structures, which can ultimately shape the adoption of sharing-based mobility services.

4.1.4.1   Socioeconomic inequalities

Inequalities between the various regions of the city increase pressures on the current infrastructure, safety, education, transport, and health public systems. In this context, the Fortaleza Integrated Cycling Master Plan (ICMP) recognizes the need for better public services. The ICMP was created by the city government to guide the elaboration and implementation of actions and projects related to bicycle-based urban mobility.

> (...) it is clear that there is a close relation between neighborhoods with a greater share of low-income population and illiteracy and neighborhoods with the worst urban infrastructure. That context points to the need for expanding public policies that seek to promote improvements in the neediest neighborhoods, especially with improvements in education, security, and health. Furthermore, this, and the other indicators presented point to the clear disparity between the central area and the peripheral region of the municipality in terms of infrastructure and development. (Doc #7)

The lowest income populations are concentrated in the peripheral areas of Fortaleza. These people may be more dependent on commuting by bicycle or on the public

transport system, as they generally lack the resources to own a car, and even to get a driver's license. The availability of a bicycle sharing system and associated infrastructures thus contributes to reducing social and economic inequalities, as it can help low-income workers in their daily commutes and emancipate them. In the opinion of Bicicletar user B3, "Bicicletar is a great system, it made things much better for low-income workers because at times they can use the bus and then use the bicycle for part of their trip."

In the words of the policymakers, the Bicicleta Integrada program, for instance, is strongly focused on social inclusion.

> We did research and saw that we were reaching people in the lower-income categories, so there is a strong focus there on social inclusion. So it has this character more of a loan, the user uses it for 14 hours, right? (Policymaker P1)

In comparing the audience profile of the two bicycle sharing systems, a policymaker notes that both Bicicletar and Bicicleta Integrada serve low-income people, yet there are differences: the former's audience is relatively more educated, whereas the latter's most frequent users are the lowest-income people.

> With Bicicletar we have a more educated public. But there is a characteristic in both, that most of the public is low income. (...) what we noticed is that there is a disparity within the lower-income range: even though Bicicletar serves a lot of low-income people, [Bicicleta] Integrada reaches very low-income users. (Policymaker P3)

Therefore, evidence shows that bike sharing schemes in urban mobility are aimed at allowing low-income people to get around the city, to engage in social practices and relationships, and to use public spaces that also belong to them. From this angle, **sharing-based business models are a response to socioeconomic inequalities**, since they contribute to reduce economic disparity and to promote social inclusion.

4.1.4.2 Family structure

Following a global trend, the city of Fortaleza is experiencing a sustained reduction in birth rates. This phenomenon is associated with increasing economic

development, and its consequences manifest in the structure of families, which are gradually smaller and, not infrequently, have no children.

> Another important aspect to be analyzed is the age of the population. According to data from the 2000/2010 Censuses, there was a 27.88% drop (35 thousand persons) in the population ages 0-14 years. That reduction is explained by the drop in birthrates and by the new structure of families, with fewer members. As for the 5-9 year-old range, the population fell from 206,078 to 176,363 over those ten years in Fortaleza. (Doc #7)

The way the family structure influences adoption and, ultimately, the emergence of sharing initiatives, specifically in urban mobility, is not so deterministic. However, some participants mentioned aspects that deserve further discussion. Typically, having children changes the structure of personal preferences and priorities (i.e., behavior), which leads to several implications for adoption and use of both bike sharing and electric car sharing systems. On that subject, user B12 mentions:

> There are periods during the week when I use [Bicicletar] three or four times, and then comes month where I use it once a month. It depends on my routine here with the children. [With] my husband traveling, I can't leave them alone. And then I can't use only a bicycle.

On the other hand, raising children requires great dedication. Thus, **parental obligations can make sports and health care practices unfeasible**. One user stated that commute from home to work, previously done with the family car, started to be done with the use of shared bicycles (Bicicletar) in order to enjoy the moment as a practice of physical activities.

> Being a father, with children, right, we can't have a daily routine, of going to the gym, because there is homework to help with, you have to be with the children, right? So the time to do physical activity that I have found is when it is time to go to work. That travel has become my fitness moment, right? (User B10)

One can note that **family routine and parental obligations shape the willingness of users to use a bike sharing system**. In any case, the availability of the service

is important. Even for families with children, occasional use indicates some degree of adoption and recognition of the benefits of the system.

Another user emphasizes the importance of owning a car to meet the needs of the family. For him, the bicycle sharing system is another mobility option, which should be available to citizens so that they can use it according to their needs and preferences.

> I have to have options. But in my case, where I have kids that I need to leave at school, and thank God, I am able to have a car, I will have a vehicle, I will have my car, my private car, get it? (User B11)

Referring to Vamo Fortaleza, policymaker P2 observes that **singles and childless families are more likely to join the electric car sharing system** because their routines neither have parallel commitments nor require mobility of care.

> Today we have a household core, a family core that is less dependent upon this enchained commute, this mobility of caring for family, of leaving kids at school, of having those other obligations. Because this is an individual who is able to have this freedom of deciding on movement (...), who hasn't got those lateral commitments. And then we see that, although it is a slower transition, this demography thing is positive for Vamo. (Policymaker P2)

In this regard, users of Vamo Fortaleza surveyed by the municipal management reported that children and other family obligations make adhesion to the electric car sharing system more difficult. As policymaker P2 describes,

> It's not that we are saying that the [private] car has to disappear. It has its uses. In fact, that is what we talk about the most with people and that is the reason it is so hard to join the program. The guy says: "Look, Vamo is interesting, but I have to leave my kid at school…" Or: "It's interesting, but..." It's for the same reason that the guy doesn't sell his car and just use Uber.

The smaller the family, the less the need for a car that is readily available at all times. In this way, smaller or childless families can resort to the electric car sharing service only as needed. One could argue, with which we can agree, that this is not a demographic, but actually, a cultural force whose impacts manifest in the demography domain (family structure). Nonetheless, the central point here is that the decrease in the average size of

Brazilian family households is a structured landscape development that may influence the adoption of both car sharing and bike sharing programs.

4.1.5 Geographical factors

Climate and topography characteristics are important external factors influencing urban mobility systems, especially those related to active mobility practices (walking or using bicycles, for example). Fortaleza is said to have favorable geographical conditions for the use of bicycles, as reported in the Integrated Cycling Master Plan (Doc #7). How the geographical influence takes place is what we discuss below. We rely on users' experiences in this regard.

4.1.5.1 The flat topography makes Fortaleza a city suitable for bicycle use

Both the documentary data and interviews show that Fortaleza is a flat city, that is, **the city's topography is conducive to the use of bicycles**. Due to this characteristic, the route taken by bicycle can sometimes be faster than by another mode.

> Bicicletar to me makes it easy to go someplace, it is sometimes faster, mainly because Fortaleza is a very flat city. (...) here in Fortaleza, since it's a flat city, it was already a cultural thing for people to ride a bicycle, mainly the workers, the factory workers. (User B3)

Besides that, as user B1 asserts, **the flatter the topography of the city, the longer the routes considered viable by bicycle**. This also contributes to Fortaleza being considered a city friendly to the practice of cycling as an alternative for urban mobility.

> Once I saw in an interview, in São Paulo, it was a traffic engineer showing that a route that could be pedaled would be up to 8km for an ordinary person. Any route longer than 8 km would be hard to handle as a daily route. Because it is a flat city with little elevation, Fortaleza is more comfortable for pedaling. I think 9 or 10 km would be something doable in Fortaleza. (User B1)

4.1.5.2 Climate and weather conditions

As previously mentioned, about 90% of the total volume of rainfall in the city of Fortaleza occurs in the first six months of the year, with a higher concentration from March to April. In this context, the data show that the intensity of heat and rainfall is an influential factor in the decision making regarding using – or not – the bike sharing system.

However, such an influence can vary from user to user, according to their personal preferences and mobility needs. According to a sponsor's participant, even among frequent users of the Bicicletar system, periods of the day with greater intensity of sun and heat show a reduction in the utilization rate of the system.

> The sun factor can also be a hindrance for people to use it at certain times. We see that from noon until 4 PM, the use of Bicicletar is quite low, I think because of the sun, right, because we have a really hot sun, and people don't want to more around then, and arrive at their spot [destination] all sweaty. (Sponsor S3)

For some Bicicletar users, heat is a barrier to the use of bicycle sharing systems, and may even act as a barrier for new users to join.

> I think that climate is a determining factor. (...) for someone using it a lot, going from one place to the other for work of studies, the heat is really complicated. I have seen several people even saying heat was a more determining factor for not using it than traffic safety. (User B11)

In contrast, other users argue that heat is not a definitive barrier, since the intensity of the winds in the city mitigates its effect: "The heat is not a problem because of the wind, which makes it easier, provides relief." (User B3) Besides, it is possible for users to prepare and adequately plan their routine, so that use becomes feasible even on a hot day. "I think like this: you can't go to work and sweat, understand? But depending on my objective, I will get a bicycle with no problem. If I'm going home afterward, then I will use it [Bicicletar]." (User B6)

In this same sense, some respondents consider that rain is a barrier to using the sharing systems. One said: "I think what would be more of a barrier would be early in the year, in the rainy season. Because then, the rain business is what I see as a hindrance for a Bicicletar user." (User B1) Another user pointed out that the use becomes impracticable because the bikes get wet on rainy days:

(…) on a day when it's raining, the bikes aren't protected, right?! It happened once to me that I was going to get a bike here at the North Shopping Station and all the bicycles were wet. So I ended up not getting one. (User B2)

Indeed, all thirteen stations visited during field observations (four for Bicicleta Integrada, six for Bicicletar, and three for Vamo Fortaleza) were installed in outdoor spaces, such as squares, streets, and sidewalks, unprotected from the rain and sun. The research data showed no evidence of the influence of this factor on the intention to use the Vamo Fortaleza car sharing system. However, it is assumed that it also exerts some influence, since the stations are also mostly installed in outdoor places, which makes the experience of accessing the system difficult (Appendix A5 shows the photographic records of these visits).

For two participants, however, rain is not a definitive barrier as long as the user owns a raincoat and prepares in advance to use the sharing system to satisfy their daily mobility needs. "For example, you won't always be able to ride a bicycle here in Fortaleza. There are days it's raining, the person needs better equipment, a raincoat, they have to go dressed for work." (User B5) Next, user B3 states: "(…) because with rain, sometimes only if you have a raincoat and everything. But I don't use a raincoat, so for me when it's raining like that it's hard for me to use it [Bicicletar]."

As noted, demographic aspects will not have a deterministic influence on the adoption of bicycle-sharing systems. This influence will be mediated by individual-level factors, which can vary from particular preferences to travel objectives. We tentatively conclude that **heat and rain could be barriers to the adoption of bicycle sharing systems** in the city. As users, these participants are to some extent enthusiastic about sharing systems. Therefore, these geographic aspects are likely to exert a more restrictive influence on the general population.

4.1.6 *Synthesis of landscape developments*

Based on the categories that emerged from the research data, Figure 21 depicts a preliminary vignette for landscape influences on the urban mobility socio-technical regime. As we have not yet discussed niche and regime data, these levels are transparent in this vignette. They will be properly outlined as the corresponding discussions take place.

Figure 21 – Vignette for landscape developments
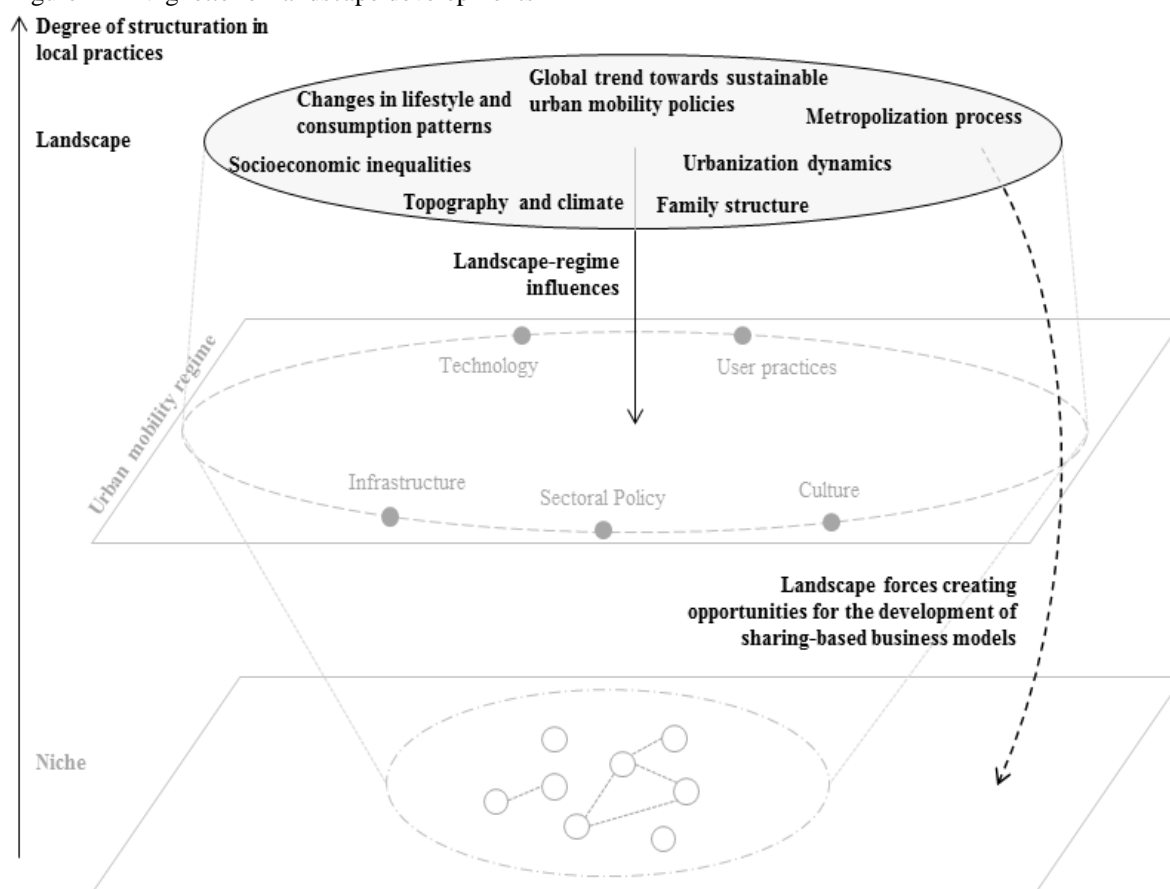
Note: The landscape-specific dynamics are in bold.
Source: The author, based on the research data.

One can note that the landscape developments can both stimulate the rise of sharing economy-based business models in the technological niches and influence actors and institutions in the current urban mobility regime to foster these new niche ventures. Besides, some dimensions in the regime can be more quickly and intensely affected than others.

For instance, taking the sectoral policy dimension: as previously mentioned by the policymakers, the designing of regulations and public policies for urban mobility (e.g., expansion of cycling infrastructure, bike sharing, and car sharing programs), is increasingly steered by sustainable principles, which may, in turn, guide the establishment of new patterns of legitimacy. Thus, the more people embed eco-friendly behaviors and lifestyles, the better the alignment with the sustainable public policies, which supports – or even increases – moral legitimacy from the normative approval of their outcomes.

Regarding the culture dimension, such landscape factors have an effect on shaping people's expectations of urban mobility policies and their impact on the user's daily routine. Since expectations guide action, user practices dimension will be molded by the range of mobility alternatives available, which in turn reinforces users' practices and expectations in a

feedback cycle. More and more people will take sharing-based business models for granted, as increases the amount of knowledge they share about them.

The infrastructure and technology dimensions are crucial to support the creation of value from urban mobility sharing initiatives and reduce barriers to adoption. Public policies should favor easy-to-learn and easy-to-use technologies. They will require less effort from current and potential users, both in the domain of bike sharing and car sharing, speeding up the understanding of the system and learning processes (cognitive legitimacy). Designing and building new infrastructures (e.g., the network of stations, bike lanes, charging points for electric cars), in turn, can give users a greater perception of physical safety (i.e., well-being) and system reliability, which satisfies their utilitarian interests (pragmatic legitimacy).

From these discussions, we argue that landscape developments observed in the research data seem to be exerting pressure on the traditional regime (inefficient, polluting, non-inclusive) of urban mobility and creating impulses for change towards sustainability. In this sense, the data showed the key role played by the municipal administration in responding to these landscape pressures and developing a policy mix oriented to the citizens' expectations. Ultimately, landscape forces will require adaptations in the way value is created and delivered in the urban mobility context, as well as adjustments in key processes and resources to meet the interests of the audience.

In the next section, we rely on the research data to frame the socio-technical regime of urban mobility. After this analysis, it will be possible to better understand the nature of the relationship between landscape and regime, whether cooperative or disruptive, and its implications to legitimation dynamics.

4.2 Framing the current socio-technical regime

In the following discussions, we are interested in identifying actors, interactions, and institutions (rules) for each dimension of the regime under investigation, namely, the urban mobility in Fortaleza. To facilitate the task of delimiting the regime, we used the guidelines proposed by Holtz, Brugnach and Pahl-Wostl (2008). The authors suggest that a regime encompasses a specific societal function that is performed by a set of elements (actors, technologies, institutions) holding strong coherence with each other. A regime has no central control and coordination. Rather, self-directed behaviors and non-guidance prevail with it, which makes it autonomous and dynamically stable while developing by internal, incremental processes.

From these guidelines, Figure 22 details the sub-regimes investigated in this research. To some extent, we based on the representation proposed by Geels (2002) to illustrate multi-actor networks in a generic regime (as in Figure 2).

Figure 22 – Fortaleza's urban mobility regime
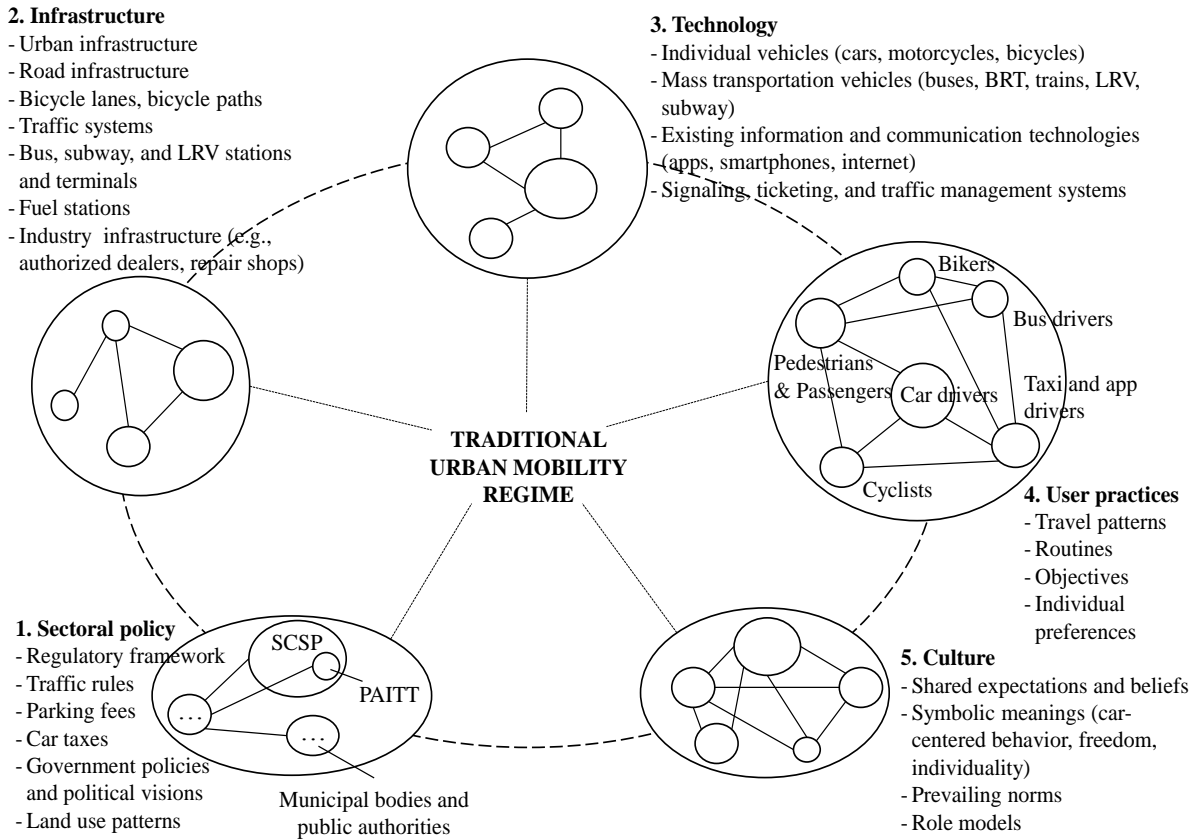
Source: The author, based on the research data.

Next, we will address each dimension of the urban mobility regime and the institutional dynamics occurring within each one. Such dynamics can be of two natures: forces that favor the change to a sustainable mobility regime (drivers to sustainability transition) and others that act as barriers to the transition (lock-ins). Having already discussed the influences arising from the landscape, we also sought to address the interactions between these levels.

4.2.1 Sectoral policy

The sectoral policy sub-regime refers to the set of rules, laws and regulations that govern the current urban mobility system at the municipal, state and national levels. At the city level, it also refers to how urban spaces should be occupied by the various modes of

transport, their equipment, relative infrastructure and their actors. It also includes master plans as well as expansion and improvement policies in the context of mobility.

At the individual level, in addition to users of mobility systems, this sub-regime includes public managers, policymakers, and managers of partner companies. At the organizational level, there are administrative bodies, public companies, agencies, and municipal departments with some influence on public policies on urban mobility, from areas such as health, sports and leisure, security, infrastructure, and urbanism and the environment (Doc #7).

Within the scope of municipal management, the urban mobility programs investigated in this research (Vamo Fortaleza, Bicicletar, and Bicicleta Integrada) are managed by an administrative body called PAITT (Immediate Actions Plan for Transport and Transit). PAITT is linked to the Municipal Department of Conservation and Public Services (SCSP) of Fortaleza, and its operation is focused on actions to improve urban mobility, both in traditional systems (incumbent) and innovative initiatives (entrants).

> PAITT was created in about February or March 2014. There were about 12 people involved, with masters and doctorates in Engineering, Architecture, people from some municipal agencies and the bicycling movement. (...) PAITT is divided into bicycle path management, which takes care of actions directed towards the bicycle path mode; there is the road circulation team (...); there is the public transportation sector, and the road safety part, which deals more with pedestrians, and actions for reducing accidents. (Policymaker P1)

Another important role of the actors in the sectoral policy dimension is to ensure the alignment of projects with the legal and regulatory framework, both at the regional and national levels (e.g., the National Policy for Urban Mobility and the Brazilian Traffic Code – CTB). This guidance is observed in several sections of the Integrated Cycling Master Plan (Doc #7) and corroborated by the public managers interviewed, as shown in the excerpt below.

> PAITT since the beginning was focused very much on mobility aligned with the National Policy for Urban Mobility, active transportation, priority for non-motorized vehicles, bicycles, pedestrians. (...) We also saw the opportunity to bring in shared electric vehicles, for a sustainability footprint, which is also focused on the National Policy for Urban Mobility, for reducing emissions. (Policymaker P3)

Examples of rules, laws and regulations (institutions) related to this dimension are the documents Doc #7 (Integrated Cycling Master Plan) and Doc #10 (Law No. 10,303 from December 23, 2014, which institutes the Bicycle Transportation Policy, approves the Integrated Cycling Master Plan for the Municipality of Fortaleza and other provisions), both analyzed in this research, as shown in Table 10.

> The Integrated Cycling Master Plan of Fortaleza (PDCI) has the objective of providing the municipality with guidelines that will inform actions for bicycling policies over an action horizon up to the year 2030. (...) The Plan will become an important management tool for continuous actions to expand and maintain the network and promote educational and dissemination plans for the population. (Doc #7)

These regulations came out from a political vision (in turn based on statistical studies) according to which the current urban mobility regime is unsustainable, as it favors individual, motorized and polluting transport, in addition to preventing more democratic access to public spaces in the city. They can be considered important guidelines for niche developments, such as sharing-based business models.

> If you look at the five main causes of death in Fortaleza today, the first is homicide, the second – I may get the order wrong for the other four – but there is heart attack, meaning heart diseases, after that cardiorespiratory diseases, lung cancer and traffic accidents. We have seen that by encouraging active and shared transport modes and all the other things, with an environmental footprint, we are working on that, on some of the main causes of death. (Policymaker P1)

According to another policymaker, this set of public policies has proved to be decisive for the process of transition to a sustainable urban mobility regime. Such policies are in line with best practices in developed countries and have received positive feedback from local society. The statements of public managers below show this perception of the population.

> We think that not only has the public authority been able to advance very much with this policy, but we strongly believe that there is no going back. Both from what we have seen done here, and have seen as a response from society, and from we see in

the world outside in terms of studies in transportation, limits to urban and highway spaces, the need for redemocratizing those spaces. (Policymaker P3)

It is not just a case of urban mobility. This action involves health, the environment... That helped very much to communicate and I think it helps the person to understand. When a person complains like "Oh, you're spending money with bicycle lands instead of hospitals..." But there is a strong link in that! If you encourage this, you reduce your expenses with health farther down the road. (Policymaker P1)

Therefore, actors and institutions of the incumbent regime – especially those of the sectoral policy dimension – actively engage in strategies aimed at promoting niche developments aligned with their expectations and visions, in turn, oriented towards a sustainable urban mobility regime. In Fortaleza, the municipal government attends to this agenda and recognizes the need for behavioral and cultural changes for the bicycle to become a daily mode of transportation. To encourage this transformation, the municipality's political background comprises education policies and awareness campaigns in both the master plan and the law.

Changes are needed in society's mentality and habits: the bicycle must be considered a means for daily transport. (...) it is important to develop attitudes, aptitudes, give society the responsibility, through rights and duties, and foster participation and decision-making in terms of bicycles. (Doc #7)

Art. 38 – The Executive Branch shall maintain permanent educational actions to promote safe and responsible behavior standards among cyclists, and it shall also promote educational campaigns, with the target audience being pedestrians and drivers of vehicles, motorized or not, seeking to disseminate the appropriate use of shared spaces. (Doc #10)

These actions take place mainly – but not exclusively – through programs and public policies, public-private partnerships, and educational campaigns, with short-term implications in the infrastructure and technology sub-regimes. Medium and long-term implications are expected to occur in the culture and user practices sub-regimes. Due to its cooperative nature, this dynamic creates opportunities for the regime to select these new business models.

4.2.2 Infrastructure

As its name suggests, this sub-regime encompasses all city's existing urban mobility infrastructure. It refers, as illustrated in Figure 22, to both the infrastructure that serves individual mobility systems and that which supports the mass transportation of passengers. The main infrastructure elements of the city's urban mobility regime are streets and avenues, traffic systems, bus corridors (Bus Rapid Transit – BRT), bus lines, stations and terminals, networks of cycle paths and cycle lanes, infrastructure related to the industry, such as car dealers, fuel distribution networks, as well as a network of maintenance services and gas stations. Fortaleza also has a subway and light rail vehicles (LRV), but they are managed by the state government, meeting the demand from users in Fortaleza and neighboring municipalities.

In addition to the road infrastructure itself, another traditional infrastructure in the urban mobility regime in the city is the Fortaleza Transport Integrated System (SITFOR), which opened in 1992. SITFOR then instituted an innovative topology, with large bus terminals in some neighborhoods, as it can be seen in Figure 23.

Figure 23 – Fortaleza Transport Integrated System topology
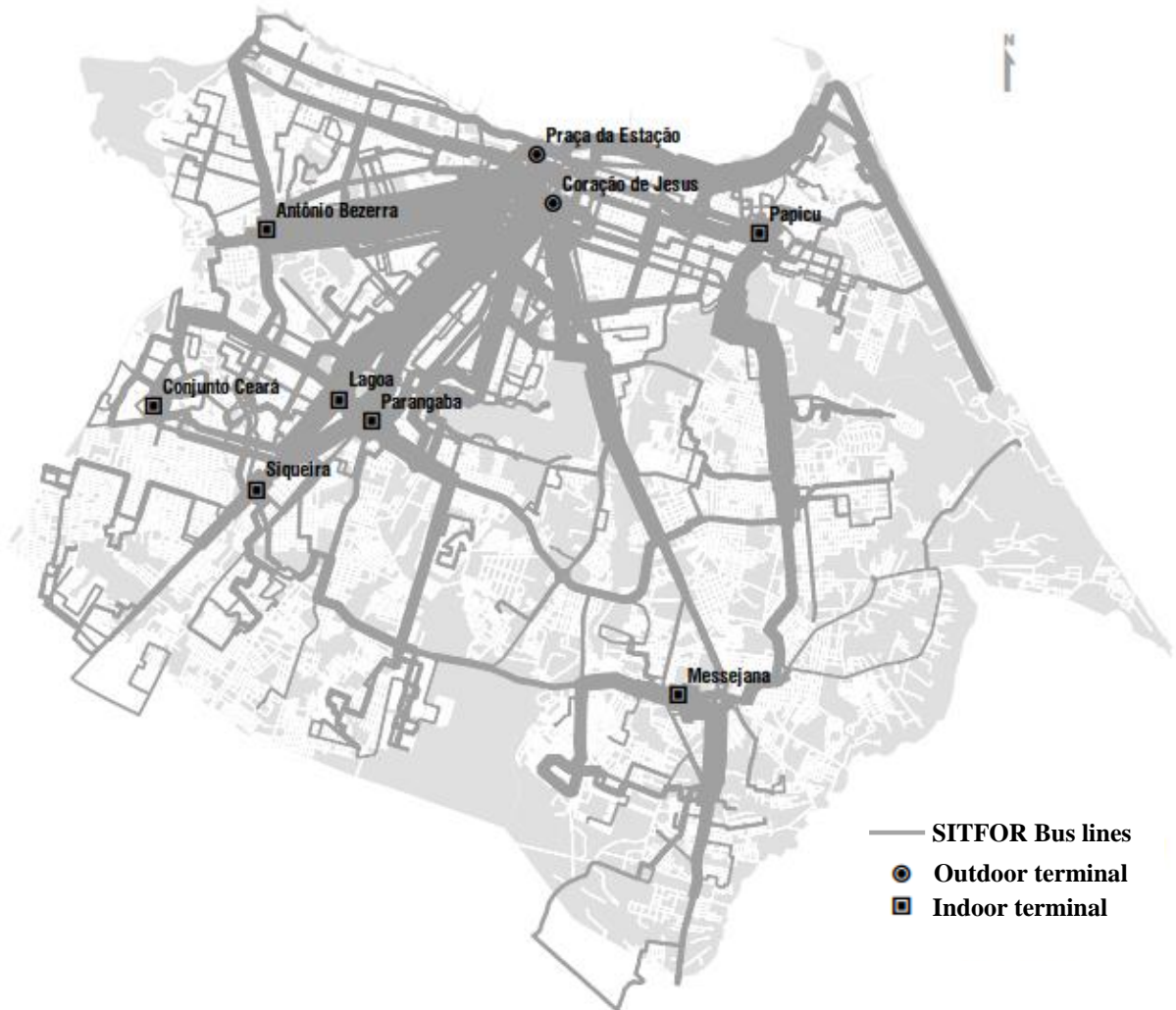
Source: Adapted by the author, from documentary evidence (Doc #13).

The system consists of seven indoor and two outdoor terminals. All terminals function as spatial integration points. Indoor terminals, in particular, also function as tariff integration points. Through this topology, the bus lines were subdivided into two categories: feeder lines, connecting the neighborhoods to the terminals; and trunk lines, which connect the terminals to the city center (Doc #13).

Since then, tariff incentives, modernization of the bus fleet, improvements in bus stops, creation of corridors, and exclusive lanes for mass transport (Doc #11) have not been sufficient to create a culture of urban mobility geared to public transport. According to a message from the mayor of Fortaleza, published in 2015 in the Integrated Cycling Master Plan (Doc #7), the urban mobility system has historically been oriented towards individual motorized transport with internal combustion. Policymaker P1 confirms this message and highlights the infrastructure gap for cyclists to access the city's mobility spaces.

> We used to think of cities very much in terms of meeting demands for vehicles. A transportation engineer would think: "... I will estimate what the demand will be and I have to design a city to meet that demand for individual vehicles." We have seen that this model is no longer viable. (...) And offering shared modes is only one of the actions. We have to redesign the city, encouraging less commuting, which can be done on foot or by bicycle, a safer infrastructure for using a bicycle.

This dominance of the private car has exhausted the road infrastructure, causing congestion and making travel more time consuming and costly. According to the research data, the only infrastructure intervention carried out objectively to manage the congestion problem is the construction of binary systems, which in pairs convert two-way roads into one-way roads. "PAITT (...) has its road circulation team, very focused on the binaries, which are one of the solutions for expanding the cycling network." (Policymaker P1) Along with improvements in traffic signaling, binaries mitigate the depleted condition, although their impact is limited in the medium and long term.

This downside to mobility by private cars could work as an incentive for the use of bicycles and the public transport system. However, there is an ingrained perception of the low quality of this system. Besides, there is a lack of adequate infrastructure for cycling, although recent efforts have been made to mitigate this problem. As a diagnosis made during the preparation of the ICMP points out, "(...) the bicycle paths and bicycle lanes present several negative aspects and deficiencies that discourage people from using them." (Doc #7) Among these deficiencies, the following stand out: physical obstructions on bike lanes (trees, poles, speed cameras), insufficient width of bike paths and bike lanes, points of physical discontinuity, interruptions at motor vehicle return points, irregular pavements, deficient or nonexistent signaling, and poor maintenance.

A policymaker reinforces this path-dependent characteristic that culminated in the current infrastructure deficit. A change is needed in the concept of cities and in the way their infrastructures are modeled, according to him, shifting the focus to sustainable mobility.

> I think that the fact that people realize they have nowhere to run to in the city. The city infrastructure is not keeping up with the growth of the vehicle fleet, with population growth. (...) So they have seen that the solution is no longer to swell out, widen roads or create more overpasses. The solution now is to invest in those modes, to reduce the dependence on individual motorized transportation. (Policymaker P1)

In the past five years, however, the urban mobility regime has experienced what may be the beginning of a transition to sustainability. The main evidence of this is the construction of a network of bike paths and bike lanes, in addition to bike rack stations. These improvements are part of the scope of the Program for Expanding the Bicycle Path Network (Doc #1), which has quadrupled the city's cycling infrastructure since 2014.

> With the Program for Expanding the Bicycle Path Network growing rapidly, (...) the city, which had only 68.2 km of cycling path network and at the end of 2012, had 257.5 km of cycling path and infrastructure (...). The ICMP calls for Fortaleza to have, altogether, at least 524 km of cycling path network available by 2030. (Doc #1)

According to the ICMP (Doc #7), bike paths are fully segregated structures from motorized traffic, thus providing the highest level of safety and comfort for cyclists. They can be constructed on urban roads – either laterally or along the median strip – as well as in parks and on the banks of watercourses. Bike lanes, in turn, are installed on the road for motorized vehicles and indicated by the application of paint and specific delimitation devices. Therefore, they provide only a virtual separation of the flow of automobiles. Figure 24 shows the differences between bike lanes and bike paths.

Figure 24 – Bike lane and bike path
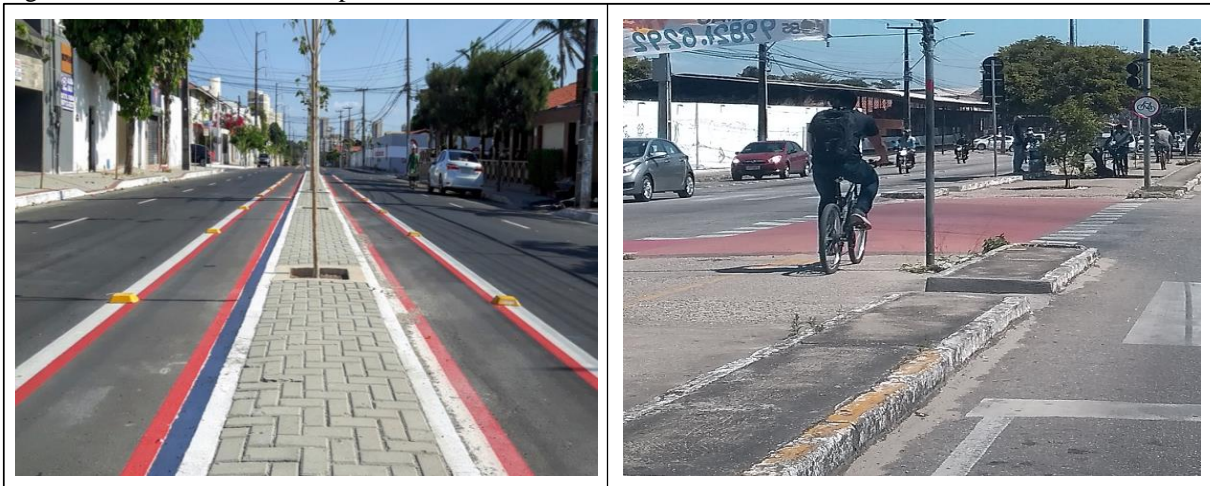
Notes: two bike lanes installed along the median strip of an avenue (left); cyclists – in the foreground and background – using the bike path at the Godofredo Maciel Ave., Fortaleza.
Source: The author, adapted from Doc #1 (left) and research data (right, own record, captured on Sep 17, 2019).

Cycling routes, in turn, are routes – signaled or not – recommended for simultaneous use by cyclists and motor vehicles, sharing the space of the roads. Cyclists must

occupy the roadway like any other vehicle, ensuring greater visibility and safety. Finally, shared sidewalks are spaces used by cyclists on the sidewalks, which must be signposted to guarantee priority to pedestrian safety. Figure 25 illustrates the existing and projected cycling network, according to the type of infrastructure.

Figure 25 – Fortaleza's cycling network
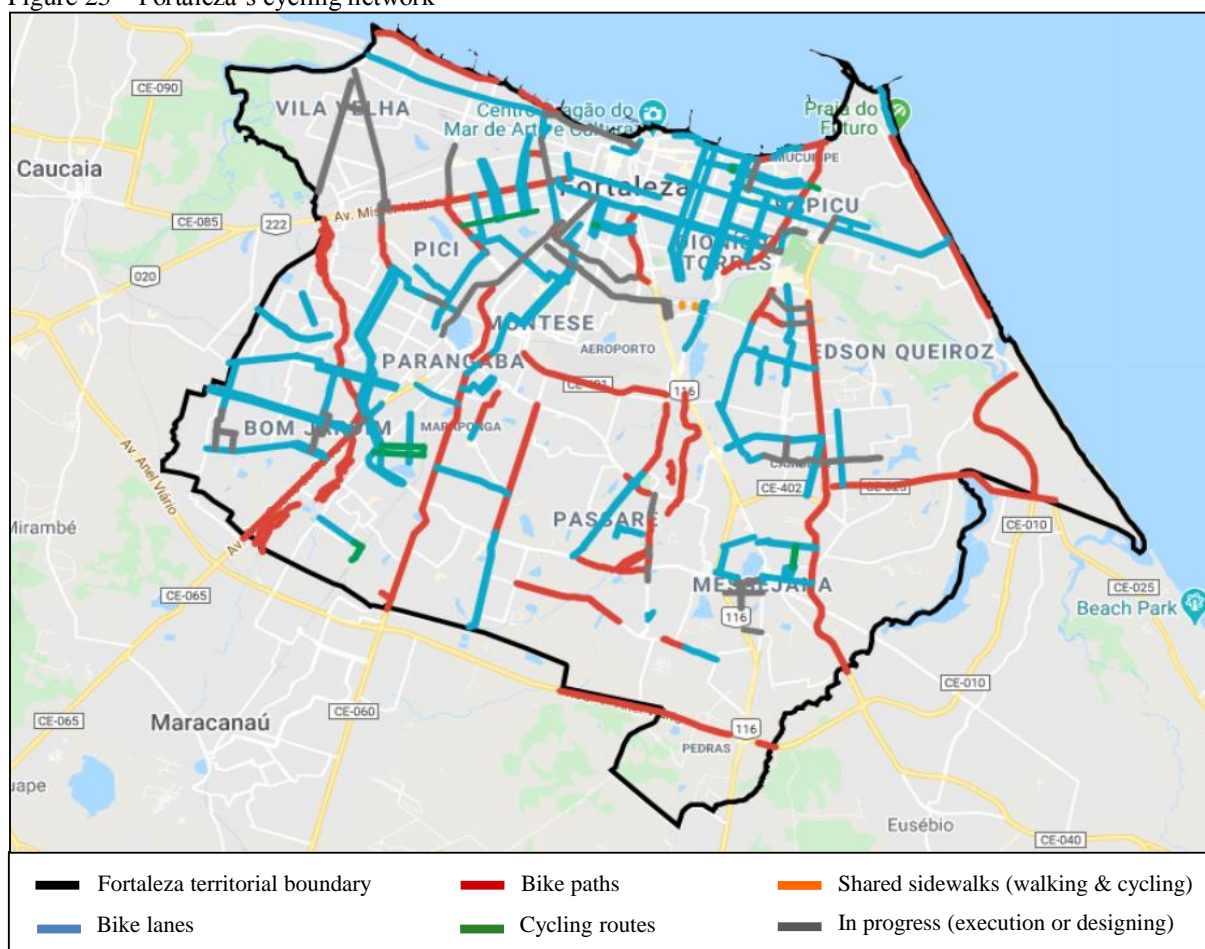
Source: The author, adapted from PAITT (2020).

As shown on the map, the network is distributed throughout the city, especially in the most densely populated areas. The cycling infrastructure has covered both the structuring network (bike paths), which flows through the main traffic corridors in the city, and the complementary network (bike lanes and cycling routes), which connects neighborhoods to the structuring network. Figure 25 is evidence of the municipal government's commitment to promoting active and sustainable mobility. Such engagement can also be seen from the performance of the Program for Expanding the Bicycle Path Network, as shown below.

> (...) the goal established by the Integrated Cycling Master Plan (PDCI) for 2020, which was for around 236 km of bicycle path network, has already been passed.

> Taking a solid step forward, the Fortaleza Municipal Government is projecting a higher goal for the end of 2020, which is to reach the mark of around 400 km of cycling path network. (Doc #1)

The transition to sustainable urban mobility also includes the expansion of the complementary cycling infrastructure, with the installation of bicycle racks, as well as improving the integration of the cycling system with other modes and public transport equipment (Doc #7). Figure 26 shows one of the most representative examples of modal integration in the city's urban mobility system.

Figure 26 – Modal integration in Parangaba (shared bicycle – bus – subway – light rail – shared electric car)
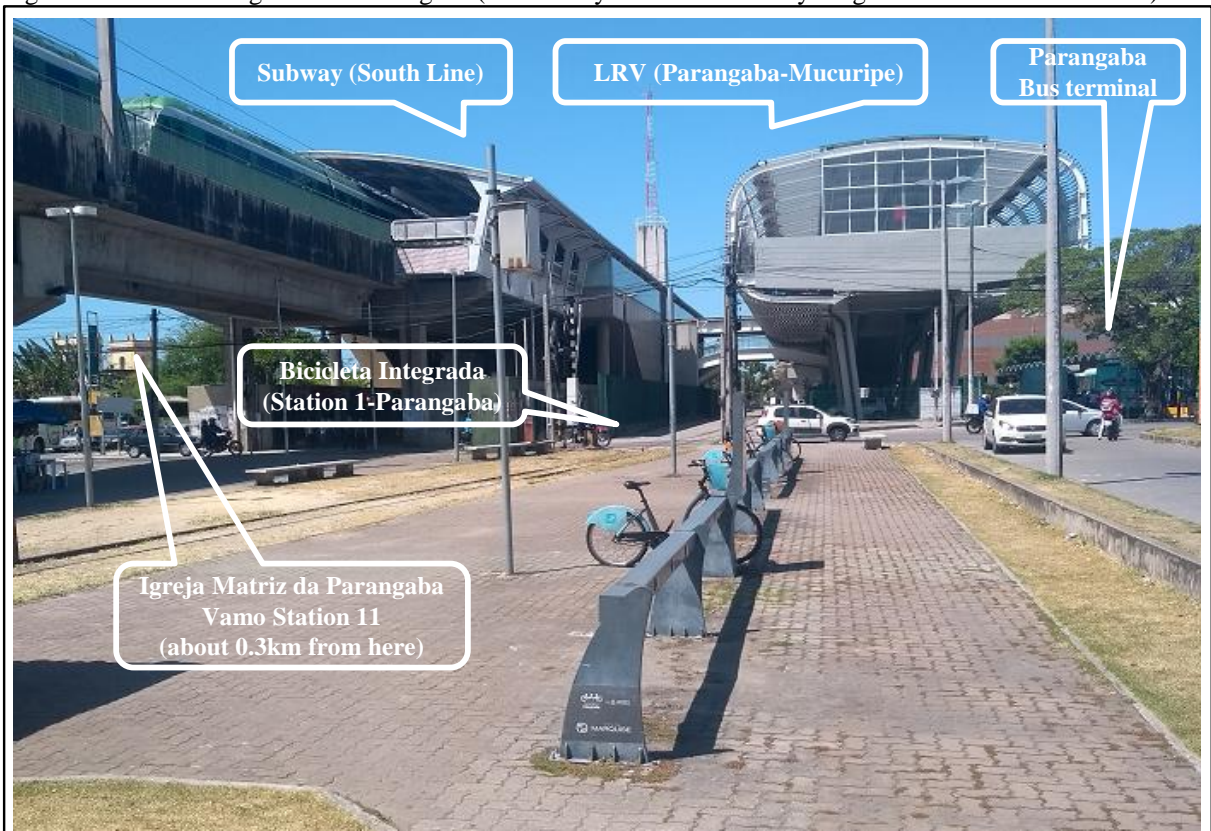
Note: Subway and LRV projects are not municipal, but state projects.
Source: The author, from the research data (own record, captured on Sep 17, 2019).

In addition to the bus, subway, LRV, and Bicicleta Integrada stations, which appear in the image, there is also a Vamo Fortaleza station very close by. During the observations at this location, an intense flow of people was identified in the square where the bike sharing station is installed. Many people were arriving and departing from these transport system equipment items, although few users of the bike sharing system were taking or returning bikes. There were also several traffic-generating buildings and facilities nearby. The

fieldnotes cite schools, a university, a private hospital, medical and dental clinics, a large shopping center, a supermarket, drugstores, restaurants, banks, among other facilities.

By encouraging the use of bicycles and their integration with the public transport system, incentives for the use of mass public transport are created, promoting the reduction of congestion, noise pollution, and CO_2 emissions. Attention to pedestrians has also been prioritized, with initiatives that give them greater security and expand the paths suitable for walking (e.g., elevated pedestrian crossings, fitting sidewalks, diagonal pedestrian crossings).

These infrastructure projects in general, and the growth of the cycling network, in particular, are not carried out without **tensions in the infrastructure sub-regime**. Its very construction implies dealing with the limitations resulting from traditional, car-based logic, such as lack of space on the roads to enable more adequate projects. User B2 addresses this point: "So the ideal, of course, would be to have a wider lane for one to go and one to come, but, after all, there isn't space for that. (...) I think that space is very necessary, even if there is a conflict with the cars."

Ultimately, there is a dispute over the finite space of the roads, so that conflicts will tend to persist. Actors most directly linked to the traditional logic of the private car question the legitimacy of these pro-cycling interventions, according to some interviewees.

> May people condemn cycling lanes and bicycle paths because they take space from cars. (...) condemn cycling lanes, bicycle paths, condemn the exclusive bus lanes, condemn the cycling lane because they say they hardly see anyone using it. (...) But I think it's like this, we see what we are predisposed to see. And those in cars don't pay attention to those riding bicycles. (User B6)

As infrastructure is a finite resource, interventions favoring the transition (e.g., cycling network, modal integration, public transport improvements, exclusive bus corridors), will often occur at the expense of some infrastructure of the incumbent regime. Thus, legitimacy with sustainability-oriented actors is gained or strengthened, as legitimacy with incumbent actors is lost, so that tension in the infrastructure sub-regime works as a lock-in mechanism, a barrier to transition.

These tensions do not occur when the entrant, transition-oriented technology is an automobile. The first steps for creating an electric car sharing system began to be implemented in 2016. Unlike bicycle sharing systems, which depend on a wide network of bike paths and bike lanes, car sharing systems do not require the construction of new basic

infrastructure. However, although they use the city's existing road network, some elements of complementary infrastructure are critical to their proper functioning. For instance, for an acceptable level of performance, a well-distributed network of charging points is required.

From the discussions above, it is noted that the changes that the infrastructure sub-regime has been experiencing come out from the action of political actors (sectoral policy) and are aligned with the sharing-based business models in development in the technological niche. But it is still necessary to analyze the technological aspects of the incumbent regime and its relationship with such models.

4.2.3 Technology

The technologies of the current socio-technical regime of urban mobility are associated with its dominant logic, centered on motorized transport and its equipment. Internal combustion vehicles are, therefore, the main technology within the regime. It is present in virtually all the private cars, motorcycles, taxis, as well as in all buses in the city's public transport system.

There are other technologies well-established or in an advanced consolidation process in the context of urban mobility in the city. They are technological artifacts linked to the mass transportation system (buses and trains) or associated with their respective infrastructures. We refer to traffic monitoring and management systems, signaling systems (Doc #7), ticketing platforms, intermodal integration (Bilhete Único, the individual pass card), travel planning and monitoring application for smartphones (Doc #12), in addition to user conveniences, such as onboard Wi-Fi and vehicle air conditioning (Doc #11).

Usage technologies (the vehicle itself), complementary technologies, and infrastructures related to mass public transport is seen, on the one hand, as an ally of the transition process. They work as incentives for the adoption of public transport and, thus, can discourage the use of private vehicles, increasing the aggregate efficiency of the entire mobility system.

On the other hand, bus technology must be analyzed cautiously. The municipal government and companies in the urban transport system have been working to renew the fleet with more modern vehicles, equipped with air conditioning and wi-fi (Doc #11), which attracts more passengers. Nonetheless, the entire fleet is powered by internal combustion engines. Thus, its contribution to the transition process is to some extent impaired, due to the noise pollution, air pollution, and CO_2 emissions that such technology produces (assessing

the degree to which such unsustainable consequences are offset by the migration of car users to the bus system is not within the scope of this thesis).

Finally, individual-use technologies (complementarities) are already largely institutionalized in the urban mobility regime. Smartphones are popularized among different social *strata*. Its integrated GPS location systems, the coverage of mobile telecommunications networks, public wi-fi networks, and the internet have facilitated the routine of users of the public transport system.

Through these technologies, users can access solutions and facilities such as the "Meu Ônibus Fortaleza" application. Among other features, the application allows citizens to monitor in real-time, by using the smartphone, the bus lines of interest, as well as to identify the bus stops closest to their current location, in addition to planning their commutes (Doc #12). Figure 27 shows some screens of this application. One can see how it facilitates the user's decision-making on routes, bus lines, and time management.

Figure 27 – Screens of the Meu Ônibus Fortaleza app
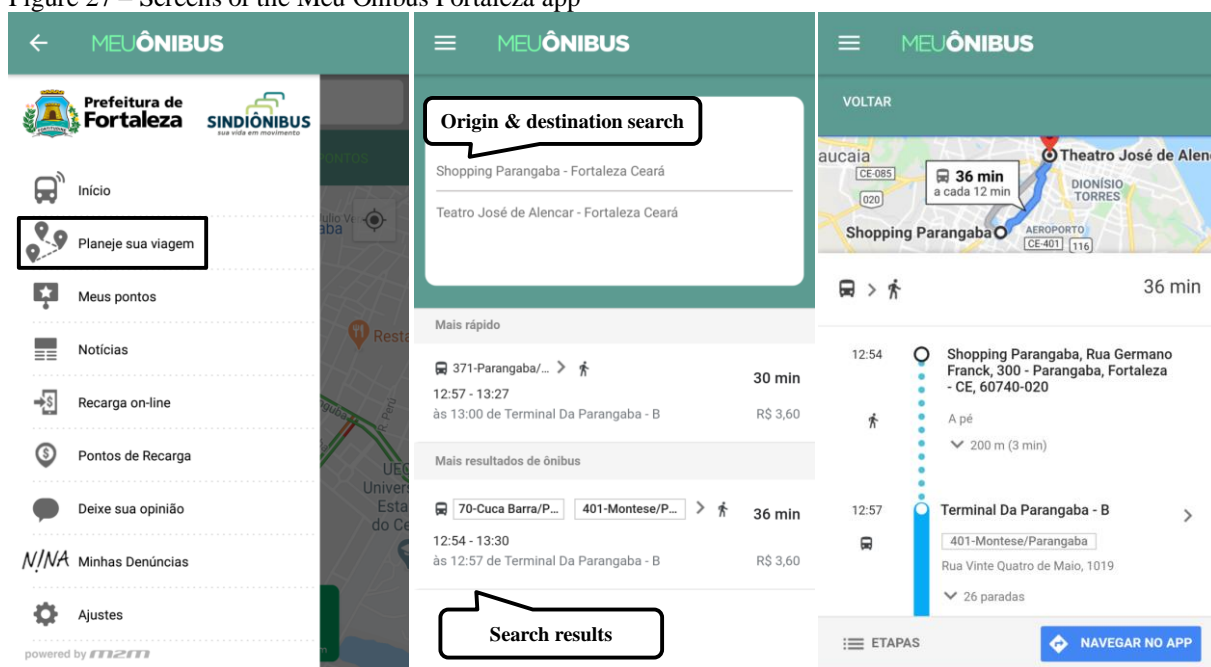
Source: The author, screenshots extracted on February 10, 2020.

Another important technology to encourage the use of public transport is the modal and fee integration system, called Bilhete Único (BU). By means of an exclusive card (see Figure 28), users perform modal integration within the city of Fortaleza, with no additional charge if lasting a given time. There is also the Bilhete Único Metropolitano, which provides the benefits of integration to intercity bus lines, assisting users who reside in other cities but work or study in Fortaleza.

Figure 28 – Individual pass card (Bilhete Único)
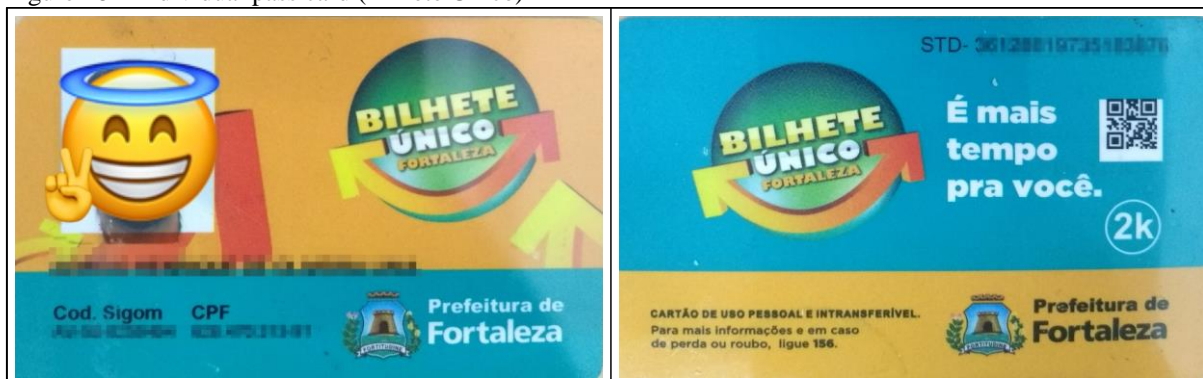
Source: prepared by the author.

The Bilhete Único card, used for modal integration, is of greater interest for this research, as it is used for registration and use of the car- and bike-sharing systems. To encourage the use of public transport, some benefits are granted to those who use these services through their BU cards. For Bicicleta Integrada system, in fact, a BU card is mandatory; for Vamo Fortaleza and Bicicletar, there are actually financial benefits.

These technologies and artifacts described are already, to some extent, legitimized among users and even among non-users of the public transport system. They are evidence that transition to sustainability in the context of urban mobility has occurred both through an evolutionary logic internal to the regime (incremental improvements and innovations) and through actions that promote niche innovations and accelerate their structuring. Modal integration and the BU system, for instance, favor selection of sharing initiatives developed in technological niches. This discussion suggests that the public authority plays a key role in transition processes.

4.2.4 Culture

As previously discussed, there are some contextual factors – landscape developments – promoting cultural transformations in the socio-technical regime of urban mobility, especially those related to changes in lifestyle. The research data confirm this dynamic, insofar as they reveal some cultural factors contributing to change, while others act to inhibit it.

Several of the interviewees recognized **the dominant culture centered on the private car** as an important barrier to the adoption of active and sustainable mobility practices, acting as a lock-in mechanism for the socio-technical transition. For some of them,

this barrier lies in the historical logic itself, revealing a path-dependent dynamic that counts for the perpetuation of car-based mobility. As user B1 opined, "Brazil has been historically focused on creating roads, for the highway system, for cars, they have ignored the bicycle even inside the cities. So this idea of cars has been passed down from generation to generation until today."

One of the reasons that reinforce this dominant logic and prevent the transition is the inertial behavior of the population: **using the car means staying in the comfort zone**, not only figuratively speaking, but literally. In a literal sense, the car provides greater comfort and some amenities for the user, especially in a city with a hot climate like Fortaleza. Figuratively speaking, the car allows the user to be in the comfort zone because changing habits and routines is naturally exhausting, leading to a consistent repetition of current behavior: "I think the culture ends up being a barrier. Leaving their comfort zone is something people aren't always willing to do." (User B2).

> You use a bicycle to get to work, you're leaving your comfort zone, right? Someone with a car available, with financial conditions, is not very likely to leave his comfort to take on that fight, to sweat, physical activity, pedal hard, burn some calories (...) It's really nice to be in your car, have breakfast in the morning, get dressed and leave the house ready to step into the workplace, right? (User B10)

Compared to cycling, **cars can also reduce risks to physical integrity**, as they provide more safety to the user and less exposure to injuries in the event of accidents. Likewise, cyclists are more exposed to urban violence, especially women.

> The world today is really violent and you expose yourself a lot on a bicycle. But we are trying to fully use the city, so I run a risk, I add another risk to my life by riding a bicycle. But live by making choices, right? That is why I can understand someone who does not adhere [to bicycles], due to insecurity. (User B6)

> I also think that because I am a woman, to a certain degree I am a bit more vulnerable, you know? (...) Of course, driving a car does not mean you can't be robbed, but a bicycle is a bit more exposed. And because we have a major problem with public safety in the city, that may collaborate towards people not using replacing cars with bicycles. (User B2)

The car-centrality could be a lock-in element even for legitimizing and structuring Vamo Fortaleza, a sustainable solution that is also based on the car. This is what policymaker P2 suggests.

> I think the main barrier is really cultural. And there is no value judgment here. It is more cultural in that we have always, for a long time, seen owning a car as an almost indivisible asset of our daily life.

This may show a **materialistic bias associated with car ownership**. Some respondents see ownership of the car as a sign of status, self-realization, or a dream of life. This symbolic meaning of the private car is another factor acting to preserve the traditional mobility regime and, therefore, a barrier to the socio-technical transition. User B9's speech validates this argument.

> I was talking to a friend and she was telling me her dream was to have a car, have a house... And all I could think of was: "My God, those are not my dreams!" (...) my dream is to live in a city where I can use public transportation. She is from a time when having a car was a child's dream, a poor family's dream. I think that this culture of cars, of status, means the bicycle is not so well accepted.

User B9 describes barriers to the rise of bicycle culture in the urban mobility regime, given the deeply rooted car-centered logic. Her expectation regarding urban mobility is the availability of efficient public transport options. Policymaker P2 explains what appears to be a movement that is beginning to gain more relevance.

> It isn't hard to find people, even friends who have sold their car, due to both the cost aspect and the quality of life aspect. People who [think]: "look, I don't want to own a car, have the upkeep, have to keep up with that all the time." We sense that people are changing, trading the bus for a bicycle, for individual transportation apps. We can sense that this culture of the car as a necessary possession for commuting is losing ground a bit.

On the other hand, some **social dynamics have** confronted this persistence of car-centered culture and **contributed to cultural change**. For instance, we can analyze the role of bicycles in this context. Given the wide range of mobility alternatives, people have prioritized

freedom of decision making based on beliefs about health, the environment, and citizenship. According to the participant of a sponsoring company,

> A person today thinks: "I want alternatives that give me a nice cost-benefit, where I have options for choosing and that break free from those rigid models we were used to." (...) People have concerns with the environment, with health, they pay increasing attention to new ways of moving around, of building society, of building the environment we live in. (Sponsor S3)

There is still the belief – and the socio-cultural and economic stigma associated with it – that the bicycle is a means of transport used only by low-income people. But that seems to be declining. It is a barrier to the faster adoption of bicycles and the practice of cycling as a commuting option, acting as a lock-in mechanism in the transition to sustainability in urban mobility. As user B12 says, "We people from Ceará... it's like we think it's... I don't know if I would say shameful... it's as if [cyclists] were marginalized class... those who have money won't submit themselves from getting a bicycle from Bicicletar."

User B6, in turn, considers that the social stigma surrounding the bicycle has decreased, but cites aspects that make it persistent. His perception is confirmed in surveys carried out by the municipal government, as policymaker P1 cites subsequently.

> People had a lot of prejudice that bicycles were not for people who had money. And I can see that change in the paradigm. When you ride a bicycle wearing a nicer, sporty outfit, tennis shoes, a helmet, I think people have more respect. "Ah, the guy is riding a bike because he wants to exercise, or wants to leave the car at home, not out of necessity." But if you are using day-to-day clothes, they don't respect you so much tanto. (User B6)

> We're doing some studies that show that the car driver, the guy on a motorcycle, respects a person on a shared bicycle more than [someone on] an ordinary bicycle. There are several hypotheses for that: there is the fact that the bicycle has a showier color; there's the fact that the person thinks "that guy there is contributing towards mobility". But the ordinary cyclist, who has his own bicycle, the worker, sometimes is kind of invisible. People often think it's a low-income worker. It's a question of prejudice, so the perception changes. (Policymaker P1)

Many factors have promoted this change in perception and the meaning shared by the population around the bicycle. Noteworthy is the expansion of the cycling network, the

advent of night bike tours around the city, and the rise of bike sharing. Thus, the influence of elements of public policy, new technologies, and social mobilization is evident.

> But I see there's been a change: at the same time people started doing the night bike rides, the movement of riding more retro bikes began. There were also shared bikes, together with an increase in bike lanes... I don't know what came first, but I do know they are all co-evolving! (User B11)

Tensions and conflicts are still frequent among actors in the cultural sub-regime, which reflects the resistance of the car-centered culture. Bringing different manifestations of these tensions, interviewees reported the fear of using the bicycle and the lack of respect on the part of bus, car, and motorcycle drivers. "(...) although there are bike lanes, a number of drivers don't respect them. We see cars stopped in bike lanes, motorcycles especially entering bike lanes when traffic is stopped, that confuses things and causes accidents as well." (User B5) "I think there is still a bit of conflict. It is usually older people in the cars, over 50, who still have closed minds. For them, it's cars only. They think bicycles shouldn't even exist." (User B1)

In this sense, car users can deliberately act to delegitimize actors, infrastructures, and technologies related to other mobility solutions, such as the bicycle and sharing programs. Pro-bike activists have sought to influence municipal management to mitigate cultural conflicts.

> The point that they [activist groups] are still complaining about is the respect by the car driver to the cyclist. And that really is the hardest point to solve, because it does not just depend on actions with our infrastructure, it depends on a change in paradigm for the population as a whole. (Policymaker P1)

As expected, tensions between cultural forces supporting the socio-technical transition and those that resist change influence individual preferences. Closing discussions on the characterization of the urban mobility regime in Fortaleza, the next section explores the last dimension of research interest, namely, user practices.

4.2.5   User practices

This dimension concerns the habits, routines, and preferences of users in the urban mobility regime. From their practices, users create their own individual commuting patterns that will ultimately shape the user practices dimension of the socio-technical regime.

Users' practices and preferences are influenced by cultural factors (e.g., normative pressures, personal values, lifestyle, and symbolic meanings) as well as by the quality and variety of infrastructure and technology available (e.g., integrated public transport system, subway, LRV, bicycles, private cars). These dimensions were previously discussed, but investigating the sub-regime of user practices requires returning to them to identify how they shape habits, routine and preferences.

One of the most popular mobility subsystems in Fortaleza is the public transport system by buses and vans. There are approximately 1.2 million daily departures, distributed in about 300 regular and complementary lines, operated with 2,300 vehicles, including buses and vans (Doc #11).

When compared with national data, these numbers seem to show contrast: according to the National Association of Urban Transport Companies (NTU), the public transport system via buses has accumulated 25 years of losses in productivity and a drop in the number of passengers (Doc #14). Such a performance, still according to NTU, is due to factors such as urban mobility policies that have historically stimulated individual passenger transport, economic incentives to the acquisition of cars or motorcycles, and the emergence of individual transport by transportation network companies (ride sharing or ride hailing platforms).

Documentary evidence from IBGE on the evolution of the vehicular fleet (Doc #15) corroborates the perception of an accelerated expansion of individual transport. Following a national trend, between 2006 and 2018 the private car fleet in Fortaleza increased by almost 85%, reaching 593,000 cars. In the same period, the number of motorcycles more than tripled, jumping to 308,200. Figure 29 graphically illustrates this evolution.

Figure 29 – The growing fleet of private motor vehicles in Fortaleza (2006 – 2018)
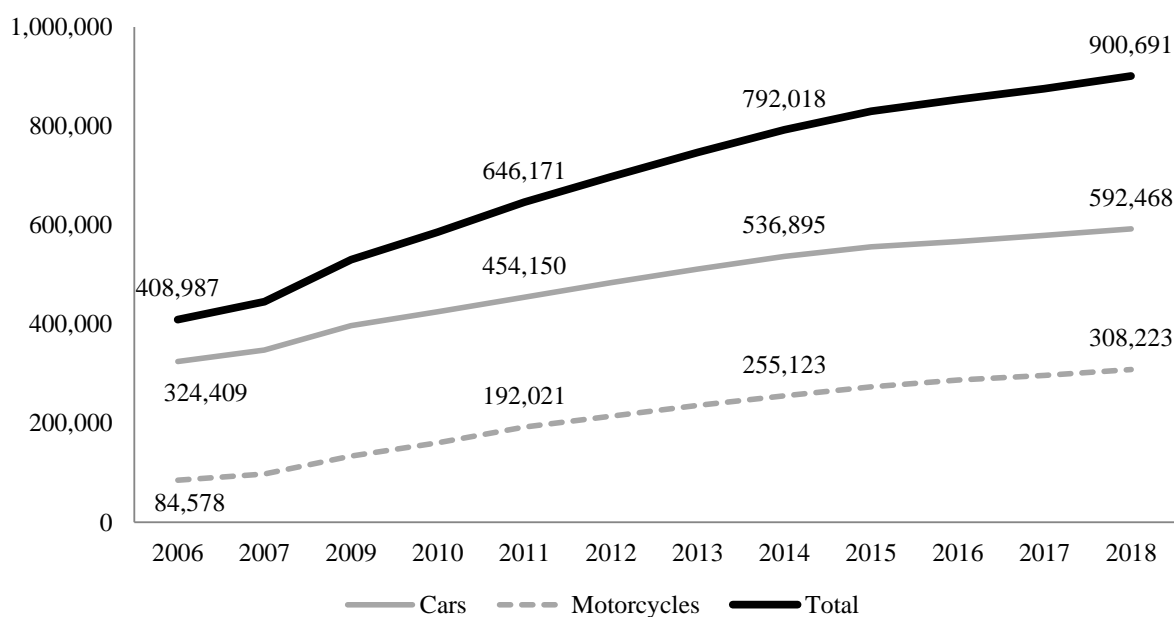
Note: Data for the year 2008 were not available.
Source: prepared by the author with data from the evidence Doc #15.

This may have strengthened practices of use centered on the private vehicle. In the Fortaleza urban mobility regime, one can see, for example, behaviors as described by one of the participants: "What we usually see is a person whose work is two blocks from home, who could walk or bicycle to work, driving the two blocks in his car. To go to the bakery, to cross the street it has to be by car." (User B7) Whether due to the aforementioned inertial behavior or for reasons of safety or personal convenience, this logic leads to indifference and, eventually, to a deliberate lack of respect with other actors in traffic, such as cyclists and pedestrians.

Another important urban mobility subsystem is formed by regular cyclists. Many of them are low-income people who do not have the resources to use the municipal public transport system and use the bicycle as a means of transportation. As discussed in the landscape analysis (see section 4.1.5), in Fortaleza, this option is favored by flat topography. However, cyclists did not have until recently a minimally adequate infrastructure to guarantee their safety, as mentioned in the diagnosis presented in the Integrated Cycling Master Plan (Doc #7).

Analyzing the sectoral policy dimension, one observes that the main implications of political action on user practices have been aimed at changing unsustainable but deeply structured habits and practices. The Ciclofaixa de Lazer program is evidence of this political

stance. By creating temporary infrastructures (bicycle lanes) along the city's main avenues on Sundays, the program encourages the use of bicycles for leisure activities and sports practices.

> There are four support points that offer several services and around 21 km route that converges on the Downtown, allowing cyclists of all ages to pedal safely and enjoy the beauties of the city. Begun on September 21, 2014, the Ciclofaixa de Lazer has been held 224 times (up to 04/07/19). (Doc #2)

The research data suggest that political action has been more by encouraging sustainable practices – focused on improving health, the use of public transport, and equity in the occupation of public spaces – than by inhibiting historically consolidated practices (Doc #7; Doc #10).

Based on a discourse to combat the main causes of death in the city (traffic accidents, respiratory diseases, and cardiovascular problems amplified by sedentary lifestyle), the public authorities adopted a position deliberately oriented towards mass public transport, modal integration, active mobility (including walking), and safety and protection for pedestrians and cyclists. In this way, the local government has encouraged the practice of healthy habits, promoted the reduction of the vehicle fleet, and the consequent reduction of CO_2 emissions and air pollution, in addition to reducing inequalities through an equitable occupation of public spaces. In the short term, these initiatives reduce deaths from traffic accidents; in the long term, they may contribute to the reduction of the other causes mentioned and of expenses with the public health system.

> We have excellent numbers in reducing traffic deaths; we have reduced traffic deaths by 40% over the last four years. Traffic accidents dropped from the sixth highest cause of death to twelfth place in two years. (...) Our public service campaigns have focused very much on respect for pedestrians and cyclists, and also on risk factors for accidents. The idea is to keep urban mobility on the agenda in the press, on social networks and in the media. (Policymaker P1)

> The first focus for reducing heart diseases, obesity, everything, is prevention. So on a bicycle, the person is pedaling, exercising, and thus improving his or her health and avoiding problems that will lead to public spending on health, right? (Operator O1)

Infrastructure and technology dimensions show, in tangible terms, the role of the public sector in the transition of the urban mobility regime. A considerable part of this influence is materialized in these domains, and the research data show an effort to adapt the city's infrastructure and incorporate new technologies to make urban mobility sustainable. In this context, we highlight the aforementioned policies for the expansion of bike paths and bike lanes (Doc #1; Doc #10), the improvement of the public transport system (Doc #11), the modal integration, the development of smartphone applications (Doc #12), among other actions.

This policy mix both benefits current users of public transport, retaining them in the system, and encourage the entry of new ones, coming from the so-called traditional logic, changing institutionalized use practices. There is evidence of this effect: some of the interviewees stated that they had already given up on the intention to purchase a motor vehicle; speaking hypothetically, another user said that he would not buy a car if he had a good cycling infrastructure at his disposal.

> If I lived in a region privileged to have a Bicicletar station close to my house, I would easily use it every day, more than I already use it. I wouldn't even need the motorcycle I intend to buy, just a shared bicycle, or my own, using the infrastructure we have today. (User B1)

> One day I was in my car, in a massive traffic jam, and I noticed the guys on bicycles passing me, with me stopped. Then it hit me. I was dying of stress, afraid of causing an accident and all that... "I think I'll get into this bicycle thing!" And then I bought a bicycle and started using Bicicletar as well. (User B6)

The data show rich evidence that the local government has adopted a position of the transformation of the urban mobility regime, considered inefficient, unsustainable, and socially and economically unequal, to favor active and sustainable mobility practices. The position of the public sector in general and the actions in infrastructure and technology domains in particular are drivers of the transition. Insofar as they contribute to changing habits, routines, and user preferences, the sectoral policy, infrastructure, and technology dimensions end up transforming institutions, rules, and interactions towards sustainability.

4.2.6   Synthesis of urban mobility regime characteristics

As we have been discussing so far, the more aligned (legitimized) the socio-technical dimensions in a given regime, the more structured, institutionalized it is. Under such conditions, changes become increasingly difficult. Unless an adequate association between landscape forces and niche developments works for change, the regime will tend to remain dynamically stable. Figure 30 shows the vignette for the socio-technical regime of urban mobility in Fortaleza, building on the landscape vignette previously presented (see Figure 21).

Figure 30 - Vignette for current urban mobility regime
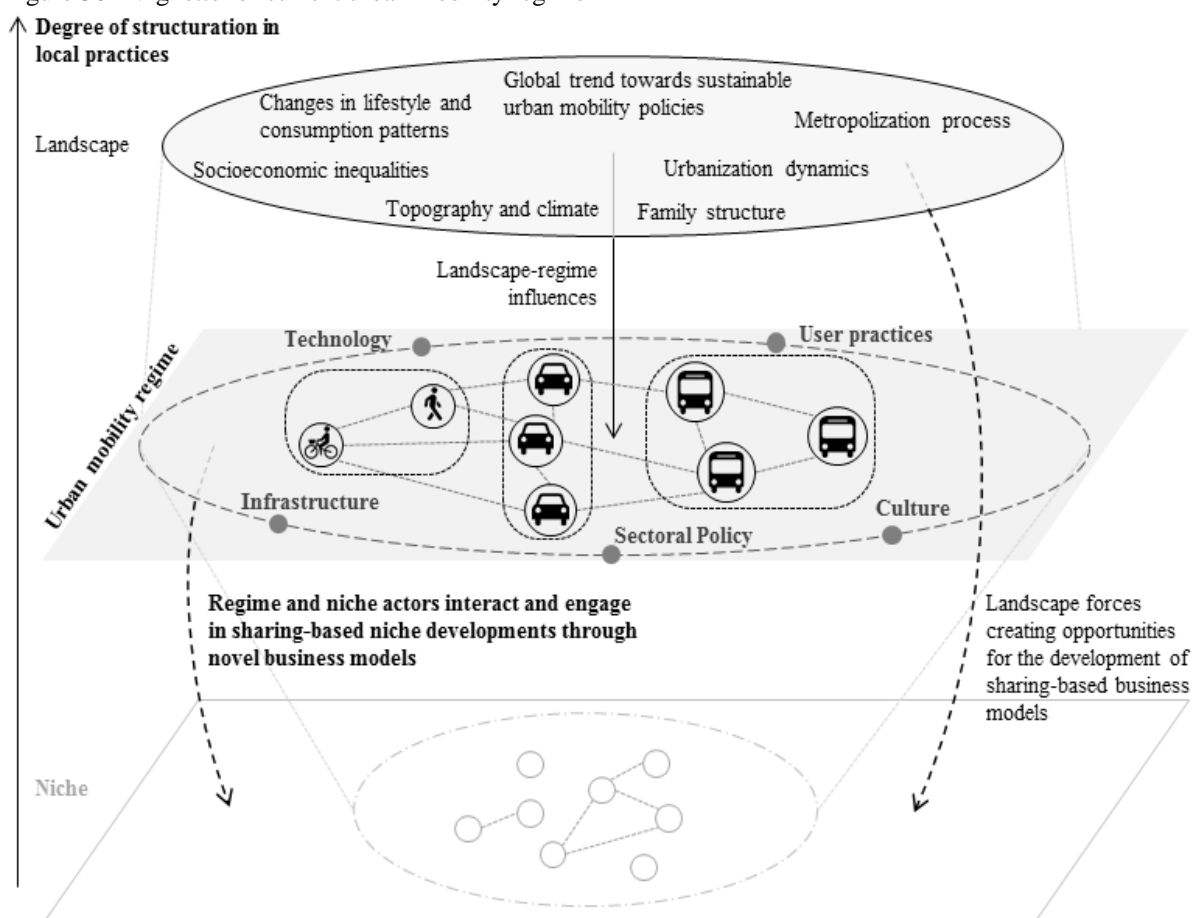
Note: Regime-specific dynamics are in bold.
Source: The author, based on the research data.

Three predominant subsystems were identified in the urban mobility regime: private motor vehicles, the public transportation system, and active individual mobility. Historically built under the dominant logic of motorized individual transportation – which is not only a local tradition but also a national one – the urban mobility regime in Fortaleza is strongly structured as a response to such logic. Its socio-technical dimensions have evolved and aligned themselves around regulations and political decisions, infrastructures, and

technologies, as well as socio-cultural constructions, habits, and individual preferences that have legitimized this car-centered logic.

Considering the influences of landscape (as discussed in section 4.1), such logic is ineffective in social, economic, and environmental terms. Nonetheless, the current urban mobility system in Fortaleza is seen as having been undergoing a socio-technical transition process from an unsustainable, inefficient regime to a sustainable one. This suggests the existence of processes to legitimize new infrastructures, technologies, organizational forms, individual preferences, beliefs, and regulations as they interact with their established counterparts.

According to the research data, this process started in 2014, when the city government shifted the public policies on urban mobility that had been in effect until then from a historical car-based orientation to a focus on sustainable mobility. The vision underlying this political commitment is that a new, sustainable urban mobility regime is capable of tackling some of the serious problems arising from disordered urban development, namely traffic congestion, traffic accidents and deaths, CO_2 emissions, air pollution, noise pollution, among others. On that subject, the municipal government has made regulatory, technological, and infrastructure efforts to change habits, practices, and ultimately culture by encouraging the use of public transport and active mobility. The progress will depend on the success in meeting requirements of cognitive, moral, and pragmatic legitimacy of the largest number of actors involved.

The interaction between landscape forces and some dimensions of the socio-technical regime was also observed, some contributing to the transition, while others to preservation. For example, at the landscape level, the city's warm climate favors dominant practices, which are based on the car. This reinforces the car-centered culture and hinders the socio-technical transition. On the other hand, the global trend of changing lifestyles towards healthy and environmentally responsible consumption practices (cultural landscape) allies with the growing concern about the negative effects of traditional urban mobility on the environment (political landscape), encouraging the transition.

At the regime level, there are divergent institutional dynamics, some counting for change, while others for preserving the status quo. Institutionalized legacy infrastructure is still a persisting factor of the traditional regime. Cultural aspects, such as the symbolic meaning of car ownership and prejudice against bicycles and cyclists, also inhibit the transition, although data have indicated that such factors have been experiencing delegitimation processes in recent years. On the other hand, in response to the sustainability

agenda mentioned above, policymakers have engaged in programs and actions oriented to sustainable urban mobility (sectoral policy dimension). Such policies impact several dimensions of the regime by encouraging the use of the public transport system, the creation and integration of new modes, the adequacy and construction of infrastructure, and the adoption of active modes by users.

The role played by these political actors has also been to promote niche developments aligned with the transition, with innovative initiatives that use business models based on the sharing economy, such as those investigated in this research. In other words, actors from the socio-technical regime (policymakers, sponsors) have interacted with niche actors (users, operator company) and engaged in sharing-based niche developments through specific rules and novel business models taking advantage of changes in the regime.

The next chapter is dedicated to exploring each of the three niche developments (cases) studied. In addition to providing detailed information about their business models and deepening our knowledge about them, we tried to identify mechanisms – drivers and barriers – that exert influence on the legitimation process underlying structuring and diffusion.

5 NICHE DEVELOPMENTS: BUSINESS MODELS CHARACTERISTICS AND LEGITIMATION DYNAMICS

In dealing with the niche level, we resort to our third assumption, that sharing economy business models are niche developments in transitions (see section 2.5.3) and put Bicicletar, Bicicleta Integrada, and Vamo Fortaleza into multi-level perspective. In this chapter, therefore, we focus the work on two analyses, as follows.

By using the building blocks of Johnson, Christensen and Kagermann's (2008) business models framework (as in Figure 1), namely customer value proposition, profit formula, key resources, and key processes, we built a business model representation for each case investigated. Next, we looked for events, actions, and interactions that might constitute categories linked to any of the socio-technical dimensions within the current urban mobility regime, as well as interactions with technological niche and landscape. These categories could indicate the mechanisms we are looking for to build a proper explanation – and ultimately, a reliable substantive theory – for the phenomenon of interest.

On that subject, for each case, we tried to identify and relate legitimacy drivers and barriers to propose vignettes for the upcoming comparison with existing literature (niche-regime analysis). To guide such an effort, we referred to the legitimacy framework for the sharing economy in the urban mobility context (see Figure 13), which depicts the relationship between socio-technical levels and the dimensions of legitimacy.

The maturity stage of each of the programs investigated in this research might indicate its degree of structuring in the face of the dimensions of the urban mobility regime. As the quest for legitimacy is critical for structuring and adoption, the understanding of how the dynamics of legitimation occur has guided the research until now. In this sense, and following the research objectives, we are interested in identifying the legitimation mechanisms of the sharing initiatives in the urban mobility context. This discussion requires an in-depth analysis of the role of each actor involved as well as their expectations and interactions towards legitimacy. How business models can be managed to strengthen legitimacy is of great interest as well.

But first, we tried to frame the cases analyzed in a sharing economy typology. Considering the taxonomy proposed by Lamberton and Rose (2012), one observes that all three cases studied are in an intermediary region between commercial good sharing systems and public good sharing systems, as shown in Figure 31.

Figure 31 – Typology for the research cases
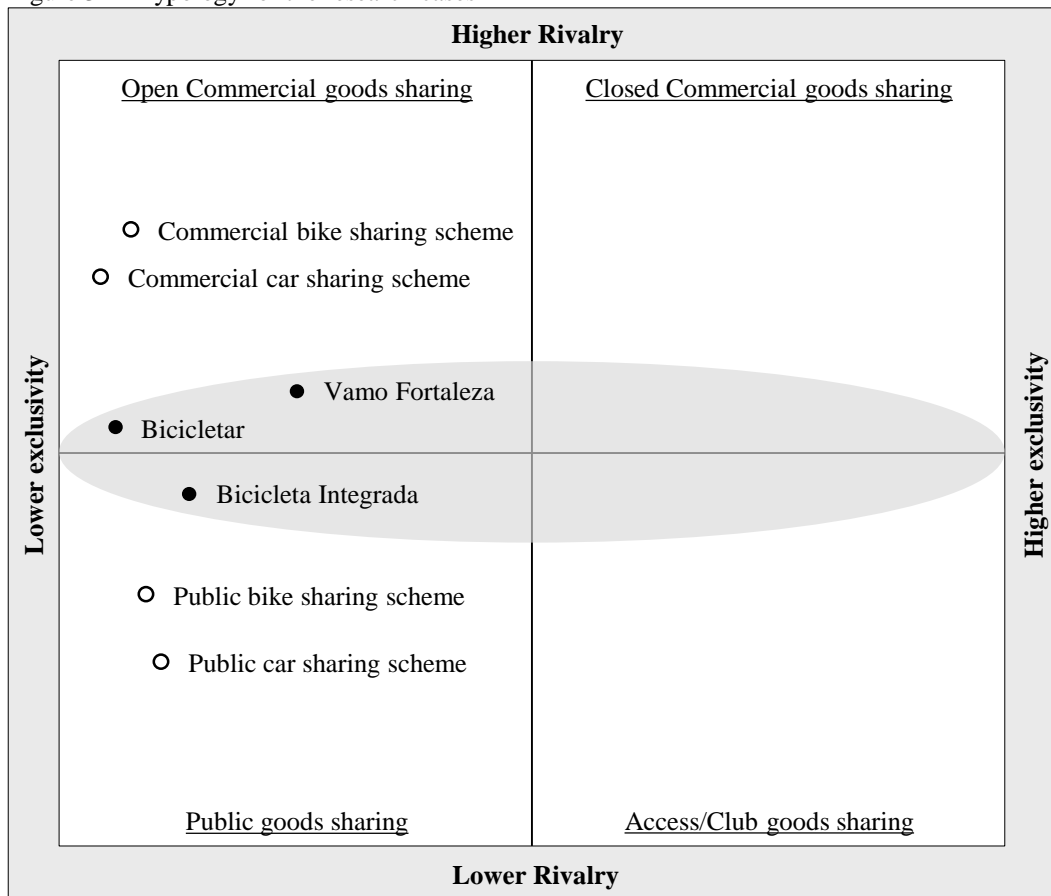
Note: Sharing arrangements in the grey area may be considered as public-private sharing systems.
Source: The author, based on Lamberton and Rose (2012) and the research data.

This is because the Bicicletar, Bicicleta Integrada and Vamo Fortaleza programs are supported by public-private partnership schemes, meaning that they came out from a public sector initiative and are sponsored and run by private companies. This finding opened a window for adding a new category to the original Lamberton and Rose's (2012) classification, which we labeled public-private sharing systems. "The model is a tripod: there is the operator for the system, a company hired through a tender process; there is the public authority, who plans and supervises the entire system; and there is a sponsor, who is the one funding the system." (Policymaker P1)

Indeed, the data show that all sharing programs in the urban mobility policy mix involve public-private partnerships. According to policymaker P1, in addition to the cases analyzed here, there are also the Mini-Bicicletar and Bicicletar Corporativo programs.

> We have *Bicicletar*, which is the most conventional model, found in several cities around the world, with spatialized stations in the city at a radius of up to 500m from each other (…). There is a second system, which is *Bicicleta Integrada*. That one

has a completely different characteristic, and Fortaleza was a pioneer with that idea (…). The third [sharing program] for bicycles is *Mini-Bicicletar*, which is similar to Bicicletar, but focused on children. (…) And there is a fourth system, *Bicicletar Corporativo*, which is in the testing phase and is exclusively for municipal employees. Four systems [for bicycles] with those distinct focal points. (…) And there is *Vamo [Fortaleza]*, for sharing electric cars. (Policymaker P1, our emphases)

Table 18 summarizes the main characteristics of each of the cases investigated in this research. It also gives some information about their current status and short-term prospects, according to the interviews with the public managers, operator and sponsors companies, as well as documentary information.

Table 18 – Key characteristics of the cases

Case (Launch)	Characteristics	Qty. of vehicles [a]	Qty. of stations	Current status
Bicicletar (December 2014)	**Brief description:** One-way station-based bike sharing system in which users can take and return a bike to any docking station within the system network. **How it works:** The system provides short-haul, short-lasting trips (up to one-hour duration) in an active, sustainable way, and is conditionally integrated into the urban public transport system as long as the user registers by using an individual pass card (Bilhete Único), so that he/she will not be charged. Otherwise, the system requires the purchase of a daily, monthly or annual pass that allows successive uses of up to one-hour duration, with 15-minute intervals between the procedures of returning and new taking (if the use exceeds one hour, there is a penalty of BRL 5.00 per hour in excess, which is why all users must enter a valid credit card number when they register on the platform). **Target audience:** city residents, temporary visitors, and tourists who need to make short trips within the city boundaries.	800	80	Structured, medium scale and expanding
Bicicleta Integrada (May 2016)	**Brief description:** Flexible two-way station-based bike sharing system in which users can take and return the bike to the original docking station. It is said to be "flexible" because the return is also allowed at any station within the system network, even though this is not common given its original purpose. It is a pioneer public bike sharing system integrated into the urban public transport system in Brazil. **How it works:** The system provides free long-term bicycle loans (up to 14 hours) for commutes in an active, sustainable way, and requires the user registers by using its individual public transport pass card. There is never any charge. Bicycles taken after 5 pm on Fridays and on the eve of holidays may be	350	7	Restructuring, small scale and expanding

Case (Launch)	Characteristics	Qty. of vehicles [a]	Qty. of stations	Current status
	returned until 9 am on the following working day without penalty to the user. There is never a pecuniary penalty and if the use exceeds the limits, the penalty is 24 hours of blocked use for every hour or fraction of an hour in excess. Target audience: the system is typically used by public transport passengers who arrive by train or bus and need to cover the last mile to their destination, either home or work.			
Vamo Fortaleza (July 2016)	Brief description: Flexible one-way station-based car sharing system in which users can take and return the electric car to any docking station. It is said to be "flexible" because the return is also allowed at some exclusive parking spaces, but unlike docking stations, they have no charging points. This feature could indicate a "quasi-free floating" characteristic. It is the first public electric car sharing system in Brazil, albeit not integrated with the public transport system. How it works: The system provides long-haul, longer-lasting motorized trips in a sustainable, non-polluting and efficient way. The system requires the purchase of a monthly pass (BRL 15.00 if registering by using the individual public transport pass card, BRL 20.00 otherwise). Such a pass gives the user a BRL 20.00 credit to use for the duration of the pass. In addition, there is a pay-as-you-go pricing depending on the duration of use the vehicle: prices range from BRL 15.00 (up to 30 minutes of use) to BRL 35.00 (up to 180 minutes); from 180 minutes, there is an additional charge per minute, being BRL 0.30 if up to 300 minutes and BRL 0.50 if more. Target audience: people who need safe, comfortable, and fast travel over greater distances within the city boundaries.	20	12 (plus 6 parking spaces)	Structuring, very small scale

Note: [a]. Number of vehicles at the time of launching each program.
Source: The author, from the research data.

From the characteristics presented, it can be seen that the three initiatives are distinguished from the mobility regime in more than one socio-technical dimension. As for the cultural dimension, there are different interpretations of symbolic meanings of acquiring and owning (regime) and sharing (niche). Given that culture both influences and is influenced by behavior, the user practices dimension is also affected: the three niche developments use business models based on sharing, while the incumbent counterpart is based on traditional consumption practices.

The other difference between niche and regime refers to technology, whether in user interfaces or artifacts. Sharing models, for instance, use their exclusive applications. In

the car sharing system, in addition, the mobility device has a novel technological base – battery powered – unlike the internal combustion engines of traditional vehicles.

Still in the technology domain, for the three cases, the innovative characteristics in their business models lie in that users can identify in real-time on their smartphone the availability of vehicles – bicycles or cars – and idle positions per docking/charging station. They can also report failures to the customer service, as well as monitor use performance. Such **technology provides features that give users autonomy and facilitate commuting decision-making**. Several testimonies show the relevance of these different features to the users' routines and needs. As user B5 said, "Sometimes when I leave the house I first see if the station near my house has bicycles available or not."

> Here where I work there are two bases very close by. One is here at Carlos Alberto Studart square and the other is in front of [Shopping] Center Um. When I need to use one, I see which base has a car. So I can always get one at [Shopping] Center Um. Here [at the square] sometimes they don't have any. (User V4)

> Bicicletar tells you "you went from point A to point B, you traveled this much, you lost this many calories..." It tells you the route you took. It's a really interesting thing. You start out going slowly, after you get the hang of it you start taking a lot less time. And you gain health. (User B8)

> The app shows all the bicycle layout and you can inform where the problem is, so they can do maintenance or exchange the bicycle. (...) because you will report the bicycle, the station where you left it, and the problem with it, if it is the tire, the brake, the chain... (User B8)

For purposes of data triangulation, during the field observations, we have realized the ease of use of the three platforms (apps) and how they give users the ability to make better commute decisions. Figure 32 shows an example of the Bicicletar system (Appendix A5 gives more details for the Bicicletar itself as well as the other cases).

Figure 32 – Screens "Stations" (map) of the Bicicletar app
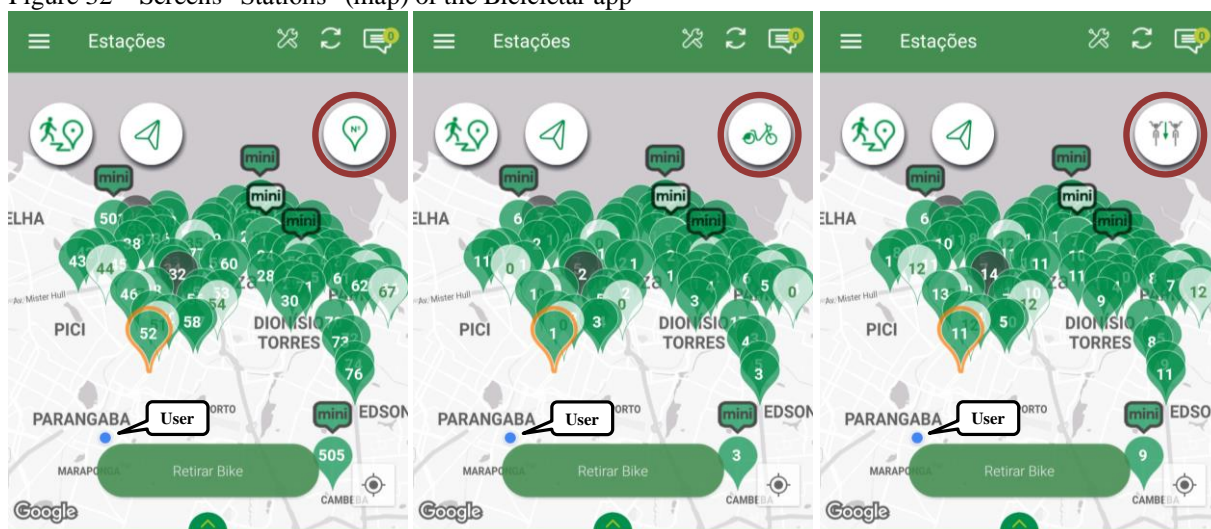
Source: The author, screenshots extracted on September 16, 2019.

The icons highlighted at the top, above the map, show different visualizations of the network: if the user intends to take a bicycle, he needs to know the number of bikes available at the nearest stations (screen in the center); if he wants to return a bicycle, on the other hand, the immediate need is to know where there are stations with available docks (screen on the right). Other features give the user autonomy in at least three ways: showing the best walking route to the chosen station to take a bike; real-time monitoring of his walk or bicycle route; and allowing him to report failures (either on the bike or at the station) and contact support services.

In addition to these essentially technological issues, the public-private partnership model itself is considered to be a niche-innovation in the urban mobility context in Brazil, where some of the largest cities have adopted such an arrangement. As in Fortaleza, municipal governments assume no financial responsibility or obligation in the system operation (at least until then; as we will discuss shortly, the expansion of Bicicletar and the operation of its new stations will not be sponsored but directly funded by public resources). Documentary evidence (Doc #4 for Bicicleta Integrada, and Doc #8 for Vamo Fortaleza) and excerpts of interviews support this information.

> In the case of Bicicletar, Unimed funds the entire system, City Hall doesn't get involved. Unimed transfers funds directly to [the operator] Serttel. (...) The same logic applies to Vamo, only the sponsor is different. Serttel won that bid too, and there Hapvida is the sponsor. So we have two health sector companies, one sponsoring Bicicletar, and the other, Vamo. (...) And with [Bicicleta] Integrada the difference is that they have a multi-sponsor set-up. (Policymaker P1)

As the same policymaker recalled, the **fully sponsored public-private partnership model facilitated the acceptance of sharing initiatives in the city**. Thereby, people's attitude toward sharing systems has been very positive over time.

> The economic issue was easy because we set up this model that does not cause any financial burden. That even helped with communication, people accept it, because lots of people say, "oh, you're spending money with bicycles when you should have been filling in potholes in the street!" But then you say "Oh, but City Hall is not spending a cent on this!" So that helped support the agenda. (Policymaker P1)

Evidence of innovation is reinforced by the vanguard discourses adopted by the public authority regarding both the public nature of the electric car sharing system and the Bicicleta Integrada's integration with the existing public transport system, as follows.

> Coordinated by the Municipal Secretariat for Conservation and Public Services (SCSP), through the Immediate Action Plan for Transportation and Transit (PAITT) (…), the Alternative Vehicles for Mobility project (VAMO) in the Ceará capital is the trailblazer in Brazil, since the Fortaleza Government is responsible for implanting the first public system for shared electric cars. (Doc #8)

> The Pioneer in Brazil because of its focus on integrating with public transportation, the new integrated bicycle loan system offers a new alternative for transportation (...). Bicicleta Integrada promotes modal integration in the city through large bicycle sharing stations close to bus stations with registration through Bilhete Único. (Doc #4)

In the next sections, we will introduce a business model approach and discuss similarities and differences between the cases. A business model framework was adopted that comprises the following components: customer value proposition, profit formula, key resources, and key processes (JOHNSON; CHRISTENSEN; KAGERMANN, 2008). We also analyze the legitimation dynamics of each of the sharing economy initiatives, that is, the actions and interactions underlying their journeys towards legitimacy.

5.1 Bicicletar business model

Bicicletar was the first of the sharing-based mobility systems implemented by the city government. Figure 33 presents the characteristics of its business model.

Figure 33 – Bicicletar business model

BICICLETAR BUSINESS MODEL BUILDING BLOCKS

CUSTOMER VALUE PROPOSITIONS

- One-way station-based model (take and return the bike to any docking station within the system)
- Short-haul, short-lasting trips (up to one hour)
- Integration with the public transport system
- Sustainable, emancipatory, active, and healthier solution

PROFIT FORMULA [a]

- Revenues come mostly from the sponsor company (Unimed Fortaleza) to the Operator (Serttel)
- Free for users, if using the individual ticket integration card; paid via credit card, otherwise (pass options: daily, BRL 5.00; monthly, BRL 20.00; annual, BRL 80.00)
- Municipal government: no charge

KEY RESOURCES

- Technology (app, bikes, stations)
- Cycling infrastructure
- Well-trained field technicians
- Customer service staff
- Know-how in sustainable mobility

KEY PROCESSES

- Maintenance routines
- User support
- Strategic performance management
- Station balancing

Note: [a]. The system is currently being expanded. Expansion itself, as well as the operation of new stations and bicycles, will be funded by public resources from the Zona Azul, the on-street parking program of the city.
Source: The author, based on the research data.

As a value proposition, Bicicletar offers current and potential users an active, healthy, and sustainable way of commuting, up to an hour-long, integrated with public transport, which allows the user to participate in social life and explore the public spaces of the city (Doc #3; Doc #5). Indeed, the reduction of CO_2 emissions allowed by the program is at the center of the city's sustainability concerns discourse.

A sustainable project from the city of Fortaleza (…). Bicicletar carbon credits (tons): 955.90. The Bicicletar public bike sharing system seeks to provide the city of Fortaleza with a sustainable and non-polluting transportation alternative. (Doc #5)

Bicicletar runs a "one-way station-based" model. As the respondent of the operating company states, "Bicicletar stations are what we call "docks". There are dockless systems, which have no stations, and dock systems [station-based]" (Operator O1) In this model, users can only take and return the bikes to docking stations within the system, unlike "free floating" (or dockless) systems, in which users can leave the bicycle anywhere within a given region (this demands a robust and ongoing routine of collecting and redistributing bikes across the city). Because it is "one-way", Bicicletar does not require the user to return a bicycle at the same station from which it was taken, giving the system more flexibility.

The integration with the public transport system can be seen from two perspectives: ticketing, as the system is free for users if they register by using their ticket integration card, Bilhete Único (BU) (users pay a fine of BRL 5.00 per hour in excess of the first hour of use); and spatial integration, since Bicicletar stations are, for the most part, close by traffic-generating area and, whenever possible, to some equipment of the public transport system, as shown in Figure 34.

Figure 34 – An example of a Bicicletar station and its location
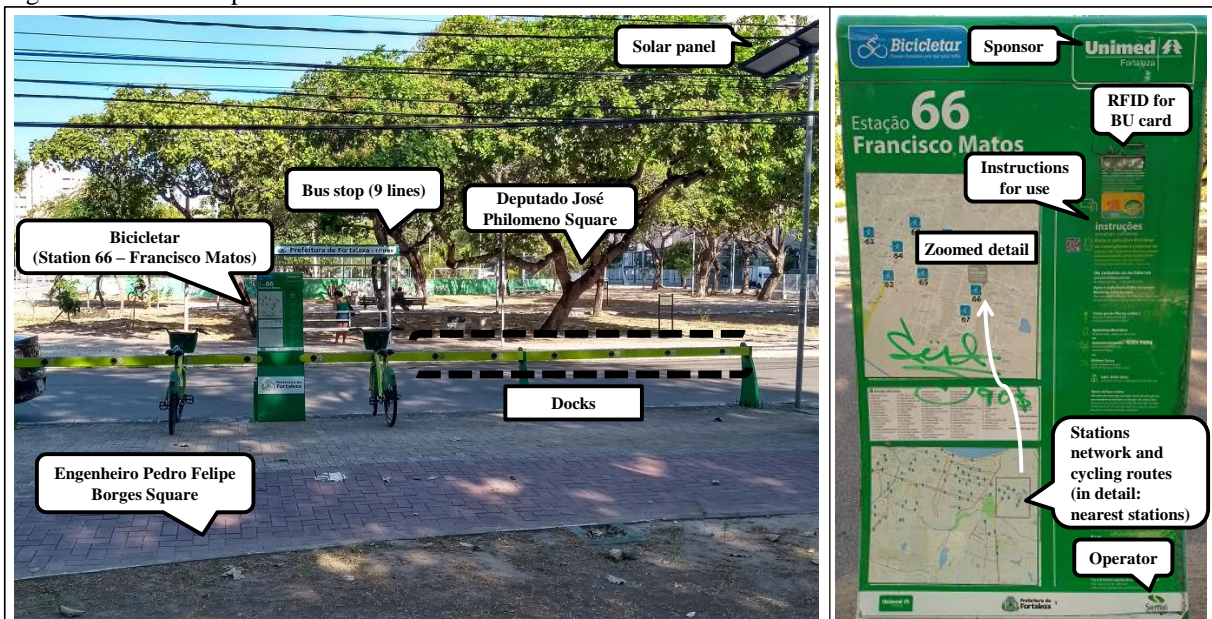
Source: The author, from the research data (own record, captured on Sep 24, 2019).

The station is installed in a square and nearby there is another large square, with a bus stop that serves nine urban lines. The street that separates the two squares is an important

traffic route in that neighborhood. Users can, therefore, make the intermodal exchange at this point in their travel, from the bus to the bicycle or vice versa. The section of the journey made with Bicicletar will have no cost for the user (if using BU). The part of the journey made by bus will be charged according to the standard fare of the public transport system. This possibility of integration is a benefit perceived by users.

> Having Bicicletar like we have nearby, instead of waiting for the bus I would sometimes go Downtown by bicycle, return it at Coração de Jesus Square or at Bandeira Square, and take a bus on Duque de Caxias Ave. to go to Aldeota. It was much quicker, even. It was much easier for me. (User B3)

Regarding the profit formula component, the operator's remuneration is provided through a sponsorship arrangement within the public-private partnership, so that municipal government – therefore citizens, indirectly – do not bear the costs of operating and maintaining the system. A secondary source of remuneration is the sale of passes – daily, monthly, or annual – for users who choose to use the system via a smartphone application instead of the BU card.

Regarding the critical resources to deliver the value proposition, we mention the city's cycling infrastructure. Without a wide network of bike lanes and bike paths covering the main urban corridors, there is no incentive for adoption. Because of this, recent efforts by the municipal government to expand infrastructure became an important factor in joining the system. Some users recognize such efforts and the resulting improvement in intermodal integration.

> Fortaleza is greatly expanding this infrastructure of bicycle paths, bike lanes, really improving. I have colleagues who today have stopped using cars and use the bike lanes, the bicycle path infrastructure, because they think it's much quicker, and if you think about it, [cheaper] economically... (User B3)

> Sometimes I have to go twelve, thirteen blocks, I get a bicycle. Knowing there is a station nearby, I ride a bike and get there much quicker. I pedal thirteen blocks and do the integration because I don't pay anything, I have the Bilhete Único. (User B6)

The network of stations and bicycles itself is also a key resource of the system. This network is reportedly well distributed in strategic points across the city, according to documentary evidence (Doc #3; Doc #5).

Another essential resource is the technology needed for the system to run: the stations, bicycles, and the smartphone application. The stations are smart, connected via wireless to the system's operations center, in addition to being powered by solar panels and having an autonomous mechanism for locking and releasing the docks (Doc #5). The solar panel and the docks are highlighted in Figure 34. On the right, one can see in detail the totem of station 66, slightly vandalized. The totem has an RFID reader for releasing bicycles via BU, the instructions for use, and the logos of all partners involved. Maps of the station network are also shown, important information for the user to plan their trip respecting the program rules, such as the maximum time of one hour per trip.

As participant O1 mentions, this technology is a competence developed by Serttel over decades of operations in the urban mobility solutions market. More recently, the company has developed know-how in new modalities such as sharing programs.

> Serttel is a company with more than 30 years on the market, right... Nowadays it's a multinational, working in other countries such as Ecuador, Argentina. Today we operate in more than 10 states in Brazil. So we have reached a level of maturity here, a lot of know-how related to bicycles. (Operator O1)

The key resources comprise not only the mobility artifacts themselves – the bicycles in this case – but also the technology embedded in these artifacts and the sharing system as a whole. In addition to mastering this technology, qualified professionals are essential for efficient performance.

> Serttel is a technology company, our strong point is technology. Anyone can run bikes, anyone can maintain them. What's behind that is lots of technology embedded in the bicycle, the stations, and especially the cars. We have our technicians, our relocators (...). These are people who have taken a technical course to be able to do maintenance on those stations. (Operator O1)

Four main processes underpin the Bicicletar business model and are thus crucial for reliability. The first two are related to maintenance routines and remote user support. Both aim to ensure that the service provided has greater availability and users can have a better

experience. This is achieved by avoiding failures or correcting them more quickly, as well as by supporting users in their needs. In this sense, the research data reveals some frequent failures, like worn bicycles, off-line stations, and application failure (section 5.1.1 provides evidence of these problems and discusses how they affect the legitimation dynamics of Bicicletar).

To deal with these maintenance issues another key process has been identified in the data, namely strategic performance management. As with Bicicleta Integrada and Vamo Fortaleza, Bicicletar is a public-private partnership arrangement of three entities (public power, sponsoring company, and operating company). There are several interests to be balanced to ensure good performance. The fragments below highlight different ways in which efforts are coordinated between these three actors.

> We have this partnership with the city (...). We have frequent meetings for improving processes, adjustments, changes in stations. If a station has few trips, why don't we move it over there to have more trips so that everyone comes out ahead? (Operator O1)

> Bicicletar is a perfect match for our brand, right? We believe it's a great tool for fostering quality of life and for doing physical activity. And since Unimed Fortaleza is a company in the health area, that is totally in line which what we are proposing (...). (Sponsor S3)

> The city government decides where the stations will go, defines indicators for monitoring the system, level of use, occupancy rate of the stations. All that planning comes from the city. And Serttel runs things, operates the whole system. And Unimed does the funding. And what we have to do is inspect things to see if the service is being run as agreed upon, how bicycle maintenance is going, how the station balancing process is going... (Policymaker P1)

The public-private partnership has operational indicators that need to be monitored and achieved by the operator company. They represent performance targets related to key processes, such as the aforementioned maintenance routines and the station balancing. If these goals are achieved, the reliability of the system will be preserved.

One of the main indicators evaluates the performance of the station balancing process, the fourth key process of the Bicicletar business model, and which is mentioned in the words of policymaker P1, above. It monitors how long the stations remain full (when the

user does not have free docks to return a bicycle), or empty (when he does not have any bicycle at disposal at the station of interest). Both situations undermine reliability, affecting the perceived quality assessment and legitimacy. The words of a policymaker illustrate how imbalanced stations impact the reliability of the system in the perception of users. Then, Figure 35 shows examples of these two situations.

> Sometimes the person is planning to go back home by bicycle, right? So if he thinks "Oh, I don't know if I will find a bicycle, so today I'll go by car, because I don't know if when I leave I will find a bicycle or if the station will be empty." So if you can overcome that imbalance you increase the system's reliability and increase the number of users. (Policymaker P1)

Figure 35 – Imbalanced vs. balanced Bicicletar stations
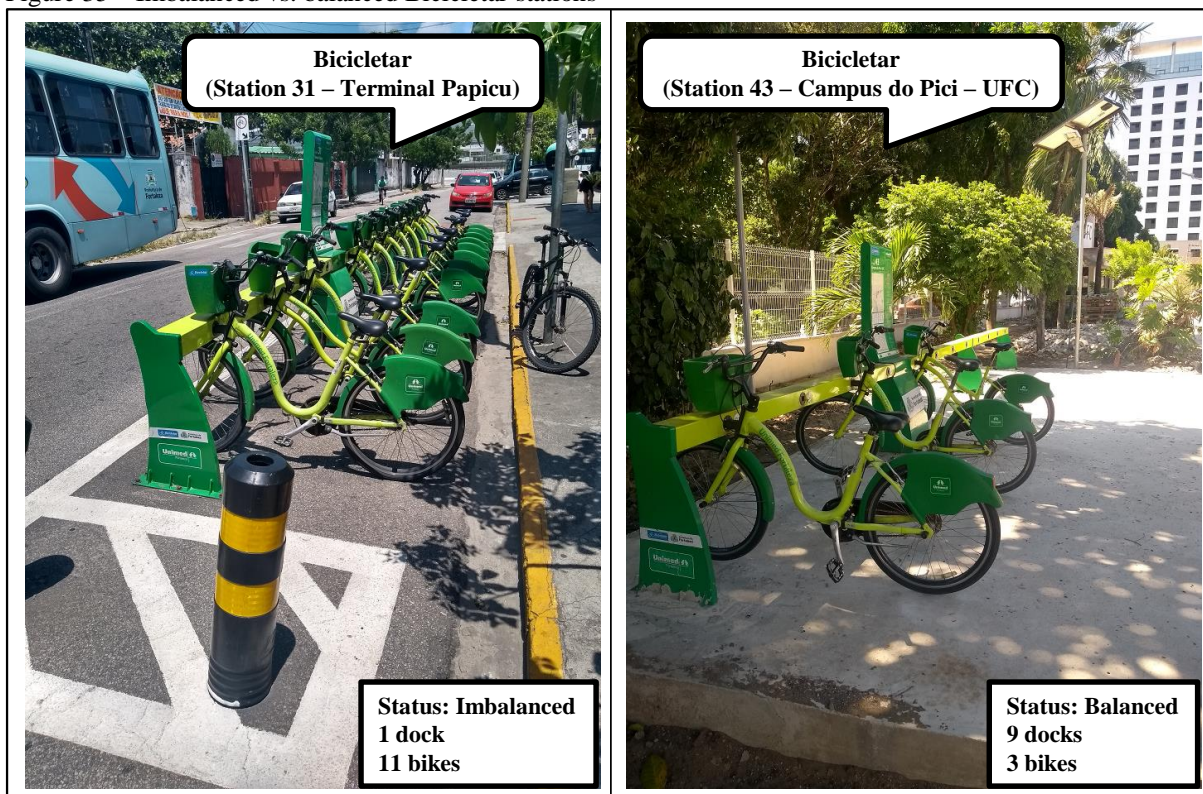
Source: The author, from the research data (own record, captured on Sep 26 (left), and Sep 23, 2019 (right)).

To avoid the problem of imbalance, the operator constantly monitors the use and occupation of each station. It has a ranking of the busiest stations, which facilitates performance analysis. In this way, it is possible to direct the efforts of relocation, balancing, and plan the expansion or adaptation of the network.

> Here is our ranking from last month: the [station] at [shopping] Benfica came in in third place. (...) Last month they had 2250 loans. The Aterrinho station [at Iracema Beach] won, they had 3154 loans. Next came the Aterro station, and after that Shopping Benfica. (Operator O1, presenting the researcher with a spreadsheet with a ranking of usage rate per station)

5.1.1 Legitimation dynamics of the Bicicletar system

Of the three cases studied, the Bicicletar program was the first to start operating. It has developed underpinned by a favorable regulatory framework at the local and national levels, as well as the role played by municipal agencies in coordinating and expanding the program, which already has new projects underway.

Its business model seems to be achieving an advanced degree of structuring. The coordination of actions at the niche level has allowed its expansion and adoption by an increasing number of users. One reason is that technologies, processes, and rules related to bike sharing systems were well-known at the time of the Bicicletar development. This allowed for the replication of good practices and the reduction of time and cost of learning processes. Additionally, this indicates that cognitive legitimacy deficits might be more easily surpassed.

> Regarding technological aspects, it was simple, because there are companies specializing in that area already operating throughout Brazil, so the technology was nothing new for us. The bicycle sharing model was something that was already quite widespread. (Policymaker P1)

According to operator O1, "In Bicicletar we are doing 55 thousand trips per month (...)". This makes Bicicletar one of the systems with the highest utilization rate in Brazil, with an average of 2,600 trips per business day (Doc #3). According to a policymaker, Bicicletar's performance is comparable to that of sharing systems in major cities worldwide.

> Bicicletar has worked as well here as in [systems from] other places. Our use rates are as high as in large cities around the world, Paris, Barcelona... Each of those bicycles has been used nine times a day, at the beginning of the system. When we analyze bicycle by bicycle, some had been used 17 times, 18 times in one day! (Policymaker P3)

Besides, the system has broad support from the population, which recognizes it as an efficient, cheap, healthy, and sustainable mobility option. These are precisely the characteristics of the Bicicletar's value proposition, so it seems to be fulfilling the mission for which it was designed. In being part of the Bicicletar customer value proposition, these aspects account for adding pragmatic legitimacy, since they denote a commitment to the well-being of society. Moral legitimacy requirements are supposed to be fulfilled as well since the sustainability appeal is increasingly gaining ground in society.

In general, legitimacy requirements are assumed to be strengthened insofar as the value proposition characteristics meet the users' expectations. And that seems to be the case with the Bicicletar program. Table 19 presents excerpts from interviews that support the users' expectations-related categories.

Table 19 – Users' expectations categories and evidence

Category	Primary evidence (Source)
Health improvement	"It's healthier, you are doing physical activity, it's a question of health that you are creating better habits, right?" (User B5)
Environmental concerns	"It's a very practical mode of transport to use, without polluting, because nowadays the air we breathe is very dirty." (B8)
Time-saving and convenience	"It's more agile in terms of traffic. It's quicker than using a bus or car, (...) sometimes I have to take a bus to travel five blocks, so it made things easier. Not to mention the commute time!" (B4)
Money-saving	"I think it's more economical than paying for fuel, right, which is extremely expensive. I was only able to take all my trips, in my humble opinion, because I was able to save lots of money on gasoline, shall we say." (B9)
Citizen emancipation through democratizing public space	"There have to be several types of transportation, more because of mobility, of facilitating access for people, including those people who have less money, to move around." (B11)
Fostering a sense of belonging and citizenship	"I see it like this... it's urban mobility, accessibility, a more democratic thing, (...) that in some way we are moving forward like the large cities... and that makes me very happy, right?" (B9)

Source: The author, based on the research data.

High adoption and utilization rates and the recognition of the value proposition are evidence of structuring. A critical mass of users and their reference groups recognize the program as a necessary public policy (taken for granted, cognitive legitimacy), and that it meets their interests and needs (pragmatic legitimacy).

> When you think of a public asset that is being shared by people, it's incredible! (...) It's not a thing where we are giving bicycles just to a few. We are giving opportunities to many. (...) So it's a project that has been tested, that works. The population approves. Correspondences are arriving every day at the Secretariat [SCSP], asking to expand it to several regions in the city. (Policymaker P3)

From the excerpts above, there is evidence of a high level of legitimacy gained before public opinion. The approval of the population suggests that Bicicletar has a considerable stock of moral legitimacy. The following discussions will show, however, that this is not a widely held perception.

At the time of this study, an expansion of the program was in planning, with the forecast to almost triple the size of the network of stations and to serve more peripheral regions. While the expansion itself reinforces the perception of successful structuring of the original project, adjustments in the business model were necessary, both in terms of funding model (profit formula) and technologies (key resources), as well as operational routines (key processes). The following discusses the restrictive factors that led to such changes, starting with the opinion of policymakers regarding the limitations arising from the sponsorship scheme.

> That sponsorship model was a learning process for us. We saw that Rio [de Janeiro] at the time was starting to suffer from that (...). The sharing system there is very much focused on the South Zone and they are unable to take it to the surrounding areas. So that was something where we personally experienced the difficulty as well. Today the system is expanding, we have overcome major problems with the business model, the operating model. I think the system is quite mature. (Policymaker P1)

The policymakers also mention some limitations that the sponsorship model presents in all cities where it has been adopted. Its main advantage, that of facilitating the expansion of sharing schemes at no cost to local government – and therefore at no cost to citizens – is accompanied by an important limitation:

> The tripod model is very good, but one limitation with it is in expanding the system, For the sponsor, the return comes with the image, publicity. So their intention is to implant the system in the more downtown areas of the city, where there is more use, more activity. It's hard to convince the sponsor to implant a station in the outlying part of town. That is a problem, and not just in Fortaleza. Every city is tied to sponsor requirements. It is understandable, really. If the target audience is not present in certain areas of the city, that area is of no interest to the sponsor. (Policymaker P1)

As the words of the policymaker P1 show, the sponsor has no incentive to expand the system beyond the geographical limits in which its branding strategy is still efficient. In other words, not always the interests of the sponsor will be aligned with the public interest in expanding the system.

The words of policymaker P3 highlight another sponsor-related factor that restricts the growth of the network of a sharing program, adding to this marketing issue: the financial limit budgeted for investments in communication and branding. Each new station, besides the investment needed for its implementation – including bicycles – there is an increase in expenses related to maintenance, a continuing recurring type expense. According to the interviewee from the sponsoring company, the Bicicletar current network already spends most of this budget.

> We aren't sponsoring the expansion. The amount was really much more than we had [budgeted] for investing. For now, we are going to use the 80 stations that are our responsibility, which will have our visual identity. But for the others, there will be no involvement by Unimed. (Sponsor S3)

Another variable that can weaken sponsored models is network spatial logic, a necessary condition to sustain the reliability of station-based sharing systems, whether they are bicycles, cars or any other vehicle. The concept of network logic refers to the maximum distance between the nodes (stations) of a network which preserves the reliability of the system as a whole. It takes into account the factors that influence the feasibility of moving both between stations and in the first and the last miles (by "first mile" we refer to the initial route a user must take when going to a station to join the sharing system; similarly, "last mile" refers to the section that the user needs to travel until reaching his final destination, after leaving the system). In Bicicletar, this logic considers three aspects, as presented in Table 20.

Table 20 – Network logic characteristics

Characteristic	Description	Related business model building block
Sharing system usage pattern	- One-way, station-based model - Short distance and short duration trips	Value proposition
Mobility artifact technology (vehicle) and station sizing	- Conventional bike (non-electric), powered by human traction - Autonomous stations, with capacity ranging between 8 and 16 positions	Key resources
Characteristic of the last mile commute or between stations	- User's ability and availability to cycle or walk between eventually unbalanced stations and in the last mile	Key processes

Source: The author, from the research data.

Taking these factors, the maximum distance between stations considered acceptable in Bicicletar is 500 meters. This distance allows a user trying to return a bicycle at a station of interest, and not finding a dock available, to reach an alternative station relatively close to make the return and then walk to his destination. Similarly, in intending to take a bicycle and not finding one available at the first station of interest, this distance allows the user to walk to the second nearest station to enter the system.

> There is the question of having a network logic, Things cannot be too separated, stations far from each other. With Bicicletar it is more restrictive, even because [the limit] is the distance to pedal. I cannot put one station too far from the other because the guy won't be able to move between them. So Bicicletar starts with a network logic. That is why it starts where things are more dense, more favorable for more travel, and expands from there. (Policymaker P2)

Distances greater than 500 meters between stations fragment the system and weaken its reliability, which ultimately harms perceived quality and inhibits new users from entering the system. Some pragmatic legitimacy may be lost by the misalignment of experience with expectations, as well as moral legitimacy, by the downrate in the evaluation users make about what the program is actually delivering. Summarizing, from the research data, the way the Bicicletar network emerged and expanded to its current coverage stems from three factors, two out of which being inherent to the sponsoring company:

1. **The brand communication strategy of the sponsor** is directed to the regions where its target audience is, so that the segmentation can maximize the return on investment by serving the most crowded regions of the city;

2. This factor is potentialized by the **branding budget limit**, that is, the financial resource that the sponsor company allocates to projects of brand communication;

3. Finally, there is a technical reason for the concentration on more central areas of the city: the already mentioned **preservation of the spatial network logic**, which determines its efficiency and reliability.

In line with these three conditioning factors, Bicicletar began to be implanted in places with dense movement of people, where the sponsor company's target audience was

more likely to see (and use) it. Since then, the network has expanded in line with the available branding budget and the principle of preserving the integrity of the system (spatial logic). The equilibrium of this model was reached with the current 80 stations (not including the five stations of the Mini-Bicicletar program), all sponsored by Unimed Fortaleza. Figure 36 shows the spatial distribution of the current network Bicicletar over the city map of Fortaleza.

Figure 36 – Coverage of the current Bicicletar's network and dense unmet areas in the city
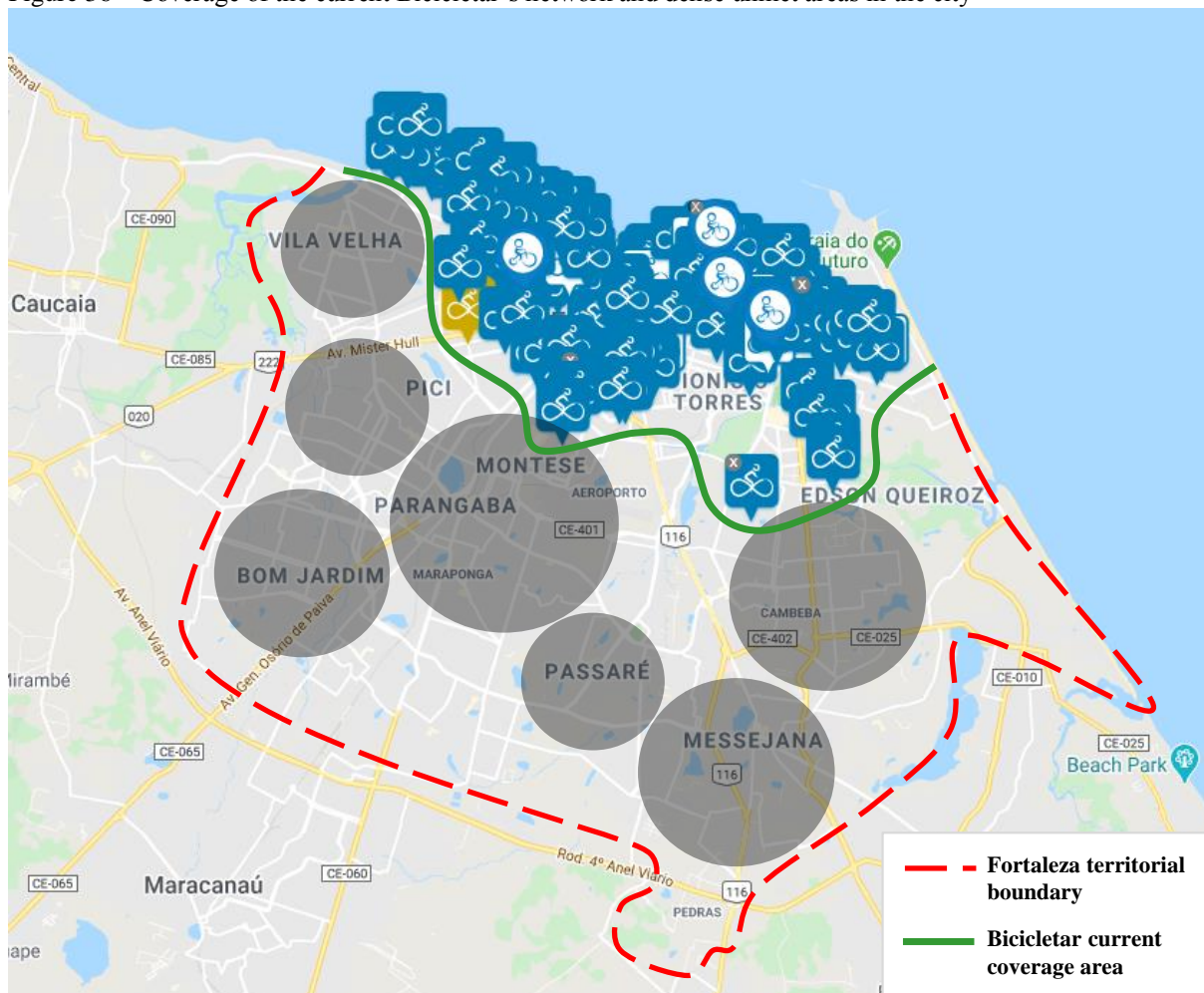
Source: The author, building on Bicicletar (2018c).

The green line delimits the region served by the Bicicletar current network. According to data from IBGE and the Institute of Research and Economic Strategy of Ceará (IPECE), cited in ICMP (Doc #7, p. 28-32), this area coincides with the most developed regions of the city, with higher average income, better access to infrastructure and better rates of schooling. Below the line, there are large urban concentrations located in more peripheral areas of the city that were not, until then, served, due to the restrictions previously discussed (the lack of interest of the sponsor, its budget limitation, and the preservation of the network logic).

The analysis of Figure 36 may suggest that Bicicletar was built in order to reinforce the existing socioeconomic segregation in the city. A public policy concentrating income, therefore. In fact, because of this configuration, a perception was built in the population, including among Bicicletar users, that it reflects the socioeconomic inequality of the city and that it would be a project deliberately aimed at serving the most developed areas. This perception is present in the statements of several interviewees. The following words are examples that illustrate this point.

> I think it is very good what they did in that area of the city, but there is another Fortaleza demanding to be served, which is not on the postcards and needs to have and initiative to serve that audience as well. To provide the same things that were provided for the beachfront, or Downtown, which is leisure and the active mode for work. For the other Fortaleza that is not on the postcards. (User B10)

> What makes me a little sad is that there is still a lot in the richer parts of the city. It's where we see there are more points. (...) because it always starts in the rich areas, right? (...) I think that this barrier of starting to go to more distant neighborhoods. (...) the best infrastructure, the most points, are always going to the richer areas. (User B9)

Although this may be a correct assessment of the phenomenon, at least from a superficial observation – the Bicicletar network surely reflects the socioeconomic inequality of the city – it cannot be concluded that this is the product of political action with this intent (as much as it should not be expected that actors of civil society know the technical criteria that led to the distribution showed in Figure 36).

In fact, as already being discussed from the research data, the reasons are both managerial (the sponsor strategy and budget for brand communication), and technical (preservation of network logic). There was no policy based on socioeconomic motivation with regressive and income concentrator bias, as emphasized by one of the public managers interviewed. But there was one to provide lower-income people with access to the system.

> The objective actually was never to make it for high income users. So much so that Bilhete Único has been the policy since the beginning of the project, for the purpose of favoring those with lower income. That is also the case with this project, even with it being allocated here [in an area where the population has a higher average income]. (Policymaker P3)

From these discussions emerges the concept of balanced legitimacy, the result of trade-offs observed in the legitimation processes: in light of these dynamics, the research data has shown that insofar as the legitimate private interest of the sponsor in maximizing the efficiency of its branding strategy is privileged, societal interest is disregarded by concentrating the station network of the bicycle sharing system far from peripheral areas of the city. In this way, cognitive, pragmatic and moral legitimacy is lost among the unattended population, and even among current users, who interpret the situation as misconduct by public authorities. Figure 37 shows this relationship and how it affects the legitimacy of the sharing system.

Figure 37 – Vignette of determinants of legitimacy in a public, single-sponsored bike sharing scheme
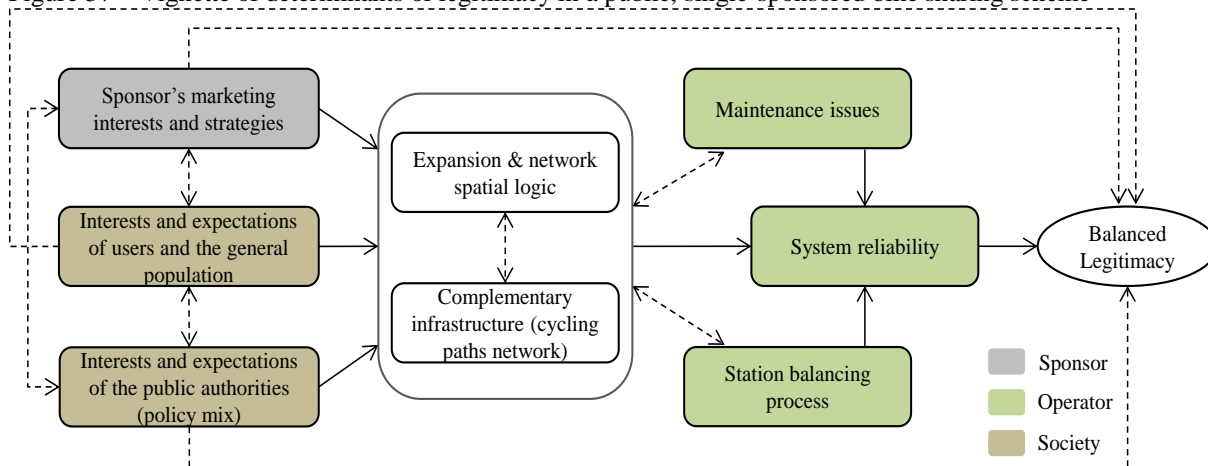
Source: The author, based on the research data.

In a fully sponsored public model, such as Bicicletar, it is expected that the interests of the sponsoring company will determine the growth strategy, although the responsibility for planning the network and monitoring its performance rests with the government. For users to perceive the sharing system as reliable and thus give it legitimacy, the growth strategy must meet the requirements of the network logic.

In respecting these assumptions, on the other hand, actors assumed a "this way or no way at all" stance: an efficient performance was guaranteed to a certain region of the city, at the cost of virtually no performance delivered to the other ones. A recent decision by the city government sought to solve this fragility by bidding for an expansion project proposing a significant expansion of Bicicletar, almost tripling the current network of stations.

(…) In March, 2019, Mayor Roberto Cláudio launched the Tender Process for expanding Bicicletar, which currently has 80 stations in the city. From now on, the program is to be expanded to a greater number of neighborhoods, with a larger coverage area in the Ceará Capital, forecast to reach 210 stations by the end of the current term in office. (Doc #3)

The reliability of the system is also a function of the quality of some key processes, such as those already mentioned maintenance routines and station balancing. Several users mention operational failures that eventually make them give up using the system and choose another modal for their commutes. Among the most cited problems are: worn out or defective bicycles (reported by five users), slowness or failure to release bicycles at the station (mentioned by five users), and failure to recognize the return of a bicycle (reported by four users). These last two categories may be problems related to station connectivity, which may be offline, preventing loans and returns of bicycles. Some excerpts from the interviews reporting different types of failures support this analysis.

> Another negative point is sometimes you get a bicycle that seems to be fine, and it has some problem that maintenance didn't catch, and it breaks down on you. Then you have to push it to the nearest station. What you want to do is leave it there right where it broke down [laughter]. (User B10)

> And one bad thing is that the app will tell you there are two, three bicycles, and when you get there they won't come out, they may be broken, I don't know, but they won't come out. So when there are only one or two at the station I won't even go there because I know there's something wrong with them. (User B6)

> Once I returned a bicycle at the station here at the university and went up to my class. Then the alert appeared, "you only have ten minutes to finish your trip." So I left the room, went down and checked. The bicycle was locked in. I reported on the app: "the bicycle is locked in, but the system doesn't recognize it". (User B7)

The problem of imbalanced stations also impacts toughly the reliability of the system. Several users report experiences of bike unavailability (reported by eight users) and dock unavailability (reported by four users).

> Sometimes there aren't many bicycles available, right? (...) And the big trick is also when you return them. You have the station where you want to leave it closer to

your work, but it's full, and the other [closer one] as well, and then I had to return it at Shopping Benfica and come back walking a bit. (User B10)

Depending on the time, I already know if there will be space for returning a bicycle. For example, at Avenida Beira-Mar it is hard to find a bicycle, but to return it there are always spaces. Close to home, sometimes there is no room to put the bicycle, so I have to go to another station to return it. (User B5)

This is considered one of the main problems observed in urban mobility sharing systems, according to policymaker P1. As in any service-based economic activity, at peak times, Bicicletar experiences bottlenecks that stress its premises of reliability.

The greatest challenge that all systems face is in balancing the system. At peak times, some regions empty while at the same time others get too full, there's no place to park the bicycles. So that was a great lesson we learned, that involved lots of logistics. Even today we are researching ways to mitigate that. (Policymaker P1)

One way to mitigate its negative effects on reliability is to strengthen the network logic, increasing the number of stations even in areas of the city where there is already coverage, further reducing the distance between stations. In this scenario, users would need to travel shorter distances to reach a nearby alternate station and take or return bicycles, which would somewhat alleviate their discomfort.

And when you also do that map, "I'm going from here to there," and you don't have a station, your area is not covered by a station, then you have no accessibility, right? You need to have more stations and more spaces for the bicycles at the station so you can arrive there, lock them in and go on with your life. (User B10)

The flaws that undermine the reliability of the system – especially maintenance problems and imbalanced stations – are exacerbated by another weakness pointed out by the policymakers: the municipal government has little enforcement ability on the system performance since the financial relationship is directly established between the operator and sponsoring company. Although PAITT is responsible for network planning, operation inspection, and monitoring performance indicators, the inspection routines are hampered by the impossibility of enforcing appropriate incentives and penalties.

In the current model, regulating [performance] is complicated, right? We have a major criticism of this project, exactly regarding the capacity for overseeing bicycle relocation and maintenance. That was one of the areas where we made the most mistakes and let down the city and the users the most. (Policymaker P3)

In view of this, the municipal government found a solution by making a fundamental reformulation in the Bicicletar business model: by law, it began to finance the expansion of the program – and the operation of the new stations – with public resources coming from the Zona Azul, the municipal system of street parking (the current network, with 80 stations, will remain under the same funding model). Thus, the limitations of the sponsored business model will be solved or at least mitigated.

Thinking of that limitation, the mayor had a law passed where all funds coming from the Zona Azul were to be exclusively applied in bicycle route policies. Now, every cent that comes into Zona Azul rotating parking goes into a fund for the promotion of cycling [policy]. And that is allowing us to expand the system to areas on the outskirts. We have 80 stations and are going to 230. But now it is just between Serttel and City Hall, there won't be any sponsors. (Policymaker P1)

The redesign will also allow greater emphasis to be placed on efficiency and reliability indicators, especially on key processes such as maintenance and station balancing. The business model is being adapted: some critical stations will work under a "corral operation" scheme, with a technical professional performing the loans and returns of bicycles at peak times.

Another thing we included was the corral operation. At some stations with higher demand, we will make corrals for distributing bicycles so the user will have unlimited spaces during peak time. We put an operator there, and the user comes and returns the bicycle. He does not have to worry about a space (...) because someone will be there to receive it. The operator will be there, at the peak time. (Policymaker P3)

In these "corrals", there will be greater availability of physical space for returning and taking bicycles, eliminating the restriction imposed by the technology of the stations (docks). Therefore, technology and processes of use are also aspects of the business model that are being modified to improve Bicicletar performance.

The operating company, sponsor, and policymakers are developing a way to allow entry without the mandatory credit card registration, but maintaining some form of monetary penalty in case the use exceeds the limit of one hour per trip. On one hand, such a procedure may require a slightly more bureaucratic process for registering and validation of user documentation. On the other hand, there will be greater participation of citizens in sharing schemes. Indeed, some users have mentioned the obligation of the credit card as a barrier to adoption: "(...) it actually provides security for the operator, right? But having to register a credit card sometimes is a barrier for the user because not everyone has a credit card." (User B4)

The expectation of a better performance in key processes such as maintenance and station balancing, as a result of the change in the system funding formula and greater enforcement by the public authority; the expansion in the number of stations and the coverage towards the outskirts; the adoption of corral type stations. All these changes in the Bicicletar business model contribute to confer greater moral and pragmatic legitimacy to the project.

In terms of use practices, there will be a need for a period of adaptation and learning, both on the part of the actors involved in offering the service and of new users, until there is a greater understanding of the program and its new procedures and technologies. This may mean a transitory decrease in the comprehensibility, which is offset by attributes of cognitive legitimacy obtained as Bicicletar is adopted and seen as necessary by a larger portion of the population now served.

Table 21 presents a summary of the main changes that the Bicicletar program has undergone in recent years, considering the respective component of the business model to which each change relates. This allows us to understand the role played by business models in the processes of learning and structuring of innovations, in this case, in the field of urban mobility.

Table 21 – Main adaptations to the Bicicletar business model main

Component	Characteristic	At the time of launch	At the time of data collection (upcoming expansion)
Profit formula	Funding	Sponsorship resources, only	Sponsorship and public funding with resources from the Zona Azul system
Resources	Number of stations	80	80, with an upcoming expansion to 210 stations
	Network coverage area	Concentrated at central areas	Expanding throughout the city including the peripheral region
	Cycling infrastructure	Expanding, but still concentrated at central areas	Continuously expanding, covering peripheral regions
Processes	Strategic performance management	No enforcement ability by the city government	Enforcement ability is enabled by the public funding model
	Station balancing	As good as possible, without penalties due to no enforcement	"Corral" operation at busiest hours in some stations, key performance indicators will be enforced, subject to penalties
	Maintenance routines	As good as possible, without penalties due to no enforcement	Key performance indicators will be enforced, subject to penalties

Note: The Bicicletar value proposition and other business model characteristics not exhibited in the table had no changes over time.
Source: The author, from the research data.

To consolidate the results presented on the Bicicletar system, we have associated the legitimacy mechanisms identified in the data with the constructs of balanced legitimacy (as shown in Figure 37). Similarly, we relate these mechanisms to each dimension of legitimacy that they influence (cognitive, moral, and pragmatic) and to business models building blocks (value proposition, profit formula, key resources, and key processes). The next section discusses the results of this deductive effort.

5.1.2 *Relating legitimation mechanisms and the Bicicletar business model components*

Table 22 presents the mechanisms underpinning the Bicicletar legitimation process. For each mechanism, we identify the role it played in this process, whether acting as a barrier (–) or a driver (+) of legitimacy. As we have argued, legitimacy is a critical resource for technological or business model innovations to flourish and ultimately contribute to the socio-technical transition.

Table 22 – Legitimacy mechanisms of the Bicicletar system

Determinants of balanced legitimacy	Legitimation mechanisms (related business model building block) [a]		
	Pragmatic legitimacy	Moral legitimacy	Cognitive legitimacy
Interests and expectations of the public authorities (policy mix)	(+) The implementation of cycling infrastructure (KR)	(+) The implementation of cycling infrastructure (KR)	(+) The implementation of cycling infrastructure (KR)
	(−) The sponsorship model undermines the ability of the government to enforce the operator's performance (PF)	(+) The fully sponsored model facilitated normative approval since there was no cost for society (PF)	(+) Replication of good practices accelerated learning processes (KR & KP)
	(+) Reformulation of the Bicicletar's business model: from only sponsored to a mixed funding model (sponsorship + public) (PF, KP & KR)	*(+) Reformulation of the Bicicletar's business model: from only sponsored to a mixed funding model (sponsorship + public) (PF, KP & KR)*	(+) Communication and educational campaigns
	(+) Expansion of the Bicicletar network to unmet regions in the city outskirts (KR)	*(+) Expansion of the Bicicletar network to unmet regions in the city outskirts (KR)*	*(+) Reformulation of the Bicicletar's business model: from only sponsored to a mixed funding model (sponsorship + public) (PF, KP & KR)*
	(+) Expansion of the complementary cycling infrastructure (KR)	*(+) Expansion of the complementary cycling infrastructure (KR)*	*(+) Expansion of the Bicicletar network to unmet regions in the city outskirts (KR)*
	(+) The public funding model gives public authorities greater enforcement capacity (KP)	*(+) The public funding model gives public authorities greater enforcement capacity (KP)*	*(+) Expansion of the complementary cycling infrastructure (KR)*
Interests and expectations of users and the general population	(+) Health improvement (VP)	(+) Health improvement (VP)	(+) Information on how to use the system is available in several ways (app, website, totems) (KR)
	(+) Integration with the public transport system (VP)	(+) The democratization of public space (VP)	(+) Communication and educational campaigns
	(+) Money-saving as the system is free for users if using the ticket integration card (VP)	(+) Sustainable mobility appeal meets environmental concerns (air pollution, CO2 emission) (VP)	(−) Users realize the current state of the Bicicletar network as mirroring the city's socioeconomic inequality
	(+) Time-saving and convenience (VP)	(+) Fostering a sense of belonging and citizenship (VP)	*(+) Expansion of the Bicicletar network to unmet regions in the city outskirts (KR)*
	(+) Bicicletar app gives users autonomy and facilitates decision making regarding their commutes (KR)	(+) The fully sponsored model facilitated normative approval since there was no cost for society (PF)	*(+) Expansion of the complementary cycling infrastructure (KR)*
	(+) The implementation of cycling infrastructure encourages citizens to engage in the Bicicletar system (KR)	(−) Users realize the current state of the Bicicletar network as mirroring the city's socioeconomic inequality	
	(+) Expansion of the Bicicletar network to unmet regions in the city outskirts (KR)	*(+) Expansion of the Bicicletar network to unmet regions in the city outskirts (KR)*	

Determinants of balanced legitimacy	Legitimation mechanisms (related business model building block) [a]		
	Pragmatic legitimacy	Moral legitimacy	Cognitive legitimacy
	(+) Expansion of the complementary cycling infrastructure (KR)	*(+) Expansion of the complementary cycling infrastructure (KR)*	
Sponsor's marketing interests and strategies	(+) The sponsorship model drives the network's growth strategy favoring its spatial logic and ultimately reliability (PF) (−) The sponsor has no incentive to expand the system to regions where its branding strategy is likely not to pay off (PF) (−) The sponsor's brand communication budget is limited to the current size of the project (PF)	(+) The sponsorship model drives the network's growth strategy favoring its spatial logic and ultimately reliability (PF)	(+) The sponsorship model drives the network's growth strategy favoring its spatial logic and ultimately reliability (PF)
Maintenance issues	(+) Well-trained field technicians perform maintenance routines adequately (KR) (+) Strategic performance management counts for improving maintenance indicators (KP) (+) The network logic relieves pressure on the maintenance routines towards reliability *(+) The greater enforcement capacity by the local government might improve maintenance routines performance (KP)*	*(+) The greater enforcement capacity by the local government might improve maintenance routines performance (KP)*	(+) Replication of good practices accelerated learning processes (KR & KP)
Station balancing process	(+) Well-trained field technicians perform station balancing routines effectively (KR) (+) Strategic performance management counts for improving station balancing indicators (KP) (+) The network logic relieves pressure on the station balancing process towards reliability *(+) The greater enforcement capacity by the local government might improve station balancing performance (KP)*	*(+) The greater enforcement capacity by the local government might improve station balancing performance (KP)*	(+) Replication of good practices accelerated learning processes (KR & KP)
System reliability	(+) Effective maintenance routines ensure the system reliability (KP) (+) The effective station balancing process counts	(−) Demand at peak times puts pressure on system reliability (±) The network logic holds the system reliability	(+) Replication of good practices accelerated learning processes (KR & KP)

Determinants of balanced legitimacy	Legitimation mechanisms (related business model building block) [a]		
	Pragmatic legitimacy	Moral legitimacy	Cognitive legitimacy
	for system reliability (KP)	while limiting its expansion	
	(−) Demand at peak times puts pressure on system reliability	(−) Imbalanced stations harm the system reliability (KP)	
	(±) The network logic holds the system reliability while limiting its expansion	(−) Technical failures impair the reliability of the system (KP)	
	(−) Imbalanced stations harm the system reliability (KP)	*(+) The greater enforcement capacity by the local government might increase system reliability (KP)*	
	(−) Technical failures impair the reliability of the system (KP)		
	(+) The greater enforcement capacity by the local government might increase system reliability (KP)		

Note: [a]. (+) driver of legitimacy; (−) barrier to legitimacy; (VP) Value proposition; (PF) Profit formula; (KR) Key resource; (KP) Key process. Mechanisms in italics are associated with the fundamental reformulation of the Bicicletar business model.

Source: The author, based on the research data.

In general terms, Table 22 summarizes the "story" narrated throughout section 5.1 so far. In the first column are the factors (constructs) presented in the Bicicletar legitimation vignette, while the following columns show the legitimation mechanisms and their relationship with the business model components. One can observe how each building block of Bicicletar's business model was designed in order to satisfy some of the legitimacy requirements.

For instance, with reference to the interests and expectations of users and the general population, we found that the value proposition meets the utilitarian expectations of the population, manifested in the form of integration with the public transport system and free use if registering the system via BU integration card (pragmatic legitimacy). Drivers of pragmatic legitimacy were also found in key resources such as the Bicicletar app, which gives users autonomy and facilitates decision making regarding their commutes; the implementation of cycling infrastructure, which encourages citizens to engage in the Bicicletar system; and well-trained field technicians capable of performing operational routines effectively (the latter is said to be associated with both maintenance issues and station balancing process, other determinants of legitimacy than users' expectations).

Our findings additionally show that health improvement, sustainable mobility appeal and environmental concerns, the democratization of public space, and sense of belonging and citizenship are all drivers of moral legitimacy, as they seem to be in line with users' culture and values. A controversial driver of moral legitimacy was the fully sponsored model (profit formula). It facilitated normative approval since there was no cost for the society for the implementation of the Bicicletar program. In this sense, the sponsorship model was found to be a powerful legitimation mechanism capable of connecting the interests of the sponsoring company, users, public authorities, and the operating company.

Such an arrangement guided the network's growth strategy favoring its spatial logic and, ultimately, reliability. For that reason, we argue that this model was an important factor of pragmatic, cognitive, and moral legitimacy, at least in the area where the Bicicletar has established its stations. On the other hand, this profit formula culminated in a "this way or no way at all" model with unsatisfactory performance. Constrained by a dynamic of three lock-in mechanisms, namely, the sponsor's branding strategy, its branding budget, and the spatial logic of the network, Bicicletar delivered a good performance to a certain region at the cost of no performance to the rest of the city, where there were no stations.

In fact, network logic plays a dual role in that it ensures the reliability of the system while inhibiting its expansion and spatial spread. Users have thus understood the current state of the Bicicletar system as mirroring the city's socioeconomic inequality. This interpretation is a barrier to moral legitimacy since broader societal expectations of the democratization of public space and a sense of belonging and citizenship end up being neglected. Requirements for cognitive legitimacy are also prevented since citizens from unattended areas on the outskirts of the city do not perceive the Bicicletar program as a recognized cultural model.

Another lock-in mechanism resulting from the sponsorship model is the little enforcement ability by the municipal government. As the financial flow takes place directly from the sponsor company to the operator, public authorities have little or no ability to enforce the operator's performance. In the end, this mechanism impairs the reliability, thus pragmatic and moral legitimacy of the system.

Research data showed that the legitimacy dynamics in a sponsorship-based configuration present several trade-offs, from which emerged what we call balanced legitimacy: Bicicletar has reached a suboptimal equilibrium in which any enforcement by public sector actors to expand the network towards regions not yet served by the system would imply violating the legitimate private interest of the sponsoring actor since this could go against its branding strategy. Moreover, this action might also weaken the network logic, necessary for the system's reliability, harming potential users who it was expected to favor.

Government authorities then carried out a fundamental reformulation of the Bicicletar business model, specifically in the profit formula component, shifting from the sponsorship arrangement to a totally public funding model. By doing so, policymakers created a significant driver of legitimacy for the bike sharing systems throughout the city.

This decision can be seen from some perspectives. The most evident of them, in operational terms, one notes that it directly meets the interests and expectations of users and the public sector itself. With the direct hiring of the operating company, without the intermediation of a sponsor, the greater enforcement ability by the local government could improve performance in terms of key processes such as station balancing and maintenance routines, increasing the system reliability (pragmatic legitimacy). The exclusive allocation of the financial resources raised by the Zona Azul system for active mobility policies will allow the expansion of Bicicletar, Bicicleta Integrada, and the cycling infrastructure to regions that currently have precarious or no service (pragmatic and moral legitimacy). Furthermore, the implementation of new stations in different areas in the two-thirds of the city not yet covered

by the network will contribute to the population's awareness about the existence of sharing programs (cognitive legitimacy).

From a socioeconomic point of view, this reformulation is a progressive political action. It indirectly transfers income from social groups with higher average income – who own individual transportation and pay to use the Zona Azul system – to poorer people – who are the majority of users of cycling infrastructure and the Bicicletar. In this way, the lower-income populations will have one more option for commuting and using city spaces (moral legitimacy).

From an environmental perspective, one sees an inefficient, polluting modal – historically institutionalized in the context of urban mobility in the city – financing the expansion of active, sustainable, shared transport (moral legitimacy). It is a strategy that meets the call for sustainable mobility by offsetting environmental impacts caused by traditional transport. Finally, from a cultural lens, the expansion will increase the comprehensibility of active and sustainable mobility in the population, through cycling and shared mobility programs, helping to reduce conflicts with other actors in the regime (cognitive legitimacy).

Despite the efforts made by all those involved in the public-private partnership for proper performance, some characteristics of the Bicicletar business model did not meet the needs of a considerable portion of the population. It is worth mentioning that even before these improvements, the program was already facing criticisms related to the lack of coverage on the outskirts. Albeit this weakness is explained by the network spatial logic and sponsor's marketing strategy, the fact is that the original model limited coverage to the more developed region of the city.

Such limitations would motivate the creation, in 2016, of the second shared mobility system in Fortaleza, Bicicleta Integrada. In facing the weaknesses of its predecessor, the program would be directed to the lower-income audience, focusing on loaning bicycles for a longer period, and totally integrated into the public transport system.

5.2 Bicicleta Integrada business model

The Bicicleta Integrada sharing system started operating a year and a half after Bicicletar, from which it incorporated part of the benefits and technical and operational characteristics. The program was a spinoff of Bicicletar, in that it sought to overcome weaknesses that its current business model presented, especially concerning serving lower-

income populations, who used Bicicletar as a way to integrate with the public transport system.

> We identified in our research that 30% of Bicicletar users did the integration before or after leaving the bicycle. (...) So we came up with the idea of [Bicicleta] Integrada, thinking of that characteristic (...). We could help to meet that demand from the outskirts with a specific project for integration. (Policymaker P3)

When the program was launched, promotional pieces reinforced this pioneering speech of integration with public transportation. In the bus terminals, posters like this one shown in Figure 38 were displayed to attract new users.

Figure 38 – Promotional poster for the Bicicleta Integrada program
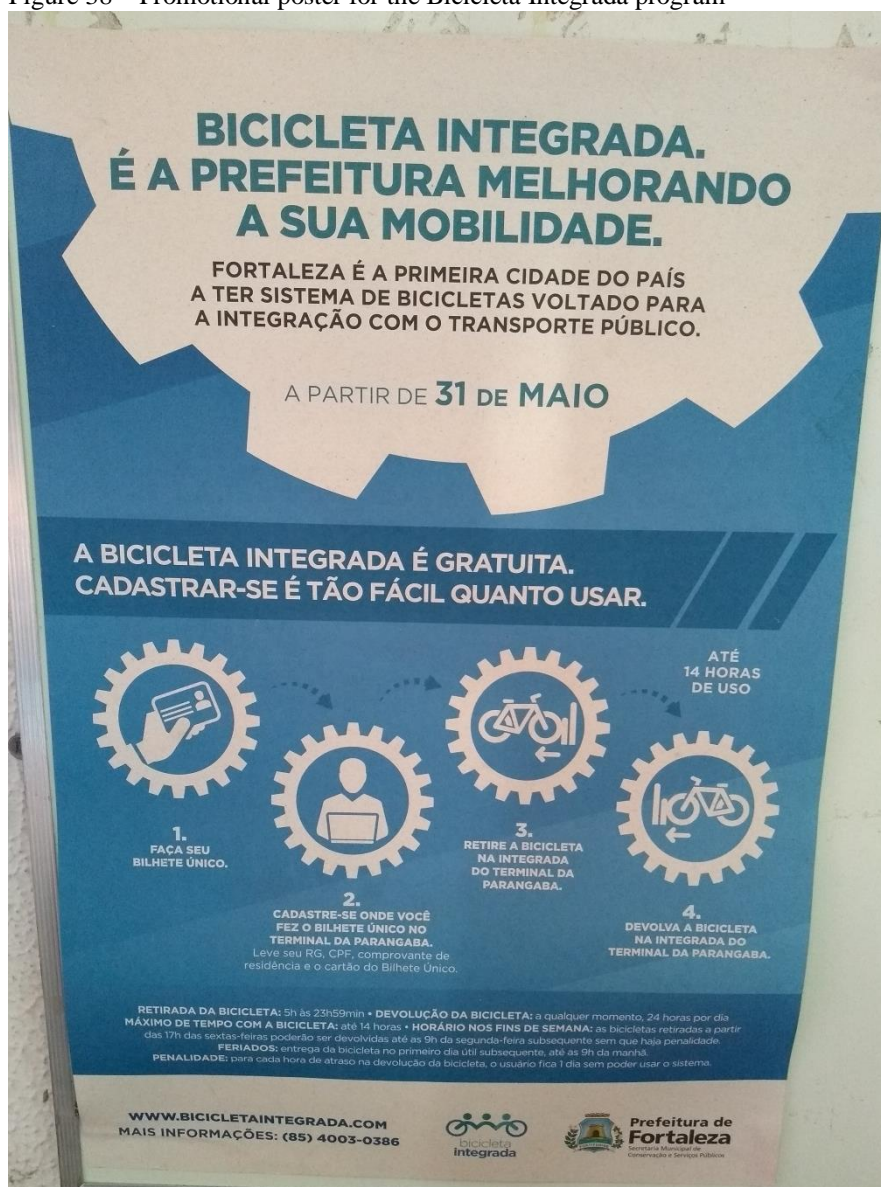
Source: The author, from the research data (own record, captured on Nov 1st, 2019 at the SCSP office).

On the top of the poster, which refers to the launch of the first station (station 01, Parangaba bus terminal), there is a mention of the paternity of the program, alluding to the municipal government, followed by the pioneering speech: "Bicicleta Integrada. This is the municipal government improving your mobility. Fortaleza is the first city in the country to have a bicycle system aimed at integrating with public transport. Starting on May 31st". The poster also illustrates the process of initial registration and use, in four stages:

1. Request your Bilhete Único card;
2. Register where you receive your Bilhete Único card at the Parangaba terminal (present your ID, proof of residence, and the Bilhete Único card);
3. Take the bicycle at the Parangaba bus terminal station;

4. Return the bicycle to the Parangaba bus terminal station.

Following, the main rules, opening hours and penalties are presented. Information on the benefit of free use, one of the main features of the project, is highlighted in the figure. Figure 39 presents the basic characteristics of the Bicicleta Integrada business model. Its value proposition reveals some similarities and differences in comparison with that of Bicicletar.

Figure 39 – Bicicleta Integrada business model

BICICLETA INTEGRADA BUSINESS MODEL BUILDING BLOCKS

CUSTOMER VALUE PROPOSITIONS

- Flexible two-way station-based model (take and return the bike to any docking station within the system, although the return is often to the original docking station)
- Long-term bicycle loans (up to 14 hours)
- Integration with the public transport system
- Sustainable, emancipatory, active, and healthier solution

PROFIT FORMULA

- Revenues come from the only one sponsor company (Marquise) to the Operator (Serttel), as four other sponsors left the partnership
- Free for users (it requires using the individual ticket integration card)
- Municipal government: no charge

KEY RESOURCES

- Technology (app, bikes, stations)
- Cycling infrastructure
- Well-trained field technicians
- Customer service staff
- Know-how in sustainable mobility

KEY PROCESSES

- Maintenance routines
- User support
- Strategic performance management

Source: The author, based on the research data.

Bicicleta Integrada delivers an active mobility solution, which is sustainable and promotes health, well-being, and a sense of citizenship through the use of city spaces. Besides, it is fully integrated into the public transportation system and is based on long-term loans (Doc #6). Bicicleta Integrada also adopts a station-based model (instead of a free floating one), and the user can return the bike at any of the other stations within the system

(one-way). But considering the observed usage practice, the bicycle return almost always takes place to the same station where the loan occurred (two-way), which is why this was considered a "flexible two-way" model.

This is largely due to another specific feature of its business model: the long period that the user can have a bicycle under his responsibility. It is seen that this is actually more of a loan than a shared use, as recognized by one of the public managers interviewed: "Bicicleta Integrada is a system with more of a focus on *lending* a bicycle. These are larger stations, with 50 bicycles. They are located in major bus terminals, at the terminals that concentrate users." (Policymaker P1, our emphasis)

Because of this, many users use the system for commutes inherent to their work activities or to integrate with the public transportation system (either on the route between home and the bus terminal where the docking station is installed or in the opposite direction, returning home from work). This need is served by the business model, which allows the loan for up to 14 hours, enough time for the user to stay overnight with the bike and return it the next working day.

Notes recorded during field observation reinforce these characteristics of use and the users' profile. Owners of small informal sales in the vicinity of a visited station (station 01 – Parangaba bus terminal) indicated that the flow of taking and return bicycles is more intense between 6:00 pm and 7:00 pm. A user of the program, appearing to be self-employed, confirms its usefulness:

> "This bicycle helps, I and two of my three children use it. Every day they pick up the bicycle at 07 in the morning and return it at 07 at night at this same station here! (...) This one with me I'm going to return around 09 tonight, so there is no danger of going past the time!" (Informal conversation with a Bicicleta Integrada user, male, ± 60 years old. Non-participant observation, docking station 01 – Parangaba)

During a non-participating observation, a man of about 30 years old approached the station carrying a bag of fast delivery services. After carefully inspecting all bicycles available, he handled the application and made his choice, without approaching the BU card from the RFID totem reader. Asked about the reason for the delay in the choice, he replied that he was looking for a bicycle in better conditions as he would use it to work making deliveries: "(...) here there are always more bicycles available, I can get a better one for work (...) In this region I have more work, I have more requests for deliveries." (Informal

conversation with a Bicicleta Integrada user, male, ± 30 years old. Non-participant observation, docking station 02 – Papicu)

The situation described above highlighted the usefulness of the Bicicleta Integrada for lower-income workers. The work routine of that user demands bicycles in a better state of repair, which is more likely to be found at stations with more bicycles available (the information that there are always more bicycles in that station was already known to the researcher, according to observations made in the program smartphone application).

The modal integration with the public transport system is not only in the spatial dimension (docking stations purposely built right next to the bus terminals). The way to access the service, only by registering in the Bilhete Único system and without any cost to the user, is another evidence of this integration. Even if the user uses the smartphone application to benefit from the ability to choose a bicycle, he will be required to have an active Bilhete Único pass (the release by the BU card – instead of the application – is random, and a bicycle can be released that is in an unsatisfactory condition of use). Figure 40 details one of the stations of the Bicicleta Integrada program visited during the research field stage.

Figure 40 – An example of a Bicicleta Integrada station and its location
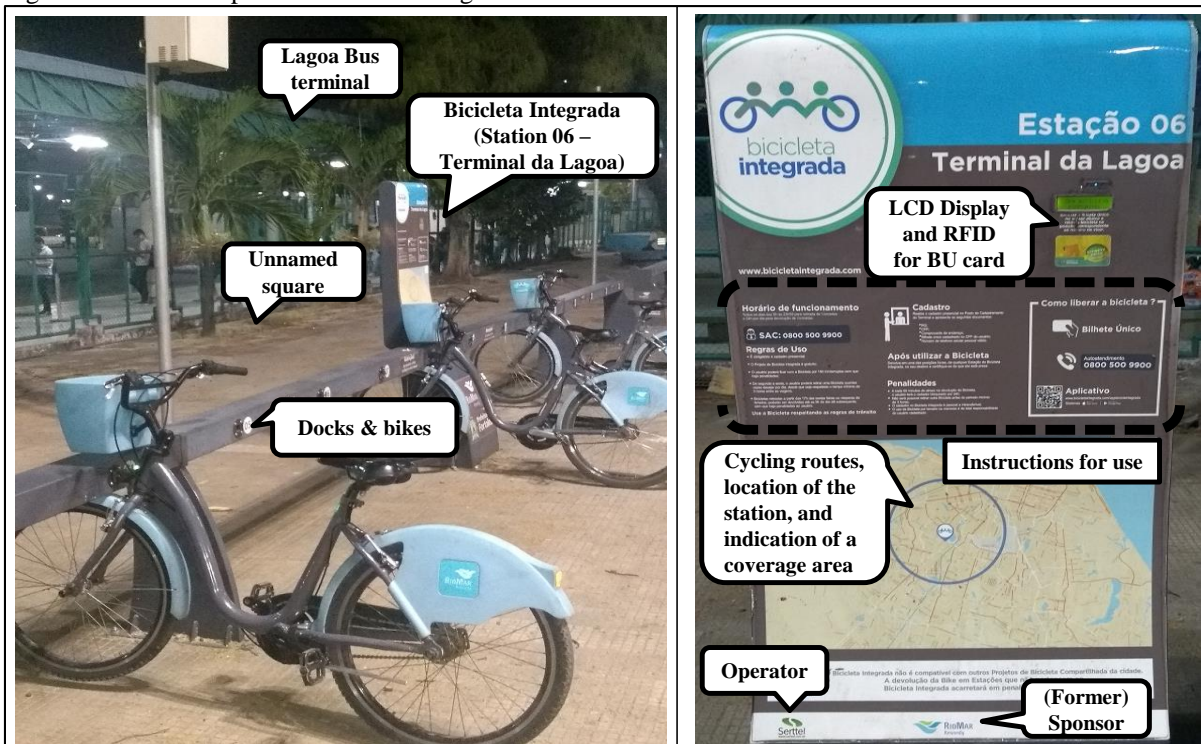
Source: The author, from the research data (own record, captured on Sep 18, 2019).

The station is installed next to the Lagoa bus terminal, on an unnamed square around which there are some commercial points such as driving schools, small snack bars,

and convenience stores. The region is an intersection of some access roads to the metropolitan area, as well as to the center and east of the city. In the detail on the right, one can see a totem of docking station 06, in good condition. As with the Bicicletar stations, It shows the rules of use, instructions on how to take a bicycle (BU, application, or via call center), an RFID reader for release via Bilhete Único, the logos of the program and the organizations involved (city hall and sponsoring and operating companies), and the map of city's bicycle path network around the station.

As for the profit formula, the only source of funding for the Bicicleta Integrada is the sponsorship resource. Because its audience is lower-income, even the penalty in case of non-compliance with the rules of the system is non-pecuniary (not returning the bicycle within 14 hours, for instance). The system adopts the temporary blocking of use.

> Its focus is to encourage this bus-bicycle integration. We were able to reach the lowest-income people because it is totally free. Even the penalty rule involves no financial measures. With Bicicletar, if you exceed one hour, you pay BRL 5 and have to register a credit card for that. But with Bicicleta Integrada, you don't register a credit card, just the Bilhete Único. For every hour of overtime, you spend a day unable to use the system. (Policymaker P1)

The main resources to deliver the Bicicleta Integrada value proposition are essentially the same adopted by Bicicletar. This denotes the similarity of technologies (applications, stations, and bicycles), infrastructure, and human resources employed in the two programs, which require de facto similar skills. Bicicleta Integrada stations are larger, but the embedded technology is identical to Bicicletar: intelligent, computer-managed stations, using solar panels and wireless communication, equipped with electromechanical devices to lock and release the bicycles (Doc #6).

Maintenance routines, remote user support, and strategic performance management are key processes of Bicicleta Integrada. A fundamental difference, however, lies in the factors that cause the problem of imbalanced stations, which would require a robust process of bicycle relocation and balancing of stations, as occurs with Bicicletar. Given the nature of their value proposition, oriented to long-term loans, stations tend to remain with few bicycles – not infrequently, even empty – most of the time. This suggests, a priori, a chronic problem of unbalancing. Indeed, this characteristic led to a restructuring of the system's business model, which affected its legitimacy dynamics.

5.2.1 Legitimation dynamics of the Bicicleta Integrada system

As discussed, Bicicleta Integrada emerged to overcome the inefficiency of Bicicletar in serving low-income people, living in the peripheral areas of the city, and who needed to integrate with the public transportation system. Figure 41 shows the complementarity between the coverage areas of each bicycle sharing program. We rely on the distribution map of the Bicicleta Integrada stations (as can be seen in Figure 17) and the outskirts areas not covered by the Bicicletar network (as in Figure 36).

Figure 41 – Bicicleta Integrada complementing Bicicletar's coverage
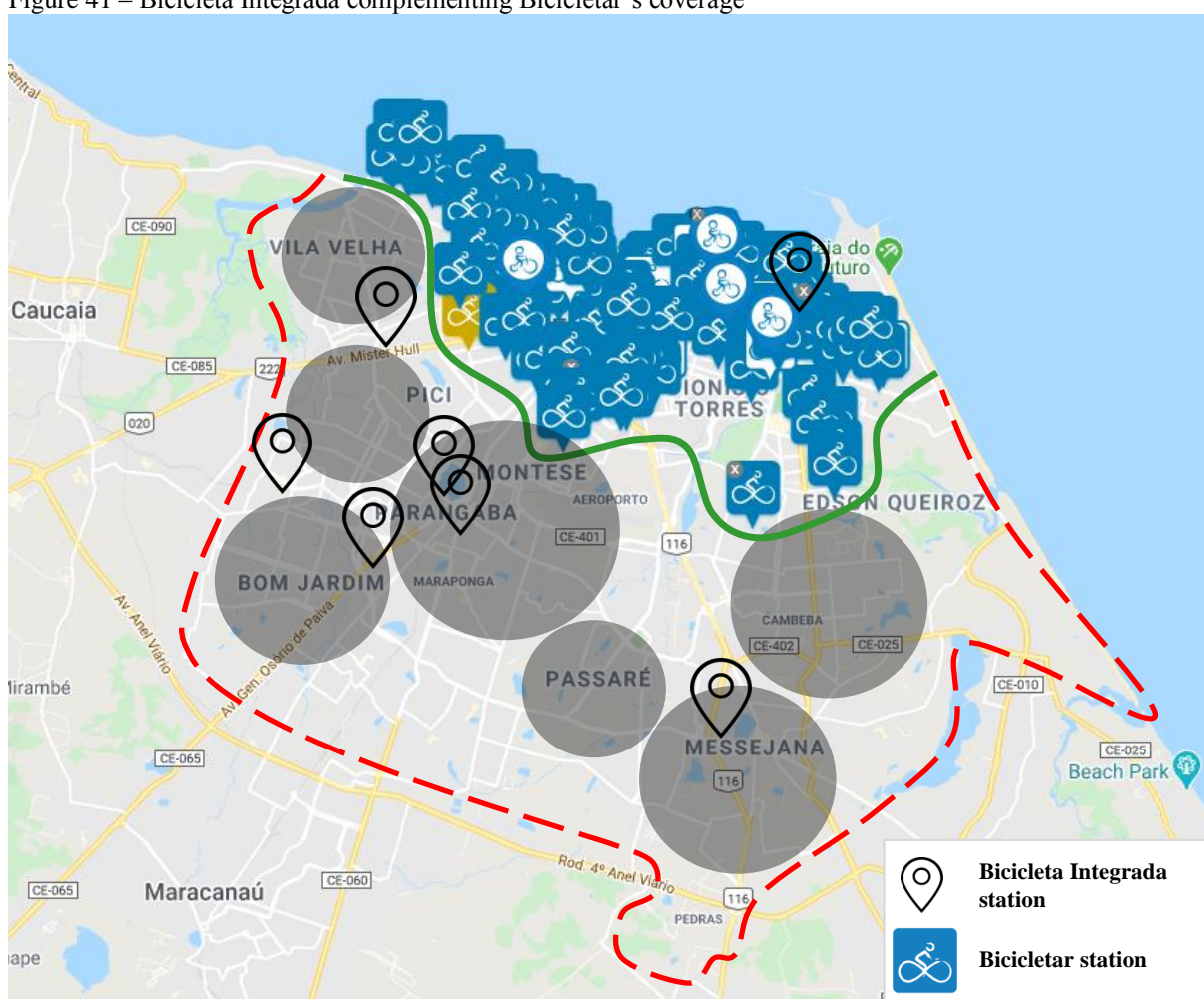
Source: The author, building on Bicicleta Integrada (2018b) and Figure 36.

Only one Bicicleta Integrada station (Station 02 – Papicu bus terminal) is located in the region already served by the Bicicletar current network. Therefore, from its design, the program has been built to provide users and residents in more peripheral regions the integration with the city's public transportation system, an objective for which its predecessor, Bicicletar, was not conceived. For this reason, and despite the many similarities between the

two business models in terms of profit formula, technologies, key processes, and key resources, the implementation of Bicicleta Integrada did not follow the same premise of preserving the spatial logic. Differently, its stations were allocated according to the deterministic criteria of spatial association to bus terminals, ensuring the full integration that its value proposition manifests.

Thus, one should not discuss network logic in the Bicicleta Integrada, since it is deliberately fragmented (the nearest stations are approximately 1.5 km from each other: Station 01 – Parangaba bus terminal and Station 06 – Lagoa bus terminal; by way of comparison, the maximum acceptable distance between Bicicletar's stations is 0.5 km). The long-term loans – up to 14 hours – is a property that fits this fragmented network topology. Users typically use the bicycles in the vicinity of the access station itself and nearby neighborhoods. Returns at other stations than those from where the bicycle was taken are less frequent.

In this sense, the Bicicleta Integrada value proposition (integration and long-term loan) meets the expectations of users in peripheral regions in their daily commutes. As intensive users of the public transportation system, and/or because they are mostly lower-income people, these users give the system some degree of cognitive legitimacy (by understanding Bicicleta Integrada as a necessary and relevant initiative), as well as pragmatic (by realizing the benefits of the program in serving their particular interests and those of the community), and moral legitimacy (by recognizing it as aligned with the values shared by this community).

Two characteristics of the Bicicleta Integrada structuring process are worth mentioning. Because a satisfactory degree of integration with public transportation would already be achieved with the stations spatially linked to the bus terminals, the need for expansion of the network of stations to other areas of the city was not on the agenda until then. Thus, the influence of a marketing criterion relate to the brand strategy of a single sponsoring company – a problem faced by Bicicletar – was not applied to Bicicleta Integrada. This, in turn, led to the formation of several sponsorship partnerships to financing the program, configuring a multi-sponsored model.

The regions served by the Bicicleta Integrada stations have more precarious cycling infrastructure in comparison with the Bicicletar coverage. Although the research data have not provided robust evidence of its influence – as with Bicicletar – the complementary infrastructure is also considered a factor mediating legitimation processes of the program.

Figure 42 presents a vignette for the determinants of legitimacy discussed so far for Bicicleta Integrada.

Figure 42 – Vignette of determinants of legitimacy in a public, multi-sponsored bike sharing scheme
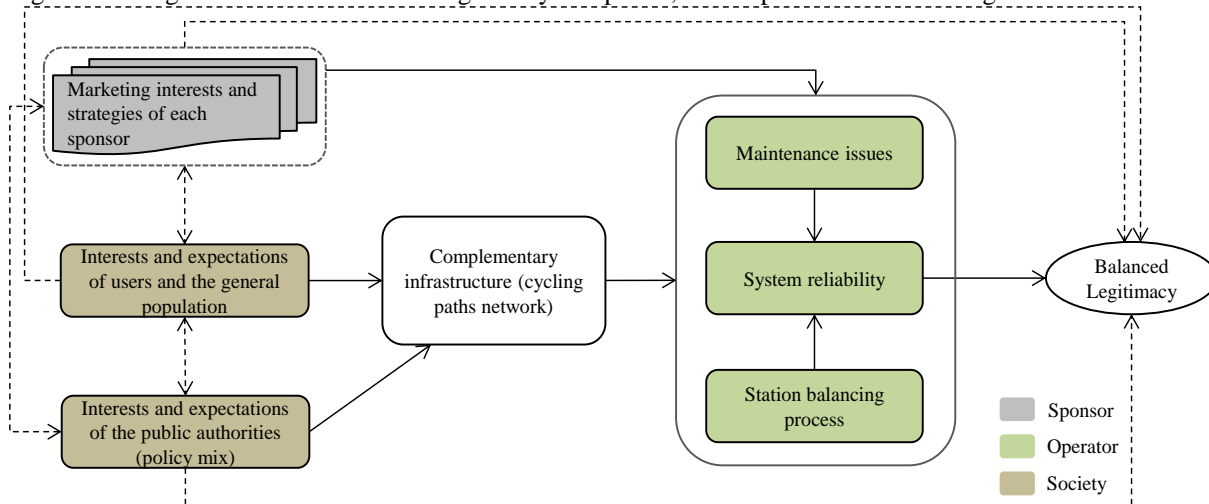
Source: The author, based on the research data.

Bicicleta Integrada presents a reasonable degree of maturity. However, after more than three years of operation, structuring, and learning, some important adaptations were necessary. It was found that users' expectations are not being fully met, contributing to the loss of pragmatic legitimacy. In addition, some sponsor companies have left the public-private partnership. These, among other factors, led to a reformulation of the program. As operator O1 asserts, "[Bicicleta] Integrada had some sponsors, some that have already left... There was Extra, Indaiá... So today we have Marquise. Shopping RioMar ended last month or month before last."

The availability of bicycles at stations, for example, is often low, leaving a repressed demand of users. By associating long-term loans with a non-pecuniary penalty mechanism, the value proposition created incentives for users to take the bicycles as their own, weakening the sharing characteristic. While the proposal of long-term loans naturally weakens the idea of shared use, this was not expected to result in the exclusivity of use, or near appropriation of bicycles by users.

The observations notes highlight this dynamic, and the way users have developed to indefinitely renew the loan of a bicycle in good condition. In an observation made at station 06 (Lagoa bus terminal), the following fragment was recorded:

> A man about 45 years old comes up to the station with a bicycle of the sharing system. He seems to begin the return process. Using the app, I follow the status of

the station in real-time. At the exact moment when the user locks the bicycle into the rack, I select the "Update" button and the return is recorded. But the same user, at the same instant, removed the same bicycle. (Non-participant observation, docking station 06 – Lagoa)

This situation can only occur if one uses a third-party Bilhete Único card, which configures a deviation from the program's rules. In another non-participating observation, a user himself declared that this is what happens when the user takes a bicycle in good condition. According to him "the person brings the bicycle to return at the station and takes out the same bicycle at that time, but using another card, and then doesn't need to wait until the return time to take it!" (Informal conversation with a Bicicleta Integrada user, male, ± 60 years old. Non-participant observation, docking station 01 – Parangaba bus terminal)

A caveat should be made about the rules for using the program: the totem randomly chooses the bicycle the user will take after the validation of the BU card. Thus, such opportunistic conduct will only be effective when (i) the user chooses a bicycle via the application, which gives him the ability to select one at his discretion, or (ii) the rack of the station at which the user will return the bicycle is empty so that the only bicycle available is properly that returned at the previous instant, neutralizing the random pattern of release via BU.

Observational evidence then confirms that the combination of long-term loans with non-pecuniary penalties contributes to a decrease in the availability of bikes. In view of this, some users who get a bicycle in good condition have developed alternative mechanisms to avoid returning it, which is considered a rent-seeking behavior: either they cheat the rules of the system by returning and immediately taking back the bike by using a third party BU card, or they admit the punishment because they consider it compensatory. The triangulation with data from interviews corroborates this finding.

> Because there is no penalty [financial], there is no [registration of] credit card, there are users who prefer to accept the penalty (...) it is a day or two without use. Besides that, the program rules already allow the person to spend 14 hours. So the system today is no longer able to serve everyone. (Policymaker P3)

Ultimately, this situation creates a vicious circle in which the value proposition and adaptability of users compete to amplify the problem of unavailability of bicycles and the consequent pent-up demand. From the point of view of legitimacy dynamics – and regardless

of any judgment about the users' behavior – it is perceived that there is a demand (expectation) that the program can't meet: people who need a bike for their daily routines and cannot afford it because they are usually low-income. It was also found that they will adopt any practices that are within their reach – even if heterodox, such as accepting the penalty or breaking rules – to benefit from the program.

> The idea of [Bicicleta] Integrada is to give an opportunity to others, as with all sharing projects. But that does not invalidate the need for the user to have a bicycle and maybe not have the means to buy one. So the city government is thinking about a project for donating bicycles, because many people behave like that, and keep the bicycle as if it were theirs. (Policymaker P3)

A project to expand the Bicicleta Integrada is underway to deal with these difficulties. It takes advantage of the already discussed decision of the municipal management to direct the resources coming from the Zona Azul street parking system to cycling-related policies, but also maintains the existing sponsorship partnerships (it is intended, in the future, to hold a new bidding process in which the system will be exclusively financed by public funds). Policymaker P3 detailed these aspects in the interview.

> There are some aspects of [Bicicleta] Integrada that means the stations are always empty. That comes from the initial design, which we are now adapting. We designed a project with large stations, and have seen they aren't needed. We are going to start bids for a new design, stations in a bike rack format with an operator.

From these words, it can be seen that a series of adaptations are in planning, both in terms of processes and technological resources deployed. For instance, the modifications to the station pattern: they will be smaller than the current ones and adopt a container format, with an operator. Nevertheless, the value proposition based on long-term loans and non-pecuniary penalties will remain the same, taking into account that it meets users' needs and expectations. It is precisely this that justifies the change in the size of the stations: the use of bicycles for long periods makes them unavailable to other users for the most time, prescinding the need for many docks into the stations.

Another change in value proposition is that Bicicleta Integrada will now allow other cyclists to use the station to temporarily store their private bikes, also facilitating the integration of these users with the public transportation system. Among other advantages, the

presence of a technical operator will restrict the possibility of opportunistic behavior, favoring the collective interest.

> With an operator we will have contact, which is one of the most necessary things in this system. (...) Today, if the user is late [in returning], the penalty is just a day without use. But on that day he can't use it, he gets a bicycle with a card [BU] from his grandfather, from a friend, and the next day he can use his own. So he isn't very worried about that. (...) That won't happen anymore, because the operator will have to recognize the individual presenting the card. (Policymaker P3)

To complement all these changes, a separate project is under study, aimed at donating bicycles to the low-income population through sponsorship. It is expected that the beneficiaries of this project will not need to use the bicycle of the sharing system frequently, since they will now have their bikes. Effectively, there will be more shared bikes available to new users as well as those not contemplated by the donation project. Although the non-financial penalty remains a feature, at least in theory users will no longer need to bend the rules of use, since the practice of successively renewing the loan will no longer be necessary.

> We saw that the [Bicicleta] Integrada user is in a very low-income range, from zero to one minimum wage (...). This is really a group that cannot afford a private bicycle. So we are seeing if we can get a large donation of bicycles. That will give us more conditions, more access and allow sharing within what was designed for the project. (Policymaker P3)

Up to the time of this research, there was no guarantee that the donation project will be carried out. Even so, the intention itself to promote the donation of bikes to low-income people can be seen as evidence of the commitment to the logic of sharing. To the extent that such a project can avoid the misuse of shared bikes, it will benefit Bicicleta Integrada, preserving the essence of its business model.

Regarding the strategic performance management process, the actors taking part in the Bicicleta Integrada program will move to another level of public-private partnership management, similar to Bicicletar. The maturity level of the two bicycle sharing systems is already advanced, and this improvement in strategic performance management is both a necessity and evidence of this.

The rules for the use system are all reconfigured in this new project. For the user it is basically the same. But for the operator it is totally different. Now there are indicators that we will follow up on, to monitor the system, indicators for quality, maintenance and logistics. (Policymaker P3)

In a summarized way, Table 23 shows the adjustments made to the Bicicleta Integrada business model, relating them to the corresponding building blocks. This visualization allows a finer understanding of how the actors involved in the public-private partnership managed the business model to enhance a niche innovation.

Table 23 – Bicicleta Integrada's business model main adaptations over time

Component	Characteristic	At the time of launch	At the time of data collection (planned expansion)
Profit formula	Funding	Sponsorship resources, only	Sponsorship and public funding with resources from the Zona Azul system
Resources	Number of stations	7 (large and often with no bicycles available)	7, with a planned expansion of new stations to other TGA's (smaller, container pattern, with technical operator)
	Cycling infrastructure	Expanding, but still concentrated at central areas	Continuously expanding, covering peripheral regions
Processes	Strategic performance management	No enforcement ability by the city government	Enforcement ability will be enabled by the public funding model
	Station balancing	Ineffective (no penalties due to no enforcement), with users engaging in rent-seeking behavior and harming reliability	The container pattern with the technical operator is supposed to prevent users' misbehavior, key performance indicators will be enforced, subject to penalties
	Maintenance routines	As good as possible, without penalties due to no enforcement	Key performance indicators will be enforced, subject to penalties

Note: The Bicicleta Integrada value proposition and other business model characteristics not exhibited in the table had no changes over time.
Source: The author, from the research data.

As we did for Bicicletar, the next section connects the drivers and barriers underlying the legitimation process of Bicicleta Integrada to the determinants of legitimacy that emerged from the data, as presented in Figure 42. Each mechanism is also associated with the dimensions of legitimacy and the components of the business model to which they are related.

5.2.2 *Relating legitimation mechanisms and the Bicicleta Integrada business model components*

Bicicletar and Bicicleta Integrada share not only the cycling infrastructure but also some characteristics of their business models. We refer, for example, to essential processes

and resources, besides the value proposition itself, which delivers an active, sustainable, and inclusive mobility solution.

Moreover, Bicicleta Integrada emerged as a spin-off project of Bicicletar, aiming to solve the main weakness of its sponsored business model, as previously discussed. For this reason, several of the legitimacy mechanisms are common to both systems. Table 24 presents a deductive analysis of drivers and barriers of the Bicicleta Integrada legitimation process, as identified and discussed throughout section 5.2. We highlight in gray those mechanisms that are not common to Bicicletar, but specific to Bicicleta Integrada.

Table 24 – Legitimacy mechanisms of the Bicicleta Integrada system

Determinants of balanced legitimacy	Legitimation mechanisms (related business model building block) [a]		
	Pragmatic legitimacy	Moral legitimacy	Cognitive legitimacy
Interests and expectations of the public authorities (policy mix)	(+) The implementation of cycling infrastructure (KR) (−) The sponsorship model undermines the ability of the government to enforce the operator's performance (PF)	(+) The implementation of cycling infrastructure (KR) (+) The fully sponsored model facilitated normative approval since there was no cost for society (PF)	(+) The implementation of cycling infrastructure (KR) (+) Replication of good practices accelerated learning processes (KR & KP)
	(−) The long-term loan characteristic is a distortive benefit as it incentives opportunistic behavior by users (VP)	(−) The long-term loan characteristic is a distortive benefit as it incentives opportunistic behavior by users (VP)	(+) Communication and educational campaigns
	(−) Non-pecuniary fines is a distortive punishment mechanism as it incentives opportunistic behavior by users (VP) *(+) Reformulation of the Bicicleta Integrada's business model (PF, KP & KR)*	(−) Non-pecuniary fines is a distortive punishment mechanism as it incentives opportunistic behavior by users (VP) *(+) Reformulation of the Bicicleta Integrada's business model (PF, KP & KR)*	(−) The long-term loan characteristic is a distortive benefit as it incentives opportunistic behavior by users (VP) (−) Non-pecuniary fines is a distortive punishment mechanism as it incentives opportunistic behavior by users (VP)
	(+) Expansion of the complementary cycling infrastructure (KR) *(+) The public funding model gives public authorities greater enforcement capacity (KP)*	*(+) Expansion of the complementary cycling infrastructure (KR)* *(+) The public funding model gives public authorities greater enforcement capacity (KP)*	*(+) Reformulation of the Bicicleta Integrada's business model (PF, KP & KR)* *(+) Expansion of the complementary cycling infrastructure (KR)*
	(+) Expansion of bicycles and container-type stations to other traffic generating areas (KR) *(+) Stations will work with an operator technician (KP & KR)*	*(+) Expansion of bicycles and container-type stations to other traffic generating areas (KR)* *(+) Stations will work with an operator technician (KP & KR)*	*(+) Expansion of bicycles and container-type stations to other traffic generating areas (KR)* *(+) Stations will work with an operator technician (KP & KR)*
Interests and expectations of users and the general population	(+) Health improvement (VP)	(+) Health improvement (VP)	(+) Information on how to use the system is available in several ways (app, website, totems) (KR)
	(+) Full integration with the public transport system (VP) (±) Money-saving as the system is unconditionally free for users (VP) (±) Convenience: long-term bike loans give users the freedom and flexibility to carry out their mobility needs (VP)	(+) Full integration with the public transport system (VP) (+) The system serves more peripheral areas of the city (VP) (+) The democratization of public space (VP)	(+) Full integration with the public transport system (VP) (+) The system serves more peripheral areas of the city (VP) (−) The users' opportunistic behavior causes imbalanced stations and unmet demand (VP)

Determinants of balanced legitimacy	Legitimation mechanisms (related business model building block) [a]		
	Pragmatic legitimacy	Moral legitimacy	Cognitive legitimacy
	(+) The implementation of cycling infrastructure encourages citizens to engage in the Bicicleta Integrada system (KR)	(+) Sustainable mobility appeal meets environmental concerns (air pollution, CO2 emission) (VP)	(+) Communication and educational campaigns
	(−) The users' opportunistic behavior causes imbalanced stations and unmet demand (VP)	(+) Fostering a sense of belonging and citizenship (VP)	*(+) Expansion of the complementary cycling infrastructure (KR)*
	(+) Expansion of the complementary cycling infrastructure (KR)	(+) The fully sponsored model facilitated normative approval since there was no cost for society (PF)	*(+) Expansion of bicycles and container-type stations to other traffic generating areas (KR)*
	(+) Expansion of bicycles and container-type stations to other traffic generating areas (KR)	(−) The users' opportunistic behavior causes imbalanced stations and unmet demand (VP)	*(+) Stations will work with an operator technician (KP & KR)*
	(+) Stations will work with an operator technician (KP & KR)	*(+) Expansion of the complementary cycling infrastructure (KR)*	
		(+) Expansion of bicycles and container-type stations to other traffic generating areas (KR)	
		(+) Stations will work with an operator technician (KP & KR)	
Marketing interests and strategies of each sponsor	(−) Sponsors have left the public-private partnership		
Maintenance issues	(+) Well-trained field technicians perform maintenance routines adequately (KR)	*(+) The greater enforcement capacity by the local government might improve maintenance routines performance (KP)*	(+) Replication of good practices accelerated learning processes (KR & KP)
	(+) Strategic performance management counts for improving maintenance indicators (KP)		
	(+) The greater enforcement capacity by the local government might improve maintenance routines performance (KP)		
Station balancing process	(−) The station balancing process is harmed by opportunistic behavior by users (KP)	(−) The station balancing process is harmed by opportunistic behavior by users (KP)	(+) Replication of good practices accelerated learning processes (KR & KP)
	(−) The low availability of bicycles at stations creates unmet demand (KP)	(−) The low availability of bicycles at stations creates unmet demand (KP)	(−) The station balancing process is harmed by opportunistic behavior by users (KP)

Determinants of balanced legitimacy	Legitimation mechanisms (related business model building block) [a]		
	Pragmatic legitimacy	Moral legitimacy	Cognitive legitimacy
	(+) The greater enforcement capacity by the local government might improve station balancing performance (KP)	*(+) The greater enforcement capacity by the local government might improve station balancing performance (KP)*	(−) The low availability of bicycles at stations creates unmet demand (KP)
System reliability	(+) Effective maintenance routines ensure system reliability (KP)	(−) The low availability of bicycles at stations creates unmet demand (KP)	(+) Replication of good practices accelerated learning processes (KR & KP)
	(−) The low availability of bicycles at stations creates unmet demand (KP)	(−) Imbalanced stations harm the system reliability (KP)	(−) The low availability of bicycles at stations creates unmet demand (KP)
	(−) Imbalanced stations harm the system reliability (KP)	(−) Technical failures impair the reliability of the system (KP)	
	(−) Technical failures impair the reliability of the system (KP)	*(+) The greater enforcement capacity by the local government might increase system reliability (KP)*	
	(+) The greater enforcement capacity by the local government might increase system reliability (KP)		

Note: [a]. (+) driver of legitimacy; (−) barrier to legitimacy; (VP) Value proposition; (PF) Profit formula; (KR) Key resource; (KP) Key process. Mechanisms in italics are associated with the reformulation of the Bicicleta Integrada business model. In gray, we highlighted those mechanisms that are not common to Bicicletar but exclusive to the Bicicleta Integrada system.

Source: The author, based on the research data.

Among the common mechanisms acting on the legitimation processes of the two bicycle sharing programs, there are drivers of legitimacy associated with the business models components: (i) value proposition, such as health improvement, sustainable mobility meeting environmental concerns, and democratization of public space; (ii) key resources, such as the implementation of cycling infrastructure; and (iii) key processes, such as strategic performance management improving maintenance indicators and imbalanced stations harming the system reliability.

Barriers to legitimacy shared by Bicicletar and Bicicleta Integrada business models were identified for two building blocks, namely key processes and profit formula. Regarding key processes, we mention imbalanced stations and technical failures, which prevent legitimacy by harming the system's reliability. Concerning profit formula, in turn, we refer to the sponsorship model itself: this arrangement has been supporting societal approval of both programs since there has been no cost for society while undermining, on the other hand, the policymakers' ability to enforce the operator's performance.

But the research data also showed drivers and barriers specific to the Bicicleta Integrada. For instance, some aspects of the value proposition are considered important drivers of pragmatic, moral, and cognitive legitimacy, especially with the public it intended to serve. The "full integration with the public transport system" and "serving the more peripheral areas of the city" mechanisms meet the needs of low-income people, who live in poorer regions and with precarious urban infrastructure. The same can be said about factors like "money-saving" and "convenience", as the system is unconditionally free for users and the long-term bike loans give them the freedom and flexibility to satisfy their mobility needs.

While satisfying immediate needs, money-savings and convenience have stimulated opportunistic behavior on the part of users, who do not return *their* bikes to the stations to share them with other users. We argue that such behavior is a barrier to legitimacy that is inherent in the current business model. It ends up amplifying problems like the low availability of bicycles at stations (imbalanced stations), which in turn creates unmet demand by preventing the participation of other users in the system.

There is an unexpected underlying dynamic here: two characteristics of the business model, namely the long-term loans and non-financial penalties, have been working as a distortive couple of mechanisms of incentive and punishment, respectively. They encourage users to engage in rent-seeking behavior – at the cost of everyone else – in two possible manners: in bypassing "the spirit of the rule" when accepting non-pecuniary

punishment for considering it compensatory, and by bending the rule itself when using a relative or friend's integration (BU) card to renew successively the loan of the same bicycle. The interaction between a distortive value proposition and users misbehaving thus counts for impairing the system's reliability. Ultimately, this has been to weaken the Bicicleta Integrada's attributes of moral, cognitive, and pragmatic legitimacy.

To deal with these barriers, the municipal management decided to reformulate the Bicicleta Integrada business model. Although the financing through the sponsorship partnership that is still in force, the improvements will also be based on the same political decision that determined the funds raised in the Zona Azul system to be applied to cycling and active mobility policies.

In addition to expanding the cycling network to unmet regions (complementary infrastructure, which is a key resource), other measures include: expanding the number of bikes available to the community (key resource), deploying new stations in other traffic-generating areas, adopting the container-type station pattern (key resources) and, mainly, changing the functioning model of stations, which will be operated by a technician who will assist users in the procedures of taking and returning bikes (key resource and key process), inhibiting opportunistic behavior by users.

By implementing these actions, the local government was able to adapt the business model to achieve several cognitive, moral, and pragmatic legitimacy requirements without thereby abandoning any of the main Bicicleta Integrada's value propositions. The program will remain unconditionally free for users, with non-pecuniary penalties, and delivering long-term bicycle loans with full integration with the public transport system.

The business models and legitimacy mechanisms and dynamics discussed so far have been restricted to bicycle sharing systems in the city. The third case studied – Vamo Fortaleza – adopts an electric car sharing model, which means different technologies, processes, and expectations. The next section begins by opening its business model to discuss how these differences influence legitimacy strategies and dynamics.

5.3 Vamo Fortaleza business model

Vamo Fortaleza electric car sharing system started operations in July 2016, still in the testing phase and presentation for citizens. As stated by policymaker P2, "(...) the objective was to really be cutting edge, in the sense of breaking with the concept of shared mobility being only with bicycles in Brazil. So this is the first public system for sharing cars,

and the first public electric system as well." Figure 43 presents in detail the characteristics of its business model.

Figure 43 – Vamo Fortaleza business model
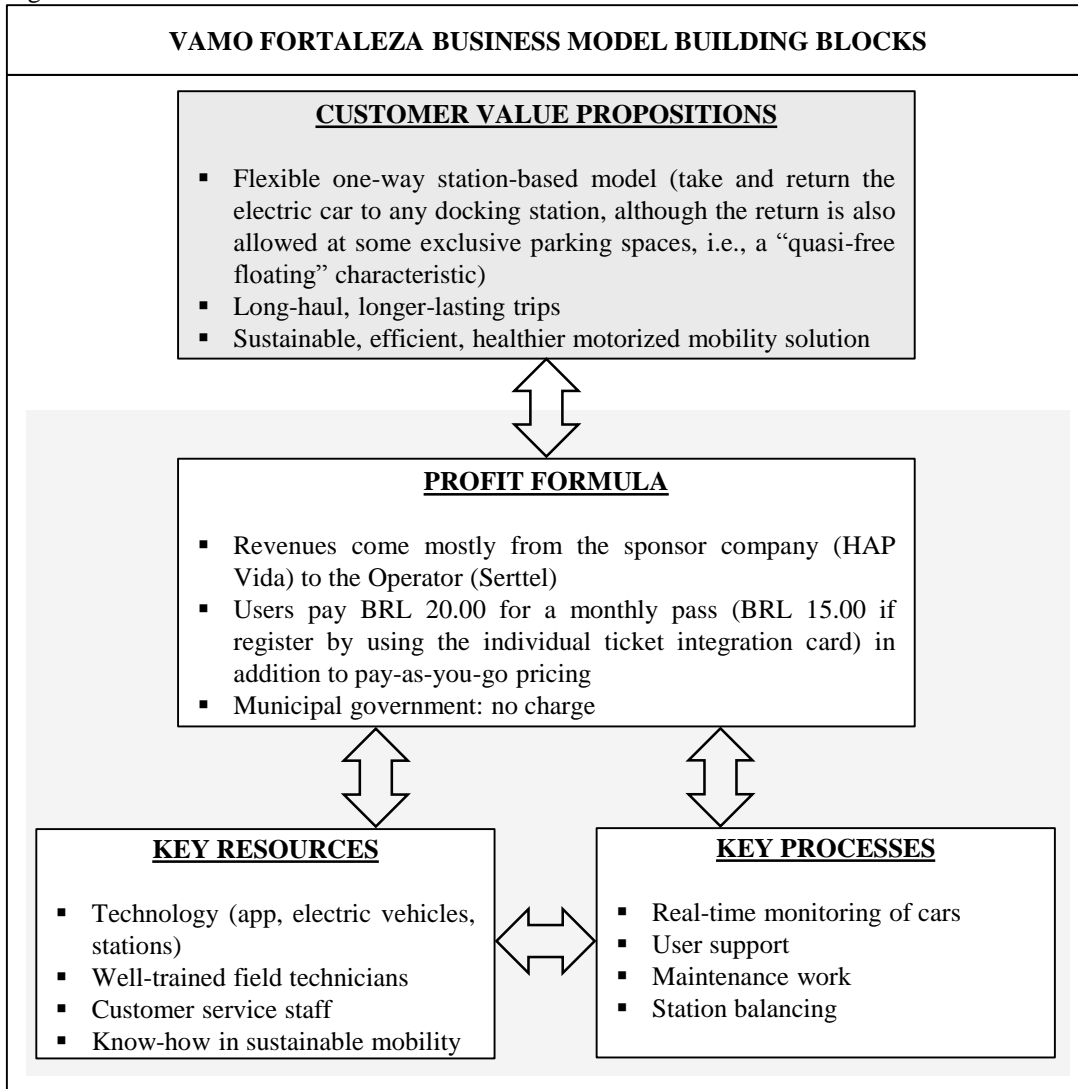
Source: The author, based on the research data.

In September 2016, the program entered the assisted commercial operation phase, serving all users whose registrations were duly validated. According to its value proposition, it is a flexible one-way station-based model, where the user can take an electric vehicle from one station and return it to any of the other stations of the system. "There are 12 stations for taking out, returning and recharging cars, as well as 6 more spaces only for returning cars." (Doc #8)

Vamo Fortaleza is said to adopt a flexible station-based model because there is also the option of return in exclusive spaces distributed by some neighborhoods. Although on a very small scale, such a feature keeps similarity with free floating sharing models, in which

vehicles can be returned anywhere in the city or within a radius of distance to the nearest recharging station.

Vamo Fortaleza is one more alternative for long-range and long duration commutes – therefore, motorized – besides being sustainable and healthier than its traditional counterparts, powered by internal combustion engines (Doc #8). As policymaker P2 stated,

> We work using some principles, and one of them is to reduce emissions, mainly related to transportation. We understand that the individual motorized [vehicle] also has a role in this panorama. (...). Vamo comes into this idea for promoting an alternative to complement the other modes.

Among other benefits provided by systems like Vamo Fortaleza, there is a possible money-saving for users, since the shared electric vehicle "(...) avoids the need for purchasing and maintaining a private car." (Doc #9). In this context of utility benefits, and regarding Vamo users, a public manager declares:

> It is an audience that has understood that one does not need to own the good to enjoy the service. He does not need a car for every commute, he does not need to have the car all day long; he can make one section of the commute by bicycle, or bus, and for another section, if it is most convenient, he can take the car and use the service. All without having the overall cost of owning the car. He doesn't have to worry about depreciation, maintenance, purchase, etc. (Policymaker P2)

Car sharing systems can also enable more space on public roads and greater availability of parking spaces, resources that are known to be scarce in large cities. This would result from the potential reduction in the number of private cars, although it should be noted that such benefits are only perceived from very wide scales of operation, with each shared car avoiding between six and nine private individuals (Doc #9). Besides, "(...) the idea is that Vamo will also encourage ride sharing, thus promoting collaborative and shared consumption." (Doc #8)

Regarding the financing model (profit formula) of Vamo Fortaleza, there are two main sources of funding directly transferred to the operating company: the sponsorship resource, condition of the public-private partnership, and the revenue from the sale of monthly passes and charging for time of use. Thus, as with Bicicleta Integrada and Bicicletar programs

(for the latter, until the recent expansion, as already discussed), the municipal government has no operating cost of the system, which indirectly benefits the entire local society.

One of the documents analyzed mentions that "the system integrates with the other transportation modes." (Doc #9) Taking the urban mobility regime of Fortaleza as a complex system, constituted by a variety of alternatives of commuting, each one with its actors, resources, processes, and purposes, the characteristic of modal integration can be seen as inherent in the Vamo Fortaleza. According to a policymaker, the system is one more alternative within an urban mobility network made available to citizens.

> Vamo fits in with this sense of being able to construct a multimodal network. Make it so the user is not tied to the concept of the car as an asset, the car as a possession, when effectively moving around the city. He has options for deciding within his needs, according to what is most appropriate. (Policymaker P2)

However, from a technical perspective, the only integration with the public transport system empirically observed – both through field observations and interviews – is the spatial distribution of the station network. Vamo stations and exclusive spaces are located in regions with great demand for traffic, some close by some public transportation system equipment. An example has already been discussed in Figure 26: Vamo 11 station – Igreja Matriz da Parangaba is shown a few meters away from a bus terminal, a subway station, and an LRV station, where there is also a Bicicleta Integrada station. Another example is shown in Figure 44.

Figure 44 – An example of a Vamo Fortaleza station and its location
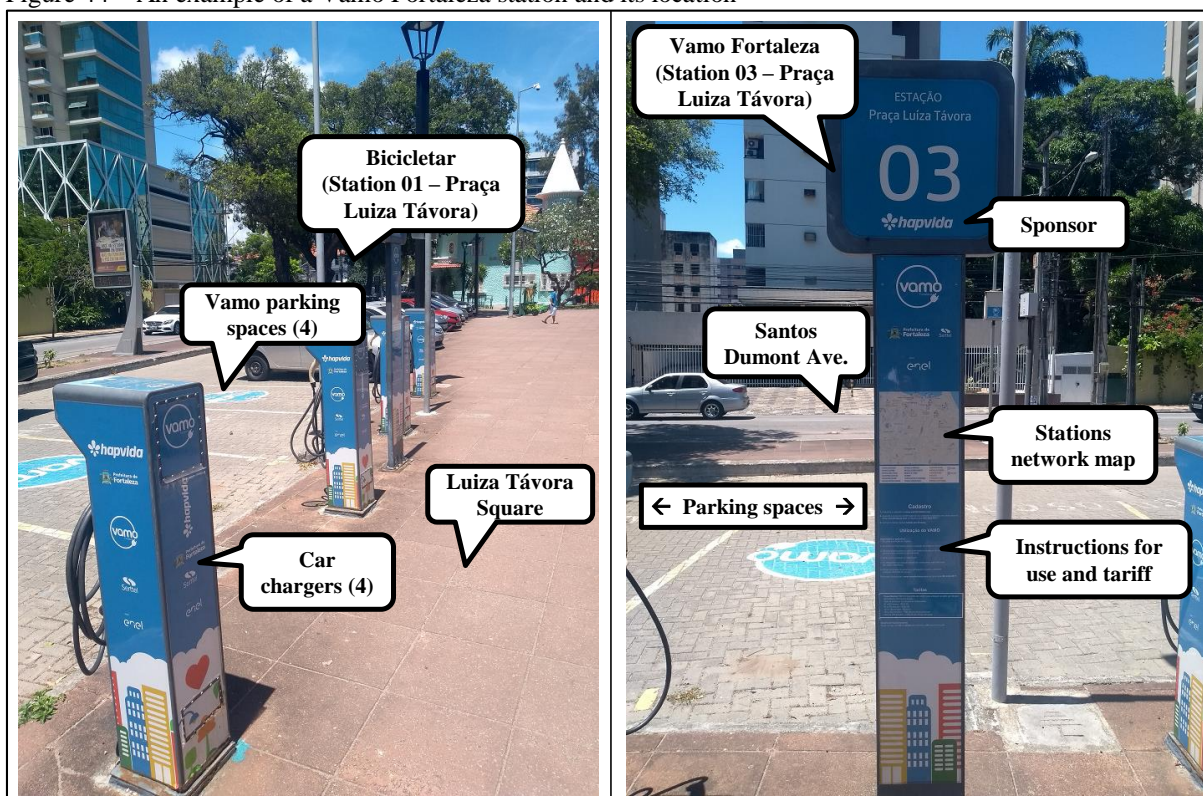
Source: The author, from the research data (own record, captured on Oct 23, 2019).

The picture shows Vamo station 03 – Luíza Távora Square, which has four parking spaces for electric vehicles, each with a battery recharge point connected to the commercial energy network. The area around the square that gives the station its name is a very busy area of the city, with many commercial and residential buildings. Santos Dumont Ave., which borders the Vamo station itself, is one of the most important urban corridors in the city of Fortaleza, where several bus lines also run. In the square, there is also a handicraft center, besides buildings of public bodies. There is also the first station of the Bicicletar system (station 01).

In terms of ticketing, however, there is nothing that could be considered integration with public transportation. There is, in fact, a kind of incentive for the user to register in the system using the Bilhete Único (BU) card. As the price list informed in Doc #9 indicates, these users have an additional benefit: a 25% discount on the price of the monthly pass, going from BRL 20.00 to BRL 15.00, being fully maintained the table credit for consumption. For other users, registered without BU information, the monthly pass costs the standard price of BRL 20.00.

About the essential resources to bring Vamo Fortaleza's value proposition to effect, there are similarities in comparison with the two bicycle sharing systems. Firstly, one

cites the know-how in sustainable mobility solutions, although in the case of Vamo it is not the so-called active mobility but a motorized one. As in Bicicletar and Bicicleta Integrada, the development of the car sharing application was also done by the operating company.

Due to the greater technological sophistication embedded upon and operational complexity – compared to sharing bicycles – Vamo Fortaleza also has technical professionals trained among its resources, both for field routines and those supporting users. Additionally, the company sponsoring the program has know-how in partnerships focused on sustainable mobility.

> Vamo was born from this idea of taking to the population a means for locomotion that does not pollute the environment and is shared (...). Regarding shared bicycles, we have this service in Belém, which is present in areas with a lot of movement and tourist spots. (Sponsor S1)

Concerning technology-based resources, one mentions the stations and their related infrastructure (spaces, chargers), as presented above; the smartphone application; and the electric cars themselves. As with bicycle sharing systems, the Vamo application allows the user to make autonomous commuting decisions. This feature could be confirmed both by users and through participating observation notes: "Use of the app is intuitive: it shows the number of cars available at the station, with a photo of the model, charge level of the battery and the position (charger) where it is connected." (Participant observation, February 06, 2020, from Vamo station 11 – Igreja Matriz da Parangaba, to Vamo station 01 – Igreja de Nazaré)

> (...) usually I always like, before requesting the car, I always see if there is a car available at the base, and reserve it. (...) I open the app, see where the vehicle is, reserve it and go get the vehicle. Then with the app I am able to open the door, turn on the vehicle, and then the clock starts running. (User V4)

Figure 45 displays three screens of the Vamo Fortaleza application. They illustrate the use steps that precede the confirmation of reservation and use of a vehicle. On the left, one can see the map with the location of the stations and exclusive spaces. It is also observed the position where the user is – in this case, the researcher – so that it is possible to identify the most convenient Vamo station to access the service.

Figure 45 – Screens "Stations" of the Vamo Fortaleza app
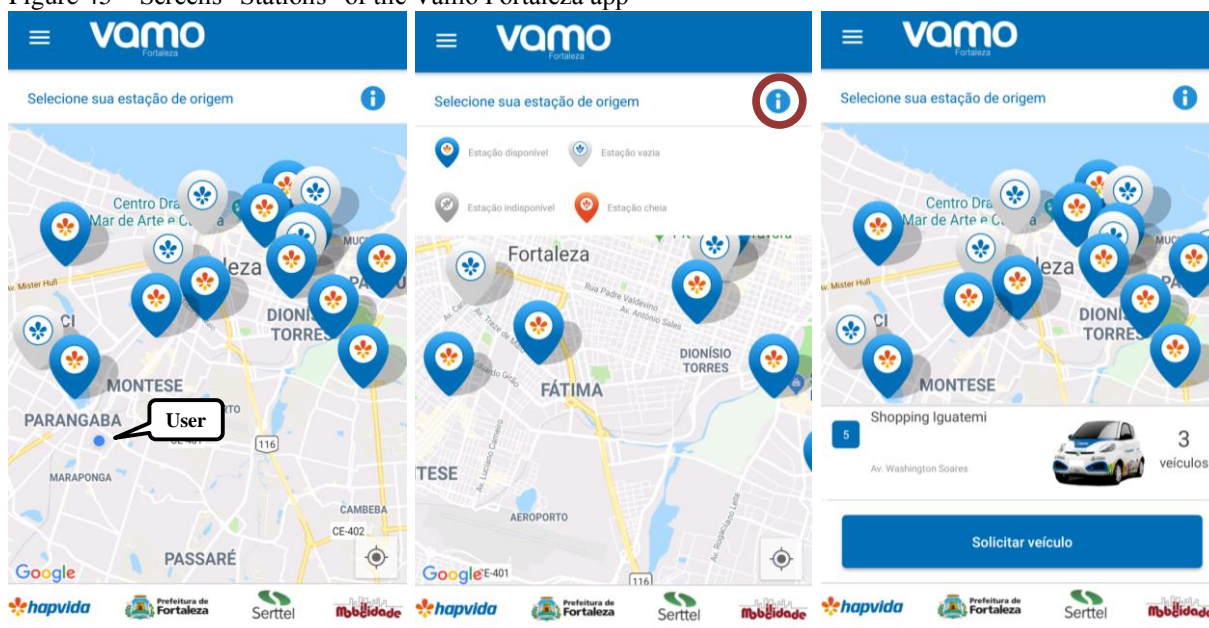
Source: The author, screenshots extracted on September 16, 2019.

On the center, in the upper part, one sees the detail of the legend, which can be displayed by pressing the information icon (as highlighted). Finally, on the right, the figure shows the selection of a station (Station 05 – Shopping Iguatemi), which had, at that moment, three electric vehicles available for use. The user must then press the button "request vehicle" to proceed with the request.

In addition to these, all other procedures necessary to use the system can be performed via the application. This includes the registration and submission of documentation (personal identification data, national driver's license, and proof of address), the purchase of monthly passes, as well as the routines of use themselves, namely: performing a virtual test-drive, selecting of stations and requesting of vehicles (according to Figure 45), return vehicles, monitoring in real-time the level of charge of batteries, unlocking and locking doors, requesting for remote support in emergencies, and checking travel history. Figure 46 shows examples of application screens with some of these features.

Figure 46 – Examples of screens when using the Vamo Fortaleza system

Source: The author, screenshots extracted on February 06, 2020.

Regarding the vehicles, according to the analyzed documents, the system went into operation "(...) with 20 shared electric cars, models "BYD e6" and "Zhidou EEC L7e-80," both models being 100% electric." (Doc #8) Figure 47 shows one of the two electric vehicle models adopted at the beginning of the Vamo's operation.

Figure 47 – Electric vehicle, model Zhidou EEC L7e-80

Notes: As we will discuss later, this model was removed from the Vamo's fleet in October 2019, and replaced by the Renault Zoe model in late December 2019; the green license plates indicate that the vehicles were undergoing experimentation, not yet approved for commercial use in Brazil.
Source: Doc #8.

In view of the innovative character of both its business model and the vehicle technology itself (electric, start/stop button, automatic gearshift), some processes are considered essential for the proper operation of a sharing system such as Vamo Fortaleza. User support is an example. This process is already observed in the first stages of service provision, in the routine of registration of users, as detailed in Doc #8.

> To register, users must provide an electronic address (e-mail) on the system website www.vamofortaleza.com. (...) they should also send via the website their personal data and photos of their Driver's License (CNH) proof of residence (…). The information will be verified by the operator, who will contact the user to schedule a time, date and station chosen by the user for signing a Term of Responsibility, as well as for a test-drive accompanied by a technician. (Doc #8)

The fragment above also mentions the performance of test-drives, another important process for user learning, reducing cognitive barriers to use, and increasing the system's comprehensibility. In the initial months of operation, the operator company (Serttel) assisted users during scheduled test-drives at a station of their interest, which is considered another evidence of this support process.

> To date, the system has 4,239 registrations and *1,479 test-drives have been carried out (currently, the test-drive is optional for the user)*, and has provided 4,959 commutes, involving more than 122 thousand kilometers traveled (…), which corresponds to almost 17 times the length of the Brazilian coastline. (Doc #8, our emphasis)

The research data also show another key process: the remote supervision of vehicles and stations, either for maintenance work or for emergencies with users. In this way, it is verified that the support to users during the practice of using the system also occurs, and is only possible because of this monitoring ability. The words of the user V2 serve as evidence for this.

> I have always had lots of support. For example, from using the car a load its battery was running down, and I got a call from the control center saying "Hi, [User's name omitted]. Your car is running down! The closest station to you is on such and such road, so why don't you change cars there?" It's a very nice touch. (User V2)

As with Bicicletar, in which empty or full stations damage the system reliability, the balancing of stations aiming at the adequate distribution of electric vehicles among them is also a key process for Vamo Fortaleza. This process becomes more relevant because users can return the cars in any of the six exclusive spaces that have no recharging point. Unless the battery charge level is still satisfactory – which can be remotely monitored – returns in these places will require the operator company to relocate the cars to one of the twelve main recharging stations.

Unlike the Bicicleta Integrada and Bicicletar, the data have no provided evidence that strategic performance management is a key process for the Vamo Fortaleza's operations. The interviewees did not mention the existence of structured models for monitoring performance indicators and operational routines. Although there should be performance targets in the public-private partnership contract, this finding reinforces the evidence of the Vamo's maturity stage, still in the structuring phase, operating on a very small scale.

5.3.1 Legitimation dynamics of the Vamo Fortaleza system

Vamo Fortaleza was the last of the three cases analyzed in this research to start operations. As discussed in this section, the structuring process of the program has advanced in some dimensions (e.g., technology) more than in others, leading to its current stage of maturity and scale of operation.

The data obtained show that the program is seen as a pilot project, experiencing learning processes and improvements needed for its structuring. They point out some factors that may be acting as barriers – lock-ins – to its establishment at the level of the socio-technical regime, among which are the insufficient direct and complementary infrastructures, the lack of knowledge about the use procedures on the part of potential users, the requirements necessary for entry into the system, and the search, still underway, for a viable economic model.

It has been previously discussed that the city government has demonstrated, in several ways, commitment to the transition to sustainability in the context of urban mobility. As with Bicicletar and Bicicleta Integrada, Vamo Fortaleza appears as another venture in this scenario. Its existence, per se, not only confirms this commitment but also evidences an effort to legitimize the sustainable mobility agenda. From a political action perspective, and given its pioneering character in Brazil, the project is considered to be a strategy to raise discussion around this agenda, that is, a showcase. This is what the words of a public manager denote.

> Vamo is more of a *showcase*, since it is too small to serve the population as Bicicletar already. (...) But the idea really was to have a project as a *showcase*, to bring to the city a discussion on sustainable mobility and emission reduction. Electric cars can also play that role. And also for us to start to encourage placing chargers in the city so that over time people can start buying electric cars because they are already familiar with the technology... (Policymaker P3, our emphases)

Considering that 60% of the CO_2 emissions in Fortaleza come from the transportation system, a brief comparison with the current scale of the program is enough to realize the still incipient character of the initiative. Indeed, with only a few electric vehicles, 12 charging stations, and six exclusive parking spaces, the Vamo Fortaleza still seems embryonic, which indicates an early stage of structuring.

In comparison with the other cases investigated, Vamo is, in fact, the one which is at the earliest stage of development, an opinion shared by the three policymakers participating in the research. According to interviewee P1, "Bicicletar and Bicicleta Integrada are already public policies, they have become public policies, they have expanded. Vamo is now leaving its pilot nature and beginning to be a public policy." For the policymaker P2, Vamo Fortaleza "(...) is, above all, a pilot, a proof of concept for us to understand what are the barriers and what level of adherence exists for this mobility demand today." Therefore, it has not yet achieved a stabilized level of structuration, sufficiently legitimized.

Recognized by the municipal management as a pilot project, there is vast evidence that, to gain stability, Vamo Fortaleza has undergone a continuous process of experimentation based on trial-and-error routines. The lack of reference models within the Brazilian context has prevented the identification and incorporation of best practices and lessons learned. This represented a challenge of cognitive legitimacy, which led those responsible for implementation to seek references outside the country. Adapting international experiences to the local scenario made their structuring and stabilization process more costly.

> With Vamo we made more mistakes, because as it was the first system in Brazil, we had no reference at all. We didn't even know what fee to charge! The people from France were the ones we talked to most. But it is very different from pricing a system in France, totally different purchasing power, different currency. (...) so we made lots of mistakes but also got things right. I think that is why Vamo hasn't taken off yet. (Policymaker P1)

This means a greater intensity of adjustments and improvements in its business model, which is typical of innovations at an early stage of development. These are adaptations aimed at obtaining or expanding legitimacy in its pragmatic, moral, and cognitive dimensions. As has been argued so far, legitimacy is a crucial resource for the success of shared mobility programs, such as those implemented in the city of Fortaleza.

5.3.1.1 Value proposition

The Vamo Fortaleza value proposition, based on a sustainable motorized mobility solution by electric vehicles, is recognized by users. Except for the user V3, for whom "protecting the environment does not play a role [in the decision to adopt the system]", this aspect is present in the speech of other interviewees, as the fragment below illustrates.

> For me, it is a very nice alternative way not to pollute the environment. So that is one of those things, like, that most drew my attention to use it. Because I know I am one less person producing CO_2. (User V2)

Although the value proposition has remained the same, the way it is delivered has undergone several changes since the creation of the program. In seeking greater alignment with the needs and expectations of users and other actors (sponsor, operator, public power), and with the current regulatory framework, the business model has undergone adjustments, both in terms of the technology and infrastructure employed, as well as processes and funding model.

The users' profile presents some typical characteristics. It is a predominantly young public, up to 40 years old, enthusiasts of multimodality. Curiously, only one out of the interviewed users is within this age group, while two others are slightly older, aged 42 and 43. According to policymaker P2,

> Vamo has molded itself especially to a younger audience. The majority, I think more than 50%, almost 60% are up to 40 years old. It's a younger audience, and one with a more multimodal profile. It's the guy who rides the bus, rides the bicycle to work, comes back by Vamo (...). We talk with users and generally those who use Vamo use it to complement another mode or in specific situations.

This multimodal profile drawn by the policymaker P2 was verified among the users addressed in the research. When asked about the reasons for using Vamo, a participant emphasized: "I use it *in addition to bus, taxi, uber*, which are close by and cheap. I seldom need a car, it's not worth the cost to own one." (User V3, our emphasis) On the other hand, user V2 stated that besides Vamo, it also uses the shared bicycle system and ride sharing platform services like Uber.

> I have access to Uber, my family, my sisters have access. But we often get a bike that that is on the corner of my street, at a station, to go to the supermarket, to pay a bill. So. Alike, it's something that is part of the life of someone in Fortaleza today, this system (User V2)

As can be seen, these are people who disregard the possession of a private car to benefit from the mobility options existing in the city. This indicates that the offer of different mobility alternatives plays a role in the individual willingness to purchase a car. Among the users, only one (V4) reported owning a private car, but still made frequent use of Vamo Fortaleza. Besides the sustainable appeal, motivations related to the Vamo's innovative appeal were identified.

> It's because I think if it were a combustion vehicle, shared, I wouldn't get it. Because I already have, already have a combustion car. So why would I get an electric one? Because it's different! That's the appeal of the thing (...) Why don't I get a shared bicycle? Because I already have a bicycle! I'm not gonna get a bicycle. Now if it were an electric bicycle... I would get it! (User V4)

In socioeconomic terms, the system serves a segment of users who have a higher average income profile than users of shared bicycle systems. As a public manager will argue below, this is not, by purpose, a political decision aimed at privileging the higher-income population. This is due to the very legal requirements for driving cars, a characteristic intrinsic to the service offered. Meeting these requirements gives Vamo Fortaleza pragmatic legitimacy by aligning with the regulatory framework.

> Vamo was designed with these sustainability issues more in mind. So then the target audience ends up really being those who have access to getting a driver's license. That limits things a bit, because not everyone has an automobile driver's license. It

> was not designed with a specific target audience of a higher income class, but it actually ended up serving that audience more. (Policymaker P3)

But not only does regulation restrict the adoption of Vamo Fortaleza. The need to register an active credit card for using the system is another barrier to the entry of low-income people. The acquisition of a monthly pass and the pay-as-you-go fee are both automatically charged using a credit card informed by the user at the time of registration. The credit card is an unavailable resource to most of the population, mainly in a metropolis with great social inequalities in a developing country. As user V1 argues, "The person will need a credit card, and not everyone has a credit card, do you agree? The great majority do not. So that inevitably segregates people."

> And I think that another issue that may have an impact is the price. Not everyone can link to their credit card, or think going by Vamo is accessible. Although I, as a user, always say that yes, right, the price is fair... I think it's super fair! (User V2)

And even for those who have a credit card, the cost of the service can be considered prohibitive. As noted above by user V2, although the price is considered accessible and fair for the service offered, it is not a value that every citizen can easily afford. The user V4 confirms this perception.

> It's not so fair for you to get a vehicle where you pay like about BRL 15 per hour, and it ceases to be accessible. It's a cheap price, but if you get like, three hours, you're gonna spend BRL 45. (...) So really, I have spent up to around BRL 500 per month using it, so it's not so cheap, right? (User V4)

In some way, these legal (driving license) and commercial restrictions (price) act as a barrier to the adoption and popularization of Vamo Fortaleza. It is necessary to emphasize, however, that like any solution or service, its value proposition will align more to certain segments than others, bringing different challenges to obtain legitimacy.

5.3.1.2 Profit formula

The first effort to deal with such challenges took place in the profit formula building block, which is divided into two sources: sponsorship resources and fees for passes

and use. In the original business model, fees were considered high, which led the program managers to decide on its reduction a few months after the beginning of the operation, as documentary evidence points out.

> In March 2017, the City Government of Fortaleza (...) reduced fees for using Alternative Vehicles for Mobility (VAMO) by up to 68&, to encourage a continuous increase in their use (...) as well as to stimulate sharing of vehicles by users and serving more people. (Doc #8)

Both the purpose and the message this decision signals to society – to expand access by allowing a greater number of citizens to participate – gives the Vamo Fortaleza greater normative acceptance and thus play a role in driving moral legitimacy. Besides lowering one of the access barriers, the reduction in the price of the service has brought a utility benefit to current and potential users, contributing to the gain of pragmatic legitimacy. Some testimonials validate this finding.

> I think the price is a factor for access. Up to three hours [of use] is an accessible factor. But after three hours it starts getting rather steep. I don't understand very well what the projection was, but I remember I once did an analysis of more or less what I was using, and I saw that it was worthwhile up to three hours. (User V1)

> The price for one use is quite accessible. If you keep the car for up to three hours you pay BRL 35, and you don't have to gas up, right? Three hours is enough, get it? It's cheaper than a Uber! If you take a ride with Uber, it comes close to that ore even more. And the car [Vamo] is there with you, at your disposal, right? (Operator O1)

In these words, participant O1 alludes to Vamo's economic advantage when comparing its prices with those of a consolidated, competing solution, namely, Uber. It is worth mentioning that the revision of the prices of monthly passes and per-time use fees was not exclusively motivated by the need to seek greater adherence by the population. The research data showed that there was another factor to influence the legitimation dynamics of Vamo Fortaleza: the threat of other new entrants into the same market of shared mobility. We refer to platforms whose business models are based on ride sharing (or ride hailing), such as Uber, 99 Taxi, among others.

> Vamo was a little more complex because when we were planning the system, we still did not have the platforms here, the transportation apps like Uber, 99. So it was a strong option, it had a price that was very compatible with a taxi. But as soon as we inaugurated Vamo, the digital platforms arrive, a competitor who came in with a bang. (Policymaker P1)

Although the price originally charged to Vamo users was competitive compared to the traditional taxicab solution – then its main rival – the ride sharing platforms entered the local market with an aggressive pricing policy, eliminating this relative advantage. More than that, the main service offered by these new substitutes was and still is, the same, that is, long-distance, motorized and short-term mobility. Despite this, at that time, the more competitive prices they charged could provide the user with an advantage that exceeded the distinction offered by Vamo Fortaleza with its value proposition of healthy and sustainable appeal. In a sentence, the utilitarian benefit provided by one alternative could supplant the benefit of normative approval from the other (it is worth mentioning that ride hailing companies often claim environmental benefits from their operations due to an allegedly smaller number of cars on the streets).

With the price change, Vamo Fortaleza has equated itself to ride hailing solutions – such as Uber and others – in terms of financial benefits provided to users. Excerpts from interviews show how the system has become a more advantageous substitute for these platforms, meeting the needs of many different ones.

> I don't need to rent a car, don't need to bother family members to borrow a car. And I don't need to spend a pile of money getting a Uber. Just one place where I have some properties I rend out, going by Uber it's BRL 80, just one way, understand? (...) So it depends very much on the user profile a person has. (User V1)

> In a large car I can take five friends. So it's cheaper than calling Uber. And there isn't this business of paying a dynamic fare, which you sometimes pay with Uber. (...) For example, New Year's Eve it's impossible to get a cheap Uber! It's easier to use Vamo and go to your friends' house. (User V2, referring to the BYD e6 electric vehicle, the only one with five seats at Vamo Fortaleza at the time of the interview; the other available model, Zhidou EEC L7e-80, has only two seats)

This way, the price reduction was able to unify the utilitarian advantages (pragmatic legitimacy) to those of social or normative nature (moral legitimacy), which met

users' expectations and amplified the access to the system. On the other hand, a challenge remains: to find a financial equation that makes its expansion possible. In this respect, the words of policymaker P1 are elucidative.

> The great challenge today with Vamo is the fee issue, right? I mean... how to find a financial equation so it's more accessible to everyone. There was a reduction, and use increased greatly. (...) We've gotten past the technology barrier. The challenge now is the business model, finding a financial equation to make the fee more inclusive. That involves a talk with the sponsor and the system operator. (...) that is an equation between them, there. (Policymaker P1)

One notes that there is a predisposition of the public manager to defend what he considers an even "more accessible" and "more inclusive" price, using his words. He makes it clear, however, that this is a "great challenge". This is because any reduction in the prices paid by the users can bring a risk of financial imbalance to the operating company. These fees represent a considerable portion of its revenue. Consequently, any waiver of revenue from one source (e.g., fees) will need to be counterbalanced by the other source (in this case, sponsorship resources). This calls to the importance of another actor, the sponsoring company, which also has its image interests to look after.

5.3.1.3 Key resources

Further adaptations were made to the essential resources of the program, not only in the technological aspects but also in the infrastructure of the station network. It is in the technological dimension, by the way, that the public managers recognized the main advances in the structuring of Vamo Fortaleza.

> Our idea currently was to test the technology, whether the car works, whether it has the autonomy the supplier says it has. (...) test how things work with every part of the app. Today you open the car door with the app. With that technological barrier overcome, that the system works, we saw that it works, even the stations... With that taken care of, we are now trying to see how to expand, move beyond the pilot nature and really become a program with an impact. (Policymaker P1)

For the public managers involved with the Vamo Fortaleza, the embedded technology (application, electric vehicles, station network, and its recharging points) has

already been exhaustively tested and can be considered well developed, stabilized. Reports from some users, however, pointed out the need to correct application errors, such as slowness in locking or unlocking the car doors, the need to authenticate several times in the system, or the difficulty of managing the registered credit cards.

> I had to re-apply for my existing membership twice when the app stopped working. That worked online, but may be not everyone will think of that solution. (…) Sometimes it takes time and various efforts to open or close the doors via the app. (User V3)

> I had a credit card cloned, and they don't allow you to use two cards. You have to call there and say. "look, I'm trying to change, cancel this card because I'm trying to register another one and cannot." (...) They should allow you to add several [means] for payments. In fact, you only know you have to get in touch [with support] because you are tying with the app and are not able to. (User V1)

> I was trying to use the app, but it says that for some reason my registration is not active. And I wanted to know what it wasn't active and could not talk to anyone to get an answer. (...) But it's always had glitches. I think that something positive would be to work on really improving the app. That is also something that encourages the users, right? I know there won't be a glitch, that I will not have any problems when I need to talk with Vamo. (User V2)

These fragments show how failures and malfunctions undermine the perceived reliability of Vamo Fortaleza and how this affects its attributes of legitimacy. In the records of participant observations were also identified evidence of failures related to the application and Vamo internet website. They occurred on two occasions: during the registration procedures and in the initial attempt to purchase a monthly pass to use the system.

The first failure occurred due to the obligation, not clarified by the system to the user, to inform a valid BU card number to complete the registration via the platform website. Evidence has shown, for instance, "the absence of a specific error message to make the user aware of the problem in the registration procedure", and "vague and inefficient guidance from the support team, with the solution being obtained by the researcher himself through trial and error" (Participant observation, procedures for registration in the Vamo Fortaleza system, from August 28 to September 30, 2019).

These records show some inconsistencies in the technology dimension (application, website platform) that hinder the usability of Vamo Fortaleza and decrease its reliability, while perceived by users. These circumstances can be very stressful for users, due to various unsuccessful registration attempts. They can also bring discomfort and uncertainty: the lack of clarity of information about what would be causing the failures and how to solve them make users hesitant and skeptical.

To better illustrate the second situation of technological inconsistency (failure when trying to purchase a monthly pass), Figure 48 presents some screens extracted from the researcher's smartphone at the time such a problem occurred. The figure is followed by complementing notes, also retrieved from the participant observation records.

Figure 48 – Errors in the Vamo Fortaleza app
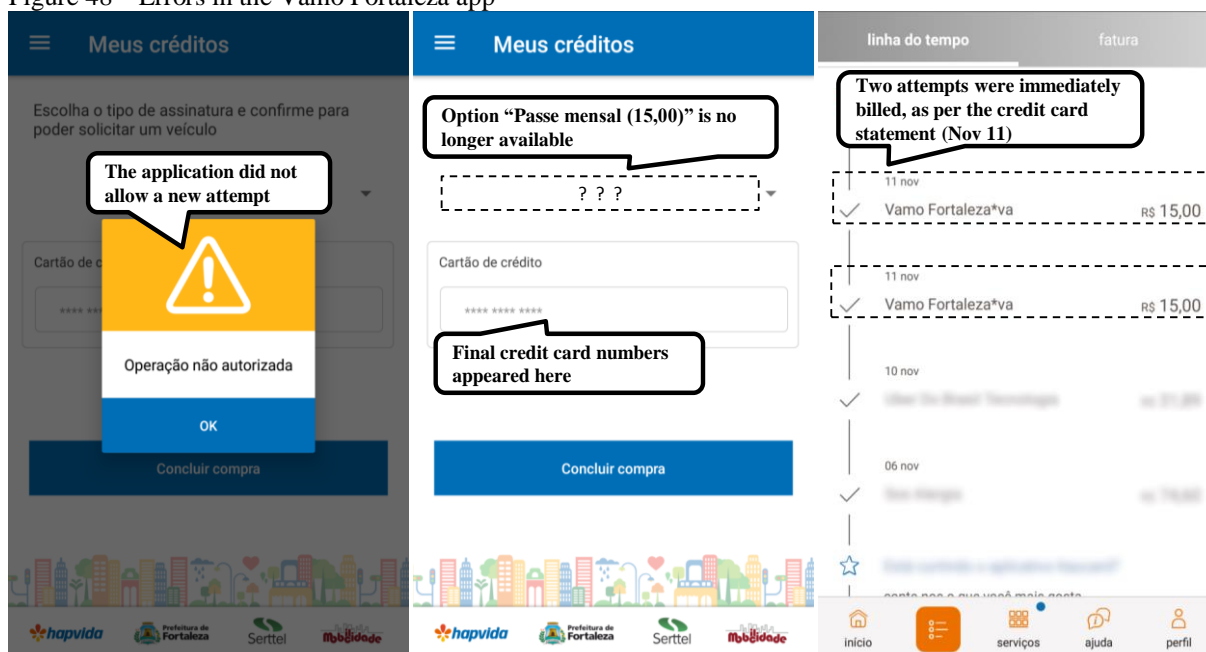
Source: The author, screenshots extracted on November 11, 2019.

The screenshots above depict some steps of the researcher's personal experience during the purchasing of a pass to use the system. In this process, the display of ambiguous, unassertive messages, as well as the suppression of information previously registered in the application were interpreted by the researcher as error warnings when making the purchase.

> Nov 11, 2019: I am trying to purchase the "Monthly Pass (BRL 15.00)" – the only option available – and select the button "Conclude purchase." The system comes back with a message that seems to be an error: "Your password will expire on 11/11/2019 6:37:52". But that is the exact time when I am trying to make the purchase. In doubt, I try to redo the procedure. Now there is a message of

"Operation not authorized" [see the screen to the left, in Figure 48], and the field for the credit card number shows only asterisks where previously there were the final numbers [central screen]. There is also no more option for selecting the "Monthly Pass (BRL 15.00)". Unsure as to whether the purchase was made, I see that in my credit card statement there is not one, but two records [screen to the right]. Successive attempts at contacting support go to a recorded message: "The number you have dialed is outside of the coverage area or turned off." (Participant observation, procedures for purchasing a Vamo monthly pass)

As can be seen in the detailed report, no confirmation message was displayed by the application until two purchases were actually noticed on the credit card statement. On the contrary, inadequate messages were exhibited, suggesting inconsistencies that the researcher – as a user – could not certify or solve at that time. The feeling of doubt and insecurity regarding the procedures carried out was amplified by unsuccessful attempts to contact the support service (weeks later, the smartphone application would again allow a new purchase attempt – the third one in this participant observation – now successful; however, the success of this last attempt was inferred not by any message of successful purchase displayed, but by the inexistence of any error message).

From the reports of the two previous situations, it can be seen that the solution came from stressful trial-and-error routines in which the user himself decided to engage. In these concrete cases, the user was the researcher himself, as a participant-observer and motivated by research needs. It is plausible to admit that a portion of those who only intend to use the service may decline when faced with such difficulties. In these situations, they will withdraw their recognition of the legitimacy attributes of the innovative business model.

Innovations in a more advanced stage of structuring can accurately signal to users about the diagnosis of errors or improper procedures, either by the platform itself or by the support team, to avoid users dropouts and allow them to make better decisions. For this reason, the process of structuring innovative business models under development in the socio-technical niches encourages efforts to eliminate barriers that impose cognitive pains on users and undermine reliability. By doing so, more interactions between actors, technologies, and rules (institutions) will be fostered and gaps in legitimacy will be eliminated, while innovation gains traction towards the socio-technical regime.

Still regarding adjustments in the key resources for the legitimation of Vamo Fortaleza, the research found that the fleet of electric vehicles has also undergone important changes. This change, however, was not something that the interviewed managers were

willing to clarify during the interviews. When asked about the number of cars in the fleet, a public manager preferred not to give more details:

> We had 20 vehicles and it is going to 15 now. They are exchanging a model. I don't want to get too far ahead of myself with news, because the company is mobilizing for that. We are going to do the transition with the fleet, but up until recently, it was 20 vehicles: five SUV's, and 15 of the little one [Zhidou EEC L7e-80]. So we are transitioning with the little ones. We're trading them for another model (Policymaker P2)

This replacement strategy had not happened without damage to Vamo Fortaleza's reputation and reliability perception. The removal of the smaller vehicles was not exactly accompanied by the entry of the new model, concomitantly. The replacement would come with a delay of many weeks. This ended up giving an image of the weakening of Vamo Fortaleza, which was also perceived by the study participants, such as user V3: "Vamo was and is very small scale. At the moment there are only three cars available, while most of the others suddenly disappeared!" Notes from some non-participating observations also pointed out this problem already in September 2019.

During observation work at station 01 – Igreja de Nazaré, after almost an hour of waiting and no car returned, the researcher contacted the Vamo's customer support service to investigate why there were no cars there, or at any other station in the system, as seen in the application. The technician on duty informed, without giving more details, that "there actually are no vehicles in circulation, all the cars in Fortaleza are in maintenance *today*." (Non-participant observation, station 01 – Igreja de Nazaré, September 25, 2019, our emphasis)

In further observation, this time at station 03 – Luíza Távora Square, an event happened that may suggest a possible cause for this problem of withdrawal of cars from circulation. A technician from the operator arrived at the Bicicletar station, installed in the same public space of that Vamo Fortaleza station. He was returning to the station some bicycles that had been removed for maintenance. Asked informally about the reason why the electric cars apparently went out of circulation throughout the network, as the smartphone application showed, he confirmed that almost all were removed, and mentioned: "(...) it seems there is some bureaucracy about the license plates." (Non-participant observation, station 03 – Luíza Távora Square, October 23, 2019)

As previously shown (see Figure 47), the Zhidou EEC L7e-80 vehicles, a two-seater model that was removed from the fleet during the fieldwork, used green license plates.

This indicates that they were in a trial period. They would be replaced by 10 units of the Renault Zoe model, with five seats, which would only be concluded and officially announced by the municipal government in the second half of December 2019, already after the stage of the interviews. Thus, even though the number of cars was reduced, the system was modernized and its capacity increased from 55 to 75 people transported simultaneously.

On the other hand, regardless of the reasons for the sudden reduction of the fleet, its renewal seemed something already desired by the users, as expressed by some of the interviewees. In their opinion, the original fleet was already wearing out. They also pointed out problems with the maintenance of electric cars.

> The cars are starting to get beat up. In the beginning, the car was all in shape, all clean, all fixed up. But now the cars are showing scratches, having accidents, you know? So I got a car that was drifting in one direction, you know? And like... it's a service you pay for, you want to get it in working order. I've gotten a car where the air-conditioning wasn't working right, so I reported it using the app. (User V4, not yet aware of the fleet modernization that would take place in a few weeks)

> It's happened that I was taking this 'tour' of mine, of solving a thousand things, and the car's battery was... lazy, right, how do you call it? And it went out on me on top of an overpass [laughter], 7 o'clock at night. (User V1)

Regardless of the reasons that culminated in the fleet replacement – whether to meet regulatory requirements or to improve the fleet (the research was unable to verify) – in the period between the withdrawal of one model and the introduction of another there was a drop in performance, both in terms of availability of electric cars and in support service. There was no clear disclosure to society about the reformulation that Vamo Fortaleza was experiencing at the time. Using the app itself as a direct channel with users could be an effective and inexpensive communication strategy. It would help to shape expectations and mitigate potential dissatisfactions.

These aspects damaged the perception of quality and reliability of the program, requirements for obtaining and maintaining legitimacy in its three dimensions studied here: cognitive legitimacy (the users' community had no awareness about what was happening, generating uncertainty about current rules and the future of the service), pragmatic legitimacy (the system was unable to meet users' needs), and moral legitimacy (the normative approval

of the system was affected as the performance of its processes, structure, and outcomes being questioned).

The infrastructure is another relevant resource that has also undergone modifications over the almost four years since Vamo Fortaleza started operations. In the beginning, the program was based on a purely one-way station-based feature: the only points to take and return vehicles were charging stations (station-based); vehicles could be returned at any of the stations in the network, not only that from which it was taken (one-way).

As policymaker P2 explains, the station-based model provides users with the security that they will always find a place to return the vehicle, increasing their confidence in the system as a whole: "The user has a restriction with the station, a spatial restriction with the station, but that is relative because, on the other hand, the station is a safety point, it is a secure point where the users know they can go to take out a vehicle." And this was ratified by an interviewee's statement: "(...) Vamo has the practical advantage that you can commute without worrying about where you are going to park. So you have parking already guarantee, where you go and from where you leave there is always a space available." (User V4)

On the other hand, as can be seen in the public manager's speech above, this same factor can imply a barrier, a "spatial restriction" to make the use more difficult: the user will always need to move to (or from) a point on the network, that is, the station. This will occur in two moments: in the first mile, in the route to access the system, to get to a station and take a vehicle; and in the exit from the system, in the last mile, after having returned the car in a station. To make these two routes, another way of commuting will be necessary, demanding from the user some planning. Records of a participant observation illustrate this point.

> 10:00 am: By the application, the nearest station (Station 11 – Igreja Matriz da Parangaba) is 1.5km from my location, and how to reach it shows a first restriction. I verify that this route will take 20 minutes if entirely done on foot. There is an alternative bus to the Parangaba bus terminal, followed by a 300m walk to the station. (...) I get a car ride to there.
>
> 12:18 am: I return the vehicle at Station 01 – Igreja de Nazaré, the closest to my last destination. Here is the same problem I had at the beginning of the journey: once the car is returned, I need some kind of locomotion to my final destination. (Participant observation, preparation routine for using the Vamo, February 6, 2020)

In other words, the same characteristic – the station-based topology – can be observed as an advantage, but also as a disadvantage. In effect, as with Bicicletar, this

discussion also revolves around an important aspect: the network logic. It results from the interaction between the technology employed in the system, its infrastructure, its processes, and the expectations of the actors involved, directly influencing reliability.

The undesirable effect of the station-based pattern is not observed in its counterpart, the free floating (dockless) models. Because they do not have stations as points of reference for users, these systems either use a larger number of vehicles or are limited to a smaller coverage area to perform minimum criteria of economic feasibility and reliability (the user does not need to get long distances to a nearest available car).

> This discussion about having the station, we see with other systems, in another context. But these are what we call dockless systems, there is no station, the car is left loose, on the street (...). And these are combustion cars, much cheaper, and you can permeate the city with a larger number. In the dockless system, either you need more cars, or the area of operation has to be much smaller. And because it is a public initiative, we don't want to restrict the Vamo area of operation too much. (...) with the station plan, we are able to permeate the area a little more, and with few cars. (Policymaker P2)

The interaction between technology, infrastructure, processes, and value proposition is at the heart of this discussion. The "more cars vs. less coverage" trade-off in free floating models has important implications for the business model. In the first case, the adoption of electric car technology may make the free float system economically unviable due to the amount of initial investment from the high prices of these vehicles. The lack of complementary infrastructure, with a network of battery recharge points nonexistent in the city, is another limiting factor. Together, these factors could reduce the interest of possible sponsoring companies and, at the limit, force the use of traditional cars, with the internal combustion conventional technology, while a larger urban area, on the other hand, would be served.

In the second case, restricting the program coverage to a few more profitable areas of the city would require a smaller and more concentrated recharging point infrastructure. It could also ensure the financial sustainability of the operator and satisfy the image interests of sponsoring companies. It would, however, bring a political cost to Vamo Fortaleza: the image of a public policy that is oriented to higher-income people, amplifying inequalities.

Therefore, this trade-off required from the local public sector a balanced solution, considering that either of the two choices in the dockless modality – wider coverage, but with

traditional cars, or less coverage with electric vehicles – would result in an inadequate solution for the city of Fortaleza. One notes that both of them would affect the value proposition of a "showcase" program of shared, inclusive, and sustainable mobility. The solution to this equation lies in a network logic based on the use of stations. P2 policymaker explains this logic:

> Because Vamo is not so limited by the network logic, although it also has to have a network logic. We cannot put one station too far from the other. They have to be at a reasonable travel time to encourage travel between them. (...) the Vamo region started out in a somewhat denser region, where there is more commercial activity, but it is able to get away a little bit from that area, but not so far that it will break the network logic.

Such characteristic allows the Vamo Fortaleza network to cover a larger area of the city, avoiding an operation exclusively directed to areas of higher demand and more economically profitable. Associated with this station-based topology, there is the stimulus to the registration with the use of the Bilhete Único, adding to the program an image of inclusion and accessibility, besides benefiting the user of the public transportation system. Through the 25% discount on the value of the monthly pass purchase, the adhesion to the program is encouraged and the use of public transportation is encouraged as a way to overcome the last mile barrier.

> That is why we chose to start with the station. Because it is a point that if you go there it is normal, expected, that there will be a vehicle there. It is a point that gives the user confidence. If you break that logic with few vehicles, they end up being dispersed and the user cannot identify [with the program]. (Policymaker P2)

Thus, Vamo Fortaleza was able to guarantee a certain pattern of performance (reliability) and meet, to some extent, the interests of the operator and the sponsor. However, it still did not benefit from something that only dockless models have: the flexibility provided to users. It can maximize the entry of new users and increase the number of trips, contributing to greater profitability of the system. For this reason, this is the most used standard, as the interviewee of the operating company argues: "What I see is like this, it is a process with growing maturity, right, and the trend that is also a worldwide trend is not to have fixed stations, with cars using a dockless model as well, understand?" (Operator O1)

In this sense, the network's logic was improved with the expansion of its infrastructure. In addition to the 12 existing stations, the system has now six exclusive spaces in different regions of the city. The location of these spaces was chosen based on the criteria of being places of great circulation and traffic interest, normally shopping centers and large squares.

Figure 49 presents a map with the Vamo Fortaleza's network of stations and exclusive spaces. We used the same geographic cutout where the station networks of the bicycle sharing systems were previously presented. As one can note, there is a predominance of network nodes in the area above the green line, as well as in Bicicletar. This region of the map covers the most developed areas of the city in terms of social and economic indicators.

Figure 49 – Vamo Fortaleza network (stations and exclusive parking spaces)
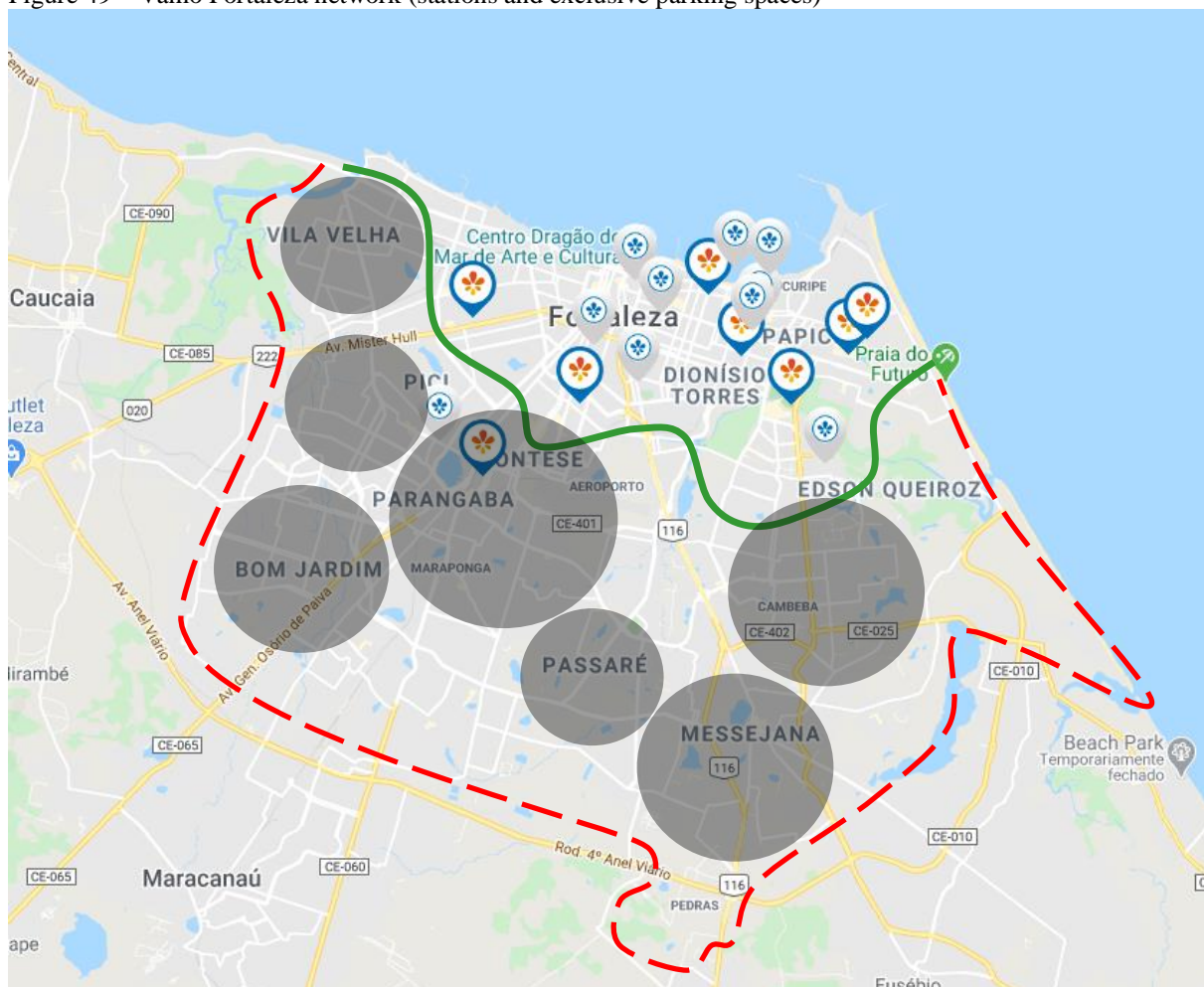
Source: The author, building on Vamo Fortaleza (2019).

Two nodes are located in a region just below the green line. These are station 11 (Igreja Matriz da Parangaba) and station 12 (North Shopping Jockey), which are nodes

existing since Vamo's original network. This way, the expansion of exclusive spaces occurred in the region that already had the largest number of access points.

> Vamo had 12 stations and you could only return cars at them. So we marked out some parking spaces where you could finish the trip, without the station for recharging. (...) [the user] leaves the car in the space, Serttel goes there and moves it to a station. That also increases capillarity and was a lesson we learned. (Policymaker P1)

This initiative has added more flexibility to the network. It provided the system with greater capillarity and, consequently, allowed more accesses and a greater flow of trips. Nevertheless, in terms of geographic coverage, about two-thirds of the city area, especially in the most peripheral regions, does not have a station, which inhibits adoption.

For this reason, some users still complain about the small size of the network. One of them even makes recommendations for a more efficient expansion, optimizing resources: "More stations and more cars would be nice. Could be small ones, with two spaces with one charging machine with two connections." (User V3) Another one questions the limitation imposed by the deficient complementary infrastructure, which does not have a network of recharging points but that formed by the main 12 stations.

> At the stations, the cars don't arrive fully charged. They come in with 80, 85% or so, I have seen that. But this specific car's battery wasn't good. So at 20% I was already starting to think "My God, I have to get out of here and find a station!" In a way, that is something that traps you. Because you have to go to the station. Where are you going to charge the car? You can't, it's at the station! (User V1, reporting when a Vamo vehicle he used ran out of batteries)

Along with the lack of a well-distributed network of recharging points, the concentration of the network in one part of the city acts as a barrier to access, since many users may not feel safe to overcome longer routes (e.g., towards peripheral regions), despite the technical specifications of the vehicles suggesting otherwise. The interviews corroborate the perception that the network is still too small, diminishing the capacity of the system and impairing its quality evaluation. In their words, they seem to associate the location of the stations also with a socioeconomic criterion for serving the wealthy regions of the city, or demonstrate some dissatisfaction with the difficulty of accessing the system due to its spatial

concentration: "I think they could make more vehicles and more stations available. (...) With the app you already see that it is more centralized, here, right? The network is small, and is more in richer neighborhoods." (User V4)

> I think that [the network] is even more concentrated in key neighborhoods, I think it could be spread out to more distant places so you could have that access in the city, of getting one closer by. (...) there should be more parking points, for stopping and such, of cars in the city, so as not to concentrate in X or Y neighborhoods, have greater coverage, to provide access to more people, in those other neighborhoods. (User V2)

Such a perception can damage the program's reputation and its moral and cognitive legitimacy among users and even the general population. It is a problem with which the actors involved in the public-private partnership need to deal since the only criterion used for the geographic disposal of the stations would have been the system's economic viability for operator and sponsor companies. It is, thus, a *sine qua non* condition. According to policymaker P2, "[with the stations] we could move away from that logic of focusing on the rich core, which in fact is the denser core. It's not differentiation by income. It's more because the density of the trip allows more commutes, so it is more profitable."

The municipal government maintains the intention of expanding the coverage area of Vamo Fortaleza with a larger number of stations and cars. It even recognizes the possibility of incorporating new vehicle technologies, which reinforces the character of a niche stage development that is attributed to the system.

> Vamo is still at a stage with lots of experimentation, there are possible ramifications, they are going to change the technology of the vehicle, if I am not mistaken they are going to change the type of car, they have ideas to test it with natural gas. (...) But it's being tested for ramifications with new technologies, or different partnerships with Enel [local utility for electricity distribution]. (Policymaker P3)

> What is worthwhile is to expand, and also diversify, even think about new models. Of course, that is up to the logic of the sponsor, and of the arrangement that we have today. But the logic is to always try to increase the service, try to benefit an increasing number of persons. (Policymaker P2)

Any effort to expand will face the difficulty of finding a financial equation that can balance the legitimate needs of the various actors, in comparison with the technologies, infrastructure, and processes employed. The fragments above may indicate the direction the program would be taking – partnerships and technology adjustments – to solve such an equation. Unlike the current state of Bicicletar, Vamo Fortaleza does not have public resources dedicated to its expansion, depending exclusively on the sponsor's budget.

> This issue of expanding Vamo, it's more sensitive. Unlike Bicicletar, which is entering a new phase now [with expansion funded by resources from Zona Azul], this expansion with Vamo is done more together with the sponsor than as a result of direct action by us. (Policymaker P2)

The sponsor has both financial and reputation interests to balance in its strategic decision. Therefore, as with Bicicleta Integrada and Bicicletar, the balance between the interests and expectations of all parties involved – society, public sector, sponsor, and operator company – is ultimately the main challenge for Vamos's expansion and structuring. These interests are sometimes conflicting.

As a corollary, one notes that strategies that increase legitimacy from the perspective of a group of actors – e.g., users – have the potential to undermine legitimacy from the perspective of others. This is precisely the trade-off that Vamo Fortaleza seems to be facing: the alignment of visions and expectations essential to the process of structuring niche innovations.

An electric car sharing business model that adopts a station-based design, with few charging stations, covering approximately one-third of the city's geographic area, may have some aspect of its legitimacy questioned. When, in addition, the complementary charging point infrastructure is non-existent, the pressure on processes that are critical for the business model increases. In other words, solutions to mitigate the effects of deficiencies related to key resources may lie in the key processes.

5.3.1.4 Key processes

Changes made in some elements of the business model often lead to changes in others. This is what is observed in Vamo Fortaleza: infrastructure adaptations in the stations and spaces led to the need for improvements in some essential processes such as the station

balancing. When such improvements were discussed, with the inclusion of the six exclusive spaces, the public managers cited the learning and efficiency obtained in the works of the relocation of cars between stations and from spaces to stations.

Also, in evaluating the Vamo's business model key processes, we identified an important obstacle already briefly reported in a participant observation record: the difficulty of getting in touch with the support service staff (the report was about application failures when purchasing a pass and the researcher's attempts to obtain guidance on how to proceed). This same difficulty was reported by a user who had participated in the research in that same period, between October and November 2019.

> I think that the remote service leaves much to be desired. I have had good experiences, but today I am having horrible experiences because I'm trying to talk to someone from there [from support] and so far, I'm not able to. It's been about two weeks! So I think they need consistency, really, with the support they are providing, understand? (User V2)

Process adaptations were also needed due to the technology of electric vehicles. Some users claim to have no difficulties, especially because they are familiar with the technology of the car or the application.

> In the beginning, I thought that joining was instantaneous. I didn't know you had to wait 24 hours for the process of analyzing your documents, etc. (...) the rest was easy, super easy. I saw the instructions on the app, how to use the car, and there were no surprises later on. (...) There really is no difficulty. (User V2)

Nonetheless, others consider electric cars to be easy to drive but require a certain level of practice from the driver, or some period of adaptation. Due to their more advanced technology and higher complexity of use, in the first contact, the cars can be non-trivial to handling and using. Users who are unfamiliar with the automatic transmission, the start/stop system, and the specific features and procedures of the sharing system may be insecure.

The testimony of another user and participant observation records mention some of these difficulties, such as "uncertainty about the time the user has between requesting the vehicle in the application and opening the doors", "vehicle model is different from the model used in the virtual test-drive", "unawareness of the sequence of procedures needed between reserving the vehicle and starting the commute, such as unplugging the charger and unlocking

the doors". (Participant observation, February 06, 2020, from Vamo station 11 – Igreja Matriz da Parangaba, to Vamo station 01 – Igreja de Nazaré)

> The cars are different. The little one [Zhidou EEC L7e-80] has a dynamic that is different from that of the larger car [BYD e6]. This last time I used the larger car and could not locate the handbrake. So I drove off with the handbrake engaged, and only later was I able to identify where it was [laughter]. They are not ordinary cars, from our day-to-day experience. (...) When I order the car through the app, how long do I have until it opens? Will the car freeze up? Will it work? In the beginning, you have a little difficulty. (User V1)

These reports show worries that users encounter when using the system, at least in the first use of each of the vehicle models. There are issues related to lack of technical knowledge, insufficient information, risk of causing damage, and discomfort. In exceptional situations, some of these aspects can increase the risk of accidents. Hence the relevance of strategies aimed at user learning to eliminate or reduce barriers of lack of knowledge regarding the use of the system.

Cognitive legitimacy is what is obtained by adopting measures in this direction. One of them might be the test-drive, which was already mentioned when the Vamo Fortaleza business model was presented. There has been an important change in the offer of this facility, which can affect the cognitive legitimation dynamics of the program: the test-drive now only takes place virtually: the user performs it through the smartphone application, watching a video of fewer than three minutes that explains the operation of the system and one of the vehicle models of the fleet. Figure 50 illustrates the step by step of this process.

Figure 50 – "Taking a virtual test-drive" screens in the Vamo Fortaleza application
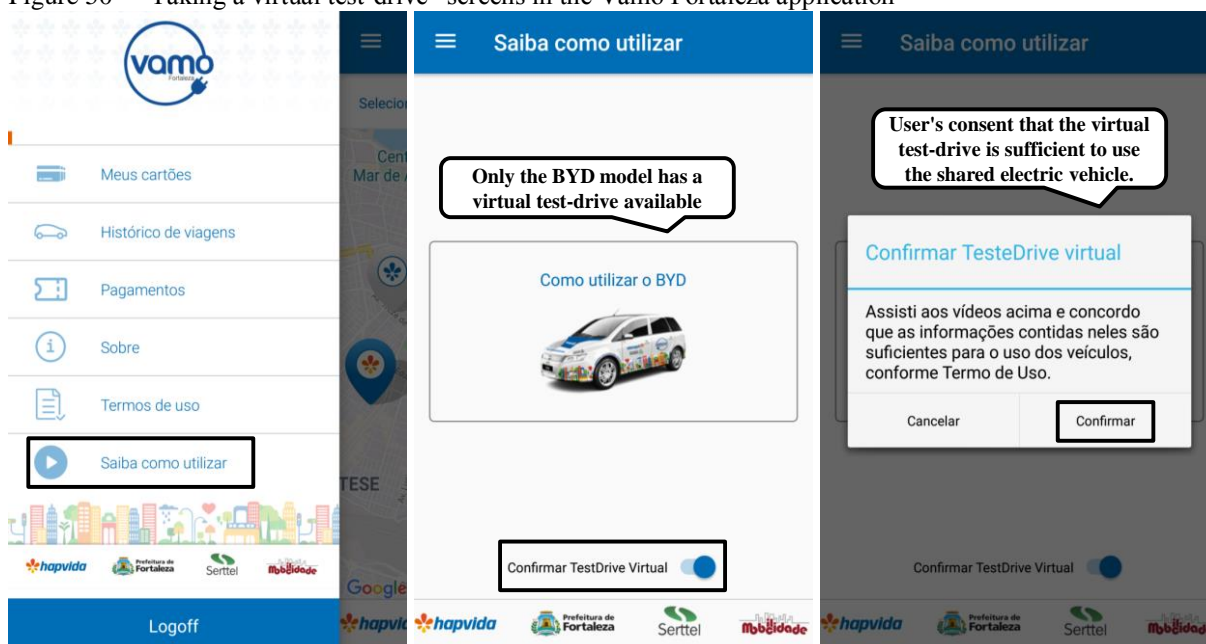
Source: The author, screenshots extracted on December 22, 2019.

After selecting the option "Learn how to use" ("Saiba como utilizar"), in the app main menu (highlighted on the left in the figure), the only car model available is the BYD e6 (image in the center), which today represents one-third of Vamo's fleet, with five units (as already said, the fleet includes another 10 Renault Zoe, recently incorporated).

> I did not do the test-drive. You just jump right in! You arrive, get a car you know nothing about and have no idea where anything is, and you have to look at the components and such. (...) No test-drive, OK? You have to understand! A person, for example, with less schooling, who has not seen different cars, who has not experienced a lot of technology, that person will probably have lots of difficulties and will give up. (User V1)

> I think they need to work more on this issue of experimentation, I don't know, test-drives, all that.. Show that it is something accessible. So, have more points of contact, not just of the car directly with the person, but have agents there who can get out and explain how it works. (User V2)

It can be seen that the traditional test-drive assisted by the operator, as it happened when the system started operations, would still be important today. Although instructive, its virtual alternative may not be enough, a perception reinforced by the inexistence of a video tutorial concerning the most numerous vehicle model in the fleet.

Besides, some users point out the need for greater communication with the public in a broad sense. Despite the initial efforts to present the program to society and promote adoption, users complained about the lack of promotion and communication.

> The way they communicate this project, they don't give it due attention. (...) I have looked for specific Vamos pages on the internet, for example, either to share or to show to friends or even to leave a comment, and I don't find anything. They don't disseminate it. It is something that isn't polluting the environment, so can democratize access to the city, all that. Nice things that they could be talking about, but they just don't bother. (User V2)

> I wonder why not everybody in Fortaleza with a driver license is a member. It's free until you use it, and cheap so far. There must be something wrong with the public relations of Vamo. Or with the mentality of the population. (...) Vamo should do more public relations, after they put more cars on the road. (User V3)

Through communication and education campaigns, public authorities, operators, and sponsors can attract new users and establish a closer connection with the general population. Evidence of this can be seen in the level of satisfaction that users manifest, despite these specific reports about flaws or errors in the application and difficulties in getting in touch with the support service. Some users even show a certain affection towards the program.

> I thought it was a great initiative, I was happy when I saw it. I thought: "Wow, that's cool! Fortaleza is evolving! They have shared cars!" and such... For me, that is something I have already internalized. Like, for me, it's as if it were already part of our daily lives, you can put it that way. (User V1)

An appropriate communication process is important for obtaining and maintaining legitimacy. From an individual point of view, cognitive legitimacy is gained through the routines of facilitating user learning, as already discussed. To obtain cognitive legitimacy from the society, however, another strategy is necessary. It should promote Vamo Fortaleza in order to make it a recognized, even desirable model, that is, one that has societal comprehensibility. Moral and pragmatic legitimacy would increase by identifying society's cultural and utilitarian expectations regarding Vamo Fortaleza and promoting the points in which the value proposition finds them.

Table 25 presents a summary of the main changes made to Vamo Fortaleza over time. It relates changes to each element of the business model.

Table 25 – Vamo Fortaleza's business model main adaptations over time

Component	Characteristic	At the time of launch	At the time of data collection
Value proposition	Modality	One way, station-based, only	Flexible one way, station-based
Profit formula	Price	Expensive, at the level of taxi companies	Competitive, at the level of Uber and the likes
Resources	Number of stations	12	12
	Parking spaces	0	6
	Number of electric vehicles	20, being 5 BYD e6 (5 seats) + 15 Zhidou EEC L7e-80 (2 seats)	15, being 5 BYD e6 (5 seats) + 10 Renault Zoe (5 seats)
	System capacity	Up to 55 people simultaneously	Up to 75 people simultaneously
Processes	Test-drive mode	Assisted	Virtual
	Station balancing	Only among stations	Among stations and parking spaces

Note: Other Vamo Fortaleza's business model characteristics not exhibited in the table had no changes over time.
Source: The author, from the research data.

The evidence shows the trial-and-error learning and adaptation routines in which the actors engaged to improve the reliability of Vamo Fortaleza. From the discussions, it can be concluded that calibrating the elements of its business model (value proposition, profit formula, key processes, and key resources) to balance eventually conflicting interests of the various actors involved is a challenge yet to overcome. Figure 51 presents the vignette, emerging from the research data, for the Vamo Fortaleza legitimation process.

Figure 51 – Vignette of determinants of legitimacy in a public, single-sponsored car sharing scheme
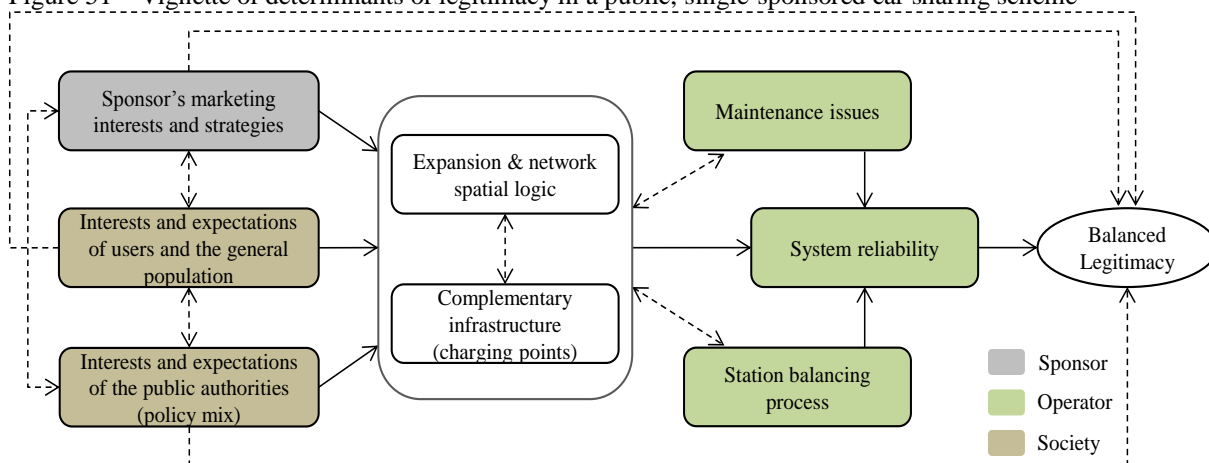
Source: The author, from the research data.

The above explanatory constructs of balanced legitimacy have several underlying mechanisms acting as drivers or barriers to the legitimation of Vamo Fortaleza. Following the pattern that we have adopted for bicycle sharing cases, the next section links these

mechanisms to each determinant present in Figure 51, as well as the dimensions of legitimacy that they influence and the business model components.

5.3.2 *Relating legitimation mechanisms and the Vamo business model components*

The legitimacy mechanisms of Vamo Fortaleza presented here are based on the evidence discussed throughout section 5.3. Due to its status as a pilot project, Vamo Fortaleza has gone through several processes of improvement, experimentation, and trial-and-error learning.

As with the analyses of legitimation mechanisms of shared bicycle programs, we tried to demarcate a specific moment of its fundamental reformulation, as shown in Table 26 (in bold). We argue that this facilitates the analytical process and the understanding of how these mechanisms have influenced legitimacy. However, we emphasize the robust evidence indicating that Vamo Fortaleza has always been in a continuous process of improvement, mainly due to the lack of reference models, a first barrier to obtaining legitimacy and structuring.

Table 26 – Legitimacy mechanisms of the Vamo Fortaleza system

Determinants of balanced legitimacy	Legitimation mechanisms (related business model building block) [a]		
	Pragmatic legitimacy	Moral legitimacy	Cognitive legitimacy
Interests and expectations of the public authorities (policy mix)	(−) Network coverage and complementary infrastructure are still incipient (KR) (−) The early price of the service was considered prohibitive, comparable to traditional taxi companies (PF) (±) The station-based model balances network logic and value proposition but fails in flexibility (VP) (−) The entry of new, cheaper substitute service providers like Uber *(+) Reformulation of the Vamo Fortaleza's business model (PF, KP & KR)* *(+) Considerable reduction in the prices of the service (PF)* *(−) The Vamo Fortaleza's funding model is not yet stabilized, as price reductions undermine economic viability and hinder expansion (PF)* *(−) The fleet replacement strategy hindered the system's performance for a few months (KP& KR)* *(+) The fleet renewal met users' expectations (KR)* *(+) Exclusive parking spaces added flexibility to the system (KR)*	(−) Network coverage and complementary infrastructure are still incipient (KR) (+) The fully sponsored model facilitated normative approval since there was no cost for society (PF) (+) The Vamo Fortaleza system is a flagship project to promote the debate on sustainable mobility agenda (−) The early price of the service was considered prohibitive, comparable to traditional taxi companies (PF) (−) The entry of new, cheaper substitute service providers like Uber *(+) Reformulation of the Vamo Fortaleza's business model (PF, KP & KR)* *(+) Considerable reduction in the prices of the service (PF)* *(−) The Vamo Fortaleza's funding model is not yet stabilized, as price reductions undermine economic viability and hinder expansion (PF)* *(−) The fleet replacement strategy hindered the system's performance for a few months (KP& KR)*	(−) Network coverage and complementary infrastructure are still incipient (KR) (−) Lack of reference models forced experimentation and trial-and-error learning routines *(+) Reformulation of the Vamo Fortaleza's business model (PF, KP & KR)* *(−) The Vamo Fortaleza's funding model is not yet stabilized, as price reductions undermine economic viability and hinder expansion (PF)* *(−) The fleet replacement strategy hindered the system's performance for a few months (KP& KR)*
Interests and expectations of users and the general population	(+) Long-haul, longer-lasting trips by sustainable and efficient motorized mobility solution (VP) (+) Avoidance of car ownership and the related overall costs (VP)	(+) Sustainable mobility appeal meets environmental concerns (air pollution, CO2 emission) (VP) (+) Avoidance of car ownership and the related overall costs (VP)	(+) Information on how to use the system is available in several ways (app, website, totems) (KR) (−) Users realize the current state of the Vamo Fortaleza network as mirroring the city's socioeconomic inequality

Determinants of balanced legitimacy	Legitimation mechanisms (related business model building block) [a]		
	Pragmatic legitimacy	Moral legitimacy	Cognitive legitimacy
	(+) Integration with other transport modes (VP)	(+) Integration with other transport modes (VP)	(+) Integration with other transport modes (VP)
	(+) Vamo Fortaleza app gives users autonomy and facilitates decision making regarding their commutes (KR)	(+) The fully sponsored model facilitated normative approval since there was no cost for society (PF)	(+) User support facilitates learning and increases system reliability (KP)
	(−) System infrastructure and network coverage are still incipient (KR)	(−) System infrastructure and network coverage are still incipient (KR)	(+) Assisted test-drive helps to overcome cognitive barriers (KP)
	(±) Vamo's technology is seen as relatively stable even though undergoing continuous improvements (KR)	(−) Users realize the current state of the Vamo Fortaleza network as mirroring the city's socioeconomic inequality	(−) System infrastructure and network coverage are still incipient (KR)
	(−) The early price of the service was considered prohibitive, comparable to traditional taxi companies (PF)	(+) Users are proud to use Vamo Fortaleza	(−) Users realize the current state of the Vamo Fortaleza network as mirroring the city's socioeconomic inequality
	(−) The entry of new, cheaper substitute service providers like Uber	(−) The early price of the service was considered prohibitive, comparable to traditional taxi companies (PF)	(−) Lack of reference models forced experimentation and trial-and-error learning routines
	(+) Considerable reduction in the prices of the service (PF)	(−) The entry of new, cheaper substitute service providers like Uber	(±) Vamo's technology is seen as relatively stable even though undergoing continuous improvements (KR)
	(−) The Vamo Fortaleza's funding model is not yet stabilized, as price reductions undermine economic viability and hinder expansion (PF)	*(+) Considerable reduction in the prices of the service (PF)*	(−) Vamo's public relations and educational campaigns need to improve (KP)
	(−) The fleet replacement strategy hindered the system's performance for a few months (KP& KR)	*(−) The Vamo Fortaleza's funding model is not yet stabilized, as price reductions undermine economic viability and hinder expansion (PF)*	*(−) The Vamo Fortaleza's funding model is not yet stabilized, as price reductions undermine economic viability and hinder expansion (PF)*
	(+) The fleet renewal met users' expectations (KR)	*(−) The fleet replacement strategy hindered the system's performance for a few months (KP& KR)*	*(−) Virtual test-drive does not seem to substitute assisted test-drive adequately (KP)*
Sponsor's marketing interests and strategies	(+) The sponsorship model drives the network's growth strategy favoring its spatial logic and ultimately reliability (PF)	(+) The sponsorship model drives the network's growth strategy favoring its spatial logic and ultimately reliability (PF)	(+) The sponsorship model drives the network's growth strategy favoring its spatial logic and ultimately reliability (PF)
	(−) The sponsor has no incentive to expand the system to regions where its branding strategy is likely not to pay off (PF)		

Determinants of balanced legitimacy	Legitimation mechanisms (related business model building block) [a]		
	Pragmatic legitimacy	Moral legitimacy	Cognitive legitimacy
	(−) The Vamo Fortaleza's funding model is not yet stabilized, as price reductions undermine economic viability and hinder expansion (PF)		
Maintenance issues	(−) Technical failures in the app or the absence of clear warning messages cause discomfort and undermine system reliability (KR) (+) Well-trained field technicians perform maintenance routines adequately (KR)	(−) Technical failures in the app or the absence of clear warning messages cause discomfort and undermine system reliability (KR)	(−) Technical failures in the app or the absence of clear warning messages cause discomfort and undermine system reliability (KR)
Station balancing process	(+) Well-trained field technicians perform station balancing routines effectively (KR) *(−) The low availability of vehicles at stations creates unmet demand (KP)*	*(−) The low availability of vehicles at stations creates unmet demand (KP)*	*(−) The low availability of vehicles at stations creates unmet demand (KP)*
System reliability	(+) Effective maintenance routines ensure system reliability (KP) (+) The effective station balancing process counts for system reliability (KP) (−) Imbalanced stations harm the system reliability (KP) (−) System infrastructure and network coverage are still incipient (KR) (±) Vamo's technology is seen as relatively stable even though undergoing continuous improvements (KR) *(−) The fleet replacement strategy hindered the system's performance for a few months (KP& KR)*	(−) Imbalanced stations harm the system reliability (KP) (−) Technical failures impair the reliability of the system (KP) (−) System infrastructure and network coverage are still incipient (KR) *(−) The fleet replacement strategy hindered the system's performance for a few months (KP& KR)*	(+) User support facilitates learning and increases system reliability (KP) (−) System infrastructure and network coverage are still incipient (KR) (−) Lack of reference models forced experimentation and trial-and-error learning routines (±) Vamo's technology is seen as relatively stable even though undergoing continuous improvements (KR) *(−) The fleet replacement strategy hindered the system's performance for a few months (KP& KR)*

Note: [a]. (+) driver of legitimacy; (−) barrier to legitimacy; (VP) Value proposition; (PF) Profit formula; (KR) Key resource; (KP) Key process. Mechanisms in italics are associated with improvements in the Vamo Fortaleza business model.
Source: The author, based on the research data.

One can observe that most of the attributes of its value proposition, considered drivers of moral and pragmatic legitimacy, meets the expectations of users and a growing portion of society, such as environmental concerns, the integration with other transport modes, and the avoidance of car ownership and the related overall costs. The station-based model, in turn, had a dual role: it balances network logic and value proposition but fails in flexibility, as users had to take and return the electric car to the docking stations, unlike free floating models.

Regarding key resources, insufficient station network coverage, concentrated in one region of the city, and the lack of complementary infrastructure of battery recharge points, are important barriers hindering the process of structuring the program. As observed in Bicicletar, these aspects lead to another barrier to legitimacy, since users realize the current state of the Vamo Fortaleza network as mirroring the city's socioeconomic inequalities. Its technology is seen as relatively stabilized, which would be seen as a driver of pragmatic and cognitive legitimacy. However, the data showed that several technical failures and ambiguous warning messages (or no messages) in the smartphone application cause discomfort and undermine both the system's reliability and the legitimacy status. Thus, we identified a dual role played by technological resources, as improvements are continuously undergoing in that dimension.

Some key processes were found to be drivers of legitimacy. At the beginning of the operations, for instance, assisted test-drives helped users to overcome cognitive barriers related to technological (app, electric vehicle) and procedural issues. Likewise, user support service facilitated learning and increased system reliability as well. The Vamo Fortaleza business model is capable of promoting pragmatic legitimacy through effective station balancing process and maintenance routines, as these critical processes ensure the system's reliability. In contrast, the station balancing process has not yet stabilized and has hindered the legitimacy of the business model.

Still analyzing key processes, two promising but underused drivers of cognitive legitimacy are public relations and educational campaigns. Users even criticized the lack of information and promotion of Vamo Fortaleza in the press and social media.

Now addressing profit formula-related legitimacy mechanisms, the research data revealed two initial drivers of legitimacy: first, as with Bicicletar and Bicicleta Integrada programs, the fully sponsored model facilitated normative approval since there was no cost for society (moral legitimacy); besides, such an arrangement guided the network's growth

strategy favoring the system's spatial logic, ultimately reliability. This model, however, conditions the expansion of Vamo Fortaleza to the sponsor's marketing strategy, limiting its legitimacy.

Another barrier to legitimacy related to the profit formula component was the initial price of the service, which was considered prohibitive, comparable to traditional taxicab companies. Amplifying this factor, at the time of the beginning of Vamo Fortaleza's operation, new, cheaper substitute service providers like Uber entered the mobility regime in the city. In that scenario, the model was restructured, beginning exactly with the profit formula component. Actors in the public-private partnership lowered the service prices significantly, with adoption rates rising in response (this denotes gains in pragmatic and moral legitimacy).

In addition to price reduction, key resources were also managed to increase legitimacy in the Vamo Fortaleza system. Six exclusive parking spaces – without charging points – were implemented that added flexibility to the system. The fleet renewal, in turn, met users' expectations by replacing 15 small, worn out and (probably) not yet approved cars with ten new and more modern five-seat cars.

The replacement strategy however hindered the system's performance for a few months during which time the system had very few cars available. Consequently, the low availability of vehicles affected the station balancing process and created unmet demand. At the end of this process, according to the research data, the legitimacy of Vamo Fortaleza had weakened, with some of the interviewed users reporting uncertainty about their continuity.

At the time of this study, the system is in the structuring process, and the main barrier to legitimation lies in the profit formula, as the current funding model has not yet stabilized. Despite the interest of the public authority to make Vamo Fortaleza more accessible, further price reductions to attract new users could undermine economic viability and hinder the expansion of the system.

The next section discusses the main similarities and distinctions between the legitimation dynamics of the three cases analyzed. In this comparison, the actions taken by the different actors involved and the institutional influences (e.g., established rules, artifacts, technologies, and cultural patterns) will be related to the dimensions of legitimacy (moral, cognitive, and moral) to which they are associated.

5.4 Synthesis of niche developments and legitimation dynamics

Briefly analyzing the results about the three business models, one can note that although based on somewhat similar key processes and resources, the sharing systems differ in some aspects. While "sustainable mobility" is a convergent discourse in their customer value propositions, the way they deliver value is diverse.

For instance, as its name suggests, the Bicicleta Integrada is spatially tightly integrated into the public transport system, and there is never charge on the users, as even fines are non-pecuniary-type. Bicicletar also has some integration, but only in terms of ticketing, as users can use it for free as long as accessing the system via BU card.

Vamo Fortaleza, in turn, charges users a per-time fee (pay-as-you-go) in addition to a monthly pass. The system delivers a faster and more comfortable solution as it is supported by electric vehicle technology. Additionally, each case aims at serving different target audiences, which gave rise to different legitimation mechanisms and strategies.

Another interesting finding is that the three sharing systems started operations in very close times. Together with incremental actions and improvements at the regime level, this indicates a commitment by the municipal public authority to the shift towards a new urban mobility paradigm, that is, a sustainable socio-technical urban mobility regime.

In this regard, we analyzed the research data intending to identify evidence of such transition. As legitimacy is consequential for the spreading of innovative business models, data from documents, observations, and in-depth interviews were explored with the purpose of identifying mechanisms related to the pragmatic, moral and cognitive legitimacy dimensions. Evidence was found to comprise a variety of actions, strategies, technologies, institutional rules, and interactions between actors from both technological niches and socio-technical regime levels. Broader landscape developments also played an essential role in the dynamics of transitions, so that evidence for this influence was sought as well. Ultimately, such factors represent the mechanisms driving – or preventing – the legitimation process of the sharing economy initiatives and shaping the pathways for the aforementioned transition.

Comparing the legitimation dynamics discussed throughout this chapter may provide some contribution to the theoretical and empirical literature on legitimacy. In the sharing economy context, in particular, this assumes relevance since its legitimation processes are still little studied.

In general, the findings show that Bicicletar presents a more advanced level of structuring in comparison with the two other cases investigated. On the other hand, considering the scale of operation and other evidence raised, Vamo Fortaleza seems to be in a

less advanced structuring phase (although its technological artifacts are already at a relatively more mature stage in this process).

The high adoption rate of Bicicletar and Bicicleta Integrada reveals a close alignment with the users' interests so that they can benefit from the program (pragmatic legitimacy). Normative approval is also considered to be a driver for the adoption of new organizational forms or innovative business models as they become morally accepted (moral legitimacy). The findings support the assertion that the two bike sharing systems have high societal approval.

In addition, the perception of the model as something culturally recognized, i.e., comprehensible, taken-for-granted (cognitive legitimacy) is crucial for the adoption and could explain the emergence of the bike sharing business models in the city. From the research data, unlike Bicicletar and Bicicleta Integrada, Vamo Fortaleza is not yet a culturally recognized initiative, which is in line with its less-developed degree of structuring.

Following the incremental approach adopted both in chapter 4 and this chapter so far, Figure 52 presents the characterization of the socio-technical levels for urban mobility in the city of Fortaleza. It places the three business models side by side and allows us to evaluate their structuring stages. We draw upon Figure 30 and advance it by highlighting the findings for the technological niche level.

Figure 52 – Socio-technical levels for urban mobility regime in Fortaleza
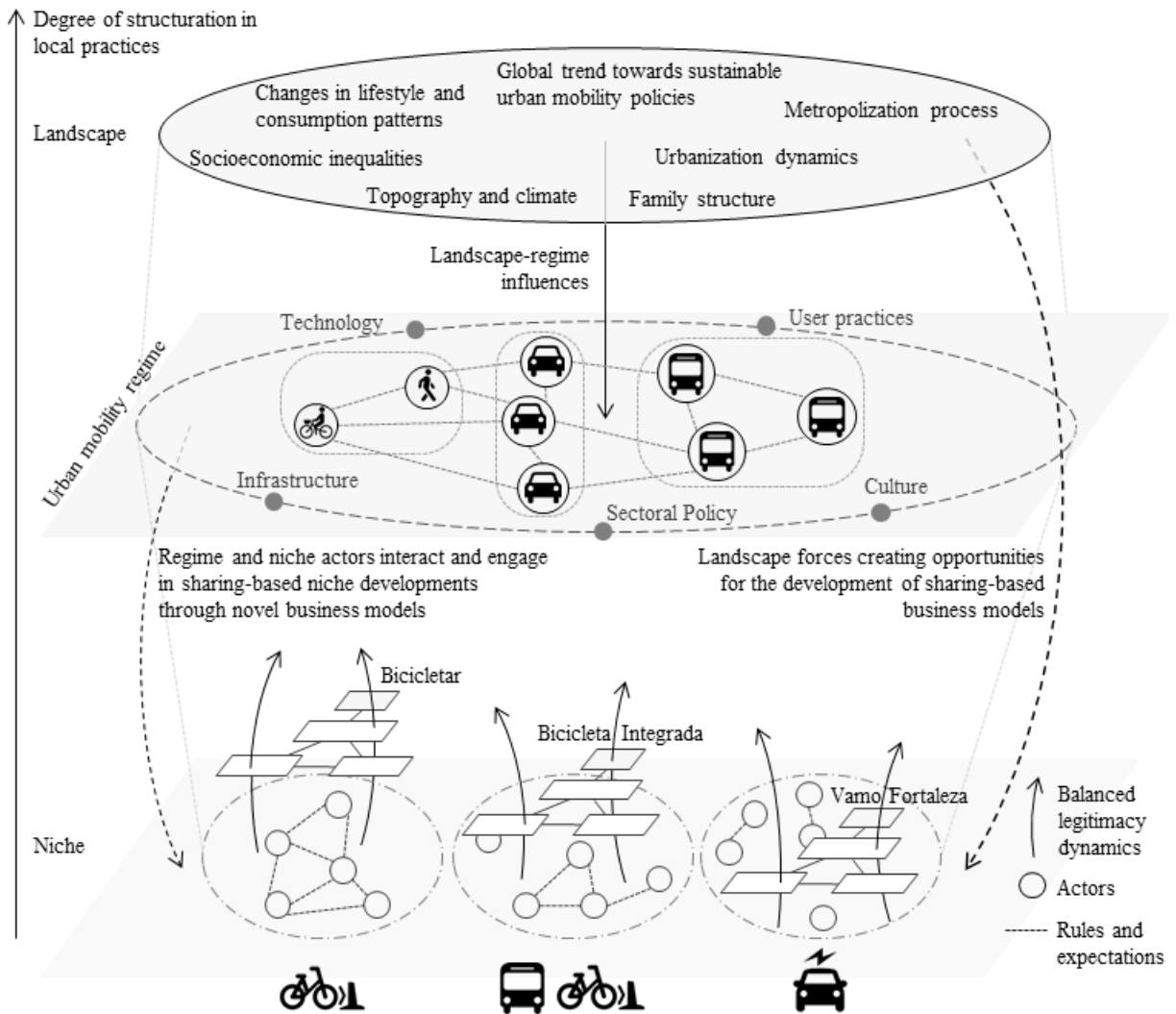
Source: The author, based on the research data.

The bottom-up curved arrows indicate the legitimation dynamics of sharing business models and their underlying mechanisms, as previously presented and discussed throughout sections 5.1, 5.2, and 5.3 (respectively for Bicicletar, Bicicleta Integrada, and Vamo Fortaleza). In specific, they represent the vignettes of balanced legitimacy (Figure 37, Figure 42, and Figure 51), with their legitimation mechanisms and corresponding business models building blocks (as summed up in Table 22, Table 24, and Table 26).

The manner we adopted to better depict the degree of structuring (and legitimacy) of these three niche developments is twofold: we use the height of each business model structure (building blocks) in relation to the *Y*-axis, and the number of relationships established between actors within each of the initiatives. These relationships mean recognized rules and expectations shared by different actors so that the greater the number of linkages

between actors involved in a business model, the greater the level of balanced legitimacy and, consequently, the degree of structuring.

Therefore, Figure 52 shows that Bicicletar and Vamo Fortaleza have, respectively, the highest and the lowest degrees of structuring. For the former, users, the sponsor, and the operator share the same vision and well-established rules. Despite this high structuring, tensions with actors of the regime – related mainly to culture and user practices – undermine a few of its current legitimacy status. The perception that the program is oriented to higher-income classes is challenged by the argument of network logic associated with market logic inherent in the sponsored model. Indeed, there is a lack of cycling infrastructure and stations of the system in peripheral areas of the city.

The program is undergoing incremental improvements to the current coverage network (80 stations) – which follows the sponsored model – while a considerable expansion already planned will be based on these same successful rules. For the stations included in the scope of the expansion project, the business model will undergo a reformulation in the financing structure. From now, there will be no sponsors: the new network will be fully financed with public funds raised from car users who use the Zona Azul, the municipal street parking system. Thus, soon, Bicicletar will have two networks living under the same operating rules, operated by the same operating company. This will occur in a transparent way for users, but with changes in terms of performance management in the relationship between municipal management and operator.

In a way, the second bicycle sharing system, Bicicleta Integrada, is a Biciletar's spin-off. It emerged as a strategy to mitigate the problem of misallocation of network resources caused by both network logic and sponsor market logic. With a more inclusive value proposition, oriented to the needs of the lower-income population (e.g., modal integration, long-term bicycle loans, non-pecuniary penalties), Bicicleta Integrada also has the support of the population.

The spatial configuration based on the deterministic criterion of physical association with bus terminals has eliminated the influence of the network logic. The business model, however, presents some weaknesses, as evidenced by the research data. The evasion of sponsors (only one of the five original sponsors remains taking part in it), the frequent lack of bicycles in the stations, with users cheating the rules of operation are some issues which led the municipal government to reformulate the program.

Regarding Vamo Fortaleza, the number of stations also raises the perception that the program aims to serve the wealthiest areas of the city. As with Bicicletar, this is a

characteristic hindering the evaluation of legitimacy. Policymakers interviewed argue that this is mainly due to the need to combine network logic with areas of a greater flow of trips, aiming at the financial balance of the program. Users also question the lack of communication about the program and its rules and benefits on channels such as social media platforms, which is why Vamo Fortaleza would still be little known in the city.

Another evidence of the incipient stage of structuring is the recognition by public managers themselves that Vamo Fortaleza is considered a pilot project. As a pioneering initiative in Brazil, its structuring was hampered by the absence of replicable models and best practices in the national context. They also affirm that the program is a showcase for the sustainable mobility agenda to which the local government is committed. Failures in processes and operational routines and technical problems hinder the structuring of the business model, which is also harmed by a funding formula that is not economically viable to support any expansion initiative.

In the next chapter, the results presented will be compared with the literature visited in order to identify gaps and points of convergence and divergence. In doing so, we intend to formalize and propose bases for a grounded theory to explain the substantive phenomenon under analysis: the legitimation process of the sharing economy in the context of urban mobility.

6 DISCUSSION AND COMPARISONS WITH EXISTING LITERATURE

In this chapter, we assess the research findings in light of each specific objective. Thus, discussions in the next sections are guided by an objectives structure in order to provide a finer explanation for the phenomenon investigated. We made comparisons with the literature consulted and pointed out similar and conflicting aspects, as well as highlighting novel contributions. In this particular, we also enunciate some hypotheses grounded in the data for further research.

6.1 Specific objectives 1 and 2

The first specific objective was to "*characterize the socio-technical levels of the urban mobility transition to sustainability*". To a large extent, this was the effort we undertook throughout both chapters 4 and 5. There, we adopted a discovery-oriented posture to cumulatively sketch vignettes to represent the socio-technical levels directly from the research data, and Figure 52 showed the final socio-technical representation.

This characterization, however, would not be effective in bringing to light all dynamics underlying each relationship, within and between socio-technical levels and their actors. For that reason, we suggested the second specific objective in this research, which was to "*analyze the nature of relationships between the landscape, regime, and technological niche levels towards transition*". Through it, we were interested in discovering how the socio-technical levels interact with one another in terms of the nature of relationships, whether favorable or contrary to the transition to sustainability.

According to the multi-level perspective on socio-technical transitions, the rise and diffusion of innovations depend on the nature of interactions between institutional forces clashing or reinforcing one another between three socio-technical levels: landscapes, regime, and niches (GEELS, 2002, 2005, 2018b; KÖHLER *et al.*, 2019). The literature review showed that the nature of relationships between these levels directly influences the transition process and the possible trajectories it may assume (GEELS *et al.*, 2016; GEELS; SCHOT, 2007; SMITH; RAVEN, 2012; VAN DRIEL; SCHOT, 2005).

By analyzing how the interactions between the socio-technical levels were presented, in comparison with the literature visited, it is possible to meet the second specific objective of the thesis. These interactions are discussed below, considering the role played by the actors, rules, and institutions of each of the cases studied.

6.1.1   Landscape influences on the regime and niche levels

Geels and Schot (2007) asserted that both landscape forces and regime pressures can influence niche developments by shaping niche actors' expectations and the size of support networks. Later, Geels *et al*. (2016) added into the discussion the role of agency (how actors interpret and mobilize towards transitions) as well as institutions and technologies (how innovations are institutionally embedded). These authors operationalize the definition of landscape developments as being the highest degree of structuration of activities in local practices. In the theoretical literature on transition pathways, discussions on landscape influences suggest that they all manifest jointly, in a single, homogeneous direction: for instance, exclusively "disruptive" *or* "reinforcing", as in Geels and Schot's (2007) seminal typology and its further developments.

Despite this assumption, in this research, our open, heuristic stance allowed us to capture landscape forces influencing the regime and niche levels regardless of their nature, whether counting for the change or acting to prevent it. From the research data, landscape developments are not singular, nor is the regime one-dimensional. We then embrace a terminology considered recurrent in transition pathways studies (e.g., Geels and Schot (2010) and Bidmon and Knab (2018)) and propose three natures of pressures coming from the landscape that might shape transitions: cooperative, competitive, and dual influences. Ultimately, all three forces may be running at the same time, as follows in Table 27:

Table 27 – Nature of landscape pressures on niche and regime

Landscape influences	Socio-technical regime	Technological niche
Cooperative (+)	<u>Over steady regime dimensions:</u> cooperative influences act to slow down or even prevent the process of socio-technical transition, favoring lock-in mechanisms that will preserve the stability of actors, technologies, and incumbent rules. <u>Over changing regime dimensions:</u> cooperative forces count for the regime shift by nurturing transition drivers which destabilize rooted patterns and rules.	Concerning the niche, these influences count for the stabilization of new technologies and business models and the alignment of expectations and knowledge bases among the various actors, allowing the formation of innovation support networks.
Competitive (−)	<u>Over steady regime dimensions:</u> competitive forces undermine the stability of the system and foster the change process, enabling or strengthening mechanisms that will act as drivers of transition. <u>Over changing regime dimensions:</u> competitive influences count for the regime stability strengthening lock-in mechanisms.	At the niche level, they act as preventing pressures, hindering the evolution of learning processes and the construction of internal momentum, which in turn hinders the formation of support networks.
Ambivalent (±)	Pressures that can be both cooperative and competitive, according to the socio-technical regime dimension from which the analyst observes the phenomenon (e.g., infrastructure, sectoral policy, technology).	Similarly, such forces can be both cooperative and competitive concerning the different actors and expectations at the niche level.

Source: The author, based on the research data.

The structure of Table 27 emphasizes the nature of the relationship between each landscape development and each regime dimension (or niche actor) with which (whom) they interact. Therefore, the same landscape factor may exert different influences on the incumbent regime, according to the dimension being analyzed. Similarly, different niche actors engaged in new product development or emerging business models may differently interpret landscape pressure. It is a proposition that meets the complexity and diversity of forces identified in empirical work and complements theoretical literature that considers contextual pressures as being homogeneous, as previously discussed.

Table 28 presents the interactions between landscape and other socio-technical levels, based on the research data. It highlights the nature of these influences on the development of shared mobility business models in the niche, as well as on each of the dimensions of the incumbent mobility regime.

Table 28 – Landscape pressures on the niche and regime levels

Landscape forces	Influence	Mechanisms	Nature of the influence on niche level (Case studied) [a]	Nature of the influence on the urban mobility regime [b]				
				User Practices	Culture	Tech-nology	Infra-structure	Sectoral policy
Cultural influence	Changes in lifestyle and consumption patterns	Cultural shift towards active and sustainable urban mobility practices	+ (B) (BI) (VF)	±	−	+	±	+
		People are increasingly concerned with issues related to health improvement	+ (B) (BI) (VF)	−	−	+	−	+
		"Sharing rather than owning" phenomenon	+ (B) (BI) (VF)	−	−	+	±	+
		Generational change that favors sharing schemes	+ (B) (BI) (VF)	−	−	+	±	+
	Cultural path dependence	Local urban mobility practices have been guided mainly by the logic of the private, individual automobile (one car, one person)	− (B) (BI) (VF)	+	+	+	+	−
Macropolitical influence	Global trend towards sustainable urban mobility policies	Governments' efforts towards environmentally-friendly urban mobility	+ (B) (BI) (VF)	±	±	+	±	+
		Several countries and cultures have been supporting bike sharing or similar schemes	+ (B) (BI) (VF)	−	−	+	±	+
	Technological path dependence	Fossil-fuel based deeply structured mobility practices	− (VF)	+	+	+	+	−
Urban developments	Metropolization process	Greater demand for alternative mobility modes integrating the municipalities in the region	+ (B) (BI) (VF)	+			−	+
		The need to integrate the intercity bus system with the bicycle sharing system	+ (B) (BI)	+			−	+
	Urbanization dynamics	The accelerated growth of urban centers is related to increasing air pollution, congestion, health risks, depletion of urban infrastructure, and social exclusion	− (B) (BI) (VF)	+	+	+	+	−
		High population density increases the demand for commuting	+ (B) (BI) (VF)	+			+	
		Sharing-based business models mitigate the misallocation of urban mobility resources	+ (B) (BI) (VF)	−	−	+	±	+
		Sharing-based business models are drivers to sustainable urban mobility	+ (B) (BI) (VF)	−	−	+	±	+
		Bike sharing systems play an emancipatory and exercising citizenship role	+ (B) (BI) (VF)	−	−	+	±	+
Demographic factors	Socioeconomic inequalities	Inequalities increase pressures on the current infrastructure, safety, education, transport, and health public systems	− (B) (BI) (VF)	+	+	+	+	−
		Sharing-based business models are a response to socioeconomic	+ (B) (BI) (VF)	−	−	+	±	+

Landscape forces	Influence	Mechanisms	Nature of the influence on niche level (Case studied) [a]	Nature of the influence on the urban mobility regime [b]				
				User Practices	Culture	Technology	Infrastructure	Sectoral policy
		inequalities						
	Family structure	Parental obligations can make sports and health care practices unfeasible	± (B) (BI)	+	+		+	
		Family routine and parental obligations shape the users' willingness to use a bike sharing system	± (B) (BI)	+	+		+	
		Singles and childless families are more likely to join the electric car sharing system	+ (VF)	−	−	+	+	+
Geographical factors	The flat topography makes Fortaleza a city suitable for bicycle use	The city topography is conducive to the use of bicycles	+ (B) (BI)	−	−	+	±	+
		The flatter the topography of the city, the longer the routes considered viable by bicycle	+ (B) (BI)	−	−	+	±	+
	Climate and weather conditions	Heat could be a barrier to use bike sharing systems	± (B) (BI)	+	+		+	
		Rain could be a barrier to use bike sharing systems	± (B) (BI)	+	+		+	

Notes: [a] (B) Bicicletar; (BI) Bicicleta Integrada; (VF) Vamo Fortaleza; [a,b] + Cooperative relationship; − Competitive relationship; ± Ambivalent relationship. If blank, the research data have provided no evidence.

Source: The author, based on the research data.

Regarding landscape-regime interactions, the research findings show that landscape pressures can take on different natures simultaneously, depending both on which regime dimension is being observed as a reference in the analysis, and on the way actors within this dimension translate and interpret such pressures.

For instance, because individual practices and preferences are tributary to symbolic meanings and normative influences, user practice and culture dimensions are understood to be affected by the landscape forces in a comparable way. This was observed for changes in lifestyle and consumption patterns and cultural path dependence forces. The former, acting as a driver to transition, by grouping influences like sustainable urban mobility and health improvement concerns; the latter, hindering transition by working as a lock-in mechanism. In the long run, the recursive influences between the user practices and culture dimensions are shaped by these landscape forces.

Specifically, regarding the influence of cultural shift towards active and sustainable urban mobility practices, we argue that it exerts an ambivalent pressure on the user practice regime dimension: there already is a traditional, well-established subsystem of people from the city's outskirts that have historically used bikes as a cheaper transport mode, even the only viable one. With the cultural dimension, in turn, such landscape influence seems to maintain a competitive relationship. That is due to the dominant car-centered culture, which is confirmed in the users' excerpts about conflicts experienced and ratified by the public managers interviewed.

Lock-ins and drivers from macropolitical influence, urban developments, and demographic and geographical factors were also identified as exerting pressures on user practice and cultural dimensions within the regime. Regarding macropolitics, we identified an ambivalent landscape factor influencing these two dimensions: the governments' efforts towards environmentally-friendly urban mobility. Despite the deeply rooted automobile culture, the data showed that the public transport system is a quite relevant urban mobility subsystem as well. As these sustainable efforts are partially directed to public transportation itself (improving it and encouraging its use), this factor then exerts an ambivalent influence, counting simultaneously for both the maintenance of current practices and the change of the socio-technical regime of mobility.

It was observed that landscape influences are generally maintaining cooperative interactions with the technology dimension of the urban mobility regime. In this case, this does not indicate such influence is counting for the system stability, but rather, that it is reinforcing the transition characteristic already existing in that dimension. Indeed, the data

showed that most of the actions aimed at sustainability in the local mobility regime take advantage of existing technological bases (e.g., smartphones, internet, applications, software, monitoring systems, modal integration systems).

It should be noted, however, that in terms of propulsion technology in Brazil, there is virtually only one: fossil fuel internal combustion engines. Taking only this specific aspect, it would not be wrong to consider the technology dimension deeply locked-in since there is no other stabilized sustainable propulsion technology in the Brazilian scenario than internal combustion engines. This is a nationwide political-economic aspect (Brazil is an importer of technologies such as electric cars), and the research context was local. Thus, we consider that the technology dimension, from a place-based analysis, is favoring a change in the local urban mobility regime.

Regarding the infrastructure dimension, several interactions with landscape proved to be ambivalent, therefore, counting for both the system stability and change. The reason for that is threefold. First, empirical work has shown that this is a changing sub-regime. It has already been experiencing a transition process, especially since 2014, through improvements in the road infrastructure of the public transport system and a large project to expand the cycling network. Both actions discourage the use of private individual transport and reduce CO_2 emissions. Second, despite this commitment of the public sector, many areas of the city still lack cycling infrastructures, especially those more peripheral. Finally, at least for one of the investigated cases, i.e., the Vamo Fortaleza system, the established road infrastructure is already adequate, since it is a car-based solution.

Therefore, technology and infrastructure domains were found to be in transitions largely due to the role played by the local government, which brings the discussion to the sectoral policy dimension. Research findings brought extensive evidence of local government commitment to the transition to a more sustainable regime of urban mobility. In this sense, the landscape forces identified as maintaining a cooperative influence on this specific dimension of the regime (see Table 28) are those that act to accelerate the transition.

Otherwise, pressures acting to stabilize the incumbent mobility regime maintain a competitive interaction with the sectoral policy dimension. Examples include socioeconomic inequalities and the culture of car ownership. This also indicates how public authorities and policymakers interpret these landscape influences and translate them into transition-oriented programs, policies, and projects. And it is in this scope that niche innovations are inserted, as with the three cases analyzed in this research.

Landscape influences on structuring processes of niche developments can also manifest in heterogeneous ways: some landscape forces seem to accelerate new business models to stabilize, while others hinder that process. For instance: From a cultural perspective, despite the presence of a path dependence factor (local urban mobility practices mainly guided by the logic of the private automobile), the research data show that some changes in lifestyle and consumption patterns (e.g., growing concerns about health issues) have created opportunities for the emergence of sustainable initiatives in urban mobility such as sharing-based business models. In response, the municipal government has acted directly in developing and supporting these initiatives.

This attitude of local public authorities is not a domestic phenomenon. As shown in Table 28, there is a global trend towards sustainable urban mobility policies, with local governments engaging in environmentally friendly technologies and business models such as bike sharing and car sharing systems.

Fortaleza has traditionally experienced a disorderly growth, being one of the most unequal cities in Brazil. Under such conditions, some urbanization and socioeconomic dynamics have been historically established, leading to increased congestion, worsening air pollution, depleting urban infrastructure, and causing social exclusion. On the other hand, they ended up becoming triggers for the adoption of sustainability-oriented practices and public policies. In this context, sharing economy business models arise as drivers to sustainable urban mobility and responses to socioeconomic inequalities: when running on a large scale, they are understood to be capable of mitigating the misallocation of resources and playing an emancipatory and exercising citizenship role.

Another demographic factor influencing the legitimation processes of niche innovations is changes in the pattern of family structure. The phenomenon of the decrease in the average size of Brazilian family households seems to favor the adoption of electric vehicle sharing systems like Vamo Fortaleza. Single people and young or childless couples tend to have fewer lateral commitments (e.g., commutes for their children's needs), so that shared solutions could meet their expectations without the burden of owning a vehicle. People raising children can use shared bicycles for physical activities during routine travel since family day-to-day life can make them unfeasible.

The data also showed an influence of geographic factors on the legitimation dynamics of bicycle sharing business models. The flat topography provides a less stressful experience for cyclists, which counts for greater user adoption. Climate, on the other hand, is an ambivalent influence. Some users have reported that their use of the system is conditioned

by the purpose of the trip (unlike commuting home to the workplace, use for leisure would be less impaired by heat). Personal preferences also mediate the effect of the rain factor, with some users having mentioned a reduction in the use of shared bicycles in rainy seasons.

By addressing the mechanisms underlying the landscape influences on the socio-technical regime and the technological niche, we have been able to expand the meaning of these relationships. Until the completion of this study, they were merely conceptual, as initially proposed in Figure 13. As we have already argued, little was known about their content and nature in this specific urban context, a gap we intended to narrow, at least to some extent.

In this sense, the above discussions may be considered the first contribution of the research to the transitions field. Typically, this literature deals with landscape influences on the socio-technical regime in a homogeneous form, and thus argues about how they shape the transitions pathways. However, as the results here have shown, these forces coming from the landscape and acting on both the legitimation dynamics of niche developments and each dimension of the regime may be of different natures.

An illustrative example, taking a seminal contribution by Geels and Schot (2007): from our empirical analysis, their idea of *disruptive* pressures (nature) coming from landscape to regime, associated with *not yet sufficiently developed* niche innovations (timing), resulting in a transformation-type pathway, sounds incomplete. Because landscape pressures are not singular, but a bundle of heterogeneous, concurrent forces, timing-and-nature-based propositions like that should be followed by questions such as: What influences are we exactly talking about? What is the nature of each one? How do they interact with each dimension of the current socio-technical regime (e.g., technology, sectoral policy, culture, and so on)? How do actors in there interpret them?

Our results discussed above are in line with more recent empirical transition literature, either on urban mobility regimes (GEELS, 2012, 2018b; MORADI; VAGNONI, 2018) or other ones (e.g., Geels *et al.* (2016) and Kungl and Geels (2018)). These works leave the deterministic grounds of the so-called transition pathways literature a little aside and recognize the existence of a variety of landscape pressures and more complex interactions with niche and regime levels towards transitions (GEELS, 2019).

Transitions literature is mostly focused on the influence of landscape on the socio-technical regime and niche-regime interactions. The existence of contextual forces acting directly on the dynamics of niche innovations, although not absent from the literature, has been very little empirically investigated. Our empirical work was also dedicated to evaluating

how this influence occurs, which would be a second contribution to the field. In addition, as the results in Table 28 show, forces adding stability to the incumbent regime will not necessarily be divergent from niche innovations, as this will depend on the nature of the relationships between niche and regime.

6.1.2 *Niche – regime interactions*

A study by Smith and Raven (2012) proposed that niche innovations might cooperatively interact with some dimensions of the regime while having a competitive relationship regarding others. Cooperative niche – regime interactions will occur whenever incumbent actors reorient their strategies and actions towards legitimacy-seeking niche innovations (GEELS *et al.*, 2016). In this way, the interaction between niche and regime actors will shape the process of selecting emerging technologies and business models.

Our discussion here will be guided by the dimensions of the incumbent socio-technical regime. The way we addressed the nature of interactions between niche and urban mobility regime was as follows: we related the state of each regime dimension – as presented in section 4.2 – to the value proposition of each sharing-based business model investigated, according to what was discussed throughout chapter 5 (the specific mechanisms underlying these interactions towards legitimacy will be analyzed in the discussion of specific objectives 3 and 4, below). Table 29 summarizes these relationships to guide the following discussions.

Table 29 – Nature of niche – regime relationships

Case studied	Value proposition	Nature of the relationship with the urban mobility regime [a]				
		User Practices	Culture	Tech-nology	Infras-tructure	Sectoral policy
Bicicletar	Sustainable, healthier, and emancipatory solution for short trips, integrated with the public transport system	±	−	+	±	+
Bicicleta Integrada	Sustainable, healthier, and emancipatory solution by long-term bicycle loans, integrated with the public transport system	±	−	+	±	+
Vamo Fortaleza	Sustainable, efficient, healthier motorized mobility solution for long-haul, longer-lasting trips	−	−	+	+	+

Note: [a]. + Symbiotic relationship; − Disruptive relationship; ± Ambivalent relationship.
Source: The author, based on the research data.

Bicicletar and Bicicleta Integrada systems are niche developments with similar value propositions, aimed at using the bicycle as an active, sustainable and emancipatory

mode of transportation. As expected, the interactions of the two bike sharing systems are considered to maintain similar dynamics with each dimension of the urban mobility regime.

In the user practices dimension, for example, although the main characteristic of the incumbent regime is the car-centered logic, the data showed two other relevant subsystems: the municipal public transport, and a significant portion of users who already adopted the bicycle even before any relevant adaptation or improvement in the cycling path infrastructure. For this reason, the relationship of bicycle sharing niche developments with the user practices dimension is considered ambivalent: there is a symbiotic relationship with the subsystem of active mobility practitioners, while disruptive dynamics is seen with the rest of the regime. This is supported by empirical evidence of conflicts between niche and regime actors.

The evidence corroborates the competitive interactions between niche actors – users of sharing systems – and incumbent actors, who engage in established mobility practices. Bicicletar users have reported episodes of disrespectful behavior on the part of those who use motor vehicles. They also mentioned critical attitudes toward the expansion of cycling infrastructure (e.g., bicycle lanes) because it reduces the physical space available for vehicles. As a policymaker reported, some research suggests that cyclists using shared bicycles are less subject to these incidents when compared to cyclists commuting by private bicycles. The reasons for this would be historical-cultural, related to socioeconomic prejudice. This dynamic suggests a disruptive relationship between the niche bike sharing initiatives and the cultural dimension of the urban mobility regime.

The Vamo Fortaleza electric car sharing system, in turn, maintains interactions of competitive, divergent nature with culture and user practices dimensions. Its value proposition claims a sustainable and more efficient motorized mobility solution since it reduces CO_2 emissions and would discourage the acquisition of individual vehicles. In this sense, Vamo Fortaleza might challenge the dominant "one car one person" mindset observed in the city and encourage collaborative consumption practices like rides. These challenges are thus disruptive interactions with the current regime dimensions of user practices and culture.

Regarding technology, the currently available technological artifacts and systems in this dimension (e.g., apps, smartphones, internet, bikes, automatism of stations, and ticketing integration system) are already effective, though they just have been adapted to the local context and requirements of the public-private partnerships. Empirical evidence has shown technological learning processes through which the Bicicletar, Bicicleta Integrada and Vamo Fortaleza gained momentum. As stated, however, this did not occur through an attempt

to replace incumbent technologies, but by taking advantage of them to develop new business models in urban mobility. Therefore, the three niche developments we addressed are in symbiotic relationships with this dimension.

The road infrastructure is already adequate for the car sharing system so that the infrastructure regime dimension and this niche development relate symbiotically with one another. Concerning bike sharing systems, on the other hand, an ambivalent interaction was identified. Although bicycles can share incumbent motor vehicle infrastructure (streets and avenues), cycling-exclusive infrastructure is crucial to accelerate the transition to sustainability. On that subject, the local government has undertaken efforts to provide an appropriate network of bicycle lanes and bicycle paths, especially to the unmet peripheral areas. Research data suggest that infrastructure is a subregime in transition, which is why the relationship with bike sharing niche innovations is considered to be ambivalent.

As seen, the state of the infrastructure dimension is due to the role played by the public sector. As the results indicate, local government actors and policymakers have been directly involved in the transition of the urban mobility regime, orienting their actions towards niche developments. For this reason, the three cases analyzed in this research are symbiotically related to the sectoral policy dimension, as presented in Table 29. In addition to regime improvements (e.g., cycling infrastructure expansion, enhancements in the public transport system), actors from the sectoral policy dimension (policymakers) have embraced niche-oriented strategies by establishing public-private partnerships, supporting learning processes, even adapting the sharing-based business models.

In line with recent contributions by Hess (2016) and Mylan *et al.* (2019), our results also advance Smith and Raven's (2012) proposition, based on two patterns of niche-regime relationship, and show that a niche innovation can adopt a hybrid pattern of interaction with the regime (we claim it would probably be the norm): new business models could undertake a "fit-and-conform" strategy *with* one or some dimensions of the incumbent regime while holding a "stretch-and-transform" stance *against* others.

Our findings also corroborate those found most notably by the work of Florian Kern, Karoline S. Rogge, and their collaborators (see for instance Edmondson, Kern and Rogge (2019), Kivimaa and Kern (2016), Rogge and Reichardt (2016), and Rogge, Pfluger and Geels (2020), among others), in that public sector do engage in a range of processes and strategies (policy mix) aimed at accelerating transitions to sustainability. In the context of Fortaleza, in addition to encouraging the use of the public transport system through incremental innovations within the regime (e.g., modal integration, infrastructure

improvements, adoption of amenities and comfort items, and apps enhancing users' autonomy in decision making), policymakers have also directly engaged in niche supportive actions to promote new business models like those we investigated here.

The discussions in this section have enabled us to propose some hypotheses based on the research finding. They are thus a theoretical contribution emerging from the reality observed in the empirical stage of the research. These hypotheses consider the need for the analyst, once adopting the multi-level perspective framework, to undertake as much effort as possible in order to individualize the analysis of interactions between the three socio-technical levels, emphasizing the current "state of things" in the regime (after all, the regime is actually where things happen). By doing so, he/she will be able to capture more adequately the complexity of the legitimation dynamics that underlie transition processes. Table 30 gathers these hypotheses emerging from the data.

Table 30 – Emergent hypotheses about landscape-niche-regime interactions

Landscape-regime	Landscape-niche	Niche-regime	Hypothesis
Cooperative	Cooperative	Symbiotic	H1. If a landscape development is cooperative regarding both the niche innovation and a given regime dimension, the relationship between niche and that regime dimension is then supposed to be symbiotic.
Competitive	Competitive	Symbiotic	H2. If a landscape influence is competitive regarding both the niche innovation and a given regime dimension, then the relationship between niche and that regime dimension is supposed to be symbiotic.
Competitive	Cooperative	Disruptive	H3. If a landscape pressure is cooperative regarding the niche innovation but competitive to a given regime dimension, then the relationship between niche and that regime dimension is supposed to be disruptive.
Cooperative	Competitive	Disruptive	H4. If a landscape development is competitive regarding the niche innovation but cooperative to a given regime dimension, the relationship between niche and regime dimension is then supposed to be disruptive.
Ambivalent	Cooperative / Competitive	Disruptive / Symbiotic	H5. If a landscape pressure diversely influences (ambivalently) several actors and institutions in a given regime dimension, that dimension is then likely to be destabilizing, and dominant actors in there will impose their strategic orientation regarding niche innovations, whether selecting or preventing them.
Cooperative / Competitive	Ambivalent	Disruptive / Symbiotic	H6. If a landscape pressure diversely (ambivalently) influences a given niche development, that innovation is likely to stabilize only insofar as regime actors align their strategies and actions towards its scaling-up.

Source: The author, based on the research data.

The analysis of these hypotheses allows advancing the transitions pathways literature. Whether these relationships will count for the transition or the stability of the regime, will depend on the state of each regime dimension under analysis. For example, we

argue that a symbiotic relationship between a niche innovation and a certain dimension of the regime may act to add stability to the regime as a whole. Thus, the innovation would be selected and embedded by incumbent actors, artifacts, and rules, giving them superior performance without, however, altering the basic way in which the societal function in question is performed.

Now putting landscape influences into the analysis, we refer to the situation described in hypothesis H3: a landscape pressure cooperating with a niche innovation to emerge while competing with a given dimension in the incumbent regime. Although the relationship between niche and this regime dimension is disruptive, it is not yet clear whether this interaction is counting for the regime's change or stability. Addressing this issue will require the analyst to have an accurate understanding of the state of the regime and how the landscape forces act on each dimension in there.

6.2 Specific objectives 3 and 4

As noted in the previous discussions about the nature of the relationships between socio-technical levels, the niche and regime actors were found to respond to landscape influences. Such forces then shape niche-regime interactions through the way each actor apprehend and interpret them. But in addition to the nature of the relationships itself, we were also interested in capturing the variety of interactions from the perspective of different actors playing a part in sharing-based business models, namely, users, operators, sponsors, and policymakers. This led us to address research objectives 3 and 4.

Our findings showed that both the specific objective 3 (which aimed at *identifying the mechanisms and interactions through which the legitimation process of the sharing economy innovations takes place*) and 4 (which focused on *investigating what role business models play in the legitimation process of the sharing economy*) were actually closely related.

From the research data, business models were found to work as managerial tools being handled by the public-private partnership's actors in order to legitimate sharing economy innovations (Bicicletar, Bicicleta Integrada, and Vamo Fortaleza) in the journey of a socio-technical transition to sustainability. This finding corroborates the Bidmon and Knab (2018) proposition that business models themselves can play a role in transitions.

For each of the cases, we proposed vignettes grounded in research data to explain balanced legitimacy and its determinants (see in chapter 5: Figure 37 for Bicicletar, Figure 42 for Bicicleta Integrada, and Figure 51 for Vamo Fortaleza). Next, through deductive analysis

based on the data, we sought to relate the legitimacy mechanisms subordinate to these determinants to the dimensions of legitimacy they influence (cognitive, moral, and pragmatic) as well as the components of the business model to which they are associated (value proposition, profit formula, key resources, and key processes). We presented and discussed these relationships through Table 22, Table 24, and Table 26, which refer to Bicicletar, Bicicleta Integrada, and Vamo Fortaleza, respectively.

In this way, we were able to meet specific research objectives 3 and 4. The discussions showed in detail, for the three cases studied, the mechanisms associated with each component of their business models and how they influenced the legitimation process, whether as a driver or a barrier. In general, we have found no significant differences between the cases in how their business models were handled towards legitimacy and, ultimately, transitions. Although key resources were diverse from car sharing to bike sharing systems, business models have developed essentially on the same principles in terms of value proposition, key processes, and profit formula, as a consequence of the similar public-private partnership scheme implemented.

For instance, sustainable mobility appeal influences moral legitimacy insofar as it matches the environmental concerns of the population in general. Because the reduction of CO_2 emissions and air pollution is assumed to be an accepted consequence of Bicicletar, Bicicleta Integrada, and Vamo Fortaleza, normative approval is expected to increase, accounting for changes in the socio-technical regime.

Another cultural aspect identified in the data was the use of the bicycle as an element of emancipation and exercise of citizenship. Emancipation is mentioned here in its broadest sense, as it can provide people of all ages with several benefits ranging from financial savings and improved health to expanding social interaction. Such benefits are therefore related to the improvement of individual and social welfare (pragmatic legitimacy) and are considered desirable consequences of the sharing economy (moral legitimacy).

Being a critical resource in the business models of all of the three cases, the network of stations – and relative bicycles and vehicles – is an essential factor in gaining pragmatic legitimacy. In other words, the higher the number of docking stations existing in the city, the higher the benefit perceived by current and potential users. The spread of stations also contributes to increasing the comprehensibility of the business models, which positively influences cognitive legitimacy requirements, and reinforces the argument that the programs are advancing their legitimation processes.

As with the station network, the expansion of the complementary infrastructure (cycling paths, cycling lanes, bike racks, charging points for electric cars) also contributes to achieving, even increasing, pragmatic legitimacy from the benefits it provides to users. By expanding infrastructures, one creates new access opportunities for current users while encourages those who have not yet engaged, meeting pragmatic and moral legitimacy requirements. Moreover, this creates a cognitive legitimacy spillover because infrastructure expansion makes the business models themselves recognized, inevitable, and inevitability precedes taken-for-grantedness.

Finally, from the discussions in this section, we were able to identify how a change in the business model, specifically in its profit formula building block, triggered a series of transformations in the value chain of the bicycle sharing systems. In the case of the electric car sharing system, changes in the whole model (in profit formula, as well as in key resources, key processes, and value proposition) were needed to gain legitimacy. These findings confirmed the boundary-spanning characteristics of business models, as proposed by Amit and Zott (2015): changes in the building blocks can (and even do) exert influence on other actors' strategies, such as operator, sponsor, and local policymakers.

The research data also showed that business models can work as vehicles for legitimacy by enabling niche innovations to gain stability and endogenous momentum across the value chain. The analysis of Bicicleta Integrada clarifies this discovery: its business model was developed as a response to the legitimacy deficits experienced by the business model of its predecessor, Bicicletar. Therefore, through business models, actors were capable of shifting the institutional environment and accelerating sustainability transitions by changing established normative, cognitive and regulative rules, which is in line with the studies by Bidmon and Knab (2018), Wainstein and Bumpus (2016), van Waes *et al.* (2018), and de Leeuw and Gössling (2016).

These discussions have enabled us to develop new hypotheses emerging from the data. While the first hypotheses proposed – H1 to H6 – referred to the nature of interactions between socio-technical levels (in response to specific objectives 1 and 2), those presented below seek to explain the legitimacy dynamics themselves. They were constructed from the findings for specific objectives 3 and 4.

Such dynamics, as the data have shown, will culminate in what we call balanced legitimacy, that is, a degree of legitimacy that does not satisfactorily meet the expectations of each of the actors simultaneously. In our view, therefore, legitimacy should be seen as a relative construct, especially when business models are built upon public-private partnerships

arrangements. Under these conditions, legitimacy trade-offs will be present, i.e., more legitimacy requirements of one actor or group will always be met at the expense of legitimacy requirements from another(s). Table 31 schematically presents these hypotheses, for each relationship between balanced legitimacy constructs.

Table 31 – Emergent hypotheses about (balanced) legitimacy in sharing economy – drafting a substantive theory

Relationships	Hypotheses about legitimacy dynamics
System reliability → Balanced legitimacy	H7. System reliability is a strong antecedent of balanced legitimacy so that an increase in reliability is associated with increased legitimacy.
Maintenance issues → System reliability	H7.1. Maintenance issues influence system reliability so that an increase in the number of technical failures causes a loss of reliability, ultimately harming its legitimacy.
Station balancing → System reliability	H7.2 Station balancing influences system reliability so that an increase in the number of imbalanced stations causes a loss of reliability, ultimately harming its legitimacy.
Network logic → System reliability	H8. Network logic directly influences system reliability insofar as more cohesive network logic leads to increasing reliability, strengthening the system legitimacy.
Network logic → Maintenance issues	H8.1. A more cohesive network logic mitigates losses of reliability due to maintenance failures. An unintended consequence would be that the more cohesive the network, the less effective the maintenance processes.
Network logic → Station balancing process	H8.2. A more cohesive network logic mitigates losses of reliability due to imbalanced stations. An unintended consequence would be that the more cohesive the network, the less effective the station balancing process.
Complementary infrastructure → System reliability	H9. Complementary infrastructures (e.g., cycling paths, cycling lanes, and charging points for electric vehicles) directly influence system reliability insofar as a broader complementary infrastructure available to users increases the perception of reliability and, ultimately, its legitimacy.
Complementary infrastructure → Maintenance issues	H9.1. A broader complementary infrastructure mitigates losses of reliability due to maintenance failures. An unintended consequence would be that the broader the complementary infrastructure, the less effective the maintenance processes.
Complementary infrastructure → Station balancing process	H9.2. A broader complementary infrastructure mitigates losses of reliability due to maintenance failures. An unintended consequence would be that the broader the complementary infrastructure, the less effective the station balancing process.
Interests and expectations of the public authorities (policy mix) ↕ Interests and expectations of users and the general population ↕ Sponsor's marketing interests and strategies → Balanced legitimacy	H10. In a sponsorship sharing economy business model, the interaction between diverse, even antagonistic interests and expectations from different groups of actors may reach only a balanced legitimacy. Balanced legitimacy is thus a certain degree of legitimacy that is just sufficient to enable new business models to perform under a suboptimal equilibrium, from which any gain in legitimacy for one group of actors will imply loss of legitimacy for others unless a radical transformation in the business model occurs that removes one of the groups of actors and makes the others optimally met.

Source: The author, based on the research data.

Through the hypotheses presented, we are proposing the outline of a substantive theory capable of explaining the legitimation phenomenon in the specific context addressed here. As is proper to substantive theories, the virtue of that proposed here lies not in its capacity for generalization, but in the explanatory power for the substantive area: sharing economy-based business models in the urban mobility context.

6.3 Specific objective 5

"Advance the theoretical and empirical domains on the legitimation of the sharing economy, building on business model innovation approach, legitimacy theory, and multi-level perspective on socio-technical transitions." We dealt with this fifth objective in two interrelated ways. We first carried out a theoretical discussion by orchestrating the main literature on the business model approach, legitimacy theory, and transitions perspective, then putting the sharing economy into the context. From this emerged our assumption according to which sharing economy business models are niche developments building up the alignment of visions and endogenous momentum while interacting with the incumbent institutional forces to scale up.

From this conception, as we have been to discuss so far, "incumbent institutional forces" shape the institutional logic, that is, the set of rooted beliefs, practices, technologies, infrastructures, policies, and actor networks making the current socio-technical regime relatively steady. Such shared, taken-for-granted rules characterize legitimacy requirements that sharing economy innovations (e.g., bike sharing, car sharing) have to meet to add stability and flourish.

The deductive approach to this conceptual triad enabled us to propose a theoretical framework that pictures such legitimation dynamics, as we presented in Figure 13. This framework is an early response to the specific objective 5. We claim it is a worthwhile contribution of this research to guide further empirical studies in the transitions field focused on the legitimation dynamics of new business models in general, inside and outside the sharing economy context.

Its usefulness also lies in what Suchman (1995) considered a valuable way to address legitimacy: the framework provides guidelines for capturing legitimacy dynamics from both the strategic and the institutional approaches. The former considers legitimacy as a fundamental resource for organizational survival and emphasizes the role of managerial

action. The latter shifts the analysis lens to the normative, cultural context, highlighting the institutional background while slightly overlooking managerial action.

Therefore, our interplayed approach to business models and legitimacy theory into transitions perspective seems to be a valuable contribution of the research for the Administrative Sciences. While addressing the public-private sharing economy initiatives as research objects, we argue that the theoretical framework developed could be applied to other objects and phenomena. However, we recognized that it does not provide a satisfactory response to the fifth specific objective. Indeed, content and meanings underlying the relationships and constructs in there have been insufficiently studied so far. This is because, except for the regulative dimension, legitimacy in the sharing economy domain remains poorly understood.

The second way to deal with the specific objective 5 then consisted of empirical work. We sought to identify, from a variety of perceptions of the research participants and with the support of documentary and observational evidence, the characteristics of socio-technical levels in the urban mobility context. Furthermore, we also mapped the determinants of legitimacy as well as the mechanisms and interactions through which the legitimation processes of the sharing economy took place.

In this way, we were able to discover the meanings, contents, and nature of relationships in the aforementioned theoretical framework, aspects that have already been covered in detail in the discussions on specific objectives 1 to 4. From this effort, we claim another theoretical contribution of the research: for each case investigated, we proposed vignettes grounded on the data to explain legitimacy in the context of the sharing economy.

Such vignettes included the main determinants that emerged from the data analysis, specifically in the category integration process. Collating the vignettes proposed for the two bike sharing programs (Bicicletar and Bicicleta Integrada) and that for the car sharing system (Vamo Fortaleza), we found that the meta-categories explaining balanced legitimacy are:

1. Interests and expectations of the public authorities (policy mix);
2. Interests and expectations of users and the general population;
3. Sponsor's marketing interests and strategies;
4. Network logic;
5. Complementary infrastructures;
6. Maintenance issues;
7. Station balancing process; and

8. System reliability.

According to the research data, these determinants are often antagonistic to each other, so that privileging the interest of an actor involved in the business model can end up harming the interests of others. Moreover, they may play ambiguous roles over each other. Indeed, when it comes to public-private partnerships as in the cases studied here, both institutional forces (culture) and organizational (e.g., corporate values and interests) factors will be brought up and will also mediate these interactions for legitimacy.

The trap we called "this way or no way at all" is eloquent to this discussion, as it comprises virtually all of the above determinants: the idea of adopting a fully sponsored model meets the "interests and expectations of public authorities and citizens" because there is no cost to society for the implementation and operation of sharing systems; on the other hand, the "sponsor marketing strategy" confines the coverage of the system to the geographic region where its target audience is; thus, the system delivers to that region good performance in terms of "system reliability" since it is necessary to avoid fragmentation and preserve a "network spatial logic"; consequently, this system design does not deliver any performance to the city's outskirts, which remain unserved; this ultimately harms the "expectations of the population" and even "the interests of the municipal public authority".

As one can see, legitimacy dynamics occur through interactions that can be cooperative and competitive. Because of this, the whole transition process occurs under permanent trade-offs of legitimacy. This led us to propose the concept of balanced legitimacy, which is also a contribution of this research. In sharing economy arrangements based on public-private partnerships, business models need to be able to find a balance in which an acceptable degree of satisfaction of expectations and interests will be achieved for each group of actors even such equilibrium is suboptimal.

For within-niche legitimation processes, the balance legitimacy postulates that strategies aimed at obtaining or increasing legitimacy with a group of actors can undermine legitimacy for others. However, legitimacy trade-offs do not occur only in the interaction of actors *within* socio-technical niches, but also in the interaction *between* niche and regime. When pro-transition policies and actions are implemented, legitimacy is gained or strengthened with the actors who benefit from them (niche actors, for instance). Meanwhile, legitimacy is lost with the actors of the incumbent regime (e.g., car owners criticizing the reduction of the physical space of streets and avenues for the implementation of bicycle paths).

In our view, the multi-level perspective on socio-technical transitions framework has enabled us to partially meet Suchman's (1995, p. 577) recommendation of taking "a middle course between the strategic and the institutional orientations" of legitimacy. Through this posture, we were, to some extent, able to capture and analyze both the managerial agency for gaining legitimacy and the influence of the broader institutional environment in defining legitimacy requirements by shaping expectations and perceptions.

The research also contributed to the theoretical domain of legitimacy in the sharing economy by operationalizing constructs and concepts from the business model literature applied to the field of public management. The study showed how public sector actors managed the business model building blocks intending to reach greater legitimacy and structuring (it is worth mentioning that two out of the three policymakers interviewed cited the expression "business model" a few times during the interviews).

In this regard, our findings join recent transitions literature that points out how regime actors can reorient their actions and strategies towards niche developments to improve performance in institutionalized societal functions. In the cases investigated here, public sector actors led strategies for implementing, legitimizing, and structuring niche innovations to embed them into the urban mobility regime at the local level.

Table 32 presents the main contributions of the research, both to the theory examined and for future empirical work. Through a comparison with the literature on each theoretical approach visited (business model innovation, socio-technical transitions, and legitimacy theory), we point out how the results expanded the domain of the phenomenon under investigation: the legitimacy of the sharing economy.

Table 32 – Research main contributions

Main literature	Research contributions Similar / Advance to the visited literature (+) | Conflicting (−) | Novel (→)	Studies
Business models	(+) Business models used as a managerial tool in dealing with legitimacy challenges (not public sector).	Zimmerman and Zeitz (2002), Snihur and Zott (2013), Amit and Zott (2015), Karlsson and Middleton (2015), Mikhalkina and Cabantous (2015).
	(+) Business models can be seen as a managerial tool in the public sector to improve the performance of services delivering (not transitions).	Micheli *et al.* (2012), Ranerup, Zinner and Hedman (2016), Edralin *et al.* (2018), Mattsson and Andersson (2019), Smith, Sochor and Karlsson (2019).
	(+) Business models in transitions: empirical approaches from an inter-ontology crossover position.	Geels (2009, 2020), Bolton and Hannon (2016), Huijben, Verbong and Podoynitsyna (2016), Wainstein and Bumpus (2016), Bidmon and Knab (2018), van Waes *et al.* (2018), Sarasini and Linder (2018).
	(+) Business models used by public sector actors to accelerate transitions to sustainability.	Edmondson, Kern and Rogge (2019), Kivimaa and Kern (2016), Rogge and Reichardt (2016), Rogge, Pfluger and Geels (2020).
Transitions	(+) Regime actors reorient strategies towards niche developments in order to enable and select symbiotic, cooperative innovations.	Smith and Raven (2012), Geels *et al.* (2016), Ingram (2018), Turnheim and Geels (2019).
	(−) Landscape → regime interactions: Forces from the landscape exert heterogeneous pressures on each dimension in the socio-technical regime. That is, the same landscape influence can pressure the regime to change in one dimension (e.g., technology), while adding stability to another (e.g., user practices). Analysts should thus address each landscape pressure on each regime dimension from an individualized approach as actors will interpret interactions diversely.	Geels and Schot (2007, 2010), Bidmon and Knab (2018).
	(→) Landscape → niche interactions: Landscape pressures are not singular, but a bundle of heterogeneous forces to diversely influence niche developments undergoing stabilizing and structuring processes. Analysts should therefore strive to identify all of these forces and understand how each affects the stabilization of niche innovations as actors will interpret them diversely. In addition, because the dominant literature whether overlooks landscape-niche interaction or takes it as of a homogenous nature, our study contributed to fill a gap in the field of transitions by addressing this relationship empirically.	-

Main literature	Research contributions Similar / Advance to the visited literature (+) | Conflicting (−) | Novel (→)	Studies
	(+) Traditional transitions pathways typology is not effective in capturing empirically the complexity of reality. As landscape pressures are not singular, but a bundle of heterogeneous forces, actors, and institutions interacting within and between landscape, regime, and niche levels. Instead of taking landscape as homogenous, analysts should consider questions such as: What influences are we exactly talking about? What is the nature of each one? How do they interact with each dimension of the current socio-technical regime? How do actors in there interpret them?	Geels (2012, 2018b), Moradi and Vanoni (2018), Geels *et al.* (2016), Kungl and Geels (2018).
	(+) Niche-regime interactions can assume simultaneously heterogeneous natures: new business models could undertake a "fit-and-conform" strategy *with* one or some dimensions from the incumbent regime while holding a "stretch-and-transform" stance *against* others.	Smith and Raven (2012), Hess (2016), Mylan *et al.* (2019).
	(→) Landscape ↔ niche ↔ regime interactions (Hypotheses H1 to H6, in Table 30): From the research findings, we elaborated some theoretical hypotheses grounded in the data to guide further empirical efforts in the field of transitions.	-
Legitimacy	(+) The legitimacy framework for business models in transitions (Figure 13): This theoretical framework was proposed from the literature. We claim that it provides guidelines for empirical transitions studies that focus on the legitimation dynamics of new business models in general, inside and outside the context of the sharing economy. In addition, it embraces both strategic and institutional approaches to legitimacy.	Suchman (1995), Aldrich and Fiol (1994), Dowling and Pfeffer (1975), DiMaggio and Powell (1983), Meyer and Rowan (1977).
Legitimacy of sharing economy business models in the public sector (draft of a substantive theory)	(→) Vignettes of balanced legitimacy (Hypotheses H7 to H10, in Table 31): Such vignettes emerged from the data and could orient studies addressing sharing economy initiatives led by the public sector.	-
	(→) Balanced legitimacy: Legitimacy dynamics from the perspective of transitions have been little studied so far. The concept of balanced legitimacy is an important construct, given that transition processes develop through interaction between several actors who often have divergent expectations, interests, motivations, and visions. Balanced legitimacy is a degree of legitimacy achieved by a business model performing a suboptimal performance in "zero-sum equilibrium". That is, from this degree, any gain in legitimacy for one actor or group will necessarily be extracted from another group involved in the model. Unless a radical transformation in the business model occurs (e.g., one that removes one of the groups and makes the others optimally attended), the current suboptimal performance will persist.	-

Source: The author.

The next chapter collates these contributions in comparison with the gaps that justified the study. We also evaluate the results in light of the objectives proposed. In the end, we discuss the main limitations of the study and present a research agenda that addresses limitations or complement the research findings.

7 CONCLUDING REMARKS

Despite the growing literature on the sharing economy, legitimacy issues in this specific field remain poorly understood. Aiming to fill this gap, the main objective of this thesis was to understand the legitimation process of sharing economy innovations performing in the urban mobility context, from the perspective of the different actors involved.

We orchestrated three theoretical backgrounds, namely, the multi-level perspective on socio-technical transitions, the business model approach, and legitimacy theory, and proposed a theoretical framework capable of guiding empirical efforts to achieve the research objective. From this deductive effort, sharing economy ventures were considered to be innovative business models adding stability and building up endogenous momentum within technological niches, while interacting with the institutional forces from the current socio-technical regime, which represent legitimacy requirements they have to fulfill, transform, or substitute in order to emerge and establish.

Intending to understand the interactions between actors, rules, and institutions, we conducted the investigation under the interpretivist paradigm by employing an exploratory-qualitative approach. By holding a heuristic, discovery-oriented research position, we were able to capture the content and meanings underlying each of the still elusive relationships and constructs in that conceptual framework. Three cases were selected for empirical work: a car sharing system (Vamo Fortaleza) and two bike sharing systems (Bicicletar and Bicicleta Integrada), all related to the context of urban mobility in the city of Fortaleza, Brazil. For reliability purposes, our data were collected from a variety of sources, such as documents, observations, and in-depth interviews with users, policymakers, and managers from the operator and sponsoring companies.

To the best of our knowledge, this is the first empirical investigation of the legitimation processes of the sharing economy under a transitions perspective in Brazil and one of the few in the developing world.

7.1 Evaluating the research specific objectives

The first specific objective of the research was to characterize the socio-technical levels of the urban mobility transition to sustainability. Throughout chapters 4 and 5, we sketched vignettes to represent the socio-technical levels from the research data. Figure 52 depicted the outcome of this work.

Regarding the landscape, we identified influences of different natures, such as cultural, demographic, geographical, macropolitical, and urban developments. Each of these landscape influences unfolds in some forces that operate through many mechanisms. Using the cultural influence, for instance: while changes in lifestyle and consumption patterns are underway (e.g., people are increasingly concerned with issues related to health improvement), path dependence mechanisms like the "one car, one person" logic add stability to the current urban mobility regime and hinder the pace of the change. The global trend towards sustainable urban mobility policies, in turn, is a macropolitical force influencing regime actors. Such influence takes place through efforts by governments towards environmentally friendly urban mobility. In this sense, sharing economy-based schemes have been supported by countries and jurisdictions in several cultures.

Concerning the regime level, the data revealed three main subsystems: the municipal public transportation system, notably based on the bus; private motor vehicles, and active individual mobility (bicycles and pedestrians). It has been found that the urban mobility regime has historically been developed upon infrastructures, regulations and technologies that reflect the dominant logic of individual transport. This has contributed to the construction of a culture (reflected in consumer practices and habits) that has become institutionalized around the symbolic meaning of car ownership.

Nevertheless, the empirical work has highlighted characteristics of transition processes in the current regime, with the establishment of regulations and public policies, infrastructure improvements, and technology enhancements in the incumbent regime itself, favoring the sub-systems of public transport and bicycle mobility. The data also showed continuous support to new business models experiencing improvements and learning processes at the niche level. These actions indicated the local government's leading role in promoting the transition.

In concluding the evaluating of the first specific objective, we also analyzed the innovations developing in the technological niche. We then put the Bicicletar, Bicicleta Integrada and Vamo Fortaleza business models into the multi-level perspective. Although they began operating close in time, the three cases seem to be distinct in their degree of maturity and structuring (i.e., legitimacy). Because the programs are supported by public-private partnership schemes – and due to all the repercussions from this – we labeled them public-private sharing systems.

The business model framework proved to be useful in outlining the characteristics of each system. It allowed us to identify similarities and distinctions in terms of value

proposition and profit formula, as well as key processes and key resources needed to deliver such value. At large, the three business models differ mainly in infrastructure, rules, and some technologies, yet they share some actors, strategies and policies while carrying a manifesto of a sustainable, healthier, and inclusive mobility solution. This approach gave us, in addition, some insights into the nature of relationships between the niche and other socio-technical levels and how such interactions take place.

The nature of relationships was then addressed by the second specific objective. Our work here has been divided into two stages: the first analyzed the landscape influences on both the regime and the niche; we then focused on the interaction between the niche and the regime. In general, the results showed that the influences underlying the relationships between the socio-technical levels are not homogeneous. For instance, the same landscape force can influence regime in different ways (cooperative, competitive, even ambivalent, allowing for both change and stability), depending on the state of each dimension within the regime and how actors in it interpret such influences. On that subject, we found that technology, infrastructure and sectoral policy are regime dimensions in transition, pushed especially by public sector actors. Additionally, our findings showed that landscape-niche relationships are heterogeneous as well, with some forces accelerating the stabilization of new business models, and others making this process more difficult.

The current state of regime dimensions was useful to analyze the nature of niche-regime interactions as well. Both symbiotic (fit-and-conform) and disruptive (stretch-and-transform) as well as ambivalent relationships were found, as some dimensions have oriented strategies for niches while others seem to prevent the transition. From these comprehensive findings, we were able to propose some hypotheses grounded in the data to advance the theoretical domain of transitions in general and pathways literature in particular.

The third specific objective was to identify the mechanisms and interactions through which the legitimation process of the sharing economy innovations takes place. Here, we were interested in capturing a variety of perceptions from different actors (users, operator, sponsors, and policymakers). From the analysis of interactions came the concept of balanced legitimacy, in which gains in legitimacy for one group of actors involved in the sharing initiative come at the cost of legitimacy for others.

In addition, according to the category integration work, the main determinants of balanced legitimacy were identified, as follows: interests and expectations of the public authorities (policy mix); interests and expectations of users and the general population; sponsor's marketing interests and strategies; network spatial logic; complementary

infrastructures; maintenance issues; station balancing process; and system reliability. These constructs and their relationships form the vignettes of balanced legitimacy we proposed for each case investigated.

For each of the cases, research data showed that the mechanisms acting on the legitimation dynamics were closely related to the business model building blocks so that barriers and drivers of legitimacy were identified for all of these elements. Indeed, the business models could be seen as functioning as managerial tools by which actors in the public-private partnerships implemented changes towards legitimacy. This finding meets the fourth research specific objective, which was to investigate what role business models play in the legitimation process of the sharing economy.

The value proposition component of each case manifests a sustainable mobility appeal which calls for the reduction of CO_2 emissions and air and noise pollution, the promotion of healthy habits, the fair and equitable distribution of urban spaces, and the sense of belonging and exercise of citizenship. Integration with the public transport system, autonomy in decision making regarding commutes, money-saving, time-saving, and convenience were all perceived by users as benefits, and thus drivers of legitimacy and structuring. In this sense, the business models might be seen as mechanisms underlying the transition to a more sustainable urban mobility regime, insofar as such appeal meets expectations in the broader society.

Key resources and processes, in turn, are a means of ensuring delivery of these value propositions. They affect directly maintenance issues, station balancing process, and reliability of the entire system. Well-trained field technicians, comprehensive infrastructure, bicycles, and electric vehicles in good conditions, stable smartphone applications were some of the resources identified in the research as driving the legitimacy of sharing-based innovations. Regarding processes, we mention strategic performance management, station balancing, user support services, maintenance routines, and communication and educational campaigns, among others. Concerning the profit formula building block, the sponsorship model mechanism was found to be a driver of legitimacy since there was no cost for society and it favored the upkeep of the network's spatial logic.

All things considered, the research findings highlighted policymakers as influential actors in transitions as well as in legitimation processes of the sharing economy in particular. Municipal agencies directly coordinate public programs and policies toward cycling urban mobility. The local government has engaged in regulatory matters, technological and business models innovations (such as the car sharing and bike sharing

systems), infrastructure efforts, development of public-private partnerships, education policies, and awareness campaigns aiming at changing habits, practices, and, ultimately, culture by encouraging the use of public transport, active mobility, the democratization of public spaces, resource sharing, and reduction of CO2 emissions.

In other words, actors from the public sector were found to be purposefully accelerating the transition to sustainability in the local urban mobility context. They established a set of sectoral policies within both the regime and niche to promote innovations towards a more sustainable mobility regime. By engaging in these strategies, policymakers and public authorities are building the foundations of pragmatic (regulations and benefit promotion), moral (normative approval), and cognitive legitimacy (expanding knowledge about sharing systems and their infrastructure).

Based on the evaluation of objectives made above, we discussed some relevant implications for administrative practice, especially in contexts similar to the one explored here. The first contribution concerns the determinants of legitimacy and their mechanisms – drivers and barriers – that we identified in the data analysis work. These can guide actors engaged in public-private partnerships for urban mobility in eliminating barriers and promoting drivers to increase the reliability – thus, legitimacy – of the service that the partnership delivers. The three vignettes of balanced legitimacy proposed – for a single-sponsored and a multi-sponsored bike sharing systems, and a single-sponsored car sharing scheme – can be useful in this regard.

Outside the context of urban mobility, these vignettes lose explanatory capacity since the mechanisms that emerged from the data as underlying those relationships might not be applicable. However, some hypotheses that describe their relationships may still have theoretical value in generic terms, especially those that refer to the interaction between expectations of different groups. Such hypotheses may provide guidelines for decision making.

Our results showed a set of difficulties – barriers to legitimacy – related to the single-sponsored models that led the municipal government to make contingency decisions, via experimentation and trial and error routines. Awareness of these difficulties by public authorities in other jurisdictions engaging in innovative models of shared mobility could be useful in accelerating learning processes and ultimately legitimizing these initiatives. Problems like the "this way or no way at all" trap, which arise from the interaction between network logic and sponsor interest, could be better addressed.

Our results suggest that business models are a useful tool for dealing with the challenges of balanced legitimacy, including by public sector actors, a field within which the business model notion is still incipient. Through their building blocks, public managers and private partners can guide learning processes while calibrating compliance with legitimacy requirements from the perspectives of other actors.

In this context, trial-and-error learning and improvement routines proved relevant to the development of business models, especially in the case of Vamo Fortaleza, where few or no lessons learned by other similar initiatives could be replicated in the local scenario. However, this was also evidenced in the bicycle sharing initiatives; after all, the Bicicleta Integrada emerged as a proposal for solving the gaps of legitimacy that the Bicicletar presented to the populations living in the outskirts of the city of Fortaleza.

Moreover, in engaging in ventures towards transitions, public authorities need to be able to identify and employ specific strategies to release lock-in mechanisms inherent to each dimension of the regime. This is because there is no unique, singular landscape force to influence all regime dimensions homogenously. Instead, landscape and regime relate to each other in a complex, varied way, which depends on the state of each regime dimension, the agency power of each actor, and the way they interpret such relationships.

7.2 Contributions to the field

The research brought contributions to the fields of studies in socio-technical transitions and the sharing economy. Some of these contributions have already been presented in our discussion of the fifth specific objective, in section 6.3. There have been advances in the literature of business models and legitimacy theory derived from the attempt to connect different ontological conceptions. This strategy has proved to be somewhat effective since theoretical and empirical frameworks emerged that other analysts may adopt as guidelines for future studies. We caveat analysts, however, to be aware of the contextual characteristics in which the empirical work was carried out.

Other contributions of the research lie in gaps in the literature that it sought to overcome since they guided its implementation. To discuss them, we recall some of the study's procedures and results and show how they explored these opportunities. The main gaps mapped were:

1. Transitions literature has overlooked the emergence of new organizational forms and markets for sustainability (BOON; EDLER; ROBINSON,

2020), which requires analyzes of legitimation processes between the socio-technical levels;

2. In the sharing economy field, "legitimation" has been reduced to "regulation" (DYAL-CHAND, 2015; KATZ, 2015; MILLER, 2016; RANCHORDÁS, 2015), as studies have considered only the regulatory (a pragmatic-type) dimension of legitimacy;

3. Geopolitics: transitions studies have been focusing predominantly on the developed world; even in the context of developing countries, Brazil seems to have still little prominence (MARKARD; RAVEN; TRUFFER, 2012; WIECZOREK, 2018);

4. Locus of analysis: national approaches are still the norm in transitions literature (MARKARD; RAVEN; TRUFFER, 2012) although urban, city-level analyses have been increasing in number.

In our view, the present study dealt effectively with each of these gaps. In addressing the sharing economy from the multi-level perspective as a new organizational form (a business model) under development in the socio-technical niche, it was possible to identify the mechanisms that support and those that hinder legitimacy dynamics in the interaction between the socio-technical levels towards transitions. The sustainable appeal characteristic of the sharing economy in general, and of car sharing and bike sharing business models in particular, was empirically verified as a legitimation mechanism.

The alignment with the regulatory framework is only one of the legitimacy dimensions. Indeed, it is one of the most important streams of studies within the sharing economy. These works are focused on how to regulate the sharing economy, not how to legitimize it in the broad sense. The reasons for this have already been discussed, and go back to the criticisms that these business models receive, often related to tax evasion, legal uncertainty, lack of labor protections for workers, among others.

For the cases analyzed here, empirical work has shown that this regulatory dimension does not reproduce the tensions present in those criticisms (directed mainly at initiatives such as ride hailing and peer-to-peer accommodation). One of the reasons for this is that the cases are business models led by the public sector itself, which mitigates risks of misalignment with local regulations. Another may be that the rules of bike sharing and car sharing systems conform to the established regulatory framework, even at the national level, not giving rise to greater tensions. Thus, the data provide evidence of mechanisms – drivers and barriers – of moral, cognitive and pragmatic legitimacy for the three cases (Bicicletar,

Bicicleta Integrada, and Vamo Fortaleza), and from the perception of several actors, as shown in the discussion of the results.

The field of socio-technical transitions studies is characterized by its predominantly Eurocentric production. The provenance of the mainstream institutions in the area supports this view. Despite the growing interest in research in the developing world, Brazil is still on the periphery of knowledge production in this field. As one of the largest and most unequal economies in the world, and given its prominence among developing countries, socio-technical transitions studies in Brazil are especially timely. Our research took this opportunity and contributed to filling this gap.

Furthermore, research on transitions has been mostly directed to works that address socio-technical systems from a national or global perspective. Like any ontological and methodological choice, this alternative has upsides and downsides. Its effectiveness lies in evaluating broader institutional contexts and high-order dynamics underlying transitions (e.g., political and cultural landscapes, geopolitical convergence and conflicts, greater economic decisions, and power games). Such an approach, on the other hand, does not provide the analyst with the ability to capture place-specific dynamics like local rules and institutions affecting transitions processes. The city-level approach we undertook in this research met this need. Fortaleza is one of the largest Brazilian cities and has stood out in recent years for restructuring its urban mobility system, shifting public policy decisions mainly towards the public transport system and sustainable sharing schemes.

7.3 Limitations of the study and a research agenda

One of the Grounded Theory's strengths is that its constructs and hypotheses emerge from the data, which gives them explanatory power. Generalizations, on the other hand, should be considered sparingly. The present study focused on the urban mobility regime, taking new business models based on the sharing economy (car sharing and bike sharing systems) as research objects. The substantive theory proposed here and its vignettes explaining legitimacy in the sharing economy still require further validation efforts by the scientific community. Empirical approaches to these frameworks in other contexts would also be recommended. In this sense, future research could explore other areas of the sharing economy and its respective regimes, such as those presented in Figure 12 (e.g., tourism and hospitality, employment, and production-consumption).

Even in the urban mobility regime, comparisons with purely private bike sharing and car sharing models, arrangements that already exist in several cities inside and outside Brazil, could bring interesting insights. How interactions between niche and regime actors occur towards legitimation and structuring of these initiatives and how they affect transition dynamics are questions not addressed in this research (consider, for instance, that in the wealthy Brazilian Southeast, some exclusively private programs were closed down after a few years of operations). Furthermore, because they are not public-private partnership schemes, the role played by the public sector is restricted to middle or support activities, such as regulatory action. Whether and how this affects the ability of public authorities (agency) to accelerate transitions therefore become emerging research topics.

Most socio-technical transitions studies undertake national approaches. For this reason, research using a city-level approach could be a promising investigation, a lack of literature that this research has attempted to explore (HÖLSCHER *et al*., 2019). However, since the three cases investigated are in the same city, such an attempt may have disregarded other determinants of legitimacy absent in the context in which it was conducted. There is an opportunity to compare similar sharing initiatives implemented in different Brazilian cities, favoring a more in-depth geographic analysis. Comparing initiatives from different countries could introduce elements from distinct institutional contexts to the analysis.

By methodological option, this work employed the multi-level perspective framework. The ontological and epistemological debate about the multi-level perspective and its downsides is far from over. Svensson and Nikoleris (2018) argue, for instance, that the ontological foundations of the MLP framework undermine its explanatory capacity (see Genus and Coles (2008), Smith, Voß and Grin (2010), Geels (2011), and Sorrel (2018), for some further examples). Thus, we consider that studies intended to evaluate legitimacy dynamics of the sharing economy under transition perspectives and from other ontological alternatives than MLP are appropriate and timely. We refer here to approaches such as technological innovation systems, strategic niche management, and transition management, each of them bringing different methodological and ontological considerations.

One of the downsides this research needed to deal with was the framing challenge, i.e., empirically operationalize regime, niche and landscape levels for the urban mobility context. This challenge requires the researcher some degree of discretion, which may vanish the robustness of findings. Besides, analyzing legitimation processes from a transitions perspective is a complex task, given the variety of interactions between different actors and institutions, expectations and worldviews, norms, and interpretations of external influences.

As much as we have faced this challenge by seeking in the empirical evidence the grounds for the delimitation of the socio-technical levels, we caveat that the scrutiny of the academic community on the results presented here is necessary and will contribute to the improvement of the research.

Still concerning methodological limitations, we recognize that addressing "unfriendly" incumbent actors (e.g., non-sharer users) could help to discover insightful information about lock-in mechanisms preventing the legitimation journey of the sharing-based new business models. People who deliberately refuse to engage in sharing schemes could enrich the research findings by raising factors other than those mentioned by the informants addressed here. This limitation stems from the very research object, that is, the focus on bicycle sharing and car sharing initiatives.

Despite the attempt to capture legitimation dynamics comprehensively in the three cases investigated and analyze the various dimensions of legitimacy, we recognize that such an effort may have left gaps. Our operationalization of the construct was mainly guided by a strategic perspective, emphasizing managerial actions as a way to achieve balanced legitimacy. Therefore, although we have tried to capture the role played by institutional dynamics by putting sharing-based business models into a transition perspective, we could have overlooked potential contributions from the cultural-institutional approach of legitimacy.

To deal with that limitation, we argue that the form in which the institutional environment influences the construction of legitimacy requirements may vary between the pragmatic, moral and cognitive dimensions. Consequently, pragmatic legitimation dynamics will by nature be distinct from those inherent to cognitive legitimacy, which, for their part, will be different from moral legitimation dynamics (although pragmatic and moral requirements are supposed to be closer). We thus recommend that research activities focus on each dimension and its specific dynamics. That should provide gains in the focus and depth of analysis, which will complement the broad focus orientation already employed in this thesis.

Similarly, we tried to explore the legitimation dynamics and interactions simultaneously in the various socio-technical sub-regimes (user practices, culture, technology, sectoral policy, and infrastructure). This has created opportunities for studies oriented to particular sub-regimes. By doing so, one can explore stronger associations between types of legitimacy and specific dimensions of the regime. Studies dedicated to analyzing processes of pragmatic legitimation (personal benefits, utilitarian expectations) in the sharing economy should focus, for instance, on user practices or technology sub-regimes. On the other hand,

researchers interested in understanding moral or cognitive legitimacy dynamics need to pay attention mainly to the culture sub-regime.

Culture dimension is also the arena when it is intended to investigate the influence of personal values, motivations, and worldviews on the adoption, thus legitimation, of shared mobility systems. Albeit these engagement factors are well studied, a legitimacy approach for them is still needed. In addition, as consumers, users experience changes in these factors as they progress through their life cycle, which underlines some still preliminary findings of the research: routine and parental obligations hamper adoption whereas childless families and singles would be more open to doing it. That is, the family structure could shape the willingness to adopt shared mobility initiatives, and further research is needed to bring a finer understanding of this.

Another type of affinity may arise between the dimensions of the regime and specific theoretical approaches. On that subject, the user practices dimension seems to be an epistemological bridge connecting transitions perspective to social practices theory. This is an ontological connection suggested in research agendas such as the studies by Köhler *et al*. (2019) and Zolfagharian *et al*. (2019). Indeed, as transitions are multi-dimensional phenomena, inter-ontology crossovers are even desirable in attempting to gain explanatory power and understanding (GEELS, 2009, 2020). Our findings could be developed by addressing legitimacy in the sharing economy through the social practices theory lens.

Quantitative approaches in socio-technical transitions studies are a promising research stream. Within this scope, the so-called modeling studies are beginning to gain prominence (e.g., Epprecht (2014), Holtz *et al*. (2015), Papachristos (2019)). It is also a crossover inter-ontology, since the ontology of socio-technical transitions is mostly tributary to the interpretivist paradigm (of which the present research is an example). Future research could then undertake quantitative analyses to assess transitions in the context of urban mobility and underlying legitimation dynamics. We also emphasize that urban mobility and transportation is a positivist functionalist-oriented field, since modeling, scenario predictions and flow predictions are the norm.

During the research, we came across some topics we considered timely for future research. An emerging sharing economy-related concept which has gained relevance in the literature is the so-called "sharing cities" (e.g., Harmaala (2015), Cohen and Muñoz (2016), Augenstein and Bachmann (2018)). Besides the sharing economy itself, it seems also to link transitions studies with smart cities literature. As such in this thesis, legitimacy issues are supposed to be at the center of the transition arena. In fact, it is still unclear whether the

sharing economy business models are part of a transition to a new sharing cities regime or a smart cities one. Moreover, questions such as how they relate to each other – as well as their actors and institutions – and how they contribute to a wider sustainability transition lack proper answers to date. Thus, the boundaries delimiting these fields demand further exploration and may be considered a promising research object.

Another related topic that emerged during this research was the Mobility as a Service (MaaS) approach. It is an innovative business model in which all urban mobility services available in a given jurisdiction (both the traditional and emergent ones, such as sharing models) are offered in an integrated manner through digital platforms. There is a considerable similarity with the cases analyzed here: the context itself, that is, urban mobility; the system is run through public-private arrangements; the use of platforms; the participation of different actors with diverse expectations; development in the technological niche; and the multimodal profile of the users of electric car and bicycle sharing systems. Therefore, it is suggested that the analysis of the legitimacy requirements necessary for the structuring of MaaS business models could draw upon the findings of this research.

Mobility as a Service, sharing cities, and smart cities are all emerging and interrelated fields of research and social practice wherein innovations are central and the diversity of actors with different worldviews and expectations are the norm. This evokes one of the main emergent constructs of the study: balanced legitimacy. It proposes a more relative understanding of legitimacy, seen as a result of trade-offs. As discussed, the core argument here is that increases in legitimacy for a group will only be obtained at the expense of other groups, which will experience losses in legitimacy. Until a sub-optimal equilibrium is reached that ensures a minimally satisfactory performance for the social function in question, routines of trial-and-error learning and experimentation will be ongoing.

Our understanding is actually that the balanced legitimacy concept is inherent in structuring processes of any new business model, new technologies, or organizational forms whose social function is performed on these trade-offs. This applies to initiatives in the public sector, in the private market, and at the intersections between them such as the sharing programs investigated here.

As the boundaries between public and private become more and more blurred, Marketing and Society literature might bring interesting contributions to the field. For instance, public-private partnership arrangements could be analyzed from a more in-depth business model approach. This could complement the results of the thesis since we focused only on the business models of the sharing programs themselves, overlooking those of other

actors. From such a lens, balanced legitimacy would be a result of interactions between sponsor companies' business models and sharing programs' business models. Misalignments between their building blocks could undermine the current attributes of cognitive, pragmatic, and moral legitimacy.

In this context, another important research finding highlights the crucial role played by public sector actors in accelerating transitions towards sustainability. We argue that the intersection of these findings – balanced legitimacy and the role of the public sector – opens the opportunity for studying these trade-offs from the economic perspective of public choice, especially when investigating the role of policymakers in transition processes in general and in establishing public-private partnerships, in particular.

Transitions are considered to be subject to the actions of well-informed pressure groups, with a greater or lesser degree of organization, to influence the public choice in the direction of change or to preserve the status quo. It should be noted that this view is also in line with the concept of balanced legitimacy. In our understanding, the public choice paradigm can furnish an as useful ontological basis to address transitions as evolutionary economics. An epistemological dialogue between them might be fruitful as well.

In this regard, we put forward the following thesis: in the presence of conflicting interests, the decision-making process in public policies will often come up against trade-offs of legitimacy. The choice by policymakers of which of the antagonistic requirements of legitimacy should be met – and which one should be passed over – may consider the influence of their self-interest as political actors. How this dynamic may impact the legitimation processes of innovations under socio-technical transitions is yet to be investigated.

The above proposals meet the limitations of this study while providing guidelines for future investigations and research paths. Albeit not an exhaustive list, these recommendations seem timely. Most of them indicate paths still little explored in the current theoretical and empirical literature, and to some extent could bring to light relevant contributions to both transitions and sharing economy studies.

When referring to the congruences between the multiple streams of the legitimacy literature, Suchman (1995, p. 604) considered his seminal "Managing legitimacy" article as "only one step in a long journey." Twenty-five years later, the journey still seems far from over, and those contributions continue to be applied to more and more fields of interest. This thesis is an example of this approach when inserting itself into the journey. It is not a definitive work, but it marks another starting point by rescuing some themes with a vast tradition in the Social Sciences field (innovation, legitimacy) and putting them in dialogue

with contemporary issues (sharing economy, sustainability transitions) that have dominated the debate throughout society, from the academic context to the business environment, from political action to social and consumer relations.

In this endeavor, contributions such as the balanced legitimacy concept and its determinants, as well as the hypotheses stemmed from the empirical handling of interactions between socio-technical levels, represent a starting point, an invitation for further research on transitions, even aside from the sharing economy.

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APPENDICES

A1. Documentary collection protocol

Items for documentary data gathering
Search for urban mobility government plans regarding bike sharing.
Search for urban mobility government plans regarding car sharing.
Search for bills, laws and regulations related to bike sharing.
Search for bills, laws and regulations related to car sharing.
Search for documents, official websites, projects or manifestos from organizations performing or supporting sharing economy urban mobility projects in Fortaleza.
Search for documents, reports, and statistics related to Fortaleza's urban mobility system in general and public transport system in particular.

A2. Observations protocol

A2.1 – Bicicletar and Bicicleta Integrada systems
The general condition of the station.
User profile (gender, age, purpose of use).
Observe user experience when taking a bike.
Observe user experience when riding the bike through the streets, bike paths, and bike lanes.
Observe user experience when returning a bike.
Observe how the interactions with other actors (such as pedestrians, cars, and buses) take place.
Try to identify barriers that have hindered or might hinder the user experience (cultural, infrastructural, technological, and environmental barriers).
Observe user experience when handling the app, when applicable.
Observe user experience when requesting help from the support service, when applicable. Evaluate the elements of the relative infrastructure (exclusive bicycle lanes, shared bicycle lanes, stations, and user support service).
Evaluate the integration between the bike sharing system and other transport modes.
Invite users to participate in the research (in-depth interviews).

A2.2 – Vamo Fortaleza system
The general condition of the station.
User profile (gender, age, purpose of use).
Observe user experience when taking a car.
Observe user experience when driving the car through the streets.
Observe user experience when returning a car.
Observe how the interactions with other actors (such as pedestrians, cyclists, and buses) take place.
Try to identify barriers that have hindered or might hinder the user experience (cultural, infrastructural, technological, and environmental barriers).
Observe user experience when handling the app.
Observe user experience when requesting help from the support service, when applicable.
Evaluate the elements of the related infrastructure (stations, user support service).
Evaluate the integration between the car sharing system and other transport modes.
Invite users to participate in the research (in-depth interviews).

A3. Interview protocols

A3.1 – Bicicletar and Bicicleta Integrada users
OPENING
Initial presentation, permission to record, the purpose of the research, and informed consent.
Demographic variables: age, gender, profession, level of education, marital status.
How long have you used the Bicicletar/Bicicleta Integrada system?
USER PRACTICES
Do you already have or plan to have your own car or motorcycle? If so, do you intend to continue using the

A3.1 – **Bicicletar and Bicicleta Integrada users**
Bicicletar/Bicicleta Integrada system?
Why do you use Bicicletar/Bicicleta Integrada? (values, motivations, lifestyle, worldview, etc.).
Habits and goals: frequency, origins and destinations, alone or with somebody else.
How does the interaction with other participants (such as pedestrians or bus, car, and taxi drivers) across the streets take place? Have you experienced any conflict?
How was your adaptation to Bicicletar/Bicicleta Integrada?
What barriers have hindered or might hinder your use of Bicicletar/Bicicleta Integrada? (cultural, infrastructural, technological, natural or environmental barriers).
Could you please describe your general perception about Bicicletar/Bicicleta Integrada user experience and the service as a whole (user safety, availability, accessibility, what (and how) it could improve, satisfaction, self-efficacy)?
TECHNOLOGY
Could you please describe in detail how you use Bicicletar/Bicicleta Integrada and its technologies? (bicycles, stations, app, payment system, prices, routines of taken and return the bike, etc.).
How complex do you think the system, its technologies, and interactions are?
How do these technologies help you to solve your day-to-day problems and needs?
INFRASTRUCTURE
Could you please describe some elements of the Bicicletar/Bicicleta Integrada infrastructure? (exclusive bicycle lanes, shared bicycle lanes, stations, support to users, etc.).
How do you evaluate the infrastructure provided for users to adopt Bicicletar/Bicicleta Integrada? How appropriate is the current infrastructure?
How do you evaluate the integration of Bicicletar/Bicicleta Integrada and the other elements of the public transport system?
CULTURE
Who did inspire or encourage you to adopt Bicicletar/Bicicleta Integrada? If there was someone, how did they/he/she convince you?
What does Bicicletar/Bicicleta Integrada mean to you? How do you feel when using the Bicicletar/Bicicleta Integrada?
How do you feel about people who prefer to use their own car/motorcycle instead of using a shared mobility solution like Bicicletar/Bicicleta Integrada?
What do you think about social movements and societal groups challenging the dominant car-centered order? What do you think about their discourse? (sustainability, anti-consumerism, lifestyle, health, etc.)
In your opinion, are we experiencing a cultural shift towards more sustainable urban mobility? What do you think about this?
What do you think about "sharing" models in urban mobility?
SECTORAL POLICY
How do you evaluate the role played by the municipal government and policymakers regarding this bike sharing system? (infrastructure expansion, public policies, 3P business model, educational campaigns, etc.)
Whenever creating or expanding cycling-friendly infrastructure affects or reduces motor vehicle infrastructure, there is a conflict. For example, creating bicycle lanes reduces street space for motor vehicles and eliminates parking spaces. How do you see this conflict? What do you think about it?
What would you propose to the public sector actors to improve your experience as a Bicicletar/Bicicleta Integrada user?
CLOSING
Acknowledgments and closing of the recording.

A3.2 – **Vamo users**
OPENING
Initial presentation, permission to record, the purpose of the research, and informed consent.
Demographic variables: age, gender, profession, level of education, marital status.
How long have you used the Vamo system?
USER PRACTICES
Do you already have or plan to have your car or motorcycle? If so, do you intend to continue using the Vamo system?
Why do you use Vamo? (values, motivations, lifestyle, worldview, etc.).
Habits and goals: frequency, origins and destinations, alone or accompanied.
How was your adaptation to the Vamo sharing system?

A3.2 – Vamo users
What barriers have hindered or might hinder your use of the Vamo system? (cultural, infrastructural, technological, natural or environmental barriers).
Could you please describe your general perception about the Vamo user experience and the service as a whole (user safety, availability, accessibility, what (and how) it could improve, satisfaction, self-efficacy).
TECHNOLOGY
Could you please describe in detail how you use Vamo and its technologies? (cars, stations, app, payment system, prices, routines of taken and return the car, etc.).
How complex do you think the system, its technologies, and interactions are?
How do these technologies help you to solve your day-to-day problems and needs?
CULTURE
Who did inspire or encourage you to adopt Vamo? If there was someone, how did they/he/she convince you?
What does the Vamo system mean to you? How do you feel when using Vamo?
How do you feel about people who prefer to use their own car/motorcycle instead of using a shared mobility solution like Vamo?
What do you think about social movements and societal groups challenging the dominant private car-centered order? What do you think about their discourse? (sustainability, health, anti-consumerism, lifestyle).
In your opinion, are we experiencing a cultural shift towards a more sustainable urban mobility? What do you think about this?
What do you think about "sharing" models in urban mobility?
INFRASTRUCTURE
Could you please describe some elements of the Vamo infrastructure? (stations network, chargers, parking lots, support to users, etc.).
How do you evaluate the current infrastructure provided for users to adopt Vamo? How appropriate is it?
How do you evaluate the integration of Vamo and the other elements of the public transport system?
SECTORAL POLICY
How do you evaluate the role played by the municipal government and policymakers regarding this electric car sharing system? (infrastructure expansion, public policies, 3P business model, educational campaigns, etc.).
As a Vamo user, what would you propose to the public sector actors to improve your experience?
How do you see Vamo in the context of the city in the coming years? (can you imagine the city without Vamo or any other car sharing system?)
CLOSING
Acknowledgments and closing of the recording.

A3.3 – Operator company [protocol partially based on van Waes *et al.* (2018)]
OPENING
Initial presentation, permission to record, the purpose of the research, and informed consent.
How long have you been working at this company?
Position in the company.
ABOUT THE COMPANY
When was the company established in Fortaleza and how did this process take place?
What is your background and experience?
BUSINESS MODELS (FOR BICICLETAR, BICICLETA INTEGRADA, AND VAMO)
What is the status of each sharing initiative?
What value is delivered and to whom?
How does the company create value while providing value for the customers?
What processes and key activities are needed to deliver value?
What are the key resources needed to deliver value?
INDUSTRY STRUCTURE
What is the current status and size of the company and the market?
Who do you view as your competitors?
Are you engaged in partnerships? If so, what is the experience of your partners?
CULTURE
What is your view on the urban mobility sharing initiatives debate?
What norms and societal values are linked to your company and the sharing initiatives in the context of urban mobility?
What habits or cognitive frames are supporting or hindering the development of bike sharing and car sharing

A3.3 – Operator company [protocol partially based on van Waes *et al.* (2018)]
arrangements?
In your opinion, are we experiencing a cultural shift towards more sustainable urban mobility? What do you think about this?
SECTORAL POLICY
What kind of formal rules and regulations the company deal with?
How do you evaluate the role played by municipal government and policymakers regarding these sharing practices? (infrastructure expansion, public policies, 3P business model, educational campaigns, etc.).
What is your view on local policies with regard to the bike sharing and car sharing systems? Have they been appropriate and successful?
What are the barriers to the development of bike sharing and car sharing systems?
How do you evaluate the infrastructure provided for users to adopt bike sharing and car sharing in the city? How appropriate is the current infrastructure?
How do you see Bicicletar, the Bicicleta Integrada and the Vamo in the context of the city in the coming years?
CLOSING
Acknowledgments and closing of the recording.

A3.4 – Policymakers
OPENING
Initial presentation, permission to record, the purpose of the research, and informed consent.
How long have you been working at the municipal government?
Position in the municipal government.
STRATEGY
Could you please talk a little about the urban mobility sharing projects that the municipal government currently coordinates? (scope, goals, target audiences, etc.).
What factors have led the municipal government to engage in and promote policies and projects such as Bicicletar, Bicicleta Integrada, and Vamo? (User practices, Culture, Technology, Infrastructure, Public policies).
What role do Bicicletar, Bicicleta Integrada, and Vamo Fortaleza play in the public administration strategy and vision?
BUSINESS MODELS (FOR BICICLETAR, BICICLETA INTEGRADA, AND VAMO)
How do you describe Bicicletar, Bicicleta Integrada, and Vamo Fortaleza business models?
What are the actors involved and their respective roles?
What are the main similarities and differences between these models?
Who is responsible for the operating and expansion costs of each system?
How do you evaluate the performance and stage of maturity of Bicicletar, Bicicleta Integrada, and Vamo projects?
Is there any difference in maturity stages? If so, what are the reasons?
SECTORAL POLICY
What is your view on local policies with regard to the bike sharing and car sharing system?
Have they been appropriate and successful?
How do you evaluate the role played by municipal government and policymakers regarding these sharing projects? (infrastructure expansion, public policies, P3 business model, educational campaigns, etc.).
Are there any plans to expand current urban mobility sharing initiatives?
Are there any plans to develop other initiatives in this context?
How do you see Bicicletar, Bicicleta Integrada, and Vamo in the context of the city in the coming years?
INSTITUTIONS
What habits or cognitive frames are supporting the development of sharing schemes in the context of urban mobility?
And what habits or cognitive frames are hindering such a development?
In your opinion, are we experiencing a cultural shift towards a more sustainable urban mobility? How does this relate to the Government's vision and values?
What socio-cultural, technological, political-legal, economic, environmental factors have contributed to the consolidation or expansion of each project?
What socio-cultural, technological, political-legal, economic, environmental factors have harmed the consolidation or expansion of each project?
CLOSING

A3.4 – Policymakers
Acknowledgments and closing of the recording.

A3.5 – Sponsors [protocol partially based on van Waes *et al*. (2018)]
OPENING
Initial presentation, permission to record, the purpose of the research, and informed consent.
How long have you been working at this company?
Position in the company.
ABOUT THE COMPANY & STRATEGY
Why does the company support the bike / car sharing project?
What are the plans and expectations of the company with regard to this sharing initiative?
What is the role of Bicicletar / Bicicleta Integrada / Vamo in the company's strategy?
USER PRACTICES
In your opinion, why users join bike / car sharing schemes?
And why do other people not do it?
What barriers have hindered or might hinder the use of Bicicletar / Bicicleta Integrada / Vamo system? (cultural, infrastructural, technological, natural or environmental barriers).
TECHNOLOGY
How complex do you think Bicicletar / Bicicleta Integrada / Vamo system, its technologies, and interactions are?
How do these technologies help users to solve their day-to-day problems and needs?
INFRASTRUCTURE
How do you evaluate the infrastructure provided for users to adopt Bicicletar / Bicicleta Integrada / Vamo?
How appropriate is the current infrastructure?
CULTURE
What is your view on the urban mobility sharing initiatives debate?
What norms and (public) values are linked to your company and the sharing initiatives in the context of urban mobility?
What habits or cognitive frames are supporting or hindering the development of sharing schemes in the context of urban mobility?
In your opinion, are we experiencing a cultural shift towards a more sustainable urban mobility? How does this relate to the Company's vision and values?
SECTORAL POLICY
What is your view on local policy with regard to bike sharing / car sharing system?
How do you evaluate the role played by municipal government and policymakers regarding these sharing practices? (infrastructure expansion, public policies, 3P business model, educational campaigns, etc.).
How can the development of bike sharing / car sharing be supported? What are the barriers to the development of bike sharing / car sharing system?
How do you see Bicicletar / Bicicleta Integrada / Vamo in the context of the city in the coming years?
CLOSING
Acknowledgments and closing of the recording.

A4. Consent form

UNIVERSIDADE
FEDERAL DO CEARÁ
FACULDADE DE ECONOMIA, ADMINISTRAÇÃO
ATUÁRIA E CONTABILIDADE

PROGRAMA DE PÓS-GRADUAÇÃO EM
ADMINISTRAÇÃO E CONTROLADORIA

Prezado(a),

Venho respeitosamente convidá-lo(a) a participar de uma pesquisa científica conduzida por mim, Sérgio Henrique de Oliveira Lima, RG 98010011090, aluno de Doutorado em Administração e Controladoria (matrícula 383334) da Universidade Federal do Ceará, sob orientação do Prof. Dr. Áurio Lúcio Leocádio. Informo antecipadamente que sua participação é voluntária, sendo importante que leia as informações sobre a pesquisa. Em caso de dúvidas, elas serão prontamente esclarecidas.

1. O objetivo da pesquisa é analisar iniciativas de compartilhamento de carros elétricos e bicicletas como novas práticas de mobilidade urbana em Fortaleza. Espera-se que os resultados do estudo possam beneficiar a sociedade através do desenvolvimento de políticas públicas em mobilidade urbana, além da ampliação do conhecimento científico neste campo.

2. Os resultados serão apresentados em eventos acadêmicos e revistas científicas. Nestas ocasiões, sua identidade será integralmente preservada, de modo que nenhuma informação publicada será suficiente para identifica-lo(a). Desta forma, sua participação não acarretará riscos à sua saúde, imagem, ou outros de qualquer outra natureza.

Eu, _____, portador(a) do RG _____, declaro ter sido suficientemente esclarecido a respeito das informações acima, de modo que DOU O MEU CONSENTIMENTO PARA PARTICIPAÇÃO VOLUNTÁRIA por meio da entrevista que se iniciará, estando ciente de que posso retirar meu consentimento a qualquer tempo e sem qualquer tipo de ônus.

( ) Usuário Bibicletar
( ) Usuário Bibicleta Integrada
( ) Usuário Vamo Fortaleza

( ) Poder público
( ) Empresa patrocinadora
( ) Empresa operadora

Fortaleza, ____ / ____ / _____.

_____
(Assinatura do(a) participante)

_____
(Contato)

_____
(Sérgio Henrique de Oliveira Lima – pesquisador)

APPENDIX A5 – FIELDWORK PHOTOGRAPHIC RECORDS

Doctoral Thesis:

The Sharing Economy in Transitions: Legitimation Dynamics in the Urban Mobility Context in Fortaleza, Brazil

Doctoral candidate: Sérgio Henrique de Oliveira Lima, MSc.

Supervisor: Prof. Áurio Lúcio Leocário, Dr.

FORTALEZA, 2020

Content:

Seq	Sharing system	Station ID	Station name
1	Bicicleta Integrada	1	Parangaba bus terminal
2	Bicicleta Integrada	6	Lagoa bus terminal
3	Bicicleta Integrada	4	Messejana bus terminal
4	Bicicleta Integrada	2	Papicu bus terminal
5	Bicicletar	43	Campus do Pici
6	Bicicletar	44	Igreja Redonda
7	Bicicletar	66	Francisco Matos
8	Bicicletar	50	Igreja de Nazaré
9	Bicicletar	33	Shopping Benfica
10	Bicicletar	31	Papicu bus terminal
11	Vamo Fortaleza	1	Igreja de Nazaré
12	Vamo Fortaleza	3	Luiza Távora Square
13	Miscellaneous records	-	-

1. Bicicleta Integrada – Station 1 (Parangaba bus terminal)

Totem (vandalized) containing instructions and cycling map / Few bicycles at the station
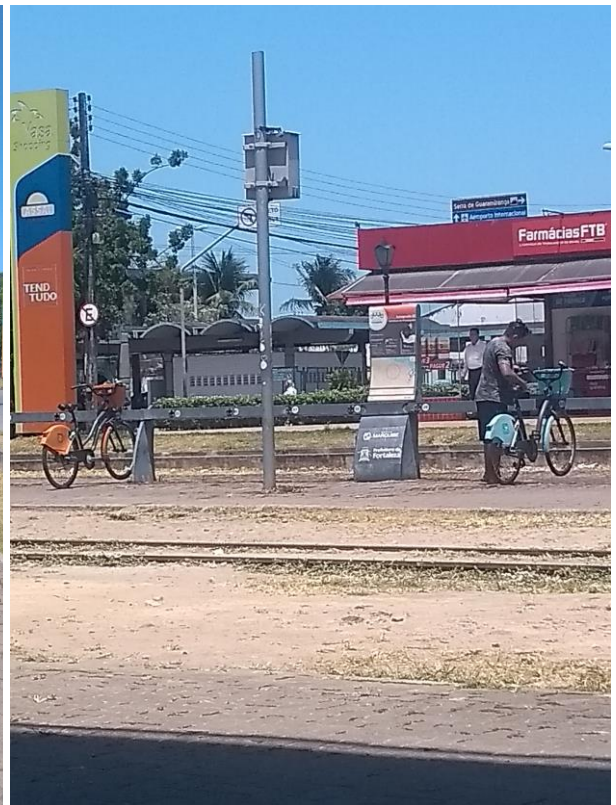
Integration with the public transport system / A user trying to take a bicycle from the station

2. Bicicleta Integrada – Station 6 (Lagoa bus terminal)

Totem in good condition / View of the bicycle station and integration with the bus terminal

3. Bicicleta Integrada – Station 4 (Messejana bus terminal)

Totem (damaged) / View of the bicycle station and integration with the bus terminal

View of the bicycle station / Public bike rack and docking station (background)

4. Bicicleta Integrada – Station 2 (Papicu bus terminal)

Totem in good condition / View of the bicycle station and integration with the bus terminal

5. Bicicletar – Station 43 (Campus do Pici)
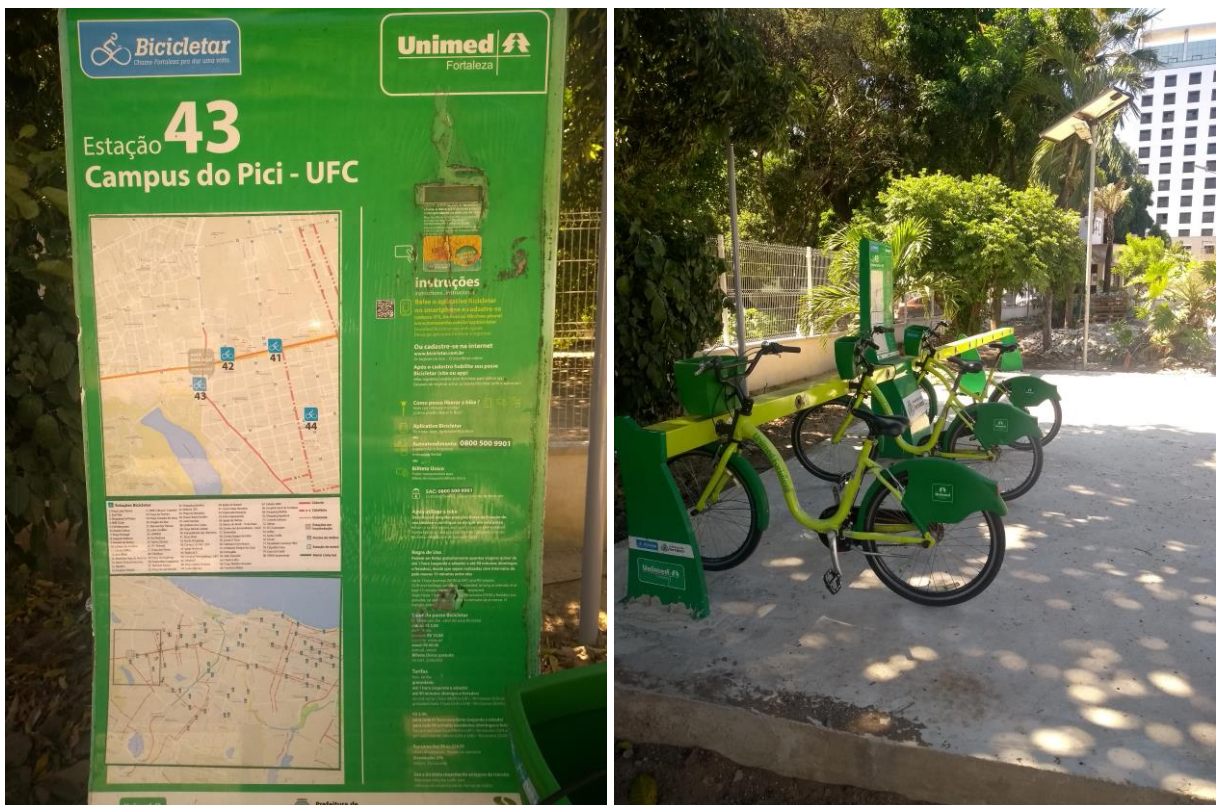
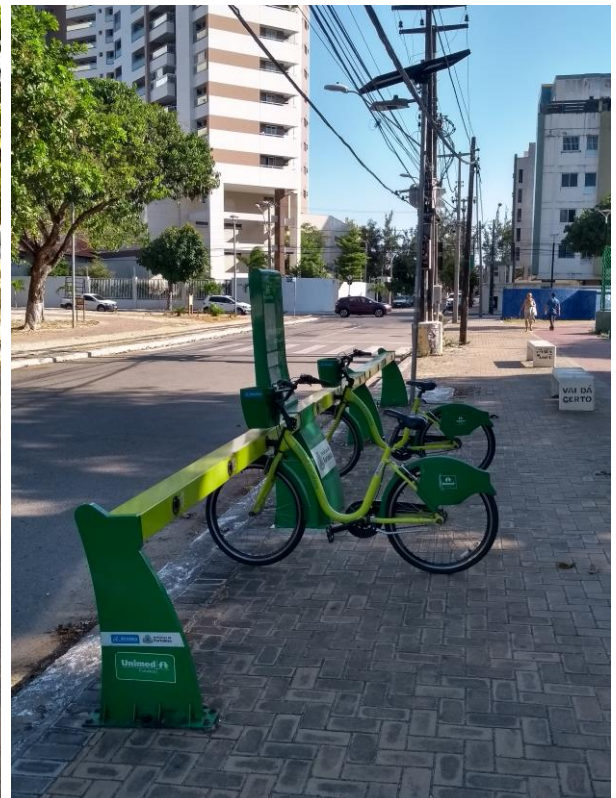Totem (slightly worn) / Station installed at the entrance to the campus, solar panel in the background

6. Bicicletar – Station 44 (Igreja Redonda)

Totem in good condition / Station installed on the side of the street, next to the square

7. Bicicletar – Station 66 (Francisco Matos)

Totem in good condition, but vandalized / Station installed on a square, in a residential area.

8. Bicicletar – Station 50 (Igreja de Nazaré)

Totem damaged at the top / View of the station installed on the side of the street, next to the square
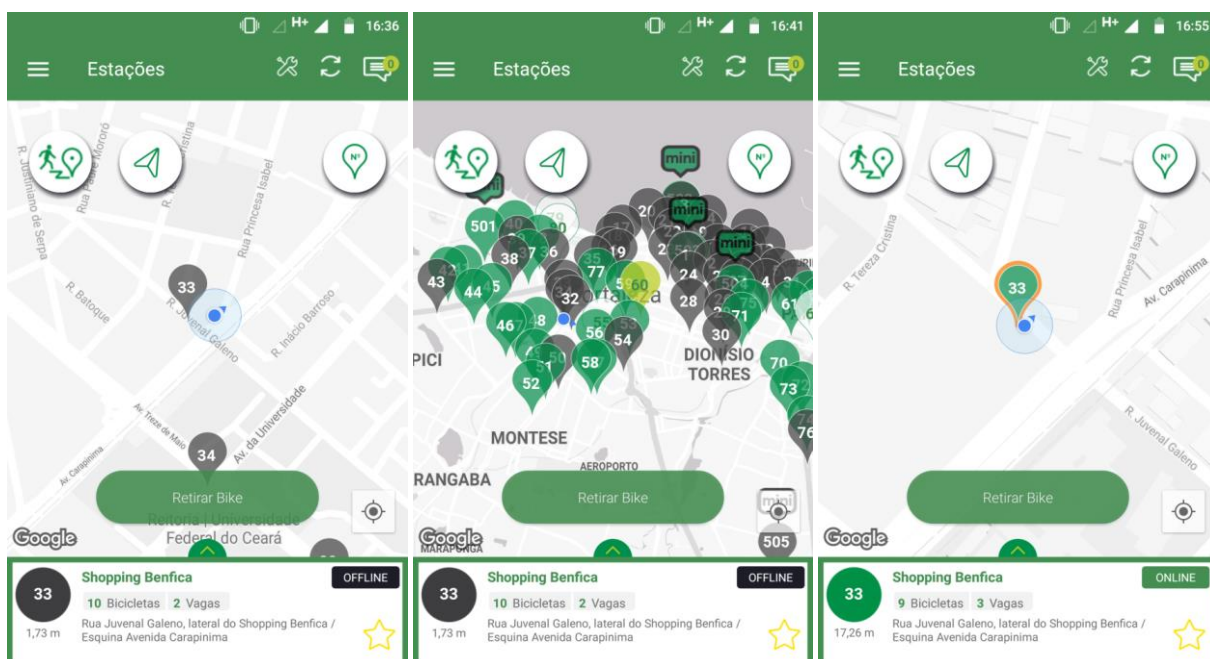

The solar panel is in the foreground / Station is balanced

9. Bicicletar – Station 33 (Shopping Benfica)

Station's totem / View of the station installed on the sidewalk next to the mall

During the observation (September 25, 2019), station 33 was temporarily offline, from 4:36 pm to 4:55 pm (in fact, about half of the stations were affected)

10. Bicicletar – Station 31 (Papicu bus terminal)

Station's totem / View of the station installed on the street, in front of the bus terminal (station is imbalanced)

11. Vamo – Station 1 (Igreja de Nazaré)

Four parking spaces marked on the street, in front of the church / Four charging points

Station totem, with instructions for use / A charging point in detail (the QR code is used when returning a car to the station)

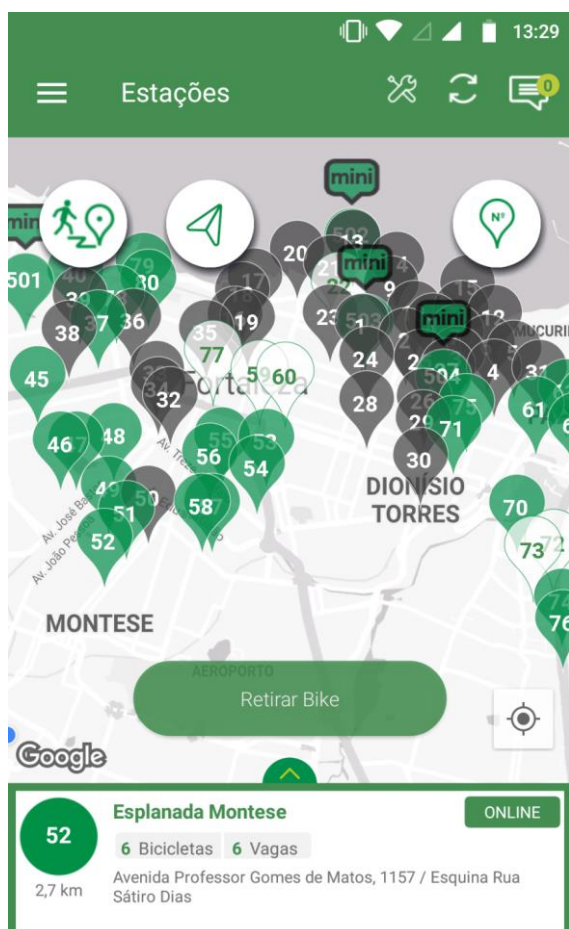## 12. Vamo – Station 3 (Luíza Távora Square)

Station totem, with instructions for use / Four exclusive parking spaces and charging points installed on the square
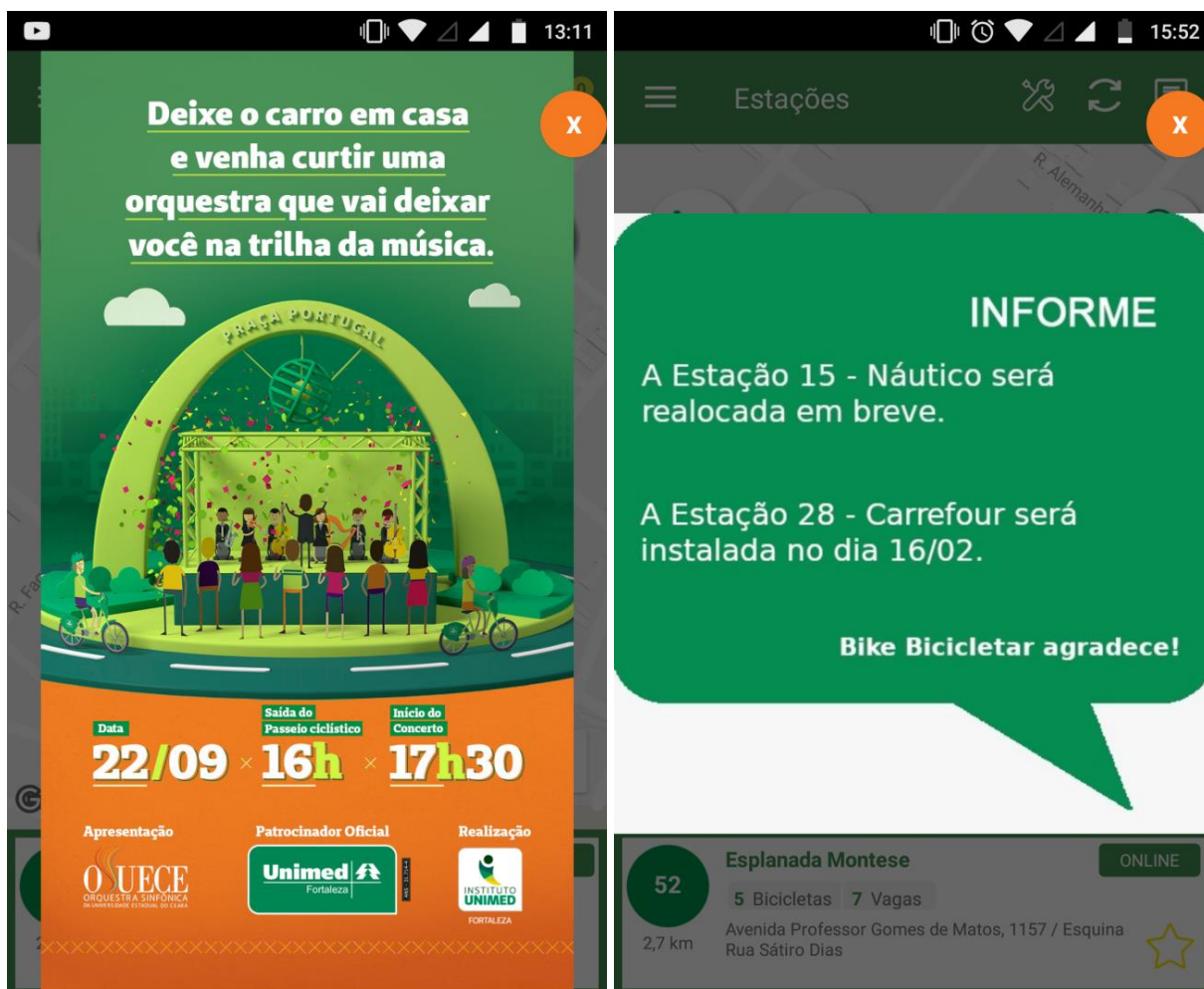
13. Miscellaneous records

Cyclist using bike path on Godofredo Maciel, Ave.

September 19, 2019: 38 stations in the network are off-line

Bicicletar app used by the sponsor company as a communication channel with users: (i) September 19, 2019: World Car Free Day promotional campaign; (ii) February 16, 2020: operational information about the installation and relocation of stations.

Renault Zoe, new electric vehicle in the Vamo Fortaleza's fleet (Station 11 – Igreja Matriz da Parangaba)

Renault Zoe dashboard / Instructions for using the vehicle

Start/Stop button / Zero Emission / Multimedia system