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**Business model innovation towards sustainable urban mobility transition:** an investigation of conceptual elements, barriers, drivers, and factors influencing their implementation

**Original version**

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Thesis presented at the Polytechnic School of the University of São Paulo in candidacy for the Doctor of Science degree.

Concentration area: Production Engineering

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**Inovação em modelos de negócios em direção à transição para a mobilidade urbana sustentável:** uma investigação dos elementos conceituais, barreiras, facilitadores e fatores que influenciam sua implementação

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## ABSTRACT

SOUZA, J. V. R. de (2023). **Business model innovation towards sustainable urban mobility transition**: An investigation of conceptual elements, barriers, drivers, and factors influencing their implementation (Ph.D. Thesis). Polytechnic School of University of São Paulo, São Paulo.

The objective of this work is to contribute to the discussion on how business model innovation could influence sustainable urban mobility transition. Especially in emerging countries, in which demands regarding mobility, as well as their trajectory concerning the development of transport systems, historically assume very particular characteristics in comparison with those of developed countries. It starts from the idea that the field of urban mobility, driven by the increasing concentration of the production of goods and services in large urban agglomerations, has increasingly demanded innovative solutions that contribute to the sustainable development of this sector, given the participation of urban transport in greenhouse gases (GHG) emissions and, consequently, in meeting the sustainable development goals. In this sense, it is notable how the field of urban mobility has attracted the attention of new actors interested in developing business in this sector, expanding the frontiers of an industry previously dominated by incumbent companies. However, although the literature has discussed the relevance of the emergence of new business models for promoting sustainable mobility, how business model innovation could influence sustainable urban mobility transition need to be clarified, as many of them fail or remain isolated. To contribute to this research gap, this thesis is structured in three papers. It starts from a theoretical discussion in the first paper, which presents a conceptual framework that helps to understand what constitutes innovative business models oriented to sustainable urban mobility. This conceptual framework, used in both the second and third papers, is translated into areas of application of business models and supports the empirical investigation of the subsequent papers in the thesis. Paper 2 investigates the institutional, strategic, and operational barriers and drivers associated faced by companies when implementing the analyzed business models. In Paper 3, the discussion is expanded to understand how these business models can act as intermediaries between technological niches and the socio-technical system. It investigates which factors influence their development and the stabilization process of the regime in which they are inserted, from the proposition of an analysis framework. Finally, research propositions, implications and recommendations for future investigations are derived.

**Keywords:** Business model. Business model innovation. Sustainable business model. Sustainable urban mobility. Sustainable transitions. Socio-technical transitions.

## RESUMO

SOUZA, J. V. R. de (2023). **Inovação em modelos de negócios em direção à transição para a mobilidade urbana sustentável**: Uma investigação dos elementos conceituais, barreiras, facilitadores e fatores que influenciam sua implementação (Tese de Doutorado). Escola Politécnica da Universidade de São Paulo, São Paulo.

O objetivo deste trabalho é contribuir para a discussão sobre como modelos de negócio inovadores podem desempenhar na transição para sistemas mais sustentáveis de mobilidade urbana, sobretudo no contexto de países emergentes, nos quais as demandas relativas à mobilidade, assim como a sua trajetória em relação ao desenvolvimento dos sistemas de transporte, assumem, historicamente, características muito particulares em relação àquelas dos países desenvolvidos. Parte-se da ideia de que o campo da mobilidade urbana, impulsionada pela concentração crescente da produção de bens e serviços em grandes aglomerados urbanos, tem demandado, cada vez mais, soluções inovadoras que contribuam para o desenvolvimento sustentável desse setor, haja vista a participação do transporte urbano nos índices de emissões de gases de efeito estufa e, conseqüentemente, no cumprimento dos objetivos de desenvolvimento sustentável. Nesse sentido, nota-se como o campo da mobilidade urbana tem atraído a atenção de novos atores interessados em desenvolver negócios neste setor, ampliando as fronteiras de uma indústria dominada anteriormente, em grande medida, por empresas incumbentes. No entanto, embora a literatura tenha discutido a relevância do surgimento de novos modelos de negócio para a promoção da mobilidade sustentável, não é claro como essas iniciativas podem influenciar nessa transição, já que muitas delas falham ou se mantêm isoladas. Para contribuir com essa lacuna de pesquisa, essa tese, estruturada no formato de três artigos, parte de uma discussão teórica, no primeiro artigo, em que se apresenta um framework conceitual que ajuda a compreender o que constitui modelos de negócio inovadores orientados à mobilidade urbana sustentável. Esse framework conceitual, utilizado tanto no segundo quanto no terceiro artigos, é traduzido em áreas de aplicação de modelos de negócio, e suportam a investigação empírica dos artigos subsequentes da tese. No segundo artigo, investiga-se, então, as barreiras e facilitadores institucionais, estratégicos e operacionais associadas à implementação dos modelos de negócio analisados. No terceiro e último artigo, amplia-se a discussão para compreender como esses modelos de negócio podem atuar como intermediários entre nichos tecnológicos e o sistema sociotécnico, investigando quais fatores influenciam o seu processo de desenvolvimento e os de estabilização do regime no qual estão inseridos, a partir da proposição de um framework de análise. Finalmente, derivam-se, então, proposições de pesquisa, assim como implicações e indicações de investigações futuras.

**Palavras-chave:** Modelo de negócio. Inovação em modelos de negócio. Modelo de negócio sustentável. Mobilidade urbana sustentável. Transições sustentáveis. Transições sócio-técnicas.

## LIST OF PAPERS IN THIS PHD THESIS

### **Paper 1**

SOUZA, J. V. R. de; MELLO, A. M. de; MARX, R. When Is an Innovative Urban Mobility Business Model Sustainable? A Literature Review and Analysis. **Sustainability** (Switzerland), v. 11, n. 6, p. 1–18, 2019.

### **Paper 2**

SOUZA, J. V. R. de; MELLO, A. M. de; MARX, R. Barriers and drivers to implement innovative business models towards sustainable urban mobility. **International Journal of Automotive Technology and Management**, v. 22, n. 4, p. 485–505, 2022

### **Paper 3**

SOUZA, J. V. R. de; MELLO, A. M. de; MARX, R. Between niches and socio-technical regimes: exploring factors influencing business model innovation towards sustainable transitions from the case of urban mobility. **Ready for submission**, 2023.



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## ABBREVIATIONS

BM	Business Model
BMfS	Business Model for Sustainability
BMI	Business Model Innovation
GHG	Greenhouse Gas
ICT	Information and Communication Technology
MLP	Multilevel Perspective
R&D	Research and Development
RQ	Research Question
SBM	Sustainable Business Model
SDN	Sustainable Development Goals
SO	Specific Objectives

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## 1 INTRODUCTION

### 1.1 INTRODUCTION TO THE SUBJECT, JUSTIFICATION AND GENERAL RESEARCH OBJECTIVE

The broad challenge of climate change, translated into the need for actions towards low-carbon transition in society, encompasses an urgent call to develop sustainable solutions (GEELS, 2012). Human activities related to burning fossil fuels, deforestation and industrial processes result in more significant greenhouse gas (GHG) emissions. This challenge requires coordinated actions from different sectors of society, such as agriculture, energy and transport, to reduce GHG emissions and contribute to the achievement of sustainable development goals (SDG) (UNITED NATIONS, 2021).

The transport sector accounts for around 20% of global emissions, which may vary from country to country. However, this challenge is accentuated in large urban centers, which concentrate the majority of vehicle emissions. Brazil, for instance, is a predominantly urban country, with more than 80% of its population living in urban areas, and this concentration tends to increase even further in the coming years (CARVALHO, 2011).

Therefore, large urban centers' economic, social and environmental functions are being increasingly pressured to develop more sustainable solutions in cities. In this sense, urban mobility plays a fundamental role, since transport systems and their externalities are essential for the sustainable development of cities (BANISTER, 2011; SPICKERMANN; GRIENITZ; VON DER GRACHT, 2013). Reducing the dependence on the private car use model to increase the offer of other more sustainable alternatives is one of the main challenges to achieving sustainable mobility in large urban centers (BEIRÃO; CABRAL, 2007).

This challenge seems to be underlined in some emerging countries, such as Brazil, in comparison with developed countries, either due to the different demands in terms of urban mobility solutions or due to the peculiar trajectory of development of their transport systems, which accumulate structural gaps that intensify the call for more sustainable solutions (CERVERO, 2013).

In this context, it is increasingly possible to observe the growth of new players interested in developing solutions aligned with the idea of more sustainable mobility,

including new players who are not originally from this industry, such as information and technology companies through the implementation of new business models (STEAD, 2013; TURNHEIM; GEELS, 2019; WEGENER, 2013; WELLS, 2013).

The emergence of new services, usually based on the development of technological solutions, such as vehicle and bicycle sharing schemes, initiatives to promote intermodality and incentives for public transport, are just some examples of new business models that are emerging in the mobility industry (COHEN; KIETZMANN, 2014).

All of these solutions, recurrently addressed in the literature through the business model innovation (BMI) approach, indicate ways in which some initiatives could fight for a space that allows them to positively influence the urban mobility systems, potentially contributing to the sustainable development of cities as whole, although not all of them explicitly incorporate this concern in their value propositions (SPICKERMANN; GRIENITZ; VON DER GRACHT, 2013).

However, even assuming that new business models may contribute, in some way, to the transition to more sustainable mobility, time and a set of enablers, not only at the firm level, are required. Culture, institution, behavior and marketing are just some aspects that influence how urban mobility is accessed and enabled between actors involved in this system (GEELS, 2012).

While it is clear how some innovative business models offer, to some extent, a positive contribution to the development of sustainable mobility, it is still being determined how these models could influence this transition since many of these initiatives remain isolated or even fail as businesses (TURNHEIM; GEELS, 2019; WELLS, 2013).

Complementarily, although the business model approach is being widely applied to drive the development of initiatives towards sustainability, there is an opportunity in the literature for greater depth in this field. Adjacent fields suggest that BMI, notably the sustainability transitions, has solid and long-term societal impacts, enabling nowadays, for instance, the mass consumption of produced sustainable goods from the last century. Investigations applying BMI approach to enable sustainability transitions configure a vast research opportunity (SNIHUR; BOCKEN, 2022).

Therefore, this thesis aims to contribute to a growing broad research agenda on the interface between BMI and sustainable transitions (KÖHLER *et al.*, 2019;



SNIHUR; BOCKEN, 2022). It contributes to comprehending how new business models organize themselves and promote sustainable mobility.

The general research objective of this thesis is to understand how business model innovation could influence sustainable urban mobility transition. To achieve this general objective, we argue that it is important to derive the following specific objectives (SO)

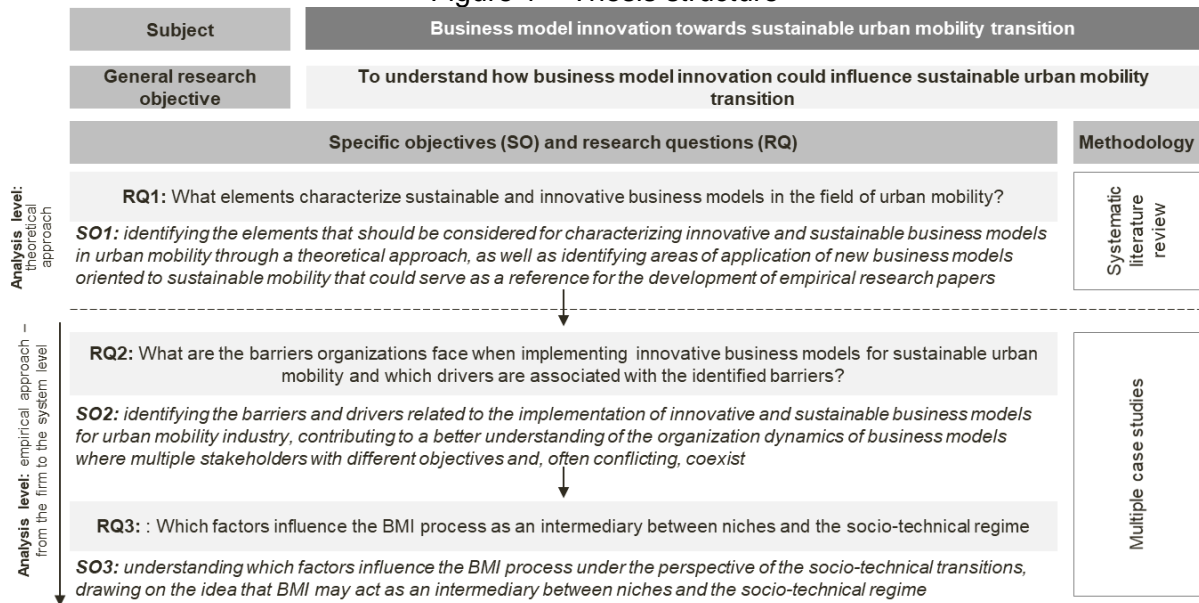
- (I) Identifying the conceptual elements that should be considered for characterizing innovative and sustainable business models in urban mobility. Paper 1 addresses this objective;
- (II) Identifying the barriers and drivers related to the implementation of innovative and sustainable business models in urban mobility. Paper 2 addresses this objective;
- (III) Understanding which factors influence the BMI process under the perspective of socio-technical transitions. Paper 3 addresses this objective.

By fulfilling these objectives, we propose a discussion, especially in the last paper, which addresses the general research objective of the thesis and brings implications from this investigation. The next session describes the thesis organization format and how each objective is achieved.

## 1.2 RELATIONSHIP BETWEEN PAPERS

Unlike a conventional thesis, which generally follows the structure of a continuous text, this thesis was developed over three scientific papers divided into two levels of analysis: a theoretical and an empirical one, as described throughout this section. Each paper is independent from the other. They answer their specific objectives (SO) and research questions (RQ). However, these works contribute to the broader objective of the thesis. In other words, the integrated papers support the development and understanding of this thesis. Figure 1 describes a framework for how each paper is connected between them and to the thesis's general objective. This section describes and justifies the relationship between the papers.

Figure 1 – Thesis structure



Source: elaborated by the author.

Intending to delimit the scope of this thesis conceptually, the first specific objective that emerges, explored in Paper 1, titled “When Is an Innovative Urban Mobility Business Model Sustainable? A Literature Review and Analysis,” was promoting a discussion that contributes to bringing the approaches of business models and sustainable mobility closer together, conceptualizing what an innovative business model oriented towards sustainable mobility means. Although it is evident in the literature how these approaches complement each other, we identified few studies that characterize the context of the contribution of the business model approach – and more specifically, the business model innovation approach – to promote more sustainable mobility systems.

Empirically speaking, Paper 1 also sought to identify application areas of business models that could be associated with promoting more sustainable mobility in cities, regardless of their degree of contribution. The objective was to identify typologies of innovative business models that, in practice, were aligned with some aspect of sustainable mobility so that future empirical works of this thesis could be based on these definitions from a methodological point of view, especially for the cases selections for the subsequent papers, as discussed later.

In this way, in Paper 1, the RQ1 is “What elements characterize sustainable and innovative business models in the field of urban mobility?” The SO1 is to identify the elements that should be considered for characterizing innovative and sustainable business models in urban mobility through a theoretical approach, as well as identifying

areas of application of new business models oriented to sustainable mobility that could serve as a reference for developing empirical research papers.

Paper 2, titled “Barriers and drivers to implement innovative business models towards sustainable urban mobility”, investigated which barriers seem to be associated when implementing innovative business models towards sustainable mobility.

Based on the idea that, on the one hand, there is a growing interest in the development of business initiatives in this industry (SEE DONADA; LEPOUTRE, 2016; KROMMES; SCHMIDT, 2017; LASMAR JÚNIOR *et al.*, 2019; WELLS, 2013) but, on the other hand, part of these initiatives fail in the early stages of implementation or remain isolated and unable to be scaled and to promote systemic impacts in the context they are developed (TURNHEIM; GEELS, 2019), this paper highlights, from a multiple cases study, barriers and drivers that need to be taken into account in the organization of business models aimed at promoting sustainable mobility.

Therefore, in Paper 2, the RQ2 is “What are the barriers organizations face when implementing innovative business models for sustainable urban mobility and which drivers are associated with the identified barriers?” The SO2 is to identify the barriers and drivers related to implementing innovative and sustainable business models for the urban mobility industry, contributing to a better understanding of the organization dynamics of business models where multiple stakeholders with different objectives and, often conflicting, coexist.

As a logical unfolding of Paper 2, which reveals how business initiatives in the mobility field require dynamic interactions with the externalities present in the environment, they emerge to gain relevance (SOUZA; MELLO; MARX, 2022). Paper 3, titled " Between niches and socio-technical regimes: exploring factors influencing business model innovation towards sustainable transitions from the case of urban mobility", investigates which factors influence the BMI process under the perspective of the socio-technical transitions.

Drawing on the idea that business models could act as an intermediary between niches and the socio-technical regime at different levels of maturity (SARASINI; LINDER, 2018), we discuss through multiple case studies with ICT mobility service-based companies, implications for the BMI process towards stabilization of the socio-technical regime, contributing to the research at the interface of business model and sustainability transitions.

Finally, in Paper 3, the RQ3 is “Which factors influence the BMI process as an intermediary between niches and the socio-technical regime?” And the SO3 is to understand which factors influence the BMI process under the perspective of the socio-technical transitions, drawing on the idea that BMI may act as an intermediary between niches and the socio-technical regime.

Therefore, Paper 1 contributes to the organization of the theoretical level of the thesis by delimiting the conceptual boundaries that allow us to clearly understand our object of study based on the proposition of a theoretical framework that could be used in empirical investigations.

Papers 2 and 3, in turn, cover the thesis's empirical level of analysis, from the firm level to the system level, respectively. Paper 2 focuses on investigating the barriers and drivers for the organization of business models analyzed according to the experiences of the firms in question. Paper 3 expands the scope of this analysis. In the latter, still starting from the firm's vision, we apply the lens of socio-technical transitions to that of business models, seeking to understand how the cases analyzed interact with the elements of the socio-technical system in which new business models emerge.

### 1.3 WITH WHOM ARE WE DIALOGUING?

This thesis dialogues with some literature streams according to the specific research objectives of each stage of the thesis's development. However, transversally throughout the research, business model literature is applied as a framework for explaining how organizations translate the possibilities of introducing innovations into dynamic markets. Primarily in those in which competitiveness is based on many aspects beyond those tangible as the “price” and in which value generation mechanisms are essential for their relevance and maintenance (TEECE, 2010). It starts from the idea that this literature, which is increasingly gaining evidence between researchers and practitioners, despite many diffuse applications (see OSTERWALDER; PIGNEUR, 2005), helps us to satisfactorily understand how actors organize themselves to develop new initiatives in urban mobility, the main target of this research (SPICKERMANN; GRIENITZ; VON DER GRACHT, 2013).

More specifically, this thesis is drawn on the understanding that the business model innovation that leads to sustainability constitutes a relevant conceptual tool for comprehending sustainable innovation opportunities. In other words, from this

perspective, business models are an essential framework for researchers and practitioners to progress in sustainable innovations – translated into “sustainable business models” (BOONS; LÜDEKE-FREUND, 2013; EVANS *et al.*, 2017).

Initially, Paper 1, by embracing the objective of developing a theoretical framework to characterize business models towards sustainable mobility, delves into the literature on sustainable urban mobility, not aiming at understanding technical aspects of the organization of a mobility system, but rather the scope of this concept and the multiple ways of approaching and characterizing it as a fertile field for organizing new business models (STEAD, 2013).

Paper 2 turned to the literature that deals directly with barriers and drivers associated with the implementation of sustainable business models, as much it has been discussed about the reasons why many emerging initiatives aimed at introducing sustainable innovations into the market fail or remain isolated (TURNHEIM; GEELS, 2019).

Finally, as a starting point in Paper 2, and more deeply in Paper 3, which dialogues with the Transitions Theory, especially under the lens of the multilevel perspective. In this sense, this analytical lens is applied to discuss how business model innovations may act as an intermediary between a technological niche and the socio-technical system, contributing to leveraging sustainable transitions (SARASINI; LINDER, 2018).

#### 1.4 THESIS STRUCTURE

Following this Introduction, Chapter 2 brings relevant methodological remarks for understanding the general process of developing this thesis.

The three subsequent chapters, Chapters 3, 4 and 5, present the three papers in this thesis. Each chapter is preceded by a brief description of the paper, as explained in Chapter 2. Finally, the Final Considerations of the thesis are highlighted in the last part.

## 2 METHODOLOGICAL REMARKS

According to the format applied to structure this thesis, each paper contains its methodology and specific procedures adopted to conduct the research. However, it is essential to highlight some additional methodological aspects that are not necessarily present in the papers but are relevant for thesis comprehension. Therefore, this section aims to bring out these aspects, which are fundamental for understanding the logic applied to developing papers.

### 2.1 DATA COLLECTION, ANALYSIS AND ACADEMIC INTERNSHIPS

Part of the data applied in the paper's empirical research was collected mainly during 2018 from interviews conducted with managers in charge of strategic issues or founders of companies that are developing new urban mobility services in São Paulo, Brazil, such as bikes, cars and ride-sharing companies, as well as the provision of helpful mobility services to the citizen related to improving the conditions of access to the public transport.

In 2019, the author of this thesis and Prof. Dr Adriana Marotti de Mello had the opportunity to develop a three-month research internship at Fudan University in Shanghai, China, in partnership with the Fudan Development Institute – FDDI. During this internship, technical visits and interviews were carried out with Chinese mobility services companies and leading automakers in the Chinese market, following the same interview protocol applied in Brazil, complementing the empirical data that are part of the papers of this thesis.

From December 2021 to June 2023, the author of this thesis was a Visiting Ph.D. student based at the University of Bordeaux, more specifically at the Bordeaux School of Economics – BSE department, which proved to be extremely useful in enriching discussions during the elaboration process of this thesis and for their implications.

This cooperation is directly connected with the development of a project approved under the USP-COFECUB Program in 2019 and postponed to the 2022/2023 biennium due to the pandemic of Covid-19, in which academic missions between the teams from the University of São Paulo and the University of Bordeaux are being performed since then. This project is titled "Who drives the changes?"

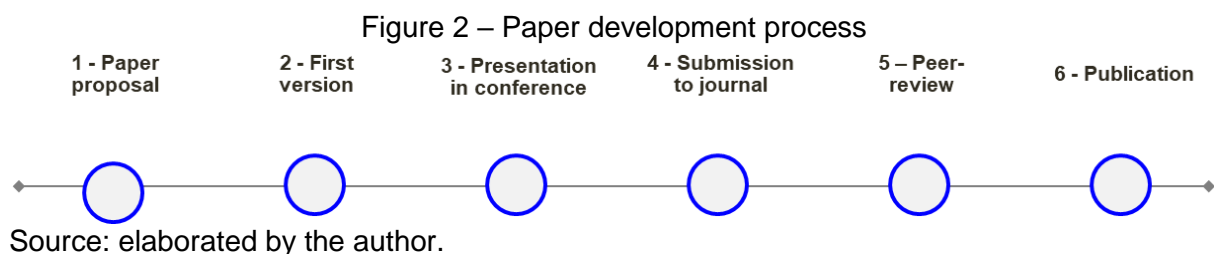
Transitions for sustainable mobility, the role of the automotive industry and new business models". It covers the analysis of new players in the mobility industry but also the role of automakers in this context.

Empirical data were analyzed via a qualitative approach. In Paper 2, the theory-building approach predominated, applying an inductive technique in which findings emerge iteratively from data analysis (EISENHARDT, 1989). In Paper 3, the thematic analysis approach predominated through a two-stage analysis (NOWELL *et al.*, 2017). The first was deductive, by coding data based on the conceptual framework, and the second was inductive, by coding findings classified in the first stage. In both papers, especially in the third, secondary data from desktop research were combined with interview data.

## 2.2 PAPER DEVELOPMENT PROCESS

It is known that the development of papers is complex and intense work. It requires many iterations due to the peer-review process of journals. Because of this, we initially adopted the strategy of submitting and presenting the first versions of the papers at international conferences, as is the case of the International Colloquium of Gerpisa and the International Conference on New Business Models.

Although this process does not ensure papers will be published in indexed journals, this strategy allows the paper to mature after the presentation at conferences, allowing a greater chance of success in the desk review of the journals selected for submission. The figure below (Figure 2) illustrates the paper development steps.



The following sections present the papers described in the section "1.4. Thesis structure", followed by a brief report on the publication status of each paper.

First version of Paper 1 was not presented at any formal conference, just an extended abstract of Paper 1 was discussed at 26<sup>th</sup> International Colloquium of Gerpisa in 2018 and then a full version was submitted directly to journal. First version

of Paper 2 was presented at 28<sup>th</sup> International Colloquium of Gerpisa in 2020, entitled “Challenges to develop business models towards sustainable urban mobility: a comparative empirical investigation between Brazilian and Chinese case studies” (SOUZA *et al.*, 2020a). First version of Paper 3 was presented at 7<sup>th</sup> International Conference on New Business Models, entitled “From niches to socio-technical regimes: exploring factors influencing business model innovation towards sustainable mobility transitions” (SOUZA *et al.*, 2022).

Finally, papers that have already been published, under the rules of the postgraduate service of the School of Engineering of the University of São Paulo, are presented exactly in the format of the journal in which they are published, including bibliographical references. When necessary, as indicated throughout the following chapter, the publisher was asked for permission to immediately reproduce the content of the paper in this thesis without embargoes applicable.

### 2.3 ADDITIONAL PUBLICATIONS

In addition to the papers that should formally compose this thesis, it is important to highlight other additional publications that, even though they do not have the same impact as a scientific journal, also contribute, in some way, to complement the discussion of the central subject of this thesis:

- Marotti De Mello A., Valsecchi Ribeiro De Souza J., Marx R. (2021) Public Transport in Emerging Countries: From Old Dilemmas to Opportunities for Transition to Sustainable Mobility Through the Case of Brazil. In: Mira-Bonnardel S., Antonialli F., Attias D. (eds) *The Robomobility Revolution of Urban Public Transport. Transportation Research, Economics and Policy*. Springer, Cham. [https://doi.org/10.1007/978-3-030-72976-9\\_8](https://doi.org/10.1007/978-3-030-72976-9_8) (MELLO; SOUZA; MARX, 2021).
- Souza, J. V. R. de, Mello, A. M. de, Marx, R., & Marques, A. M. (2020). Implantação de modelos de compartilhamento de carros elétricos no Brasil: estudo de caso de gestão de incertezas a partir da aplicação da abordagem do learning plan. *Anais Do XXII Encontro Internacional Sobre Gestão Empresarial e Meio Ambiente (ENGEMA)*, 17. <http://engemausp.submissao.com.br/22/anais/arquivos/305.pdf?v=1634501423> (SOUZA *et al.*, 2020b).



### 3 PAPER 1 – WHEN IS AN INNOVATIVE URBAN MOBILITY BUSINESS MODEL SUSTAINABLE? A LITERATURE REVIEW AND ANALYSIS

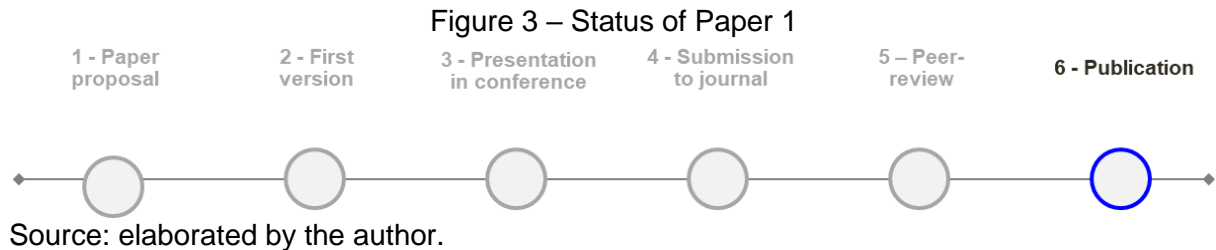


Table 1 – Detailed status of Paper 1

Phase	Status
<b>1 - Paper proposal</b>	<ul style="list-style-type: none"> <li>• Paper proposal formally structured with the thesis project from June 2018</li> </ul>
<b>2 - First version</b>	<ul style="list-style-type: none"> <li>• Completed in December 2018</li> </ul>
<b>3 - Presentation in conference</b>	<ul style="list-style-type: none"> <li>• Just an extended abstract of Paper 1 was discussed at 26<sup>th</sup> International Colloquium of Gerpisa in 2018</li> </ul>
<b>4 - Submission to journal</b>	<ul style="list-style-type: none"> <li>• Submission to Sustainability journal on December 29, 2018</li> <li>• Journal Statistics: JCR 2022: 3,9; CiteScore Scopus 2022: 5,8</li> </ul>
<b>5 - Peer review</b>	<ul style="list-style-type: none"> <li>• Three rounds of review between December 2018 and March 2019</li> <li>• Accepted for publication on March 20, 2019</li> </ul>
<b>6 - Published</b>	<ul style="list-style-type: none"> <li>• Number of citations (October 2021): Web of Science: 9; Scopus: 14, Google Scholar: 27</li> <li>• Paper published in open access</li> <li>• Available online at: <a href="https://www.mdpi.com/2071-1050/11/6/1761">https://www.mdpi.com/2071-1050/11/6/1761</a></li> </ul>

Source: elaborated by the author.

Article

## When Is an Innovative Urban Mobility Business Model Sustainable? A Literature Review and Analysis

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**Abstract:** Although researchers have increasingly examined how business models promote sustainable urban mobility through innovation, the literature has focused less attention on what constitutes a sustainable and innovative business model in the context of urban mobility. To fill this research gap, this article aims to answer the following research question: what elements characterize sustainable and innovative business models in the field of urban mobility? To identify whether and to what extent the existing intersection between business models and sustainable urban mobility literature contributes to the development of this concept, a systematic review and analysis of the literature was conducted. The results indicate that the following aspects contribute to the sustainability of an urban mobility business model: favoring the use of clean energy; maximizing the use of transport resources and capabilities; encouraging substitution using sustainable modes; offering service orientation and functionality; articulating initiatives that address the needs of a wide range of stakeholders in transport systems; reducing travel demands; extending benefits to society and the environment in a systemic perspective; and developing scale-up mobility solutions.

**Keywords:** sustainable urban mobility; business model; business model innovation; sustainable business models; literature review

### 1. Introduction

Urban mobility has a central role in developing more sustainable cities, especially considering that the production and consumption of goods and services in major urban centers requires sustainable solutions that enable large masses of people to travel [1,2].

Transportation, especially based on internal combustion engines, is linked to high levels of CO<sub>2</sub> emission, energy consumption, and negative impacts on people's health and climate change [3]. The challenge of providing alternatives that promote sustainable urban mobility while reducing the dependence on private car use (without compromising the convenience of this model) has been established as a key issue in studies on this topic because the use of the previous mode has produced significant reductions in people's travel quality standards and has directly affected the economic, environmental, and social functions of cities. There is a growing awareness of the need for a transition to more sustainable mobility systems in cities [2,4–6].

Thus, the challenges of sustainable urban mobility require approaches that extend beyond the optimization of resources used in transport planning and avoid dealing with issues in isolation, a recurrent feature in the seminal literature on mobility and transport. These needs for new approaches in urban mobility, which increase quality in transport, while reducing environmental and economic impacts, generate demand for innovation in urban mobility and attract the interest of various actors in society, thus enabling opportunities to generate new business models, in order to allow the diffusion of those innovations in the market [1].

Although the literature has increasingly indicated the key role of business models in promoting sustainable urban mobility through innovation in the field, less attention has been focused on what

constitutes a sustainable and innovative business model in the context of urban mobility. There is a considerable amount of knowledge on what makes innovation sustainable at the firm level, but less is known about how sustainable innovations can be implemented and how both economic feasible and sustainable business situations can be created for those involved while actually enabling those innovations to be diffused successfully in markets. The research on business models recognizes that this concept reflects the essential elements for understanding, developing, and commercializing innovations considered sustainable; however, the models do not necessarily incorporate sustainability during their design process (value proposition) or during the execution of these models (delivery and value capture) thus limiting the clarity of the features that characterize innovative and sustainable business models, especially in the field of urban mobility [7–9].

This article, therefore, attempts to fill this gap in the literature by answering the following research question: What are the aspects of a sustainable and innovative business model in the field of urban mobility?

A literature review was conducted to enable the following: (1) a discussion on the role and relevance of sustainable and innovative business models in relation to aspects that characterize sustainable urban mobility, (2) an investigation into the intersection between business models and sustainable urban mobility to identify elements that should be considered by such models as sustainable and innovative in this field, and (3) an investigation into how these elements synthesize research and guide future investigations.

Although this article focuses on advances in theory, its contribution is directed not only toward the literature on the subject but also toward public policy decision makers and practitioners. The research seeks to promote a closer approximation between sustainable management literature and mobility and transport literature. For practitioners, the research discuss opportunities for organizing new businesses focused on sustainable urban mobility. For public policy makers, the findings discuss alternatives to encourage business models aimed at promoting sustainable mobility.

The first part of the article explains and justifies the research methodology adopted. The second and third sections provide a literature review on sustainable urban mobility and business models, respectively, and the next section discusses the results. In the conclusion, the contributions, limitations, and prospects for future research are presented.

### *Basic Concepts and Terminology*

To establish the assumptions underlying this research, basic concepts and terminology are first defined. In this research, the term urban mobility is applied to refer to the spatial dimension of mobility, which is composed of various terms and conditions of temporary relocations of people in the context of urban space [10]. Urban mobility refers not only to the aspects that allow people to get around but also to people's ability to reach their destinations by using the infrastructure available in the urban space.

According to the United Nations World Commission on Environment and Development report [11] (p. 16), sustainable development refers to "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The definition contains two key concepts in the term "needs": (1) the notion of priority in relation to the essential needs of people and (2) the idea that the state of technology and social organization has imposed limitations on the environment's ability to meet present and future needs [11]. Thus, sustainable urban mobility is essential to the broader challenges of sustainable development [12].

## 2. Materials and Methods

### 2.1. Rationale for Literature Review, Analysis, and Definition of Characteristics

No other literature reviews have clearly and systematically articulated the concepts required to respond to the research question, therefore limiting an essentially empirical research theme. Thus, a literature review was conducted to focus on the qualitative aspects of the articles analyzed through content analysis.

The function of the literature review is to clearly delineate what research must be conducted in an area of study and why it is important, as well as to articulate the practical significance of research, to synthesize previous research to provide a new perspective, and to critically analyze the research methods used in previous investigations [13].

Moreover, the role of a literature review is to seek new research avenues, identify relevant variables for the theme, relate practical ideas, or place research in a historical context to show familiarity with what has been developed [14].

Certain variables must be controlled to ensure accuracy when conducting literature reviews. To guide the use of techniques for this type of research, six characteristics may be applied: focus, goal, perspective, coverage, organization, and audience [14]. Table 1 summarizes these variables and the ways in which they are monitored in this study.

**Table 1.** Ways of using and controlling qualitative variables during a literature review.

Variable	Definition	Ways of Using and Controlling Variables in This Research
Focus	What aspects are focused on in the review, avoiding simple bibliographic citation	Concepts that have a central discussion on aspects that characterize (1) sustainable urban mobility and (2) business models, including those that intrinsically incorporate the issue of innovation and those that discuss aspects that make them more sustainable
Goal	Whether it allows the integration or generalization of findings to resolve a debate within a study field	Integrating findings across the existing literature to contribute to the development of the research on a theme.
Perspective	Researcher neutrality	Neutrality is pursued through detailed description and use of scientific rigor regarding the employed research techniques.
Coverage	Limits considered in the review	Literature analysis is essentially qualitative (content analysis).
Organization	Text organization and structure	Findings summarizing for each reviewed article Analysis and discussion of intersection points in the literature.
Audience	Knowledge and consideration of the research target audience.	Researchers interested in the development of scientific knowledge on sustainable and innovative business initiatives in the field of urban mobility.

### 2.2. Article Search and Selection

The search for reference articles was performed in three main steps: searching research terms and filters in the databases through several iterations, reading titles and abstracts carefully to find relevant articles, besides selecting and fully reading central articles to enable the coding process described in next section. These steps were guided by the following delimitation and criteria:

- English-only, blind refereed scientific articles published in peer-review journals, indexed in the Scopus database, and preferably published after 2005 were considered, aiming to have more up-to-date and state-of-the-art literature, besides assuming that the publications on the themes analyzed have grown considerably in the past decade;
- The terms searched in the articles' titles, abstracts, and keywords were: "sustainable urban mobility" or "sustainable mobility" or "sustainable and transport" with "business model"; "sustainable urban mobility" or "sustainable mobility" or "sustainable" with "transport"; "business model" and "innovation" and "review" and "sustainable business model";
- Articles in the following sub-areas were not considered: health, mathematics, neuroscience, chemistry, biology, agricultural and medicine.
- Only articles in which the central discussion aimed at the characterization of the searched-for concepts were considered. Therefore, articles that addressed the themes but did not add to the characterization of the concepts were not prioritized in the analysis;

- For articles related to urban mobility and sustainable transport, quantitative and essentially technical studies on modeling and transport simulations as well as on ticketing and pricing were excluded because they did not contribute to the focus of the discussion. The research prioritized studies that aimed to understand which are the relevant dimensions and aspects to delimit and to characterize sustainable urban mobility;
- For articles related to sustainable business model, many of the articles found were included, since it is a recent literature and with fewer references, although it has grown considerably in recent years. The research prioritized studies that aimed to understand which are the relevant dimensions and aspects to delimit and to characterize sustainable business models; and
- For the terms whose results had a high volume of items and for which other isolated revisions had been conducted and extensively discussed—such as business model innovation literature—articles that already contemplated these revisions were prioritized.

Taking the established delimitation into account, 57 papers were selected to comprise the literature review. A detailed search and selection process is described in Appendix A.

### 2.3. Content Analysis

Once the reference articles to support the research were selected, a model was adopted to analyze their content [15]. In this model, five steps were taken:

1. Starting point—the question and objective of research that guides all the decisions and criteria used in subsequent steps;
2. Definition of aspects of main categories and subcategories based on theory—determines, from existing theory, in which categories and subcategories the collected material is placed;
3. Establishing definitions and coding rules for the analyzed material—reference articles are then classified according to the categories and subcategories defined;
4. Interpretation of results—results found in the literature that contribute to the research objective are discussed and interrelated; and
5. Review of categories, subcategories, and coding rules—if needed, these elements are reviewed from the results.

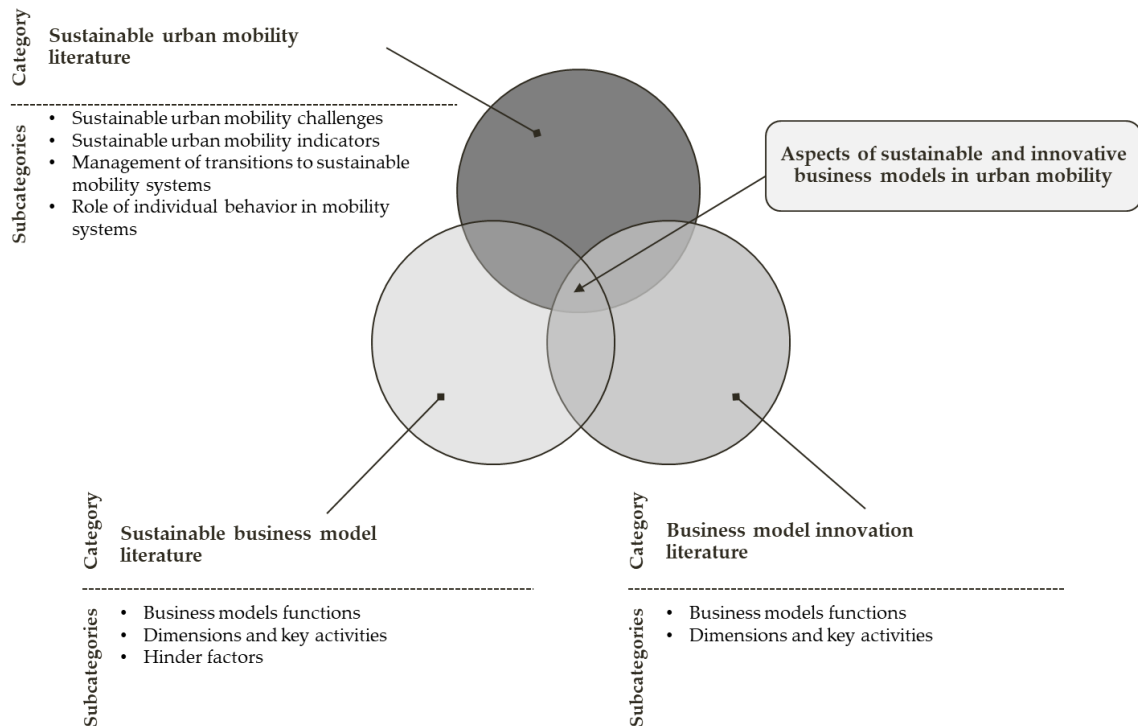
In this research, we began with certain dimensions and categories based on the initial concepts presented, and reviewed them during the initial analysis of the papers. Internal validity was established and the results were discussed among the authors, especially in steps 3 and 4, because it might be necessary to redo them several times, aiming to reduce the risk of divergent decisions on how paper articles were understood and classified. Coding rules were defined to ensure that final content analysis decisions support a clear relation with the existing literature. This method described establishes the background for the literature review presented herein. Content analysis codes tree is described in Appendix B.

### 2.4. Analysis of Collected Material and Intersection between Sustainable Urban Mobility and Business Model Literature Categorization

The analysis model defined—that is, the final categories and subcategories organized from the literature review—is separated into three parts: sustainable urban mobility, sustainable business models, and business model innovation. The latter two were divided in this way because the literature on business models does not necessarily incorporate aspects related to innovation or sustainability with business models concurrently. Therefore, this subdivision is indispensable in ensuring that these constructs are contemplated. For each of the parts, the focus was to identify which elements in the literature allow for characterizing these concepts to later delimit their intersection and, thus, build an integrated concept regarding the aspects that constitute innovative and sustainable business models of urban mobility.

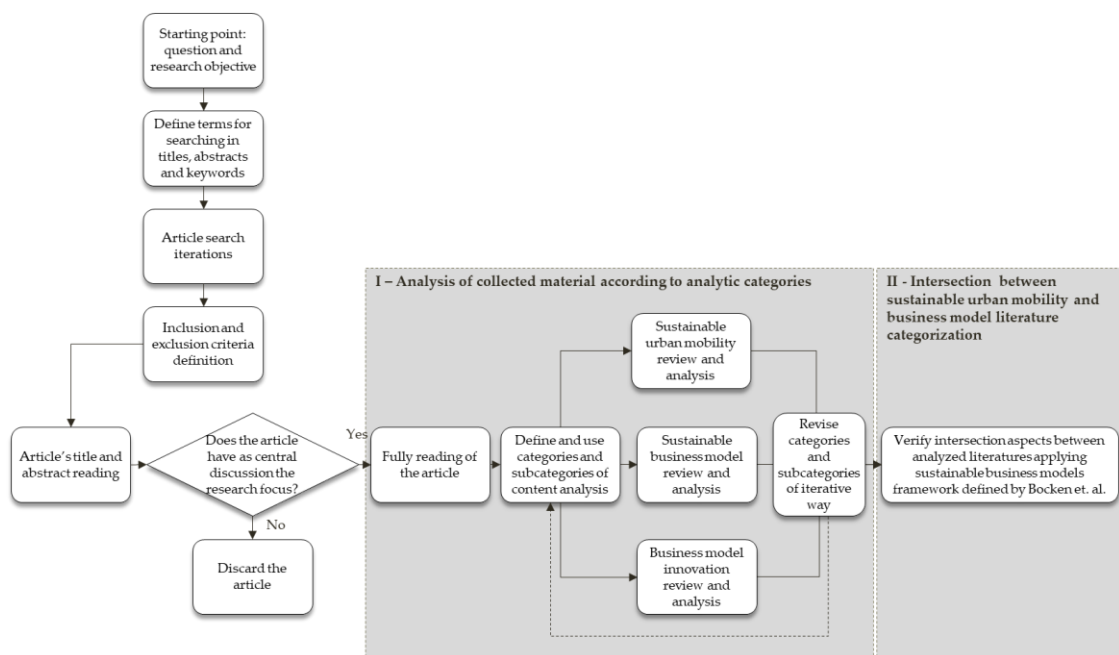
The results described in Section 3 are organized according to the analytic categories and subcategories proposed and represent the results of the individual analysis for each literature, as shown in Figure 1. The categories and subcategories were defined applying a mix of deductive approach based

on the theoretical background—specially for the subcategory “dimensions and key activities” [16] present in business model innovation and sustainable business models review—and a inductive approach from the content analysis—for all other subcategories (see Appendix B).



**Figure 1.** Conceptual analysis model proposed for the literature review.

Then, in order to identify which elements should be considered by business models to be both sustainable and innovative in the field of urban mobility, we explored the intersection literature results in Section 4, applying the sustainable business models archetypes described by Bocken et al. [17] as a starting point to describe in the context of urban mobility which elements constitute a sustainable and innovative business model. The whole research flow is presented in Figure 2.



**Figure 2.** Research flow applied for the literature review.

### 3. Analysis of Collected Material According to Analytic Categories

#### 3.1. Sustainable Urban Mobility

Broad research agendas on sustainable urban mobility characterize the study on this field, which prevents applying only one or a few lines of research in a separated manner [6]. Thus, to identify the elements that delimit sustainable urban mobility, the reference articles selected were placed into four subcategories that are not mutually exclusive: (1) articles that discuss the challenges of urban mobility becoming more sustainable; (2) articles that analyze which indicators can be applied to assess the sustainability of mobility systems; (3) articles that articulate sustainable urban mobility from a socio-technical approach to transitions; and (4) articles that discuss the essential role of individuals in achieving sustainable urban mobility.

##### 3.1.1. Sustainable Urban Mobility Challenges

Authors interested in defining sustainable urban mobility challenges usually refer to integrated actions that should be conducted in the following areas: demand management, modal shifts towards sustainable alternatives, technological innovation, along with actions of public institutions and the government. The main ideas discussed by authors are briefly listed throughout this section.

Several authors suggest that sustainable urban mobility should be promoted through solutions that reduce the need to travel, that is, the relocation demands [2,3,10]. These solutions include the promotion of non-travel activities such as telecommuting, teleshopping, and other services [6].

Moreover, authors also encourage the substitution of certain transport modes, especially regarding private cars. The importance of intermodal integration is part of this context [18]. This includes the availability of integrated and customized transportation in specific situations; the encouraged use of vehicles that use clean energy, such as electric cars and cycling; and other sustainable alternatives complementary to the traditional public transport [1,2,10,19–21].

Regarding technology, the discussion relates to the search for greater efficiency in existing transport systems, in which technological innovation and changes in user behavior have a primary role. Furthermore, intelligent transport systems can develop mechanisms that restrict traffic in central metropolitan areas, maximize public transport service efficiency, rapidly provide information for users to make decisions by using mobile technologies, and strengthen laws related to traffic management, which are crucial points of technological integration [1–3,5,6]. Regarding this aspect, the role of business models in promoting competitive alternatives to private cars through the dissemination of travel information, fare integration, vehicle-and bicycle-sharing models, incentives to reduce automobile ownership, and new integrated services for transport solutions are also emphasized [5,22].

From a public policy perspective, some authors advocate the favorable role of holistic forms of implementation and the inter-sectorial policies relevance, including the private sector, which ensure sustainable transport infrastructure, seeking the integration of local needs and values that affect policymaking at an institutional level [23–25]. Other research highlights the challenge of understanding what incentives are needed to accommodate the full range of actors involved in shared mobility contexts [26]. Additionally, for public policy design, it is also important to contemplate the challenge of integrating transportation planning with social needs—through accessibility, allocation, and planning of public space, and opportunities for social engagement—because the logic of transport planning that has prevailed in the majority of cities favors a model of car dependence, with limited opportunities to develop sustainable initiatives [3,5]. However, other authors consider that even though the government has an important role in building systems that provide better sustainable urban mobility, this transition is intrinsically linked to a social learning process involving multiple stakeholders, focusing on the following elements: the system as a whole; its spatial characteristics, infrastructure, and technology options; the individual needs of mobility and access; cultural norms and institutions; and their mutual interdependence [27].

### 3.1.2. Sustainable Urban Mobility Indicators

A number of reference articles address the development and application of indicators related to sustainable mobility (see [28]). In this sense, the construction of indicators to assess the sustainability of mobility systems requires their impacts to be considered in a balanced way, in all the dimensions of sustainable development—economic, environmental, and social—because it is not possible to assess sustainable transport without considering the integration of these dimensions [29].

In a comparative study on sustainable mobility indicators in European cities [30], some aspects are reinforced, such as: the relevance of metrics related to the presence of multimodal services; lift and vehicle sharing; the definition of urban areas with controlled access to private car to manage the transport demand; the introduction of clean vehicles and fuels; the encouraged use of bicycles; and transport system information provisions for users, developing polycentric urban systems instead of a single-center one [31], as well as addressing the issues involved in sustainable mobility reviewed in the previous section.

Another relevant point is that large urban centers generally pose greater challenges for achieving sustainability in their mobility systems as compared to smaller cities. This validation reinforces the importance of adopting measures that relate to the management of urban transport demand, as well as the application of sustainable solutions to these contexts [29,32].

### 3.1.3. Management of Transitions to Sustainable Mobility Systems

Anchored in the socio-technical systems approach to transitions, especially given the reasons elaborated by many authors (see [33–35]), several articles on sustainable mobility suggest that answers to the challenges that ensure transition to sustainable urban mobility systems require more than changes from the point of view of technological development. Notably, they should instead be addressed from a systemic point of view and consider aspects that influence current mobility regimes, such as user preferences, policies, existing technologies, market rules, cultural, and scientific aspects, and regulatory mechanisms, to address current and potential future challenges [1,33,36–38].

In this sense, a socio-technical approach to transitions should address policies oriented toward the construction of sustainable mobility models and must be more concerned with long-term results than with short-term ones [39,40]. This approach should be understood not only as an instrument but also as a management model for sustainable development, concerned with addressing persistent problems in socio-technical systems. Sustainable mobility requires knowledge from learning and expertise other than that currently applied to increase reflection on the management systems [41].

Notably, according to a study on the implementation of a socio-technical approach in Brazilian cases, this approach rarely considers the aspects of local realities involved in the socio-technical regime, such as different trajectories and the operational and institutional contexts of actors involved in sustainable urban mobility innovation processes, which are also relevant when analyzing influences on existing regimes [42].

### 3.1.4. Role of Individual Behavior in Mobility Systems

The latter aspect observed in the literature review concerns research aimed at analyzing the role of individual behavior in sustainable urban mobility, beginning with the premise that travel needs and individual behavior direct the aspects that characterize mobility systems. Individuals, in turn, prioritize options considered unsustainable—particularly regarding private car use—which directly affects the development of sustainable mobility. Addressing individuals' internal decision-making processes in relation to travel patterns is recommended, as individual choices can be influenced by numerous variables, including travel needs, standard of living, and access to information, among others [43,44]. However, transportation service quality is also an essential factor that influences individuals' decision-making and should thus also be considered [4].

## 3.2. *Business Model Innovation*

Organizations recognize the emergence of dynamic markets in which competitiveness must be based on variables in addition to price: intangible customer solutions, complementary to products that



are able to meet their needs; and demand, because customers operate in markets that are undeveloped. Due to this context, business models have recently received more attention [45].

### 3.2.1. Business Model Functions

Business models have been widely accepted and used in the literature; however, they are often applied in completely distinct ways and contexts. Business model can be defined as a conceptual tool that contains a number of interrelated elements. These allow for expressing an organization's business logic—how an organization “does business”—by describing the mechanisms through which organizations create and sustain value [46]. Business models help organizations add value, attract customers to pay for this value, and manage profit from this relationship [45].

Thus, business models are not strategies themselves but rather guidelines that reflect strategy. They are the main key to decode, understand, and effectively communicate strategy both within an organization and throughout its business ecosystem; that is, business models should reflect an organization's strategic choices and operational implications [47].

### 3.2.2. Dimensions and Key Activities

Numerous authors have sought to represent business model dimensions and key activities. In attempting to establish an integrated model to represent these elements, an author defined three key business model aspects: (1) value proposition—what an organization intends to deliver to its customers and the reasons why they would pay for it; (2) value creation—how an organization articulates resources, capabilities, processes, and networks of customers and suppliers to create and deliver the value intended; and (3) value capture—how an organization generates revenue and profit from activities [16].

Developing a successful business model is not sufficient to guarantee competitive advantage [45]. In this context, business model innovation arises. Business model innovation emerged because models could no longer be seen as static by their managers, requiring continuous reinvention in response to turbulent and dynamic environments. Thus, business models assume the role of innovation facilitators, even as units of analysis or starting points to define innovation strategies [48–51].

## 3.3. *Sustainable Business Models*

Incorporating aspects of sustainability, business models play a fundamental role in understanding and developing sustainable innovation beyond an organizational level by integrating consumption and production systems [8]. Nevertheless, business models do not necessarily incorporate sustainability issues; consequently, it is essential to understand the aspects that should be taken into account for them to be characterized as sustainable [7].

### 3.3.1. Business Model Functions

The literature examining sustainable business models has grown substantially in recent years, particularly because of their association with the performance of key functions in organizations—although there are still many opportunities for applying and experimenting with the logic of sustainable business models—[52,53], including the following: (1) the commercialization and introduction of sustainable innovations in the market [7]; (2) the assurance of a better balance of objectives for all stakeholders—including the environment and society, not only for customers—to eliminate conflicts or negative outcomes and to enable better sustainability at an organizational level [9,54–58]; and (3) the direction and implementation of corporate innovations towards sustainability, which contribute to its incorporation in organizational processes and purpose, serving as a key factor that generates competitive advantage [17]

### 3.3.2. Dimensions and Key Activities

Therefore, for business models to be considered sustainable, the literature indicates that models should incorporate specific aspects in their dimensions and key activities and consider the interrelation

of these aspects with the social, environmental, and economic dimensions of sustainable development. Table 2 summarizes the characteristics of sustainable business models according to their dimensions [16].

Some authors advance the discussion on sustainable business models by noting that there is no broad approach on how and why organizations have incorporated sustainability into their business models, although researchers have recently examined this topic [59]. A research defined eight archetypes or categorizations by which an organization can develop a sustainable business model from an approximation of standards and attributes in several categories: maximizing material and energy efficiency; creating value from “waste”; using renewable sources; delivering functionality and services, rather than ownership; adopting a management and leadership role along with stakeholders; encouraging sufficiency in consumption and production relations; re-purposing the business for society/environment; and developing scale-up solutions [17].

**Table 2.** Characteristics of sustainable business models according to their dimensions and key activities.

	<b>Value Proposition</b>	<b>Value Creation</b>	<b>Value Capture</b>
<b>Characteristics of sustainable business models</b>	<p>Measurable environmental or social values aligned with economic values [7].</p> <p>It helps to describe, analyze, manage, and communicate a sustainable value proposition to all customers and other firm stakeholders [58].</p> <p>It delivers services and functionality rather than ownership [17].</p> <p>Sustainability strategies are adopted in participation with a diverse number of local groups, which provides better opportunities for learning and creating innovative solutions [57,60].</p> <p>Value proposition reflects the triple bottom line approach. It encompasses a systemic perspective beyond the firm [7].</p>	<p>Customers and other stakeholders are encouraged to take responsibility for their consumption practices [7].</p> <p>The increase in firm profitability is provided through the efficient use of resources (human, financial, and raw materials); projects; effective enterprises; and good management, planning, and control [56].</p> <p>It demands responses to societal needs, including all stakeholders [56].</p> <p>Learning and development of capabilities are part of the stakeholder relationship process, which is a way to deal with challenges of coordination and collaboration [57].</p> <p>Suppliers adapt, engage, and get actively involved in the activities and principles related to management of the sustainable supply chain [7].</p> <p>It proactively engages with all stakeholders by ensuring social involvement through supplier accreditation programs, community development, and other aspects that can be incorporated into intangible product value [17].</p> <p>Relationships with customer are organized around the shared recognition of challenges to sustainability at various stages of the development of markets [7].</p> <p>Focus on technological innovation, consumption reduction, prioritization of renewable resources, demand-oriented models, and closed-loop systems [61].</p> <p>It finds mechanisms that convince stakeholders to change from "single" to "multiple objectives" [57].</p> <p>Harmful and irreversible changes to the environment are avoided through the efficient use of natural resources, promoting renewable resources, soil and water protection, and the skillful management of residues [56].</p>	<p>It captures economic value while maintaining or regenerating social, environmental, and economic capital beyond the firm [58].</p> <p>It enhances the role played by the government at all levels, including incentive mechanisms and exemptions [57].</p> <p>It reflects an appropriate distribution of costs and benefits among stakeholders as well as social and environmental impacts generated by firms [7].</p> <p>It uses the triple bottom line approach to measure business model performance [61,62].</p>

### 3.3.3. Hindering Factors

Other authors discuss the factors that might hinder sustainable business models, such as the non-involvement of stakeholders and shareholders in the process of value proposition and creation [58], the excessive systems of tax [61], resistance to the introduction of technology and new business models [7], gap skills and incentives [63], and specific forms of value uncaptured [64].

## 4. Intersection between Sustainable Urban Mobility and Business Model Literature Categorization

As we presented in Section 3.3.2, our research identified the main dimensions and key activities that should be taken into account when defining a business model as sustainable. The article published by Bocken et al. in 2014 [17] emerged as result of our research. This article is highly cited (it is the most cited and downloaded article from the Journal of Cleaner Production), being used since its publication by many authors to categorize and explain sustainable business models in different cases and contexts.

In this section, we departed from the dimensions presented by Bocken et al. [17] and applied those dimensions to analyze our sample of intersection articles about sustainable and innovative business models in urban mobility.

As a result, we contributed to understand how each archetype can be applied to the specific aspects that characterize sustainable and innovative business models in urban mobility, as we explain in Table 3.

**Table 3.** Model for analysis of intersection between analyzed literature.

<b>Sustainable Business Model Archetypes [17]</b>	<b>Sample of Articles That Contribute to Discuss Intersection between Analyzed Literature</b>	<b>Aspects of Sustainable and Innovative Business Model in Urban Mobility</b>
1. Maximize material and energy efficiency	Jablonski, A. [56] Stubbs, W.; Cockling, C. [61]	Favoring the use of clean energy
2. Create value from waste	Boons, F.; Lüdeke-Freund, F. [7] Bocken, N.M.P.; Short, S.W.; Rana, P.; Evans, S. [17]	Maximizing the use of transport resources and capabilities
3. Substitute with renewable and natural process	Jablonski, A. [56] Stubbs, W.; Cocklin, C. [61] Banister, D. [2]	Encouraging substitution using sustainable modes
4. Deliver functionality rather than ownership	Bocken, N.M.P.; Short, S.W.; Rana, P.; Evans, S. [17]	Offering service orientation and functionality
5. Adopt a stewardship role	Hull, A. [25] Stubbs, W.; Cocklin, C. [61]	Articulating initiatives that address the needs of a wide range of stakeholders in transport systems
6. Encourage sufficiency	Stead, D. [6]	Reducing travel demands
7. Repurpose for society/environment	Boons, F.; Lüdeke-Freund, F. [7] Schaltegger, S.; Hansen, E.G.; Lüdeke-freund, F. [58] Kemp, R.; Avelino, F.; Bressers, N. [40]	Extending benefits to society and to the environment in a systemic perspective
8. Develop scale-up solutions	Zito, P.; Salvo, G. [29] Rodrigues da Silva, A.N.; Azevedo Filho, M.A.N.de; Macêdo, M.H.; Sorratini, J.A.; da Silva, A.F.; Lima, J.P.; Pinheiro, A.M.G.S [32]	Developing scale-up mobility solutions

### 4.1. Favoring the Use of Clean Energy

Energy efficiency maximization is directly related to reducing demand for energy and resources employed in mobility systems—vehicles that are more energy efficient and that consume clean fuels such as electricity—which meet with the aspects already discussed in other studies (see [56,61]). In addition, part of this archetype is the development of business models that enable users to adopt sustainable alternatives integrated with other modes through actions that restrict the use of internal combustion engine private vehicles, consequently improving travel conditions and reducing emissions that pollute the environment.

#### *4.2. Maximizing the Use of Transport Resources and Capabilities*

In this archetype, there are business models oriented towards urban mobility systems that may address the reuse of resources that are typically seen as waste. These include models aimed at collaborative consumption and sharing practices, because one way to recapture wasted value is by maximizing under-utilized assets and resource capabilities [17]. Moreover, these models encourage users to take responsibility for their own consumption practices and recognize sustainable value in sharing practices; car-sharing, lift-sharing, and bicycle-sharing models can be examples of creating value from waste [7].

#### *4.3. Encouraging Substitution Using Sustainable Modes*

Business models that favor limiting the production of non-renewable resources by seeking other alternatives are part of this archetype. Models that guarantee the commercialization of technological innovations related to substitution through renewable energy sources are important [56,61]. There are also business models that, from a value proposition perspective, encourage sustainable alternatives and reduce car dependence [2], because substitution can be achieved not only through technological aspects but also via user behavior. Customized mobility services according to the user needs and providing real time information are also examples that encourage substitution and make public transportation solutions more competitive and integrated through technological innovations.

#### *4.4. Offering Service Orientation and Functionality*

The business models included in this archetype aim to satisfy user demands without the ownership of physical goods. This approach fundamentally involves changing the conditions under which materials are produced and transferred, reducing resource consumption and increasing rates of reuse and product durability [17]. Models that are oriented towards service provision and discourage ownership, such as sharing solutions, are also part of this category because they can contribute to changes in consumption and behavior patterns through the use of more sustainable alternatives.

#### *4.5. Articulating Initiatives that Address the Needs of a Wide Range of Stakeholders in Transport Systems*

Using activities related to value creation, the models represented in this category should articulate the needs of various stakeholders such as users and the government involved in the management of transport systems, seeking the integration of local social needs with institutional policies [25]. Therefore, it is essential to consider the needs of all stakeholders in a business model definition as much as possible, and its success is linked to meeting the expectations of all stakeholders [61]. Thus, business models should address the challenges and needs of one or more local groups, take into account the urban mobility conditions available to these groups, and articulate other actors needed to enable solutions to address these challenges.

#### *4.6. Reducing Travel Demands*

This archetype includes business models that aim to reduce the demand for travel by delivering alternatives that reduce consumption and contribute to the condition of mobility as a whole. Technological innovations in the field of urban mobility have traditionally simulated increased transport consumption due to a number of structural and economic factors [6]. More recently, technological innovations have allowed the development of solutions that may reduce this consumption demand. For example, people make fewer trips if their work activities can be performed remotely or if they can access services that do not require travel (e.g., telebanking, telemedicine). Moreover, other types of travel can be better served by technological innovation, such as trips involving leisure and large distances, which also have less impact on mobility in large urban centers.

However, information and communication technologies alone cannot modify travel patterns, indicating that there are opportunities for developing complementary approaches that may be related to travel demand reduction [6].

#### *4.7. Extending Benefits to Society and to the Environment in a Systemic Perspective*

This archetype contains business models that explicitly deliver social and environmental benefits in their logic of value creation as firms integrate various groups of stakeholders [7,58]. In relation to sustainable urban mobility, solutions are needed that benefit not only the users of mobility systems themselves—that is, customers—but also the environment as a whole. Thus, these solutions are articulated not only from the point of view of technological development associated with products and services but also in terms of other institutional, social, and political elements needed for transitions to sustainable mobility systems. The solutions also contribute to meeting an immediate need without losing sight of a long-term vision, which is a necessary condition for transitions [40].

#### *4.8. Developing Scale-up Mobility Solutions*

Scale-up solutions for urban mobility involve those that have significant potential to maximize benefits by reaching a wide range of users without costs for this extension to grow proportionally. This archetype includes business models that contribute to the conditions for urban mobility by reaching a large number of people, i.e., through technological applications. These include corporate ride-sharing solutions, mobile applications for instant information that support users in making better transportation decisions, and intelligent transport systems. The potential gains from scale-up solutions are fundamental in the context of sustainable urban mobility since its challenges are much more prevalent in large urban centers with high population density [29,32]. In addition, business models with scale-up potential can contribute to changes in consumption patterns and influence production models, which are closely linked to sustainable urban mobility challenges, since the adoption of highly scalable business ideas by users could encourage many other users to adopt them as well [17].

### **5. Conclusions**

The authors initiated an interdisciplinary discussion on the integration of existing concepts within two main research fields—sustainable urban mobility and business models—to identify the elements that should be considered for creating innovative and sustainable business models in urban mobility. This work therefore contributes to delineating hypotheses that can be subsequently tested in future studies on this theme, that is, validating whether sustainable and innovative business models in urban mobility should address the aspects discussed in each of the intersection aspects analyzed.

Before recognizing current and future challenges, the literature on sustainable urban mobility to some extent legitimizes the importance of articulating business models to ensure the successful introduction and diffusion of sustainable innovations in the field.

However, in relation to guaranteeing the incorporation of a sustainability aspect, there has been little progress in defining which characteristics define these models as actually sustainable, since innovative business models in urban mobility (even with declared sustainable purposes) could lead to negative environmental or social impacts, as to some extent happens to car sharing schemes, which are being criticized by many as an incentive for using private cars instead of public transportation, raising congestion rates in cities, for example.

Although the literature on business models has attempted to define the key terms that can characterize a sustainable business model, in a broader context, little evidence exists regarding how these terms are used in distinct situations, such as urban mobility.

The discussion in this article allows the authors to conclude that the intersection of these fields of research appears to be evident and to define the following aspects by which business models can be directed to incorporate sustainability in urban mobility: favoring the use of clean energy; maximizing the use of transport resources and capabilities; encouraging substitution using sustainable modes; emphasizing service orientation and functionality; articulating initiatives that address the needs of a wide range of stakeholders; reducing travel demands; extending benefits to society and to the environment in a systemic perspective; and developing scale-up mobility solutions.

The discussion towards a conceptual intersection between sustainable urban mobility and business models ultimately helps to explain patterns that direct and support the achievement of sustainable urban

mobility through business models, contributing to theory, management practice, the development of public policies and, finally, the promotion of sustainable development.

As our main theoretical contribution, we presented a framework from the analysis of the intersection of the literature related to sustainable urban mobility and business models, identifying which aspects should be considered to create sustainable and innovative business models for urban mobility, advancing in proposed model by other research and bringing it closer to the context of sustainable mobility. Part of our contribution was to integrate existing perspectives and building cases and new possibilities for sustainability through sustainable business models approach, as suggested by Bocken et al. as future research agenda opportunities [17].

This framework could also help innovators to develop sustainable innovations in urban mobility, using the characteristics presented in Figure 2 as a guideline to assess sustainability in new business models. Additionally, for policy makers, the aspects for sustainable business models in urban mobility presented above could be a source of guidance to develop incentives and regulations in urban mobility.

However, this study has two notable limitations: only one database (Scopus) was researched, and the practical examples referenced are only illustrative. Future research with empirical data could enrich the aspects that define innovative and sustainable business models for urban mobility and could further examine the factors that favor the incorporation of these aspects throughout the process of proposing, creating, and capturing value, supporting the validation of the theoretical framework presented in this study.

**Author Contributions:** The argument in this paper was developed from the three authors' working in a broader research project focused on understanding drivers and barriers for the production organization in the face of the new challenges to sustainable urban mobility transition. J.V.R.d.S. led the writing of the paper.

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## Appendix A

**Table A1.** Detailed search and selection process.

Category	Search Terms in Titles, Abstracts, and Keywords	Filters Applied	Number of Papers in Search Results after Filters	Number of Papers Selected after Selection Criteria
<b>Sustainable urban mobility</b>	"sustainable urban mobility" or "sustainable mobility" or "sustainable and transport" with "business model"; "sustainable urban mobility" or "sustainable mobility" or "sustainable" with "transport";	- English-only articles - Blind scientific articles published in peer-review journals	497	33
<b>Business model innovation</b>	"business model" and "innovation" and "review"	- Following sub-areas were not considered: health, mathematics, neuroscience, chemistry, biology, agricultural and medicine	104	8
<b>Sustainable business model</b>	"sustainable business model"		95	16

## Appendix B

Table A2. Content analysis codes tree <sup>1</sup>.

Research Question	Definitions to Answer the Research Question	Category	Subcategory	Applied Technique
What are the aspects of a sustainable and innovative business model in the field of urban mobility?	Aspects that characterize sustainable urban mobility	Sustainable urban mobility	Sustainable urban mobility challenges	Analytic categories and subcategories obtained from an inductive approach during content analysis
			Sustainable urban mobility indicators	
			Management of transitions to sustainable mobility systems	
			Role of individual behavior in mobility systems	
	Aspects that characterize innovative business models	Business model innovation	Business models functions	Analytic categories and subcategories obtained from an inductive approach during content analysis
			Dimensions and key activities	Analytic categories and subcategories obtained from a deductive approach from literature background. See [16].
	Aspects that characterize sustainable business models	Sustainable business model	Business models functions	Analytic categories and subcategories obtained from an inductive approach during content analysis
			Dimensions and key activities	Analytic categories and subcategories obtained from a deductive approach from literature background. See [16].
			Hinder factors	Analytic categories and subcategories obtained from an inductive approach during content analysis
	Intersection between sustainable urban mobility and innovative and sustainable business models	Not applicable	Not applicable	Adaptation of the framework of typologies of sustainable business models to the context of urban mobility [17]

<sup>1</sup> Prepared by the authors. Process of content analysis based on a previous work (see [65]).

## References

- Spickermann, A.; Grienitz, V.; von der Gracht, H.A. Heading towards a Multimodal City of the Future? Multi-Stakeholder Scenarios for Urban Mobility. *Technol. Forecast. Soc. Chang.* **2013**, *89*, 201–221, doi:10.1016/j.techfore.2013.08.036.
- Banister, D. The Sustainable Mobility Paradigm. *Transp. Policy* **2008**, *15*, 73–80, doi:10.1016/j.tranpol.2007.10.005.
- Banister, D. Cities, Mobility and Climate Change. *J. Transp. Geogr.* **2011**, *19*, 1538–1546, doi:10.1016/j.jtrangeo.2011.03.009.
- Beirão, G.; Cabral, J.A.S. Understanding Attitudes towards Public Transport and Private Car: A Qualitative Study. *Transp. Policy* **2007**, *14*, 478–489, doi:10.1016/j.tranpol.2007.04.009.
- Goldman, T.; Gorham, R. Sustainable Urban Transport: Four Innovative Directions. *Technol. Soc.* **2006**, *28*, 261–273, doi:10.1016/j.techsoc.2005.10.007.
- Stead, D. Identifying Key Research Themes for Sustainable Urban Mobility. *Int. J. Sustain. Transp.* **2013**, *8318*, doi:10.1080/15568318.2013.820993.
- Boons, F.; Lüdeke-Freund, F. Business Models for Sustainable Innovation: State-of-the-Art and Steps towards a Research Agenda. *J. Clean. Prod.* **2013**, *45*, 9–19, doi:10.1016/j.jclepro.2012.07.007.



8. Boons, F.; Montalvo, C.; Quist, J.; Wagner, M. Sustainable Innovation, Business Models and Economic Performance: An Overview. *J. Clean. Prod.* **2013**, *45*, 1–8, doi:10.1016/j.jclepro.2012.08.013.
9. Evans, S.; Vladimirova, D.; Holgado, M.; Van Fossen, K.; Yang, M.; Silva, E.A.; Barlow, C.Y. Business Model Innovation for Sustainability: Towards a Unified Perspective for Creation of Sustainable Business Models. *Bus. Strategy Environ.* **2017**, *26*, 597–608, doi:10.1002/bse.1939.
10. Wegener, M. The Future of Mobility in Cities: Challenges for Urban Modelling. *Transp. Policy* **2013**, *29*, 275–282, doi:10.1016/j.tranpol.2012.07.004.
11. World Commission on Environment and Development. *Report of the World Commission on Environment and Development: Our Common Future Acronyms and Note on Terminology Chairman's Foreword*; World Commission on Environment and Development: Oxford, UK, 1987.
12. Walnum, H.J.; Aall, C.; Løkke, S. Can Rebound Effects Explain Why Sustainable Mobility Has Not Been Achieved? *Sustainability* **2014**, *6*, 9510–9537, doi:10.3390/su6129510.
13. Boote, D.N.; Beile, P. Scholars Before Researchers: On the Centrality of the Dissertation Literature Review in Research Preparation. *Educ. Res.* **2005**, *34*, 3–15.
14. Randolph, J.J. A Guide to Writing the Dissertation Literature Review. *Pract. Assess. Res. Eval.* **2009**, *14*, 1–13.
15. Mayring, P. Qualitative Content Analysis. *Forum Qual. Res.* **2004**, *1*, 159–176.
16. Richardson, J. The Business Model: An Integrative Framework for Strategy Execution. *Strateg. Chang.* **2008**, *17*, 133–144, doi:10.1002/jsc.821.
17. Bocken, N.M.P.; Short, S.W.; Rana, P.; Evans, S. A Literature and Practice Review to Develop Sustainable Business Model Archetypes. *J. Clean. Prod.* **2014**, *65*, 42–56, doi:10.1016/j.jclepro.2013.11.039.
18. Agarwal, O.; Zimmerman, S. Toward Sustainable Mobility in Urban India. *Transp. Res. Rec. J. Transp. Res. Board* **2008**, *2048*, 1–7, doi:10.3141/2048-01.
19. Batty, P.; Palacin, R.; González-Gil, A. Challenges and Opportunities in Developing Urban Modal Shift. *Travel Behav. Soc.* **2015**, *2*, 109–123, doi:10.1016/j.tbs.2014.12.001.
20. Mathiesen, B.V.; Lund, H.; Nørgaard, P. Integrated Transport and Renewable Energy Systems. *Util. Policy* **2008**, *16*, 107–116, doi:10.1016/j.jup.2007.11.007.
21. Pucher, J.; Buehler, R. Cycling towards a More Sustainable Transport Future. *Transp. Rev.* **2017**, *37*, 689–694, doi:10.1080/01441647.2017.1340234.
22. Cohen, B.; Kietzmann, J. Ride On! Mobility Business Models for the Sharing Economy. *Organ. Environ.* **2014**, *27*, 279–296, doi:10.1177/1086026614546199.
23. Loo, B.P.Y.; du Verle, F. Transit-Oriented Development in Future Cities: Towards a Two-Level Sustainable Mobility Strategy. *Int. J. Urban Sci.* **2017**, *21*, 54–67, doi:10.1080/12265934.2016.1235488.
24. Hrelja, R.; Isaksson, K.; Richardson, T. Choosing Conflict on the Road to Sustainable Mobility: A Risky Strategy for Breaking Path Dependency in Urban Policy Making. *Transp. Res. Part A Policy Pract.* **2013**, *49*, 195–205, doi:10.1016/j.tra.2013.01.029.
25. Hull, A. Policy Integration: What Will It Take to Achieve More Sustainable Transport Solutions in Cities? *Transp. Policy* **2008**, *15*, 94–103, doi:10.1016/j.tranpol.2007.10.004.
26. Akyelken, N.; Banister, D.; Givoni, M. The Sustainability of Shared Mobility in London: The Dilemma for Governance. *Sustainability* **2018**, *10*, 420, doi:10.3390/su10020420.
27. Vergragt, P.J.; Brown, H.S. Sustainable Mobility: From Technological Innovation to Societal Learning. *J. Clean. Prod.* **2007**, *15*, 1104–1115, doi:10.1016/j.jclepro.2006.05.020.
28. Marletto, G.; Mameli, F. A Participative Procedure to Select Indicators of Policies for Sustainable Urban Mobility. Outcomes of a National Test. *Eur. Transp. Res. Rev.* **2012**, *4*, 79–89, doi:10.1007/s12544-012-0075-8.
29. Zito, P.; Salvo, G. Toward an Urban Transport Sustainability Index: An European Comparison. *Eur. Transp. Res. Rev.* **2011**, *3*, 179–195, doi:10.1007/s12544-011-0059-0.
30. Macário, R.; Marques, C.F. Transferability of Sustainable Urban Mobility Measures. *Res. Transp. Econ.* **2008**, *22*, 146–156, doi:10.1016/j.retrec.2008.05.026.
31. Doi, K.; Kii, M. Looking at Sustainable Urban Mobility through a Cross-Assessment Model within the Framework of Land-Use and Transport Integration. *IATSS Res.* **2012**, *35*, 62–70, doi:10.1016/j.iatssr.2012.02.004.

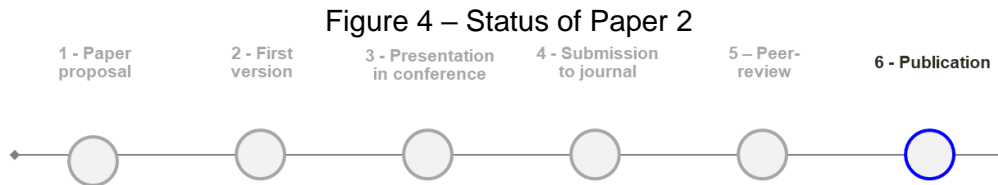
32. Rodrigues da Silva, A.N.; Azevedo Filho, M.A.N. de; Macêdo, M.H.; Serratini, J.A.; da Silva, A.F.; Lima, J.P.; Pinheiro, A.M.G.S. A Comparative Evaluation of Mobility Conditions in Selected Cities of the Five Brazilian Regions. *Transp. Policy* **2015**, *37*, 147–156, doi:10.1016/j.tranpol.2014.10.017.
33. Geels, F.W. A Socio-Technical Analysis of Low-Carbon Transitions: Introducing the Multi-Level Perspective into Transport Studies. *J. Transp. Geogr.* **2012**, *24*, 471–482, doi:10.1016/j.jtrangeo.2012.01.021.
34. Geels, F.W. From Sectoral Systems of Innovation to Socio-Technical Systems: Insights about Dynamics and Change from Sociology and Institutional Theory. *Res. Policy* **2004**, *33*, 897–920, doi:10.1016/j.respol.2004.01.015.
35. Hodson, M.; Geels, F.W.; McMeekin, A. Reconfiguring Urban Sustainability Transitions, Analysing Multiplicity. *Sustainability* **2017**, *9*, 299, doi:10.3390/su9020299.
36. Ceschin, F. How the Design of Socio-Technical Experiments Can Enable Radical Changes for Sustainability. *Int. J. Des.* **2014**, *8*, 1–21.
37. Köhler, J.; Whitmarsh, L.; Nykvist, B.; Schilperoord, M.; Bergman, N.; Haxeltine, A. A Transitions Model for Sustainable Mobility. *Ecol. Econ.* **2009**, *68*, 2985–2995, doi:10.1016/j.ecolecon.2009.06.027.
38. Marletto, G. Structure, Agency and Change in the Car Regime. A Review of the Literature. *Eur. Transp. Transp. Eur.* **2011**, *47*, 71–88.
39. Kemp, R.; Van Lente, H. The Dual Challenge of Sustainability Transitions. *Environ. Innov. Soc. Transit.* **2011**, *1*, 121–124, doi:10.1016/j.eist.2011.04.001.
40. Kemp, R.; Avelino, F.; Bressers, N. Transition Management as a Model for Sustainable Mobility. *Eur. Transp. Transp. Eur.* **2011**, *47*, 25–46.
41. de Bruijne, M.; van de Riet, O.; de Haan, A.; Koppenjan, J. Dealing with Dilemma's: How Can Experiments Contribute to a More Sustainable Mobility System? *Eur. J. Transp. Infrastruct. Res.* **2010**, *10*, 274–289.
42. Marx, R.; Mello, A.M. de; Zilbovicius, M.; Lara, F.F. de. Spatial Contexts and Firm Strategies: Applying the Multilevel Perspective to Sustainable Urban Mobility Transitions in Brazil. *J. Clean. Prod.* **2015**, *108*, 1092–1104, doi:10.1016/j.jclepro.2015.09.001.
43. Howarth, C.C.; Polyviou, P. Sustainable Travel Behaviour and the Widespread Impacts on the Local Economy. *Local Econ.* **2012**, *27*, 764–781, doi:10.1177/0269094212455149.
44. Gabrielli, S.; Forbes, P.; Jylhä, A.; Wells, S.; Sirén, M.; Hemminki, S.; Nurmi, P.; Maimone, R.; Masthoff, J.; Jacucci, G. Design Challenges in Motivating Change for Sustainable Urban Mobility. *Comput. Hum. Behav.* **2014**, *41*, 416–423, doi:10.1016/j.chb.2014.05.026.
45. Teece, D.J. Business Models, Business Strategy and Innovation. *Long Range Plan.* **2010**, *43*, 172–194, doi:10.1016/j.lrp.2009.07.003.
46. Osterwalder, A.; Pigneur, Y. Clarifying Business Models: Origins, Present, and Future of the Concept. *Commun. Assoc. Inf. Syst.* **2005**, *16*, doi:10.17705/1CAIS.01601.
47. Carayannis, E.G.; Sindakis, S.; Walter, C. Business Model Innovation as Lever of Organizational Sustainability. *J. Technol. Transf.* **2015**, *40*, 85–104, doi:10.1007/s10961-013-9330-y.
48. Schneider, S.; Spieth, P. Business Model Innovation: Towards an Integrated Future Research Agenda. *Int. J. Innov. Manag.* **2013**, *17*, 1340001, doi:10.1142/S136391961340001X.
49. Zott, C.; Amit, R.; Massa, L. The Business Model: Recent Developments and Future Research. *J. Manag.* **2011**, *37*, doi:10.1177/0149206311406265.
50. Chesbrough, H.; Rosenbloom, R.S. The Role of the Business Model in Capturing Value from Innovation: Evidence from Xerox Corporation 's Technology Spin-off Companies. *Ind. Corp. Chang.* **2002**, *11*, 529–555, doi:10.1093/icc/11.3.529.
51. Chesbrough, H. Business Model Innovation: Opportunities and Barriers. *Long Range Plan.* **2010**, *43*, 354–363, doi:10.1016/j.lrp.2009.07.010.
52. Høgevold, N.M. A Corporate Effort towards a Sustainable Business Model. *Eur. Bus. Rev.* **2011**, *23*, 392–400, doi:10.1108/09555341111145771.
53. França, C.L.; Broman, G.; Robèrt, K.H.; Basile, G.; Trygg, L. An Approach to Business Model Innovation and Design for Strategic Sustainable Development. *J. Clean. Prod.* **2017**, *140*, 155–166, doi:10.1016/j.jclepro.2016.06.124.
54. Bocken, N.; Short, S.; Rana, P.; Evans, S. A Value Mapping Tool for Sustainable Business Modelling. *Corp. Gov.* **2013**, *13*, 482–497.

55. Bocken, N.M.P.; Rana, P.; Short, S.W. Value Mapping for Sustainable Business Thinking. *J. Ind. Prod. Eng.* **2015**, *32*, 67–81, doi:10.1080/21681015.2014.1000399.
56. Jablonski, A. Scalability of Sustainable Business Models in Hybrid Organizations. *Sustainability* **2016**, *8*, 194, doi:10.3390/su8030194.
57. Matos, S.; Silvestre, B.S. Managing Stakeholder Relations When Developing Sustainable Business Models : The Case of the Brazilian Energy Sector. *J. Clean. Prod.* **2013**, *45*, 61–73, doi:10.1016/j.jclepro.2012.04.023.
58. Schaltegger, S.; Hansen, E.G.; Lüdeke-freund, F. Business Models for Sustainability: Origins, Present Research, and Future Avenues. *Organ. Environ.* **2016**, *29*, 3–10, doi:10.1177/1086026615599806.
59. Høgevoid, N.; Svensson, G.; Wagner, B.; J. Petzer, D.; Klopper, H.B.; Carlos Sosa Varela, J.; Padin, C.; Ferro, C. Sustainable Business Models: Corporate Reasons, Economic Effects, Social Boundaries, Environmental Actions and Organizational Challenges in Sustainable Business Practices. *Balt. J. Manag.* **2014**, *9*, 357–380, doi:10.1108/BJM-09-2013-0147.
60. Høgevoid, N.M.; Svensson, G.; Padin, C. A Sustainable Business Model in Services: An Assessment and Validation. *Int. J. Qual. Serv. Sci.* **2015**, *7*, 17–33, doi:10.1108/IJQSS-09-2013-0037
61. Stubbs, W.; Cocklin, C. Conceptualizing a “Sustainability Business Model”. *Organ. Environ.* **2008**, *21*, 103–127, doi:10.1177/1086026608318042.
62. Upward, A.; Jones, P. An Ontology for Strongly Sustainable Business Models. *Organ. Environ.* **2016**, *29*, 97–123, doi:10.1177/1086026615592933.
63. Birkin, F.; Cashman, A.; Koh, S.C.L.; Liu, Z. New Sustainable Business Models in China. *Bus. Strateg. Environ.* **2009**, *18*, 64–77, doi:10.1002/bse.568.
64. Yang, M.; Evans, S.; Vladimirova, D.; Rana, P. Value Uncaptured Perspective for Sustainable Business Model. *J. Clean. Prod.* **2017**, *140*, 1794–1804, doi:10.1016/j.jclepro.2016.07.102.
65. Seuring, S.; Müller, M. From a Literature Review to a Conceptual Framework for Sustainable Supply Chain Management. *J. Clean. Prod.* **2008**, *16*, 1699–1710, doi:10.1016/j.jclepro.2008.04.020.



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## 4 PAPER 2 – BARRIERS AND DRIVERS TO IMPLEMENT INNOVATIVE BUSINESS MODELS TOWARDS SUSTAINABLE URBAN MOBILITY



Source: elaborated by the author.

Table 2 – Detailed status of Paper 2

Phase	Status
<b>1 - Paper proposal</b>	<ul style="list-style-type: none"> <li>Paper proposal structured in January 2020</li> </ul>
<b>2 - First version</b>	<ul style="list-style-type: none"> <li>Completed in June 2020</li> </ul>
<b>3 - Presentation in conference</b>	<ul style="list-style-type: none"> <li>Presented 28th International Colloquium of Gerpisa in 2020</li> </ul>
<b>4 - Submission to journal</b>	<ul style="list-style-type: none"> <li>Submission to International Journal of Automotive and Technology Management on February 09, 2022</li> <li>Journal Statistics: CiteScore Scopus 2022: 2,8</li> </ul>
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## Barriers and drivers to implement innovative business models towards sustainable urban mobility

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**Abstract:** This research aims to investigate the barriers organisations face when implementing innovative and sustainable business models for urban mobility industry. Organisations and practitioners are increasingly promoting sustainable mobility-oriented initiatives, and although the business model approach is frequently associated with the transitions to more sustainable mobility systems, their adoption investigation is still limited, and many initiatives fail or remain isolated. In this sense, the following question is pursued: what are the barriers organisations face when implementing innovative business models for sustainable urban mobility and which drivers are associated with the identified barriers? Multiple case-based researches were adopted through an empirical analysis among ten business models initiatives led in Brazil and China. The research results were organised in a framework composed of five barriers faced by the analysed organisations and the respective drivers according to the parts of a business model and the category of each barrier.

**Keywords:** Brazil; China; emergent countries; large urban centres; sustainable business models; sustainable urban mobility; barriers; drivers; business model innovation; business models for sustainability; BMfS.

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## 1 Introduction

In the scenario of looking for more sustainable mobility solutions, it is widely discussed that automotive industry – which have played a central role in the city's urban mobility systems over the 20th century – began to face pressures and externalities that could significantly change the dynamics of this traditional industry, driven mainly by the growth of new technologies and market niches that could be configured in new business models for urban mobility (Geels, 2004, 2012; Banister, 2008; Spickermann et al., 2013).

Rapid population growth (Cervero, 2013), the concentration of goods, services, and people in large urban centres (Spickermann et al., 2013), accelerated process of increasing energy demand (Wegener, 2013), congestion due to the increased private car demand combined with inappropriate infrastructure development (Cervero, 2013) and air

pollution and climate changes (Banister, 2008) are just some of the aspects that characterise the current and emerging challenges for urban mobility in big cities.

Despite the pressures and efforts to ensure more sustainable mobility systems, emergent countries face even more significant and growing challenges concerning the demand for mobility, especially in large urban centres (Vergragt and Brown, 2007). The realities of those countries are substantially different from other contexts, as transport and land use planning take on particular pathways compared to the reality of the developed countries (Cervero, 2013; Marotti de Mello et al., 2021). In this context, Brazil and China are examples of countries that have large urban centres with a high demand for mobility and in which transport as a whole must contribute to achieving goals of pollutant emission reduction, contributing to sustainable development (Banister, 2011).

In this context, researchers have increasingly discussed how new business models may promote sustainable urban mobility and assume a central role in this transition (Spickermann et al., 2013; Wells, 2013; Donada and Lepoutre, 2016; Krommes and Schmidt, 2017; Lasmar et al., 2019). However, there is a crucial need to understand the scope and barriers of business model innovation for sustainability in the automotive industry and its externalities, since niche experiments in this field remain distinctly marginal to the mainstream business around the traditional car (Wells, 2013). Additionally, empirical data could enrich the relevant aspects that impact the logic of value generation for innovative and sustainable business models for urban mobility, since this is still limited in the literature (Souza et al., 2019).

Concerning new business development for the urban mobility industry and its particularities, the need for more research is intensified because the challenges for this sector require systemic approaches in which multiple stakeholders in society may play different relevant roles (Spickermann et al., 2013). Moreover, one of the critical challenges of sustainable business that calls for further research investigating the barriers firms face when dealing with conflicting stakeholder interests and skills (Matos and Silvestre, 2013).

Comparing different strategies for urban mobility system diffusion of niches brings relevant and still little explored questions in the literature, mainly because there are many examples of initiatives that are strongly oriented towards systemic changes and fail in the early phases of the business implementation. In the most recent context, in which the participation of ICT companies in the mobility industry has been shown to be a pattern, this issue becomes even more relevant. It sets a fertile ground for the study of the development of niches in sustainable transitions, which may reveal greater variety in niche development patterns (Turnheim and Geels, 2019).

In order to contribute to this research gap, this article aims to discuss the following research question: what are the barriers organisations faces when implementing innovative business models for sustainable urban mobility and which drivers are associated with the identified barriers?

Drawing on the organisation theory and, more precisely, on business models for sustainability (BMfS) background, case-based research was adopted, and multiple cases studies were assessed through an empirical analysis among ten business models initiatives led in Brazil and China, due to the apparent relevance of urban mobility issue in the realities of both countries.

As an expected theoretical contribution, it is expected to identify the barriers and drivers related to the implementation of new business models oriented to sustainable mobility, contributing to a better understanding of the organisational dynamics of business models where multiple stakeholders with different objectives and, often conflicting, coexist. It is also expected to advance the multilevel perspective (MLP) approach within the scope of socio-technical transitions by explaining why niches cannot become dominant.

As practical implications of this paper, in addition to the contribution to the literature, that had investigated few empirical studies linking urban mobility and business models perspectives so far, the findings support directly the formulation of public policies that encourage new business models creation initiatives that promote both sustainable urban mobility and practitioners interested in elaborating business initiatives in this field, from the recognition of barriers that need to be taken into account to develop business in urban mobility. As a complementary implication, the drivers to deal with barriers faced by organisations are also investigated, especially in the context of emerging countries.

This paper is structured as follows. Section 2 draws on BMfS literature to identify the barriers to developing BMfS. Section 3 presents the methods applied to gather and analyse empirical data. Section 4 discusses the findings concerning the barriers faced by the organisations and the respective drivers. Finally, in Section 5 conclusions are drawn.

## 2 Background

### 2.1 Business models, sustainability, and mobility sector intersection

Business models have been widely accepted and used in the literature; however, they are often applied in completely distinct senses and contexts. Osterwalder and Pigneur (2005) define the business model as a conceptual tool to express an organisation's business logic – how an organisation 'does business' – by describing the mechanisms through which organisations create and sustain value.

Richardson (2008) defined three key business model aspects:

- 1 value proposition – what an organisation intends to deliver to its customers and the reasons why they would pay for it
- 2 value creation and delivery system – how an organisation articulates resources, capabilities, processes, and networks of customers and suppliers to create and deliver the value intended
- 3 value capture – how an organisation generates revenue and profit from activities.

The most recurrent way in literature to analyse how business models can promote sustainability is through the integration of the BMfS perspective (Boons and Lüdeke-Freund, 2013).

In that respect, it is essential to be sensitive that sustainable innovation has different meanings in different contexts like consumer economies, emerging economies, and base-of-the-pyramid economies. Therefore, in this research, the concept of business models is applied as an important tool for researchers and practitioners to understand and make progress on sustainable innovation (Boons et al., 2013).



Evans et al. (2017) propose a unified theoretical perspective for understanding business model innovations that lead to sustainability, proposing an integrated view of BMFS. Authors argue that BMFS incorporate the concept of sustainable value, that is, BMFS should deliver not only environmental sustainability but also social and economic value, expanding both the idea of ‘value’ – beyond the economic lens widely used-, as well as the ‘sustainability’ – beyond the environmental aspect.

In the context of sustainable business for the mobility sector, Nosratabadi et al. (2019) presented transportation as one of the categories part of the application group for sustainable business through a comprehensive review conducted by the authors. They argue that disruptive business model innovation has emerged in this field, such as app-based smart-sharing systems or carpooling, expanded electric vehicle use, bike-sharing, intelligent mobility, and eco-safe driving. Such mobility business models plus low-carbon transport modes in cities can support urban mobility toward sustainability.

The issue of which business model to opt for in the mobility sector is still an open question and particularly critical for emerging countries due to the fact they should grow sustainably while satisfying local demands for affordable transport solutions (Pallaro et al., 2015).

Souza et al. (2019) proposed a framework, through a systematic literature review, presenting eight different categories by which business models may promote sustainable urban mobility: favouring the use of clean energy; maximising the use of transport resources and capabilities; encouraging substitution using sustainable modes; offering service orientation and functionality; articulating initiatives that address the needs of a wide range of stakeholders in transport systems; reducing travel demands; extending benefits to society and the environment in a systemic perspective and developing scale-up mobility solutions. This framework was based on more generic sustainable business models archetypes proposed initially by Bocken et al. (2014).

## 2.2 *Barriers for sustainable business models implementation*

Several barriers that may influence sustainable business model implementation have been discussed in the literature. In this paper, barriers are seen as factors that negatively affect the business model’s implementations.

The findings were organised according to the parts of the business model proposed by Richardson (2008), seeking to identify in which part each barrier is related (Table 1). It is important to note that some authors explore specific barriers for the case of urban mobility; however, most of them address barriers obtained from experience in other sectors, reinforcing the contribution opportunity of this study.

In addition to the aspects highlighted at the organisational level, it is relevant to note how the literature of BMFS incorporates and shows how business models may be improved – and better understood – as they incorporate activities that exceed the limit of the traditional scope of the firm, as they are often inserted in environments that change quickly and require flexibility, as is the case of the models based on sharing economy or servitisation, although these activities beyond the firms’ boundaries need to be better investigated, as described by Köhler et al. (2019) as a research opportunity for sustainable transitions agenda.

**Table 1** Barriers for sustainable business models implementation

	<i>Barrier</i>	<i>References</i>
Value proposition	Not consider from an early stage: desirability, sustainability, and feasibility	Baldassarre et al. (2020)
	Lack of consumer/customer acceptance due to attitudes and values or stakeholder pressure.	Laukkanen and Patala (2014)
	Influence people to reconsider the need for individual ownership.	Bocken et al. (2020)
	Lack of knowledge may affect consumer acceptance	Sousa-Zomer and Cauchick-Miguel (2019)
	Define a dual-value proposition addressing customers and society needs at the same time and ensure the involvement of all the necessary stakeholders in the design of the value proposition.	Sabatier et al. (2017) and Schaltegger et al. (2016)
Value creation and delivery system	Investments in the expansion of infrastructure (e.g., lack of sufficient charging infrastructure for electric mobility).	Wagner et al. (2020)
	Barriers to the diffusion of sustainable business model innovation (regulatory frameworks, market know-how, behavioural and social aspects).	Laukkanen and Patala (2014) and Van Den Heuvel et al. (2020)
	Manage organisational design factors (at institutional, strategic, and operational levels) that inhibit the dynamic capabilities for sustainable business model innovation.	Bocken and Geradts (2019)
	Manage different dimensions in the market environment: scaling, staffing, communication, alliance building, lobbying, and community engagement.	Palomares-Aguirre et al. (2018)
	Rethink design phase strategy; work on consumer education, expanding awareness, and managing expectations of customers.	Todeschini et al. (2017)
	Stakeholder management: geographic dispersion, lack of trust, lack of education, conflicting interests, local government engagement.	Matos and Silvestre (2013)
	Multi-stakeholder alignment: collaboration with unfamiliar actors, the interaction between the different organisational boundaries and external boundary changes.	Velter et al. (2020)
	Close integration with customers: help change their unsustainable consumption behaviour, increase confidence in and acceptance of decentralised technologies and reduce their perception of risk.	Sousa-Zomer and Cauchick Miguel (2018)
	Define social sustainability as a core business goal (extend the creation of value to new categories of stakeholders, promote organisational learning, enhance human capital and implement advanced managerial systems).	Rotondo et al. (2019)
	Support of local policymakers about sharing practices (e.g., enabling carsharing organisations, providing incentives and information to the public).	Bocken et al. (2020)
The interaction between the various options of transport is important to how these people use car sharing.	Svennevik (2019)	

Source: Elaborated by the authors

**Table 1** Barriers for sustainable business models implementation (continued)

	<i>Barrier</i>	<i>References</i>
Value capture	Financial viability of new business models	Baldassarre et al. (2020)
	Profitability of business models/satisfaction, lack of economic incentives, and manage financial risk	Laukkanen and Patala (2014) and Van Den Heuvel et al. (2020)
	Financial performance metrics that inhibit the dynamic capabilities for BMFS.	Bocken and Geradts (2019)
	Earnings generation, scaling up, and stimulating market forces.	Palomares-Aguirre et al. (2018)
	Find partners, share the monetary value, consider the social and profit equations jointly, align contributions and intention to provide social profits.	Sabatier et al. (2017)
	Lack of funding from investors	Lüdeke-Freund (2020)

*Source:* Elaborated by the authors

### 3 Methods

#### 3.1 Research design

Due to the fact that the intersection between barriers for sustainable business models implementation and sustainable urban mobility approaches is still little addressed in the literature (Souza et al., 2019), a multiple case-based research was applied, following the basic steps proposed by Eisenhardt (1989) as a reference to the process of a case study research.

The first step to designing a case study is to develop a prior view of the general constructs we intend to study and their relationships according to the research question (see Table 1) (Eisenhardt, 1989; Voss et al., 2002).

#### 3.2 Cases selection

The unit of analysis of this research is the business model and not the company as a whole, mainly because a company may have different business models that may not be the focus of the research.

In this research, the categorisation proposed by Souza et al. (2019) was applied in order to select the cases. According to authors' reports, this categorisation is helpful to identify practical applications areas or concrete examples of business models oriented to sustainable urban mobility to support empirical investigations. We used the saturation process, and we stopped including new cases when convergent and robust results were obtained, resulting in the ten cases included in the study (Eisenhardt, 1989).

It was identified organisations with business models related to each of the categories described above as potential cases to be included in the study. Then, during the data collection, it was verified if the business models aspects from each company were aligned with the respective categorisation. After this initial verification the collection of in-depth

information from the cases was carried out, ensuring that each selected case met the methodological criteria established, as suggested by Voss et al. (2002).

The selection of potential companies considered only organisations that already have a current established operation since many of the organisations analysed include products or services new or poorly disseminated in the market.

Although the companies included in the study may have operations in different locations, the cases from China cover business models developed in the metropolis of Shanghai, and the cases from Brazil include business models developed in the metropolis of São Paulo, major urban centres in both countries.

Table 2 presents the ten selected business models and a short description of each. Each business model belongs to a distinct company (Table 2).

**Table 2** Description of selected cases

<i>Fictitious name</i>	<i>Type of company</i>	<i>Short description of the selected business model</i>	<i>Country</i>
BIKE BR	Bike-sharing operator	Brazilian company responsible for the operation of the largest bike-sharing systems in Brazil, including the city São Paulo (dock system). The company also works on creating cycle lanes for leisure, bicycle parking, private bike-sharing systems, and other initiatives related to bicycle mobility.	Brazil
CARSHARING BR	Carsharing operator	Multinational French company which main activity is the outsourcing and management of vehicle fleets for corporations, including a carsharing service for companies with electric or hybrid vehicles. Instead of acquiring vehicle fleet contracts, CARSHARING BR customers can offer the carsharing service to their employees as an alternative for trips during work or leisure.	Brazil
CARPOOL BR	Corporate carpool sharing service provider	The company was born in Brazil as a digital platform that made it possible for people to offer and accept rides under the conditions and prices agreed beforehand. CARPOOL BR is hired by companies interested in providing carpooling services to its employees through a digital platform. Origin and destination locations of employees are exchanged between those interested in offering a ride and those interested in taking it.	Brazil
CYCLING BR	Service provider of routing platform to cyclists	CYCLING BR is a Brazilian company that has been operating for the last years in the development of a technological platform aimed to improve the cyclist's experience when pedalling around the cities through a navigation system that generates safe and customised routes to the users, including the indication of convenient locations, services, alerts and exciting information to the cyclist along the route.	Brazil

*Source:* Elaborated by the authors

**Table 2** Description of selected cases (continued)

<i>Fictitious name</i>	<i>Type of company</i>	<i>Short description of the selected business model</i>	<i>Country</i>
BUS BR	Service provider of information about public transport	Brazilian technology company that provides online information about public transportation to users, such as the real-time bus schedule, route information, public transportation occurrences sharing, routing from origin to destination, recharging electronic bus tickets, accessibility features, and more recently, public services information.	Brazil
INTEGRATION BR	Integrator of payment platform for public transport	Digital payment management service for public transportation fares. Through a free mobile application, public transport users do online credit recharges that can be used in any modal integrated with the system. Payment of fees is made by physical approximation of the user's mobile device to the charging equipment used to access the public transport through near field communication (NFC) technology.	Brazil
RIDE HAILING CH	Ride hailing service provider	One of the largest mobile transportation platforms in the world. The Chinese company offers a full range of app-based transportation services, such as private cars, taxis, bike-sharing and e-bike-sharing (dockless system).	China
CAR CH	New energy automaker	Chinese electric car automaker. The company developed three distinct models of electric cars, including some autonomous car technologies, and added services to customers.	China
BIKE CH	Bike-sharing operator	One of the largest bike-sharing operators in China. The company work with the dockless system in which users can take the bike via mobile app and return it anywhere within areas in the cities they operate delimited by the application.	China
CARSHARING CH	Electric car sharing operator	It is a 100% electric carsharing company and one of the largest in the world to operate this system. The company is Chinese, and the cars are available to users to pick up and drop off in public and private areas in cities, such as parking lots, hotels, parks, squares, shopping centres and others.	China

*Source:* Elaborated by the authors

### 3.3 Data collection and analysis

The primary source of information was obtained from conducting semi-structured face-to-face interviews both with the founders of the companies or with those directly responsible for the operation of the analysed business models. The interviews lasted approximately two hours each. Interviews with Brazilian companies were conducted between August 2017 and January 2018 and interviews with Chinese companies were conducted between September and December 2019.

Findings emerged via an inductive approach based on continuous analysis of the results while remaining open to new concepts that emerge from the gathered data (i.e., related to the drivers applied by companies to deal with the identified barriers), relying on a theory-building approach to answer the research question.

After an individual analysis of cases, seeking to identify specific patterns that emerge from each case, a cross-analysis of the research results was performed in order to discuss the patterns of results found between the cases, the divergences, and, above all, relevant aspects that allow adding elements to prior constructs through several iterations, contributing to theory building. Finally, the contents belonging to the same set of barriers were grouped together (Eisenhardt, 1989).

Afterwards, the literature-based framework was applied as the lens of analysis for this research. First, the categorisation proposed by Richardson (2008) to define the parts that comprise a business model – value proposition, value creation and delivery system, and value capture – was applied to classify the barriers when implementing sustainable business models according to their different parts.

**Table 3** Overview of data sources

<i>Company</i>	<i>Function</i>	<i>Number of interviews</i>	<i>Information gathered by</i>
BIKE BR	Founding partner and operations director	1	Interview onsite
CARSHARING BR	Specialist of sustainable products and innovation	2	Interview onsite, interview by phone
CARPOOL BR	Founding partner and CEO	1	Interview onsite
CICLYING BR	Founding partner and responsible for the operations, and products areas	1	Interview onsite
BUS BR	The manager responsible for strategic projects, products and new business models	2	Interview onsite, interview by phone
INTEGRATION BR	Founding partner, responsible for technology area	1	Interview onsite
RIDE HAILING CH	Strategy manager	1	Interview by phone
CAR CH	Product senior director	1	Interview onsite
BIKE CH	Project manager	1	Interview onsite
CARSHARING CH	Project manager	1	Interview onsite

*Source:* Elaborated by the authors

Additionally, in order to identify the level where the barrier affects the context of the business model implementation, we draw on Bocken and Geradts (2019) to classify the found barriers as ‘institutional’, ‘strategic’, or ‘operational’. The strategic barrier is applied to indicate factors that may impact the core organisational objectives and drive the long-term direction of a firm. The institutional barrier refers to well-established rules, cultural aspects, norms, and beliefs that help to describe the context and reality that the organisation is inserted and, therefore, drive their actions accordingly. Finally, the operational barrier covers factors associated with practices at operational level that support strategic focus and contribute to the achievement of core organisational objectives.

Table 3 provides an overview of the data sources and information gathered. In addition, the excerpts from the interviews used in the coding process of how the barriers and solutions adopted by the companies can be consulted in a database made available by the authors and referenced in Appendix (Souza et al., 2022).

## 4 Results and discussion

### 4.1 Barriers and drivers for the value proposition

Within the value proposition ambit, the product's value is presented and shared to its users and other interested actors. From this point of view, two main common barriers to the development of business models could be highlighted:

- 1 harmonising interests of different stakeholders groups
- 2 competition with dominant transport alternatives.

The first is the need for conciliation and articulation of interests of the various actors involved with the product, classified as a strategic barrier due to its direct impact on the firm's long-term direction. This is especially true in the context of reconciling the public, private and end-user interests when designing the value proposition of the business model. The low participation of the public sphere in the conception of many of them often makes private interests prevail over the public ones and, in some circumstances, over the end-user's interest.

It is the case, for example, conflicts emerge such as that of the Brazilian bike-sharing operator (BIKE BR), in which in cities where there was a greater participation of the public sphere in the design of the business model, it was possible to provide a service to the end-user more integrated with the other transport systems in the city, taking advantage from the knowledge and influence of the municipal public sphere:

“(…) to implement the service, we depend on the realities from city to city – cooperation with the network of companies involved in the sale of public transport credits and with local governments. If we want to sell the public transport credit in São Paulo, we need to be accredited and approved by the city. There are cities like Votorantim, which is not a public company behind the service of credits sales for public transport, it is managed by a concession of a private company. For each city it is necessary to make this alignment of interests.” (INTEGRATION BR)

The barrier of reconciling the interests of different stakeholders also takes place between competitors, as is the case of the bike-sharing operator in China (BIKE CH), who emphasised that the biggest current barrier for them is to promote greater cooperation among other players who offer new services for urban mobility, in order to generate mutual benefits for the operation of their business models. In this sense, companies that offer complementary or similar services are no longer understood as competitors and start to establish collaborative relationships to provide better mobility services to society.

This is also highlighted by carsharing operator in China (CARSHARING CH), since one of the main barriers to the implementation of the business model is the construction of charging stations in order to recognise the local needs and provide a better service, which directly benefit from the greater capacity of dialogue with the surroundings where

the stations could be build, as well as with the municipal government, to facilitate integration with public transport options:

“(...) the interface with companies allows, in addition to commercial issues, awareness of the importance of the shared car service with regard to saving resources, positive impact on mobility, exploration of a sustainable practice, among others. The interface with users is associated with awareness of responsibility for the consumption practices of this service and its benefits in a broader context.”(CARSHARING BR)

“(...) cooperation with public and private actors has been shown to be important for the creation of more stations for shared electric cars, which is one of the main challenges for business expansion.” (CARSHARING CH)

“(...) for us we all want to be the only one, we compete too hard. For example, every industry has some committee, associations or meetings, but in “two wheels’ business we don’t have this kind of committees. For example, our company didn’t agree with some decisions in the past and it’s bad for the whole industry.” (BIKE CH)

Although this barrier is discussed in the literature (see Sabatier et al., 2017; Schaltegger et al., 2016), in the business models for urban mobility perspective, this seems to be very latent and even more relevant since the value proposition point of view, as a wide range of stakeholders needs to be addressed for the mobility solutions.

Without this alignment, the opportunities for defining a value proposition more oriented to the society needs may be lost or limited since, at this moment, the mechanisms by which users perceive the value of the product are defined.

The second barrier is the competition with the dominant alternatives of transport, classified as an institutional barrier since it is directly related to the cultural context that influences the users’ choice of the traditional mobility options.

The adoption of the new sustainable alternatives depends on the user’s understanding of their value and environmental and social benefits, as reported by Laukkanen and Patala (2014) and Bocken et al. (2020).

This barrier is perceived by all the analysed business models, more sharply by those who introduce a new modal alternative based on sharing services, as is the case of the car, bicycle, and ride-sharing models, since they require a cultural change in the current patterns of user’s travel in order to ensure greater product adoption:

“(...) from the point of view of users, we need to be a practical and convenient transport system to be able to convince users to use instead of the traditional options, so operational issues are very important. Easy to use, have several ways to use. The idea is that the user has many ways to use it.” (BIKE BR)

“(...) end-user: started to look more closely. Area with the objective of approaching the user audience, using them as vectors for using the application. Events, new bus technologies, want people to ride more buses. Approaches with neighborhood communities and beyond technology audiences have been actions to encourage the use of public transport, which is in decline.” (BUS BR)

“(...) the target audience for shared electric cars is young people who seek greater convenience than public transport to get around in the cities. In order to attract this audience, we are developing partnerships and implementing stations in universities, airports, hotels and public areas so that the shared car option is more convenient than public transport is today.” (CARSHARING CH)



In order to deal with this barrier, many initiatives aimed at changing users' behaviour and making the value propositions of the products more attractive were highlighted, such as: investments in technology and partnerships with society organisations aligned with the value propositions of the business models. Nevertheless, fewer efforts are being made to change the institutional rules system that influences the choice of mobility options by users, which appear to be essential to facing this challenge.

#### 4.2 Barriers and drivers for the value creation and delivery system

From the point of view of value creation, comprised of the critical activities for the operationalisation of the business model, two common barriers could be highlighted. The first one is the:

- 1 lack of proper public policies to foster both the creation and development of new businesses aimed at promoting sustainable urban mobility
- 2 access information about travel patterns of users.

Concerning the lack of proper public policy, understood as an institutional barrier due to the clear relation with current rules within the context where the business model is inserted, it is possible to see how it impacts the business model implementation process at different levels.

In China, where there are more clear incentives for using clean energy and public policies aimed at reducing emissions, business models benefit from subsidies given both locally and nationally. For instance, this is the case of the CAR CH Company, since they sell to markets where 'new energy car' owners can get the license plate free.

Even in the context of mobility services, CARHSARING CH receives subsidies to increase the fleet of electric cars and RIDE HAILING CH has managed to increase the fleet of drivers who use electric cars in cities where there are local incentives to purchase this type of vehicle:

"(...) government determines policies to promote new energy vehicles in cities, especially in some first-tier and second-tier cities and there are some mandatory requirements for online car hailing companies. This is an indirect benefit for the business: when the government subsidizes new energy vehicles, the overall price of new energy vehicles will be lower." (RIDE HAILING CH)

"(...) our country was quite supportive to the new energy car industry in the past few years and we have state subsidies and local subsidies. New energy car owners can get the license plate free. There're more restrictions for traditional fuel cars to get their license plates than the new energy ones, especially in big cities like Beijing, Shanghai and Guangzhou." (CAR CH)

In Brazil, companies like BIKE BR, for example, aimed at encouraging active mobility by people, still depend directly on the interest of local governments in offering adequate infrastructure and security, such as anti-theft measures, for the use of bicycles by the population, as well as encouraging this type of modal.

The same applies to the case of CARPOOL BR, which could benefit from a specific regulation allowing a driver offering a carpool through their platform with three or more passengers to use lanes dedicated only for buses, as already happens in some cities in the world. However, due to the lack of this type of incentive, they cannot expand the business model reach potential and make it more attractive to the users:

“(…) the public sphere is an important part of the process but involvement varies widely from city to city. The local government will always be involved, it is difficult to be a 100% private system that is really relevant. We need the support of the government in terms of provide security force to keep the system working. We are making reinforcements to hinder the theft but it is not enough.” (BIKE BR)

“(…) In a transport analysis looking at sustainability the best solution for user is always the car. How to make it shared? If you had a shared car policy (riding in the passenger lane with more than 3 people) would be great for us.” (CARPOOL BR)

Van Den Heuvel et al. (2020) found that the lack of an adequate regulatory framework can both boost and hinder business models innovation in the urban mobility sector since changes in legislation allow services offered by mobility companies to be more attractive to a wider variety of customers and, in the opposite way, the lack of a suitable legal framework may make companies unable to apply for certain incentives or being prevented from delivering competitive value propositions.

Although this issue is far from guaranteeing the implementation and expansion of the business models for sustainable mobility – and is beyond a discussion of the regulatory framework only – it seems to be a critical point in this context, as reported by Bocken et al. (2020) in the context of sharing models for urban mobility.

The second barrier is related to the difficulties accessing information about travel patterns of users, classified as a strategic barrier due to the relation of data with the achievement of the company’s core objectives.

The barrier is to obtain reliable information that allows business models to adapt and develop products focused on the reality of the end-users. This is the case of RIDE HAILING CH, where demand management is still a barrier due to the lack of information on users’ travel patterns and needs or of BUS BR, where they rely on open data on public transport systems to provide to the users with reliable and consolidated information of public transport. This barrier is also by business models like that of CARPOOL BR, which depends on the interest of organisations in providing personal data of their employees in order to provide a corporate mobility service suited to the reality of that company and their employee’s needs.

This issue emerged as something recurrent in the cases and less discussed in the literature. It seems to indicate, from the point of view of developing new business models in this field, the need to develop a technological competence that allows managing greater integration of transport data, as well as other personal attributes of the transport system users, aiming to offer more personalised mobility solutions:

“(…) there is less supply than demand for travel, especially in the first and second-tier cities. In Beijing and Shanghai, it is a problem to solve. First of all, we should have a better understanding of the city, people’s travel demand, when and where the peak is, and then we should have a lot of data to support this. And then we can do the fitting.” (RIDE HAILING CH)

“(…) to implement the application in a city we need the data of the bus travel, it is not possible to implement the service with only static information.” (BUS BR)

“(…) open data is a great idea, but it doesn’t solve it alone. Actions that promote intelligence in public transport through information. There are many people in the private sector using public information data. There is no flexibility to map demand and supply without data.” (CARPOOL BR)

“(...) the challenge is to obtain reliable information that allows the business model to adapt and develop products focused on the reality of end-users and the dependence on the interest of organizations in providing employee data so that they can make a proposal for a corporate mobility service suited to reality of each user.” (CARSHARING BR)

### 4.3 Barriers and drivers for the value capture

The greatest barriers in the capture of value to all analysed cases is the diversification of the revenue sources to ensure the monetisation and economic sustainability of these businesses, understood as an operational barrier, due to the clear link with the company's operational performance.

This barrier requires the adoption of a series of solutions in order to diversify the revenue sources, such as services aggregation – offering additional services for the users, focus on higher value-added services within the portfolio or data commercialisation – business models have increasingly structured relevant information that can serve as inputs for city mobility planning as an additional revenue possibility.

Indeed, about the last aspect, business models have faced the challenge of structuring more and more relevant information that can serve as inputs for mobility planning of cities. In other words, on the one hand, it is expected that these companies may have more active participation in this type of discussion, since they start to obtain data that directly benefit the definition of transport policies and, on the other, it is expected that the public sphere recognises the value that this type of information could generate for the future of urban mobility in cities:

“(...) based on this application, we are creating a B2B revenue model: exploring the user base to monetize. API licensing: to charge for a service to use the routing API functionality (bike-sharing companies or bike-sharing operators could be interested). App advertising (companies' logo, ad words, placing their brand within the platform to advertise their services). Kind of market place where companies would advertise services around to cyclists during the journeys.” (CYCLING BR)

“(...) we are working on adding services to allow users use their available credit in other operators of services related to urban mobility. Discount options to encourage inter modality is being tested. We can transform it into a revenue model but it is not a standard.” (INTEGRATION BR)

“(...) we have been testing to see how you can monetize. Some alternatives are being tested: provide surveys forms for third parties in the app, job ads, but other ads like discount coupons to explore service opportunities by taking advantage of the user's audience and location. There is the possibility of offering digital services and assistance to the government through the app. Use audience data to generate relevant insights. For example, where people live and work. This is a trend among apps. Advertising cannot be the main source of revenue for the app.” (BUS BR)

“(...) exploring the diversification of services according to the users needs. Today we have services aimed at individuals (both for monthly and one-off plans) or customized for companies that want to outsource their fleet management (companies can save cost if they use the carsharing instead of using their own cars).” (CARSHARING CH)

Although the barrier of monetising the BMfS is highlighted in the literature by Baldassarre et al. (2020) and Laukkanen and Patala (2014), solutions to deal with this

have been less discussed so far, indicating that this seems to be a fertile ground for a better understanding regarding the organisation of business models aimed at promoting sustainable mobility.

In summary, even though the cases from China have a much higher proportion than the cases from Brazil in terms of company size, the barriers and drivers to deal with them in implementing the analysed business models proved to be quite similar.

A summarised view of the identified barriers is shown in Figure 1. Table 4 summarises the barriers faced by companies when implementing a business model for sustainable urban mobility and the identified drivers to deal with them.

**Figure 1** Summarised view of barriers faced by organisations when implementing business models for sustainable mobility (see online version for colours)

Business model part	Barriers	
Value proposition	Harmonizing interests of different stakeholder groups	Competition with dominant alternatives of transport
Value creation and delivery system	Access information about travel patterns of users	Proper public policies oriented to the development of new business models
Value capture	Diversification of the revenue sources	

Institutional  
 Strategic  
 Operational

Source: Elaborated by the authors

**Table 4** Barriers and solutions adopted by the companies to implement the business model

	Barriers	Description	Drivers
Value proposition	Harmonising interests of different stakeholder groups	Conciliation between the public, private and end-user interests when defining the business model value proposition	Greater participation of the public sphere in the conception of the business model or more cooperation between competitors, it was possible to provide a service more aligned with user needs
	Competition with dominant alternatives of transport	Convincing the user and other stakeholders to realise the value of adopting this alternative in comparison to the dominant options used by most people in the different contexts of travels	Promotion of awareness of users and society as a whole regarding the relevance of products, including highlighting the sustainable appeal for changing the behaviour of these stakeholders, ranging from engagement actions to user mobilisation campaigns to cause a change in the style of people's lives from their individual choices of mobility options

Source: Elaborated by the authors

**Table 4** Barriers and solutions adopted by the companies to implement the business model (continued)

	<i>Barriers</i>	<i>Description</i>	<i>Drivers</i>
Value creation and delivery system	Proper public policies oriented to the development of new business models	Development of appropriate public policies to encourage the development of new businesses aimed at promoting sustainable urban mobility, both at the local and national level and aimed at companies or the end-user	Initiatives inserted in contexts where there are public policies that encourage the use of clean energy in urban mobility or the adoption of sustainable transport alternatives are crucial for the business model development
	Access information about travel patterns of users	Obtaining reliable information that allows business models to adapt and develop products focused on the reality of end-users, including to reconcile core operations such as demand management, after-sales services, and service evolution	Investments in information technology aimed at building databases that allow a better understanding of users' travel patterns, as well as investments in technological integrations with existing databases from other sectors or companies
Value capture	Diversification of the revenue sources	Ensuring the monetisation and economic sustainability of the business model requires the implementation of alternatives to diversify the revenue sources	Aggregation and offer of complementary services to the user through the integration in technology applications, commercial focus on products with higher added value, and data commercialisation of users

*Source:* Elaborated by the authors

## 5 Conclusions

The article aimed to discuss which are the barriers and drivers associated with the implementation of business models oriented to sustainable urban mobility, given the growing interest of new players in developing business initiatives in this field and the difficulty of this type of business in evolving beyond niche or experimental initiatives (Wells, 2013; Turnheim and Geels, 2019).

The results presented show that harmonising the interests of a diverse range of stakeholders beyond the firm level and competing with the dominant alternatives of transport are vital to the value proposition of the business models. The creation of value is impacted by the lack of adequate public policies, and the difficulty in obtaining reliable data of travel patterns of users that could allow a better operationalisation of the business models. Finally, finding alternatives that permit the capture of sustainable value requires

solutions that complement the revenue sources of the business models and, at the limit, expand their reach and scope by aggregating complementary services.

As a theoretical contribution, the empirical research revealed relevant barriers as well as drivers adopted by companies that should be taken into account in order to develop new business models for sustainable urban mobility, enriching existing literature findings and contributing to build a framework aligned to the challenges of the mobility sector and the sustainable development of cities.

The results found to reinforce the relevance of investigating which activities beyond the traditional scope of the firm may be performed within the scope of the implementation of the business models for sustainable mobility context, as described by Köhler et al. (2019) as a research opportunity for sustainable transitions, since all barriers encountered require some level of integration with the external environment in order to address the challenges when implementing the business models.

In addition, the results found also allow the orientation of the managerial practices, as the paper indicates relevant common barriers and drivers adopted by companies regarding the development of business models for the sustainable mobility, especially in large urban centres, as is the case of the business models studied, contributing to a better understanding of the dimensions of barriers and drivers encountered during the implementation of the analysed business models, the role of the actors involved in this process and integration and alignment aspects that should be taken into account.

The creation of public policies aimed at promoting sustainable urban mobility may be oriented by the results provided in the research. Evidence revealed that, although new players are creating new business models in urban mobility on their own, the public sphere still has an important role in encouraging the creation of new businesses in this sector, directly and indirectly. Otherwise, inadequate policies can make the business model value generation unfeasible (Van Den Heuvel et al., 2020).

As future research, it is expected to investigate how to integrate the business models perspective from the firm level to the broader socio-technical system where new mobility initiatives emerge, since it seems clear that no single new player has enough resources or capabilities to be successful alone in doing business for the sustainable mobility sector. Moreover, despite having explored multiple cases, there are still many unknown determinants and possibilities for developing new business initiatives in urban mobility and its role in the sustainable mobility transition path.

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## References

- Baldassarre, B. et al. (2020) 'Addressing the design-implementation gap of sustainable business models by prototyping: a tool for planning and executing small-scale pilots', *Journal of Cleaner Production*, Vol. 255, p.120295, DOI: 10.1016/j.jclepro.2020.120295.
- Banister, D. (2008) 'The sustainable mobility paradigm', *Transport Policy*, Vol. 15, No. 2, pp.73–80, DOI: 10.1016/j.tranpol.2007.10.005.
- Banister, D. (2011) 'Cities, mobility and climate change', *Journal of Transport Geography*, Vol. 19, No. 6, pp.1538–1546, DOI: 10.1016/j.jtrangeo.2011.03.009.
- Bocken, N. et al. (2020) 'Emergence of carsharing business models and sustainability impacts in Swedish Cities', *Sustainability (Switzerland)*, Vol. 12, No. 4, DOI: 10.3390/su12041594.
- Bocken, N.M.P. and Geradts, T.H.J. (2019) 'Barriers and drivers to sustainable business model innovation: organization design and dynamic capabilities', *Long Range Planning*, pp.1–23, DOI: 10.1016/j.lrp.2019.101950.
- Bocken, N.M.P. et al. (2014) 'A literature and practice review to develop sustainable business model archetypes', *Journal of Cleaner Production*, Vol. 65, pp.42–56, DOI: 10.1016/j.jclepro.2013.11.039.
- Boons, F. and Lüdeke-Freund, F. (2013) 'Business models for sustainable innovation: state-of-the-art and steps towards a research agenda', *Journal of Cleaner Production*, Vol. 45, pp.9–19, DOI: 10.1016/j.jclepro.2012.07.007.
- Boons, F. et al. (2013) 'Sustainable innovation, business models and economic performance: an overview', *Journal of Cleaner Production*, Vol. 45, pp.1–8, DOI: 10.1016/j.jclepro.2012.08.013.
- Cervero, R. (2013) 'Linking urban transport and land use in developing countries', *The Journal of Transport and Land Use*, Vol. 6, No. 1, pp.7–24.
- Donada, C. and Lepoutre, J. (2016) 'How can startups create the conditions for a dominant position in the nascent industry of Electromobility 2.0?', *International Journal of Automotive Technology and Management*, Vol. 16, No. 1, pp.11–29.
- Eisenhardt, K.M. (1989) 'Building theories from case study research', *Academy of Management Review*, June, pp.532–550.
- Evans, S. et al. (2017) 'Business model innovation for sustainability: towards a unified perspective for creation of sustainable business models', *Business Strategy and the Environment*, Vol. 26, No. 5, pp.597–608, DOI: 10.1002/bse.1939.
- Geels, F.W. (2004) 'From sectoral systems of innovation to socio-technical systems: insights about dynamics and change from sociology and institutional theory', *Research Policy*, Vol. 33, Nos. 6–7, pp.897–920, DOI: 10.1016/j.respol.2004.01.015.
- Geels, F.W. (2012) 'A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies', *Journal of Transport Geography*, Vol. 24, pp.471–482, DOI: 10.1016/j.jtrangeo.2012.01.021.
- Köhler, J. et al. (2019) 'An agenda for sustainability transitions research: state of the art and future directions', *Environmental Innovation and Societal Transitions*, Vol. 31, pp.1–32, DOI: 10.1016/j.eist.2019.01.004.
- Krommes, S. and Schmidt, F. (2017) 'Business model analysis of electric mobility products and services', *International Journal of Automotive Technology and Management*, Vol. 17, No. 3, pp.316–338, DOI: 10.1504/IJATM.2017.086454.
- Lasmar, E.L. et al. (2019) 'New business models and the sharing economy: impacts and challenges for the traditional automotive industry', *International Journal of Automotive Technology and Management*, Vol. 19, Nos. 3–4, pp.301–320, DOI: 10.1504/IJATM.2019.100882.
- Laukkanen, M. and Patala, S. (2014) 'Analysing barriers to sustainable business model innovations: innovation systems approach', *International Journal of Innovation Management*, Vol. 18, No. 6, DOI: 10.1142/S1363919614400106.

- Lüdeke-Freund, F. (2020) 'Sustainable entrepreneurship, innovation, and business models: integrative framework and propositions for future research', *Business Strategy and the Environment*, Vol. 29, No. 2, pp.665–681, DOI: 10.1002/bse.2396.
- Marotti de Mello, A., Valsecchi Ribeiro de Souza, J. and Marx, R. (2021) 'Public transport in emerging countries: from old dilemmas to opportunities for transition to sustainable mobility through the case of Brazil', in Mira-Bonnardel, S., Antonialli, F. and Attias, D. (Eds.): *The Robomobility Revolution of Urban Public Transport. Transportation Research, Economics and Policy*, pp.167–179, Springer, Cham, DOI: 10.1007/978-3-030-72976-9\_8.
- Matos, S. and Silvestre, B.S. (2013) 'Managing stakeholder relations when developing sustainable business models: the case of the Brazilian energy sector', *Journal of Cleaner Production*, Vol. 45, pp.61–73, DOI: 10.1016/j.jclepro.2012.04.023.
- Nosratabadi, S. et al. (2019) 'Sustainable business models: a review', *Sustainability (Switzerland)*, Vol. 11, No. 6, pp.1–30, DOI: 10.3390/su11061663.
- Osterwalder, A. and Pigneur, Y. (2005) 'Clarifying business models: origins, present, and future of the concept', *Communications of the Association for Information Systems*, Vol. 15, pp.1–40.
- Pallaro, E. et al. (2015) 'Sustainable production and consumption in the automotive sector: integrated review framework and research directions', *Sustainable Production and Consumption*, June, Vol. 4, pp.47–61, DOI: 10.1016/j.spc.2015.07.002.
- Palomares-Aguirre, I. et al. (2018) 'Built to scale? How sustainable business models can better serve the base of the pyramid', *Journal of Cleaner Production*, Vol. 172, pp.4506–4513, DOI: 10.1016/j.jclepro.2017.11.084.
- Richardson, J. (2008) 'The business model: an integrative framework for strategy execution', *Strategic Change*, Vol. 17, Nos. 5/6, pp.133–144, DOI: 10.1002/jsc.821.
- Rotondo, F., Corsi, K. and Giovanelli, L. (2019) 'The social side of sustainable business models: an explorative analysis of the low-cost airline industry', *Journal of Cleaner Production*, Vol. 225, pp.806–819, DOI: 10.1016/j.jclepro.2019.03.345.
- Sabatier, V. et al. (2017) 'Social business model design and implementation in developing countries: learning from an affordable medicine developed in Burkina Faso', *Journal of Management Development*, Vol. 36, No. 1, pp.48–57, DOI: 10.1108/JMD-03-2015-0041.
- Schaltegger, S., Hansen, E.G. and Lüdeke-Freund, F. (2016) 'Business models for sustainability: origins, present research, and future avenues', *Organization & Environment*, Vol. 29, No. 1, pp.3–10, DOI: 10.1177/1086026615599806.
- Sousa-Zomer, T.T. and Cauchick Miguel, P.A. (2018) 'Sustainable business models as an innovation strategy in the water sector: an empirical investigation of a sustainable product-service system', *Journal of Cleaner Production*, Vol. 171, pp.S119–S129, DOI: 10.1016/j.jclepro.2016.07.063.
- Sousa-Zomer, T.T. and Cauchick-Miguel, P.A. (2019) 'Exploring business model innovation for sustainability: an investigation of two product-service systems', *Total Quality Management and Business Excellence*, Vol. 30, Nos. 5–6, pp.594–612, DOI: 10.1080/14783363.2017.1317588.
- Souza, J.V.R.D., De Mello, A.M. and Marx, R. (2019) 'when is an innovative urban mobility business model sustainable? A literature review and analysis', *Sustainability (Switzerland)*, Vol. 11, No. 6, pp.1–18, DOI: 10.3390/su11061761.
- Souza, J.V.R.D., Marotti de Mello, A. and Marx, R. (2022) 'Supplementary Information for the Paper: Barriers and Drivers to Implement Innovative Business Models towards Sustainable Urban Mobility', DOI: 10.5281/ZENODO.6577175.
- Spickermann, A., Grienitz, V. and Von der Gracht, H.A. (2013) 'Heading towards a multimodal city of the future?. Multi-stakeholder scenarios for urban mobility', *Technological Forecasting and Social Change*, Vol. 89, pp.201–221, DOI: 10.1016/j.techfore.2013.08.036.
- Svennevik, E.M.C. (2019) 'The existing and the emerging: car ownership and car sharing on the road towards sustainable mobility', *International Journal of Automotive Technology and Management*, Vol. 19, Nos. 3–4, pp.281–300, DOI: 10.1504/IJATM.2019.100914.



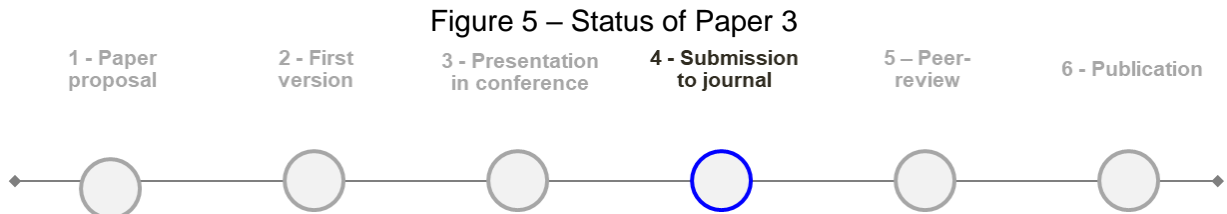
- Todeschini, B.V. et al. (2017) 'Innovative and sustainable business models in the fashion industry: entrepreneurial drivers, opportunities, and challenges', *Business Horizons*, Vol. 60, No. 6, pp.759–770. DOI: 10.1016/j.bushor.2017.07.003.
- Turnheim, B. and Geels, F.W. (2019) 'Incumbent actors, guided search paths, and landmark projects in infra-system transitions: re-thinking strategic niche management with a case study of French tramway diffusion (1971–2016)', *Research Policy*, Vol. 48, No. 6, pp.1412–1428, DOI: 10.1016/j.respol.2019.02.002.
- Van Den Heuvel, C., Kao, P.J. and Matyas, M. (2020) 'Factors driving and hindering business model innovations for mobility sector start-ups', *Research in Transportation Business and Management*, Vol. 37, pp.1–10, DOI: 10.1016/j.rtbm.2020.100568.
- Velter, M.G.E. et al. (2020) 'Sustainable business model innovation: the role of boundary work for multi-stakeholder alignment', *Journal of Cleaner Production*, Vol. 247, p.119497, DOI: 10.1016/j.jclepro.2019.119497.
- Vergragt, P.J. and Brown, H.S. (2007) 'Sustainable mobility: from technological innovation to societal learning', *Journal of Cleaner Production*, Vol. 15, Nos. 11–12, pp.1104–1115, DOI: 10.1016/j.jclepro.2006.05.020.
- Voss, C., Tsiriktsis, N. and Frohlich, M. (2002) 'Case research in operations management', *International Journal of Operations and Production Management*, Vol. 22, No. 2, pp.195–219. DOI: 10.1108/01443570210414329.
- Wagner, O. et al. (2020) 'Surviving the energy transition: development of a proposal for evaluating sustainable business models for incumbents in Germany's electricity market', *Energies*, Vol. 13, No. 3, DOI: 10.3390/en13030730.
- Wegener, M. (2013) 'The future of mobility in cities : challenges for urban modelling', *Transport Policy*, Vol. 29, pp.275–282. DOI: 10.1016/j.tranpol.2012.07.004.
- Wells, P. (2013) 'Sustainable business models and the automotive industry : a commentary', *IIMB Management Review*, Vol. 25, No. 4, pp.228–239, DOI: 10.1016/j.iimb.2013.07.001.

## Appendix

Excerpts from the interviews used in the coding process for the identification of barriers and solutions adopted by the companies.

The excerpts from the interviews used in the coding process of how the barriers and solutions adopted by the companies can be consulted in a database made available by the authors can be found at this link: <https://zenodo.org/record/6577175#.YqtcinbMLrc> (Souza et al., 2022).

## 5 PAPER 3 – BETWEEN NICHEs AND SOCIO-TECHNICAL REGIMES: EXPLORING FACTORS INFLUENCING BUSINESS MODEL INNOVATION TOWARDS SUSTAINABLE TRANSITIONS FROM THE CASE OF URBAN MOBILITY



Source: elaborated by the author.

Table 3 – Detailed status of Paper 3

Phase	Status
<b>1 - Paper proposal</b>	<ul style="list-style-type: none"> <li>• Paper proposal formally structured in February 2021.</li> </ul>
<b>2 - First version</b>	<ul style="list-style-type: none"> <li>• Completed in October 2021</li> </ul>
<b>3 - Presentation in conference</b>	<ul style="list-style-type: none"> <li>• Presented at 7<sup>th</sup> International Conference on New Business Models in 2022</li> </ul>
<b>4 - Submission to journal</b>	<ul style="list-style-type: none"> <li>• Ready for submission to the Environmental Innovation and Societal Transitions journal</li> <li>• Journal Statistics: JCR 2022: 7,2; CiteScore Scopus 2022: 13,1</li> </ul>
<b>5 - Peer review</b>	<ul style="list-style-type: none"> <li>• Not applicable</li> </ul>
<b>6 - Publication</b>	<ul style="list-style-type: none"> <li>• Not applicable</li> </ul>

Source: elaborated by the author.

## **BETWEEN NICHEs AND SOCIO-TECHNICAL REGIMES: EXPLORING FACTORS INFLUENCING BUSINESS MODEL INNOVATION TOWARDS SUSTAINABLE TRANSITIONS FROM THE CASE OF URBAN MOBILITY**

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### **ABSTRACT**

Drawing on the idea that business model innovation (BMI) may affect sustainable transitions, acting as an intermediary between niches and the socio-technical regime, this research aims to understand which factors influence the BMI process under the socio-technical transitions perspective. Although the BMI drive changes in transitions, few studies have focused on understanding which factors influence the stabilization of regimes applying the BMI process as an intermediary between niches and socio-technical regimes. Therefore, multiple case-based research was adopted through an empirical analysis among ICT-based mobility services companies from Brazil and China. The research results were organized according to the factors influencing the BMI and the stabilization processes from the firm level. We discuss our contributions to transitions and sustainable business model research. As practical implications, the findings assist both policymakers and practitioners in understanding how BMI may influence current regimes towards sustainable transitions in the mobility field.

**Keywords:** Business model innovation, sustainable business models, sustainable transitions, emergent countries, urban mobility, China, Brazil.

### **1 INTRODUCTION**

Research at the intersection of business models and societal transitions is growing due to the primary importance of sustainable development for society. Enriching the body of knowledge that brings these approaches closer is critical to this discussion, and it is just starting (Bidmon and Knab, 2018).

In the context of socio-technical transitions to sustainability and, more precisely, under the lens of the multilevel perspective (MLP) – landscape, regime, and niches - business model innovation (BMI) may play different roles and influence different dynamics in the socio-technical systems (Bidmon and Knab, 2018; Sarasini and Linder, 2018).

New business models could act as drivers for transitions in the regime, breaking the rules in which current regimes operate and modifying them. Moreover, in

the niches, they can act as drivers for sustainable transitions that are not necessarily anchored in new technologies, influencing a new regime that does not depend on technological innovation through new services propositions, for instance (Bidmon and Knab, 2018).

Once a business model is marketed and tried by consumers, it is no longer situated at the technological niche level, which is typically within a protected and controlled space where radical innovations are fostered (Geels, 2012). Based on this idea, BMI is a process that links the niche and regime levels, acting as an intermediary between them. Additionally, business models do not act alone as a basis for socio-technical transformations, as they depend on the positioning and dynamic interactions of other actors and elements within the regime (Bolton and Hannon, 2016; Sarasini and Linder, 2018).

Although BMI may influence sustainable transitions, promoting tensions in current socio-technical regimes, few studies have focused on understanding how BMI may be integrated into socio-technical regimes to foster changes and which factors influence the stabilization of regimes applying the lens of BMI as an intermediary between niches and socio-technical regimes (Sarasini and Linder, 2018). Additionally, the transitions perspective presents many opportunities to broaden the dialogue with the firm's theories, connecting the firm elements with established concepts in the transition studies (Köhler et al., 2019). Sustainability transitions and transition theories as whole not only require studying the broad conceptualization of general changes in societies, but also capture the firm-level distinctions and nuances by delving into a firm's strategic and operational activities (Hernández-Chea et al., 2021). Finally, there is a lack of comprehensive studies that systematically link business model and transition theory (Bidmon and Knab, 2018).

On the other hand, the business model perspective is widely applied as an essential approach for researchers and practitioners to understand and progress sustainable innovation, notably its substantial and long-term societal impacts. However, few tools that assist the BMI process under this context have been investigated (Snihur and Bocken, 2022; Weissbrod and Bocken, 2017).

When we analyze the transitions perspective in emerging countries, especially through the global south perspective, the focus of this research, the transformation of the regimes may not be associated with niches as the only sources of change. For instance, it is possible to observe transitions pathways in which the focus is on

improvements in the dominant regimes of mobility rather than on a new technological niche development, reinforcing the idea that BMI could play a relevant role in this context (Ghosh and Schot, 2019; Marotti de Mello et al., 2021). Complementary, there is a growing awareness and extensive literature related to the need to transition to more sustainable mobility systems in cities (Banister, 2008; Stead, 2013).

Sustainable urban mobility has been configured as a fertile ground for new business models, especially those related to the provision of new and ICT-based mobility services, such as sharing schemes. On this last aspect, it is evident that the increasing entry of new players towards sustainable mobility may reveal a variety in the patterns of niches development, involving coalitions between new entrants and incumbents, configuring as a relevant research perspective (Turnheim and Geels, 2019).

Furthermore, research into new business models for sustainability in the urban mobility context points out that the main barriers to implementing these initiatives do not depend solely on the actors experimenting with them, as many business models fail or remain isolated due to a lack of satisfactory articulation with the external environment in which these initiatives emerge (Souza et al., 2022).

Drawing on the idea that BMI may positively affect sustainable transitions and act as intermediary between niches and the socio-technical regime, driving changes in the current regimes, this research aims to understand which factors influence the BMI process under the perspective of the socio-technical transitions. In particular, we answer the following research question: which factors influence the BMI process as an intermediary between niches and the socio-technical regime?

We address this research question by analyzing some case studies of companies in Brazil and China that developed new business models in mobility anchored on services supported by ICTs.

The paper's primary contribution is to the business model perspective under the sustainability transitions theory, by revealing relevant factors that could impact the implementation dynamics of the strategic and operational activities involved in the BMI process integrated to the socio-technical regime according to the firms' perspective. By doing so, we contribute to the research at the interface of business model and sustainability transitions.

Through the lens of sustainable business models, research in this field benefits from more integrative approaches than those oriented towards strengthening this topic

as a stand-alone positioning or a sub-field of other management areas (Lüdeke-Freund and Dembek, 2017).

Another contribution is to sustainability transitions research itself by examining the dynamics of BMI and what factors influence its evolution from the niche level to stabilization of the regime, helping identifying the links between niches to regimes more consistently, including helping to answer why some niche-level innovations succeed whereas others fail (Sarasini and Linder, 2018).

Finally, the paper contributes to the development of public policies based on integrating multiple actors involved in business initiatives that promote sustainable mobility, elucidating critical aspects from the firm's side relevant to the creation of these policies.

This paper is structured as follows. Section 2 presents the theoretical background. Section 3 details the methods used to carry out this research. Section 4 presents the results based on the empirical evidence found. Finally, section 5 presents the discussions followed by the conclusions of this research in the section 6.

## **2 THEORETICAL BACKGROUND**

### **2.1 STABILIZATION OF THE SOCIO-TECHNICAL REGIME: BEYOND THE STRATEGIC NICHE MANAGEMENT APPROACH**

Transitions encompass nonlinear processes resulting from multiple interactions at three analytic levels: niches (sources for innovative transformations), socio-technical regimes (established valuable sources and associated rules), and a socio-technical landscape. Therefore, MLP helps to explain why different interactions happen simultaneously at the niche levels (micro-level in constant change and experimentation) - and the regime level (stable meso-level with well-established and relatively accepted rules) (Geels, 2012, 2004).

Within the MLP, novelties emerge in niches, known as 'protected spaces', such as R&D laboratories, subsidized demonstration projects, or small market niches where users have particular demands and are willing to support emerging innovations based on the development of new technologies. Niches are fundamental for transitions because they provide the seeds for systemic changes. For a niche innovation to

eventually break through and replace the current regime, its degree of stability needs to increase (Geels, 2012).

However, although niches are crucial for transitions, the literature has historically paid much attention to them as the primary sources of innovation for changing the regime and, in practical terms, it is already known that different typologies of innovations influence the transition paths, such as new services and incremental innovations not based on technology (Geels and Schot, 2007; Ghosh and Schot, 2019).

Different aspects can direct how niches influence the regime, according to their stabilization potential, that is, the way processes that lead to their institutionalization are orchestrated. According to Hoogma, Kemp, Schot, & Truffer (2002), there are some sub-processes of stabilization of the regime: (1) articulation of visions and expectations, (2) learning processes, and (3) building of social networks. Expectations and visions are related to stability if they are more robust (i.e., shared by more actors), more specific (i.e., may provide orientation for the coordination of actors), and with higher quality (i.e., substantiated by ongoing projects). Learning processes are related to higher stability if they allow the reapplication of accumulated learning (i.e., enable changes of previous assumptions). Finally, social networks are related to stability if they are a) broad (i.e., involve different stakeholders) and b) deep (i.e., able to mobilize commitment and resources).

## 2.2 BMI IN SUSTAINABLE SOCIETAL TRANSITIONS

Organizations recognize the emergence of dynamic markets in which competitiveness should be based on variables besides the price: intangible customer solutions - complementary to products that can meet their needs - and demand - because customers can be part of undeveloped markets. Due to this context, business models have lately received more attention (Teece, 2010).

Business models themselves have increasingly been considered subject to innovation, as they may be an enabler of innovations, acting as a promising unit of analysis or a starting point for innovation strategies within the companies (Schneider and Spieth, 2013).

Richardson (2008) indicated three essential business model parts: (1) value proposition – what an organization intends to deliver to its customers and the reasons

why they would pay for it; (2) value creation and delivery system — how an organization articulates resources, capabilities, processes, and networks of customers and suppliers to create and deliver the value intended; and (3) value capture — how an organization generates revenue and profit from activities.

In this way, BMI process take place dynamically by different but complementary initiatives, such as: adding or modifying activities in the business models to incorporate new ways of creating value, linking activities and actors towards sustainability, or even modifying one or more stakeholders' activities, as is the case of supplier activities to move towards sustainability (Hernández-Chea et al., 2021).

In the context of societal transitions and as subject to innovation, business models are an example of a non-technological niche innovation that already fulfills in some extent the sub-process of stabilization of the regime described by Hoogma et al. (2002) (see Bidmon and Knab, 2018).

Furthermore, sustainable transitions often require collaboration between various actors in the value chain. While most scholars agree on the importance of considering actors across the entire value chain to create joint value and enable transitions, the most common approach in the literature is still passively mapping stakeholders rather than understand how actively involving them in activities of value co-creation (Pedersen et al., 2022).

Although research recognizes the potential for BMI to influence in a regime and that BMI can play a role in systemic transformations, the impact of BMI in socio-technical systems remains under-conceptualized. The design of new business models is affected by the ongoing transition dynamics and this topic has received less attention in the literature. (Sarasini and Langeland, 2021; Wesseling et al., 2020)

Novel business models emerge at a higher level of stability than a technological innovation niche and directly build up a substantial part of the new regime, but with different degrees of maturity concerning these processes. (Bidmon and Knab, 2018). However, for broader diffusions of niches, as is the typical case of new business models, it depends on the firm's ability to modify the regime significantly and induce technical, regulatory, behavioral and societal change, in alignment with multiple actors. When deciding on how to position and configure a new business model, actors from niche may aim for more or less radical regime change, applying different strategies such as "fit and conform", for incremental changes in the regime, or to "stretch and transform" for more radical changes (Wesseling et al., 2020).



Even if new business models as a subject of innovation – specifically as a form of a niche not exclusively technological - already fill to some extent the sub-processes that guarantee the regime stabilization according to different degrees of maturity (see Bidmon and Knab, 2018), we argue that the stabilization process from the BMI perspective is related not only to the organization and management of its operational activities at the firm level but also to how these sub-processes are orchestrated.

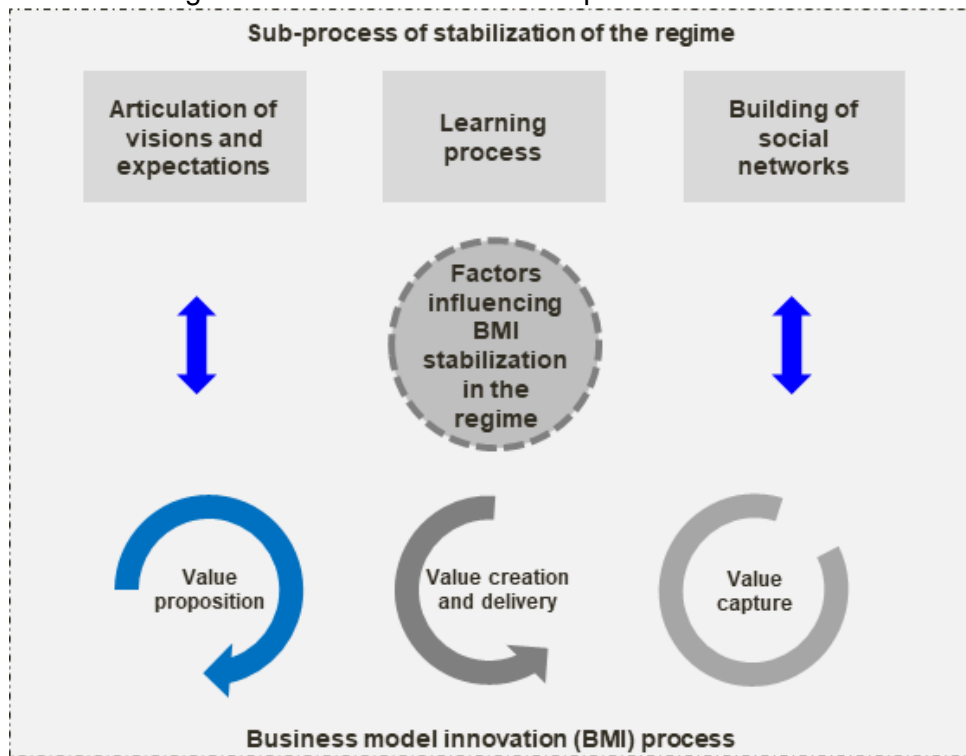
Business models could *articulate visions and expectations* being a point of communication between actors in the regime since they facilitate collective sense making when negotiating new value propositions from the niche. Business models could apply the *learning process* by continually transferring knowledge from user preferences and business specifications, improving performance. Finally, business models could assume particular relevance in building social networks by introducing and diffusing new technological innovations between actors in the broader system (Bidmon and Knab, 2018) - since even superior technologies require an appropriate business model to become viable (Chesbrough and Rosenbloom, 2002).

In this sense, how the processes that guarantee the stabilization of the regime are orchestrated may be influenced by different factors and, therefore, contribute in different ways to this stabilization, according to the strategies adopted by each niche actor.

Therefore, the comprehension of both processes regarding the development of business models at the firm level and those related to the stabilization of the regime are relevant to understand how BMI drives sustainable transitions.

We propose to analyze which factors influence the BMI and the sub-process of stabilization of the socio-technical regime by applying a framework that investigates the firm perspective, through cases of mobility (see Fig. 1).

Figure 1 – The linkages between BMI and the sub-process of stabilization of the regime



Fonte:

### 3 METHODS

Since the research objective is to investigate which factors influence the stabilization process of the regime through new business models, a qualitative research approach was chosen. Among the available qualitative research techniques, we chose to carry out a multiple case study, and the primary source of data was semi-structured interviews performed with top executives of the selected companies who have deep knowledge and influence on the strategy and operation of the analyzed business model (Eisenhardt, 1989; Voss et al., 2002).

We combined semi-structured interviews with desktop research, gathering information from the websites regarding the different organizations included in the study, such as news about the analyzed companies, interviews with founders, reports of companies' trajectories, investor analyses, in addition to the companies' institutional websites. We then applied Richardson (2008) framework to previously identify the main aspects of different business models - value proposition, value creation, and delivery system, and value capture - and we verified our findings with the interviewees. The results obtained from the desktop research were very useful and served as a basis for collecting information during the interviews.

This approach is essential and advantageous to gather the type of information we were looking for since this data is not available in a structured way and depends on the specific context of each company concerning the dimensions analyzed (Meredith and Mccutcheon, 1993).

Therefore, semi-structured interviews were used to allow respondents to freely explore the aspects addressed based on our previous research, without the content being limited only to the constructs discussed in the literature, which is an advantage of this technique (Yin, 2005).

ICT-based mobility services companies in Brazil and China were selected for the research due to the obvious relevance of the urban mobility issue in these countries. It was done since both countries concentrate a large population in major urban centers, in addition to the fact that they have particularities in their trajectory in the planning of transport solutions typically from global south compared to needs and context of developed countries (Cervero, 2013; Marotti de Mello et al., 2021).

That is, the idea was to get the variability of initiatives across different markets, although they have some common characteristics. Despite the fact that selected companies are different between them, they were selected because they represent multiple initiatives of a single phenomenon by actively experimenting through business model innovations based on ICT services that facilitate and provide different forms of mobility. Through these common characteristics, we can then qualify the sample as homogeneous and, therefore, a valid way to explore factors influencing the stabilization process of the regime according to the firm perspective (Gerring, 2007)

In order to identify application areas and ICT-based mobility services compatible with the idea of new business models oriented to sustainable urban mobility, we based on a framework proposed by Souza, Mello, & Marx (2019) as a reference. Table 1 describes the selected firms.

Table 1 – List of companies selected to the study

<b>Firms</b>	<b>Country</b>	<b>Business models</b>
Firm 1	Brazil	A platform for integration of public transport fare payment
Firm 2	Brazil	Bike-sharing operator (station based model)
Firm 3	Brazil	Corporate carpool sharing service
Firm 4	Brazil	B2B car sharing company (corporate car sharing service for companies as an alternative for fleet management)
Firm 5	Brazil	A platform for provision of public transport information
Firm 6	China	Ride hailing service provider

Firm 7	China	Bike-sharing operator (dock less model)
Firm 8	China	Car sharing operator (peer-to-peer model)

Source: elaborated by the author.

According to the constructs reviewed in the literature and summarized in the analysis framework (Fig. 1) and the desktop research, the authors prepared a set of questions. This interview guide was structured so that the interviewees first describe which factors influenced the structuring of the analyzed business model - the BMI process - according to the framework proposed by Richardson (2008) –. Subsequently, it were investigated which factors are influencing the sub-process of stabilization of the regime described by Geels (2012) and Hoogma et al. (2002) – articulations of visions and expectations, learning process, and building of social networks - and how the company has orchestrated each one of these sub-processes.

In total, we conducted 10 interviews from eight different companies (5 in Brazil and 3 in China) with managers in charge of company's strategy and operations or founders and co-founders. Interviews in Brazil took place during November-December 2018 and in China during September-December 2019.

Interviews were transcribed prior to a two-stage analysis using spreadsheet software. The transcript of the interviews was analyzed using the thematic analysis approach. This included highlighting the parts in the interview transcripts that seemed related to the dimensions of the research analysis framework according to the interviewer. This process was carried out based on the methodology suggested by Nowell, Norris, White, & Moules (2017). According to these authors, the thematic analysis comprises identifying, analyzing, organizing, describing, and reporting themes found within a data set. This approach's main advantages benefit from summarizing critical features of a large data set.

The first stage involved understanding what which aspects influenced the implementation of the BMI process using a set of codes to describe the statements of the interviewees that relate to the implementation of the business model from its different parts, again according to dimensions from Richardson (2008) (see Appendix 1).

The second stage involved a broader categorization of the interview statements to identify which factors influenced the different sub-processes involved in stabilizing business models at the regime level according to the sub-process

dimensions proposed by Hoogma et al. (2002). We draw on the idea that both the implementation of business models and consequently the stabilization process of the regime are dynamic processes that evolve all the time. However, based on the experimentation in the market, typical of any BMI process, it is possible to obtain findings that can help to explain how this process occurs (Sarasini and Langeland, 2021; Zott et al., 2011). (see Appendix 1).

As the aim of the paper is to reflect and add to the findings previously existing in the literature, a deductive approach was primarily applied (Nowell et al., 2017). This means the content of the interviews was initially tagged with predetermined codes derived from the literature, according to the categories translated into our framework of analysis. Then sub-categories were also proposed inductively when the authors perceived a particular logical pattern of the tagged content, especially in the dimensions of factors directly related to how the business models were structured according to their parts and initiatives performed by companies in order to deal with the sub-process of stabilization of the regime. That is, as new themes emerged from the analyzed data, they were added to the coding scheme. Research team rotated code proposition and validation responsibilities so codes were developed over a few iterations.

## **4 RESULTS**

### **4.1 FACTORS INFLUENCING THE BMI PROCESS**

#### **4.1.1 Value proposition (VP)**

When analyzing the VP of the business models, despite the specific benefits offered by each one, four factors were identified influencing their value proposition: improvement of the journey's convenience, offering more options to make trips, provision of more accessibility, provision of an environmentally friendly alternative and ensuring safety to make trips.

The improvement of the journey's convenience indicates if the VP intends to improve the conditions in which urban mobility is accessed by its users according to their local context and reality. In this sense, all the analyzed business models are explicitly concerned with providing better conditions for their users to move around.

Offering more options to make trips indicates that the VP diversifies the existing modal options for the users, thus generating new travel alternatives in addition to the private car option. Only business models that encourage the use of public transport do not offer a new modal as the main benefit from the service (Firms 1 and 5), but somehow, they are also contributing to the replacement by more sustainable alternatives.

Provision of more accessibility indicates if the VP intends to increase accessibility in the business model's contexts, i.e., extending the access or benefits of specific travel options to more people. It is evident in most firms, including features facilitating transport access from remote places with fewer travel options.

The provision of an environmentally friendly alternative indicates if the VP is explicitly concerned with providing environmental benefits, especially in reducing pollutant emissions in urban mobility, as is the case of the business models based on sharing.

Ensuring safety to make trips if the VP is concerned with the security of users in the whole system, providing safe conditions for their users, as is the case of the hide-hailing and carpool sharing services.

Table 2 – Factors influencing value proposition

<b>Business models aims to deliver the following value propositions by:</b>					
	<b>Improving the journey's convenience</b>	<b>Offering more options to make trips</b>	<b>Providing more accessibility</b>	<b>Providing an environmentally friendly alternative</b>	<b>Ensuring safety to make trips</b>
<b>Firm 1</b>	<ul style="list-style-type: none"> <li>• Increasing the degree of integration of public transport</li> <li>• Promoting intermodal integration</li> </ul>		<ul style="list-style-type: none"> <li>• Improving the conditions for using public transport</li> </ul>		
<b>Firm 2</b>	<ul style="list-style-type: none"> <li>• Offering more convenience for quick and short trips</li> <li>• Promoting intermodal integration</li> </ul>	<ul style="list-style-type: none"> <li>• Offering an additional transport alternative</li> </ul>	<ul style="list-style-type: none"> <li>• Expanding the access to the bicycle as a transport alternative</li> </ul>	<ul style="list-style-type: none"> <li>• Promoting healthy and active life</li> </ul>	
<b>Firm 3</b>	<ul style="list-style-type: none"> <li>• Offering a practical, affordable, and low-cost transportation option</li> </ul>			<ul style="list-style-type: none"> <li>• Ensuring less pollution and reduction of wasted resources</li> <li>• Decreasing the mobility impact</li> </ul>	<ul style="list-style-type: none"> <li>• Offering access to a safer transport alternative</li> </ul>

				in the surroundings	
<b>Firm 4</b>	<ul style="list-style-type: none"> <li>•Offering an additional benefit to employees for seasonal commuting</li> </ul>	<ul style="list-style-type: none"> <li>•Offering a transport alternative based on comfort, practicality, and convenience</li> </ul>		<ul style="list-style-type: none"> <li>•Ensuring savings of resources used in corporate travels</li> </ul>	<ul style="list-style-type: none"> <li>•Offering access to a safer transport alternative</li> </ul>
<b>Firm 5</b>	<ul style="list-style-type: none"> <li>•Providing relevant information about public transport</li> <li>•Contributing to more efficient use of public transport</li> </ul>		<ul style="list-style-type: none"> <li>•Providing relevant information about public transport</li> </ul>	<ul style="list-style-type: none"> <li>•Contributing to the sustainable development of mobility in cities through the use of public transport</li> </ul>	<ul style="list-style-type: none"> <li>•Providing relevant information about public transport</li> </ul>
<b>Firm 6</b>	<ul style="list-style-type: none"> <li>•Offering a more convenient and comfortable service</li> </ul>			<ul style="list-style-type: none"> <li>•Reducing empty and idle vehicles in transport and saving resources</li> <li>•Creating opportunities for green trips using electric vehicles</li> </ul>	<ul style="list-style-type: none"> <li>•Offering access to a safer transport alternative</li> </ul>
<b>Firm 7</b>	<ul style="list-style-type: none"> <li>•Offering more convenience for quick and short trips</li> <li>•Promoting intermodal integration</li> </ul>	<ul style="list-style-type: none"> <li>•Offering an additional transport alternative</li> </ul>	<ul style="list-style-type: none"> <li>•Expanding the access to the bicycle as a transport alternative</li> </ul>	<ul style="list-style-type: none"> <li>•Promoting healthy and active life</li> </ul>	
<b>Firm 8</b>		<ul style="list-style-type: none"> <li>•Offering a transport alternative based on comfort, practicality, and convenience</li> </ul>	<ul style="list-style-type: none"> <li>•Offering a convenient transport alternative for contexts where there is no public transport</li> </ul>	<ul style="list-style-type: none"> <li>•Ensuring savings of resources used in corporate travels</li> </ul>	<ul style="list-style-type: none"> <li>•Offering access to a safer transport alternative</li> </ul>

Source: elaborated by the author.

#### 4.1.2 Value creation and delivery system (VCD)

The local government and urban mobility system involvement, the technological resources as primary competence, and the dependence on user behavior change for product adoption usually influence the VCD.

Government involvement indicates at what level the VCD requires the public sector involvement to organize the critical activities of the business model, such as public policies and specific regulations, i.e., those that are essential for delivering the product to customers. Even services based on car or ride-sharing, less dependent on government action, could benefit from greater cooperation with local public authorities to increase the possibilities of delivering value to the user.

Urban mobility system involvement indicates how VCD is oriented to create synergies with existing transportation systems in cities as part of its key activities, especially public ones, enabling a higher level of integration between transport systems and then creating a mutual relationship of value generation for all of the users.

Own technological resources indicate how the VCD concentrates its crucial competency on developing own technological applications that support the core activities of the operation, which was common in all the observed cases, since they were born from the development of a technological solution and are not originally from the mobility sector. Therefore, technological resources are often considered a primary competence of the analyzed firms and are key in guarantying the scalability and evolution of the business.

The dependence on user behavior change for product adoption indicates the degree of change in the travel behavior patterns of users for product adoption - because transportation alternatives depend on an individual choice and change of mindset, like many innovations in this field emerge as experimental initiatives, as is the case of sharing practices.

Table 3 – Factors influencing value creation and delivery system

<b>Business models create and deliver value managing:</b>				
	<b>Local government involvement</b>	<b>Urban mobility system involvement</b>	<b>Own technological resources</b>	<b>Dependence on user behavior change</b>
<b>Firm 1</b>	<ul style="list-style-type: none"> <li>Partnerships and cooperation agreements with Municipalities to operate the business</li> </ul>	<ul style="list-style-type: none"> <li>Integration with the public transport payment system</li> </ul>	<ul style="list-style-type: none"> <li>Development of payment integration platform</li> </ul>	<ul style="list-style-type: none"> <li>Little change expected since users are used to public transport</li> </ul>
<b>Firm 2</b>	<ul style="list-style-type: none"> <li>Response to public bids to operate</li> <li>Partnerships with sponsors for financial viability aligned with the public entities</li> </ul>	<ul style="list-style-type: none"> <li>Arrangement of bike stations close to public transport in alignment with municipalities</li> </ul>	<ul style="list-style-type: none"> <li>Acquisition and maintenance of infrastructure resources</li> <li>Development of a sharing technological platform</li> </ul>	<ul style="list-style-type: none"> <li>High change expected as it is a sharing model</li> </ul>



<b>Firm 3</b>	<ul style="list-style-type: none"> <li>•Corporate agreements to offer the service</li> <li>•Attempts to cooperate with local governments to gain greater support, such as ask for the right to use dedicated public transport lanes</li> </ul>	<ul style="list-style-type: none"> <li>•Little involvement with the local mobility system</li> </ul>	<ul style="list-style-type: none"> <li>•Development of a technological platform to operate</li> </ul>	<ul style="list-style-type: none"> <li>•Request many actions to encourage users to adopt it</li> </ul>
<b>Firm 4</b>	<ul style="list-style-type: none"> <li>•Few subsidies for electric car acquisition</li> </ul>	<ul style="list-style-type: none"> <li>•Little involvement with the local mobility system</li> </ul>	<ul style="list-style-type: none"> <li>•Development of a technological platform to operate</li> </ul>	<ul style="list-style-type: none"> <li>•Request many actions to encourage users to adopt it</li> </ul>
<b>Firm 5</b>	<ul style="list-style-type: none"> <li>•Partnerships and cooperation agreements to receive public transport databases</li> </ul>	<ul style="list-style-type: none"> <li>•Integration with public transport geolocation databases</li> </ul>	<ul style="list-style-type: none"> <li>•Development of a technological platform to operate</li> </ul>	<ul style="list-style-type: none"> <li>•Little change expected since users are used to public transport</li> </ul>
<b>Firm 6</b>	<ul style="list-style-type: none"> <li>•Response to public bids to operate</li> <li>•Local government determines policies to promote electric vehicles in cities, including mandatory requirements for online car hailing</li> </ul>	<ul style="list-style-type: none"> <li>•Little involvement with the local mobility system</li> </ul>	<ul style="list-style-type: none"> <li>•Acquisition and maintenance of infrastructure resources for operating</li> <li>•Development of a technological platform to operate</li> <li>•Integration with digital payment platforms</li> </ul>	<ul style="list-style-type: none"> <li>•Little change expected since users are used to take hire hailing cars</li> </ul>
<b>Firm 7</b>	<ul style="list-style-type: none"> <li>•Response to public bids to operate</li> </ul>	<ul style="list-style-type: none"> <li>•Bicycle demand management must be aligned with public transport</li> </ul>	<ul style="list-style-type: none"> <li>•Development of a technological platform to operate</li> <li>•Integration with digital payment platforms</li> </ul>	<ul style="list-style-type: none"> <li>•Request many actions to encourage users to adopt it</li> </ul>
<b>Firm 8</b>	<ul style="list-style-type: none"> <li>•Local government offers subsidies to electric car acquisition</li> <li>•Cooperation agreements with local government for installation of car stations</li> <li>•limitations for the use of a private car in specific areas encourage the use of the sharing service</li> </ul>	<ul style="list-style-type: none"> <li>•Installation of car stations seek to supply points where there is no public transport available</li> </ul>	<ul style="list-style-type: none"> <li>•Development of a sharing technological platform</li> </ul>	<ul style="list-style-type: none"> <li>•Request many actions to encourage users to adopt it</li> </ul>

Source: elaborated by the author.

#### 4.1.3. Value capture (VC)

VC structure is typically influenced by government subsidies, cross-subsidization, and direct sales.

Government subsidies show the revenue structure is supported by public resources, either through the financial resources themselves or other types of funding

that allow the business to become feasible, such as the commercialization of services to the public sphere.

Cross subsidization reveals the revenue structure is supported through the commercialization of aggregate services, ranging from advertising, sale of name or brand rights, indirect sale of services, or commercialization of user's information such as travel patterns contained in the databases, which seems to be very frequent as a way to ensure the maintenance of the business.

Direct sales indicate if final customers resources support the revenue structure by acquiring the product.

Table 4 – Factors influencing value capture

<b>Business models capture value through:</b>			
	<b>Government subsidies</b>	<b>Cross subsidization</b>	<b>Direct sales</b>
<b>Firm 1</b>	<ul style="list-style-type: none"> <li>• Commission paid by the entity responsible for managing public transport that acquires the service</li> </ul>	<ul style="list-style-type: none"> <li>• Commission from aggregated services added to the platform (generally payment services)</li> </ul>	
<b>Firm 2</b>	<ul style="list-style-type: none"> <li>• Direct incentives from public sphere (less usual)</li> </ul>	<ul style="list-style-type: none"> <li>• Sponsorship for name rights exploration</li> </ul>	<ul style="list-style-type: none"> <li>• User fees charged</li> </ul>
<b>Firm 3</b>		<ul style="list-style-type: none"> <li>• Commission paid by the user for using the service</li> </ul>	<ul style="list-style-type: none"> <li>• Fee paid by the contracting company</li> </ul>
<b>Firm 4</b>			<ul style="list-style-type: none"> <li>• Fee paid by the contracting company</li> </ul>
<b>Firm 5</b>		<ul style="list-style-type: none"> <li>• Commercialization of aggregated services</li> <li>• Commercialization of advertising</li> <li>• Commercialization of information about the user's database</li> </ul>	
<b>Firm 6</b>			<ul style="list-style-type: none"> <li>• User fees charged</li> </ul>
<b>Firm 7</b>		<ul style="list-style-type: none"> <li>• Cars leasing</li> </ul>	<ul style="list-style-type: none"> <li>• User fees charged</li> </ul>
<b>Firm 8</b>			<ul style="list-style-type: none"> <li>• User fees charged</li> <li>• Fee paid by the contracting company</li> </ul>

Source: elaborated by the author.

#### 4.1.3 Articulation of visions and expectations

The actors involved in structuring the business models reinforce the idea that the articulation of visions and expectations in this field occurs not only through the direct involvement of many different players but often through dependence on other specific actors interested in supporting business initiatives analyzed here.

In this sense, it seems the analyzed business models are starting points that may initiate transformations in current mobility regimes, but they cannot change this dynamic on their own.

In some cases, they can offer complementary services that can encourage the adoption of more sustainable mobility alternatives, such as models based on sharing or even public transport incentives, but they will not replace the current conventional alternatives, complementing the findings provided by Ghosh & Schot (2019).

However, regardless of the role played, the results converge to the idea that business model's implementation requires articulation of visions and expectations, observed above all by the need for the involvement of multiple actors when establishing their operations (Hoogma et al., 2002).

At Firm 8, managers noticed, through conversations with the local government, the car sharing service would be in greater demand in areas where public transport is not available, as this would be the only option for many users to conclude their journeys, reinforcing the complementary service aspect of the business to the conventional transport solutions.

In Firms 2 and 7, the bike-sharing operators, the municipalities must first demonstrate an interest in carrying out projects of this nature and then formalize an agreement with the service operator through a kind of public bid.

In addition to this, the agreement's success depends on rules included in the public bid, which is only possible according to the ability to articulate and find synergies between the interests and expectations of public actors with those of the service's operator.

In Firm 5, the application that offers information on public transport, this dimension is associated with the fact that the company needs to access the open data policies of the municipalities to provide users with accurate information about public transport. Without this agreement, it is practically impossible to implement the business model.

Without this alignment of visions and expectations - even if there were no impediments to the installation of sharing systems - the business models would risk losing relevance by not being integrated into the dynamics of the transport city. This is the case, for instance, of the bicycle stations installed close to public transport, as is the case of Firm 2, which facilitates the generation of value for the user and encourages intermodal integration but requires the previous alignment.

Indeed, for a business model to emerge and to be effectively implemented, it already needs to have its visions and expectations well-articulated and communicated among the multiple actors involved in this process (Bidmon and Knab, 2018).

#### **4.1.4 Applying the learning process**

The dimension of the learning process is of fundamental importance in the evolution of the business model and the development of new service characteristics, requiring a continuous review of the value proposition.

For instance, in Firm 1, a service that directly impacts another third service – the public transport system in cities - managers perceive the application of the learning accumulated from the relationships established with partners as a relevant practice for the maturation of the business model.

This is also the case for the carpooling service (Firm 3). The learning aspects are present, above all, in the various adaptations the business model has undergone. For example, the service had a more comprehensive initial proposal for sharing rides for anyone and needed to specialize in corporate mobility to establish itself as a business. As a result, rides are shared only between employees of the same companies that hire the service from Firm 3 and are willing to offer its employees this type of initiative.

This process was linked to the recognition, through the relationship with users, that the habit of taking rides in Brazil was not explored and, therefore, requires changes in behavior and incentives in the public sphere, such as the possibility of using exclusive lanes of buses for cars with more than three people, although this last aspect is not yet fully explored.

The company that offers a fleet management service based on carsharing (Firm 4) emphasized the dimension of learning related to users' accountability of consumption practices. Since different people can use shared cars and are often not used to carsharing services, it is encouraged to check before using the vehicle, ensuring that it is in proper condition and report any abnormality. The more the user is responsible for the vehicles he uses, the cheaper the service is for the contracting company and, consequently, for the customer, reinforcing the relevance of this learning – at the company and the customer level - to the business model consolidation.

The BMI approach is intrinsically experimental and an iterative process that allows the replication of accumulated learning more quickly, facilitating its adaptation to act in a socio-technical regime. However, this transformation can often only occur when it is possible to influence the change of other business models besides the firm Sarasini and Linder (2018).

#### **4.1.5 Building of social networks**

Building a social network is a fundamental aspect of implementing business models, and different factors influence it, considering their ability to involve different stakeholders and to mobilize commitment and resources (Hoogma et al., 2002). One of them is the VC, covering how the revenue model works. Incorporating different revenue sources through the aggregation of services is a clear example in the all the cases, and it requires constructing a network of actors to support the commercialization of these services.

To some extent, some of these business models substantially expand their initial scope of operation by building networks with other actors. For example, this is the case of the hire railing firm in China (Firm 6), which currently buys the vehicles and lends them to the platform's drivers under a leasing model as a complementary source of revenue, and the case of the bike-sharing operator in Brazil (Firm 2), which has partnered with a vast food delivery company to offer e-bike rentals to couriers.

This aspect also influences local competition. For example, the bike-sharing operator in China (Firm 7) highlighted the need to establish greater cooperation between other actors operating in the same market, aiming to obtain a "one voice" speech that could represent the interests of this sector, highlighting the need to strengthen networks as an essential factor for business maintenance.

Building of social networks also takes place at the operation level. Firm 7 has partnered with one of the largest digital payment operators in China, which facilitates the instant payment of bike rentals by the user, in addition to having significantly expanded the service user base.

These findings reinforce the idea that business models require multiple actors to collaborate beyond the authority of a single organization, including demanding a high degree of commitment from these other actors. This is evidenced by the fact that a new business model presented by an actor will probably also require changes in the

business models of other actors, as is the case of the companies analyzed and that BMI could establish relations between different socio-technical systems (Sarasini and Langeland, 2021).

## 5 DISCUSSION

Given that BMI could influence socio-technical transitions (Bidmon and Knab, 2018), and how to create stability is a critical aspect of the role BMI plays in this process - and that few studies have approached how BMI may be integrated into socio-technical regimes to foster changes (Sarasini and Linder, 2018), our main theoretical contribution is to reveal factors at the firm level that could be taken into account when implementing and experimenting with new business models in the mobility field.

However, one of the main limitations of this paper is that we did not examine the perspective of other actors involved in stabilizing business models, such as public entities, partner companies or incumbent firms that play a relevant role in the mobility sector, as the results highlighted. Instead, we provide empirical evidence of the niche actor's initiatives vis-à-vis the process of structuring and stabilizing business models in the socio-technical regime.

Therefore, in what follows, we use the notion of multisystem interactions to elucidate a set of propositions from our research that may inform future streams of investigations. Drawing on the idea that scholars are increasingly calling for research that investigates the linkages between multiple regimes and systems rather than novelties within niches as a source of transformation and that BMI could establish relations between different socio-technical systems (Sarasini and Langeland, 2021) and that our empirical findings potentially span different systems (e.g. electricity, finance), we propose three key insights this research uncovers and some implications and future research directions from our study.

- Proposition # 1: BMI can bring complementary and incremental mobility alternatives to the current regimes.

The diversity of the cases reinforces the idea that even acting in different urban mobility demands, new players do not propose radical changes that will fully replace the current traditional mobility alternatives. In the context of the analyzed initiatives, this is even more evident. Given that countries like Brazil have fundamental gaps in the public transport system, for example, some of the solutions offered by new

business models will focus on meeting more fundamental needs, such as the lack of integration in public transport.

It does not mean that radical changes aimed at promoting more sustainable mobility may not be made feasible, but rather that challenges and opportunities for creating value through BMI must consider essential demands that may be substantially different from those in countries with other trajectories in mobility systems.

Therefore, future investigations can delve deeper into the opportunities for value creation by new business models in the field of mobility that are suited to the local context of emerging countries and their integration with other socio-technical systems.

- Proposition # 2: Niche actors in charge of ICT mobility service-based business models have alternatives to orchestrate the critical processes that influence the stabilization of the regimes when they can mobilize different actors and resources;

Our results show that the BMI process, through its iterative and experiential characteristic, allows managers to find viable alternatives towards stabilization of the regime in the context they operate.

It happens more clearly, for example, through learning replication mechanisms, as is the case with the various adaptations in the value proposition of business models, according to the learning accumulated during attempts to implement business activities.

However, a broad and continuous mobilization of actors and resources beyond the firm level is still required, such as creating of partnerships that aim to increase the user base of initiatives and, consequently, their relevance.

Future research could investigate the articulation of multiple actors in the mobility context more deeply, focusing, for instance, on specific initiatives in the mobility sector to examine theoretical implications for the transitions and business model linkages research.

- Proposition # 3: The stabilization process of regimes through the BMI perspective depends on commitment from specific actors from the dominant mobility regime.

Some business models do not have enough resources or minimum conditions to guarantee their operation or institutionalization on their own and the consequent creation of the proposed value (Bolton and Hannon, 2016).

The dependency relationships shown in the results indicate paths that point to the need to create specific public policies that reduce these dependency relationships without giving up the guarantees and benefits that this alignment brings to the business models. These policies could encourage the creation of business that meet local mobility demands, facilitating, for example, the integration with existing transport alternatives, increasing the relevance of business models for users and contributing to the necessary behavioral user change during their adoption and enabling its potential to gain scale through synergies with local demands.

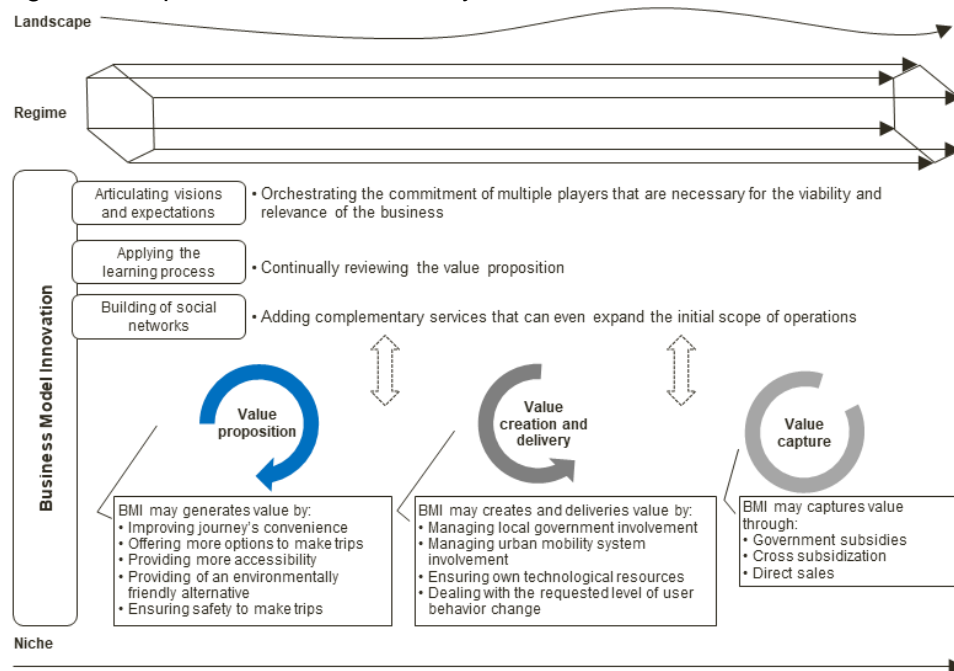
However, as expected, when there is direct involvement of actors, such as the local government in the organization of business models, as is the case with traditional shared bike models (station-based) or the fare payment integration platform, there is also a higher level of institutionalization of the business, as this involvement ensures greater alignment of the initiative within the local context, even though this may reduce the scale potential of these initiatives (Van Waes et al., 2018).

It indicates that future research may include detailing the limitations and opportunities for generating public policies for new business models to promote sustainable mobility, seeking to integrate synergies between local demands that facilitate their institutionalization, and reconciling with the creation of mechanisms that contribute to the scale potential of these initiatives.

Figure 2 summarizes factors influencing the stabilization process of the socio-technical regime through new business models.



Figure 2 – Updated framework analysis



Source: prepared by the authors.

## 6 CONCLUDING REMARKS

As a contribution, the research revealed that the BMI process might act as an intermediary between niches and regimes with a higher level of structuring than a technological niche, empirically reinforcing the conceptual findings proposed by Bidmon and Knab (2018) and Sarasini and Linder (2018), by detailing specific factors at the firm level that could be useful for implementing and experimenting with new business models in the mobility field towards stabilization of the regime.

Additionally, BMI in the mobility field can bring complementary and incremental mobility alternatives to the current regimes, incorporating concerns towards more sustainable mobility that may be integrated into the established transport options.

The findings from the analyzed business models indicate that the factors associated with the stabilization of the regime are crucial even for the emergence of these initiatives. The business model gains relevance when firms actively address and orchestrate these aspects.

Considering the reported cases, niche actors in charge of ICT mobility service-based business models could manage the critical processes influencing the stabilization of the regimes. However, it is evident how the BMI process requires

cooperation opportunities with multiple other actors to complement the necessary competencies, even modifying the dynamics of other complementary business models.

In this sense, the dependency relationships with some specific actors involved in the dominant mobility regimes are reinforced when implementing the analyzed business models, as they need additional resources to ensure their operationalization activities and institutionalization process.

The research evidenced factors influencing the BMI process, which can be considered to create similar or complementary business initiatives from the managerial practice point of view.

Even if BMI in the mobility sector can deliver sustainability and influence transitions, it is evident throughout numerous cases that the lack of supportive and specific public policies constrains many opportunities for evolving these initiatives.

**DECLARATION OF COMPETING INTERESTS**

None

## APPENDIX A – CODING SCHEME

Sample of the topics discussed in the interviews	Codes associated with the topics
<p><i>“The application has the idea of bringing information to citizens about cities... the feature that people use the most is the bus forecast... You have the option to consult the bus itinerary, reports on the status of the bus and on the driving and condition of the bus. It has a routing feature to ask to make a route</i></p> <p><i>All these resources are centered on the use of public transport”</i></p>	<p>Value proposition / Improving journey’s convenience</p>
<p><i>“It depends from city to city network (complementary ticket sales and supply network) to sell public transport tickets. If you want to sell the SP trans tickets, you have to be registered and be approved by it”</i></p>	<p>Value creation and delivery system / Local government involvement</p>
<p><i>”One of the main operation modes is the leasing company, that is, we talk to the car factory, because our bargain power is relatively large... Then use this discount to buy some cars, rent the cars to drivers in need through these rental companies, and then the driver will drive these new energy cars and pay the rent every month”</i></p>	<p>Value Capture / Cross subsidization</p>
<p><i>“So our shared bike when entered in this small city the government said it was good so they gave us a lot of support. In that time we found a way, we find a lot, paper or documents with the government allowing only one company, only us, an agreement, for 2 to 5 years in a lot of small cities”</i></p>	<p>Sub-process of stabilization / Articulation of visions and expectations</p>
<p><i>“The corporate focus ended up entering later as a matter of the company's survival. Security was a risk factor and users did not adopt the service's initial proposal”</i></p>	<p>Sub-process of stabilization / Learning process</p>
<p><i>“Bur for us we all want to be the only one, we compete too hard. For example, every industry has some committee, associations or meetings, but in two wheels business we don’t have this kind of committees”</i></p>	<p>Sub-process of stabilization / Building of social networks</p>

## REFERENCES

- Banister, D., 2008. The sustainable mobility paradigm. *Transp. Policy* 15, 73–80. <https://doi.org/10.1016/j.tranpol.2007.10.005>
- Bidmon, C.M., Knab, S.F., 2018. The three roles of business models in societal transitions: New linkages between business model and transition research. *J. Clean. Prod.* 178, 903–916. <https://doi.org/10.1016/j.jclepro.2017.12.198>
- Bolton, R., Hannon, M., 2016. Governing sustainability transitions through business model innovation: Towards a systems understanding. *Res. Policy* 45, 1731–1742. <https://doi.org/10.1016/j.respol.2016.05.003>
- Cervero, R., 2013. Linking urban transport and land use in developing countries. *J. Transp. Land Use* 6, 7–24.
- Chesbrough, H., Rosenbloom, R.S., 2002. The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. *Ind. Corp. Chang.* 11, 529–555. <https://doi.org/10.1093/icc/11.3.529>
- Eisenhardt, K.M., 1989. Building Theories from Case Study Research. *Acad. Manag. Rev.* 532–550.
- Geels, F.W., 2012. A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. *J. Transp. Geogr.* 24, 471–482. <https://doi.org/10.1016/j.jtrangeo.2012.01.021>
- Geels, F.W., 2004. From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Res. Policy* 33, 897–920. <https://doi.org/10.1016/j.respol.2004.01.015>
- Geels, F.W., Schot, J., 2007. Typology of sociotechnical transition pathways. *Res. Policy* 36, 399–417. <https://doi.org/10.1016/j.respol.2007.01.003>
- Gerring, J., 2007. *Case study research: Principles and practices*, 1st editio. ed. Cambridge University Press, New York.
- Ghosh, B., Schot, J., 2019. Towards a novel regime change framework: Studying mobility transitions in public transport regimes in an Indian megacity. *Energy Res. Soc. Sci.* 51, 82–95. <https://doi.org/10.1016/j.erss.2018.12.001>
- Hernández-Chea, R., Jain, A., Bocken, N.M.P., Gurtoo, A., 2021. The business model in sustainability transitions: A conceptualization. *Sustain.* 13, 1–25. <https://doi.org/10.3390/su13115763>
- Hoogma, R., Kemp, R., Schot, J., Truffer, B., 2002. *Experimenting for Sustainable Transport: the approach of strategic niche management*, 1st ed. Spon Press, London, New York.
- Köhler, J., Geels, F.W., Kern, F., Markard, J., Onsongo, E., Wieczorek, A., Alkemade, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., Hess, D., Holtz, G., Hyysalo, S., Jenkins, K., Kivimaa, P., Martiskainen, M., McMeekin, A., Mühlemeier, M.S., Nykvist, B., Pel, B., Raven, R., Rohracher, H., Sandén, B., Schot, J., Sovacool, B., Turnheim, B., Welch, D., Wells, P., 2019. An agenda for sustainability transitions research: State of the art and future directions. *Environ.*

- Innov. Soc. Transitions 31, 1–32. <https://doi.org/10.1016/j.eist.2019.01.004>
- Lüdeke-Freund, F., Dembek, K., 2017. Sustainable business model research and practice: Emerging field or passing fancy? *J. Clean. Prod.* 168, 1668–1678. <https://doi.org/10.1016/j.jclepro.2017.08.093>
- Marotti de Mello, A., Valsecchi Ribeiro de Souza, J., Marx, R., 2021. Public Transport in Emerging Countries: From Old Dilemmas to Opportunities for Transition to Sustainable Mobility Through the Case of Brazil, in: Mira-Bonnardel, S., Antonialli, F., Attias, D. (Eds.), *The Robomobility Revolution of Urban Public Transport. Transportation Research, Economics and Policy*. Springer, Cham, pp. 167–179. [https://doi.org/10.1007/978-3-030-72976-9\\_8](https://doi.org/10.1007/978-3-030-72976-9_8)
- Meredith, J.R., Mccutcheon, M., 1993. Conducting case study research in operations management 11, 239–256.
- Nowell, L.S., Norris, J.M., White, D.E., Moules, N.J., 2017. Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *Int. J. Qual. Methods* 16, 1–13. <https://doi.org/10.1177/1609406917733847>
- Pedersen, S., Clausen, C., Jørgensen, M.S., 2022. Navigating value networks to co-create sustainable business models: An actionable staging approach. *Bus. Strateg. Environ.* 1–19. <https://doi.org/10.1002/bse.3127>
- Richardson, J., 2008. The business model: an integrative framework for strategy execution. *Strateg. Chang.* 17, 133–144. <https://doi.org/10.1002/jsc.821>
- Sarasini, S., Langeland, O., 2021. Business model innovation as a process for transforming user mobility practices. *Environ. Innov. Soc. Transitions* 39, 229–248. <https://doi.org/10.1016/j.eist.2021.04.005>
- Sarasini, S., Linder, M., 2018. Integrating a business model perspective into transition theory: The example of new mobility services. *Environ. Innov. Soc. Transitions* 27, 16–31. <https://doi.org/10.1016/j.eist.2017.09.004>
- Schneider, S., Spieth, P., 2013. Business Model Innovation: Towards an Integrated Future Research Agenda. *Int. J. Innov. Manag.* 17, 1340001. <https://doi.org/10.1142/S136391961340001X>
- Snihur, Y., Bocken, N., 2022. A call for action: The impact of business model innovation on business ecosystems, society and planet. *Long Range Plann.* 55, 1–13. <https://doi.org/10.1016/j.lrp.2022.102182>
- Souza, J.V.R. de, Mello, A.M. de, Marx, R., 2022. Barriers and drivers to implement innovative business models towards sustainable urban mobility. *Int. J. Automot. Technol. Manag.* 22, 485–505. <https://doi.org/10.1504/ijatm.2022.126840>
- Souza, J.V.R. de, Mello, A.M. De, Marx, R., 2019. When Is an Innovative Urban Mobility Business Model Sustainable? A Literature Review and Analysis. *Sustain.* 11, 1–18. <https://doi.org/10.3390/su11061761>
- Stead, D., 2013. Identifying Key Research Themes for Sustainable Urban Mobility. *Int. J. Sustain. Transp.* 8318, 1–8. <https://doi.org/10.1080/15568318.2013.820993>
- Teece, D.J., 2010. Business models, business strategy and innovation. *Long Range Plann.* 43, 172–194. <https://doi.org/10.1016/j.lrp.2009.07.003>

- Turnheim, B., Geels, F.W., 2019. Incumbent actors, guided search paths, and landmark projects in infra-system transitions: Re-thinking Strategic Niche Management with a case study of French tramway diffusion (1971–2016). *Res. Policy* 48, 1412–1428. <https://doi.org/10.1016/j.respol.2019.02.002>
- Van Waes, A., Farla, J., Frenken, K., de Jong, J.P.J., Raven, R., 2018. Business model innovation and socio-technical transitions. A new prospective framework with an application to bike sharing. *J. Clean. Prod.* 195, 1300–1312. <https://doi.org/10.1016/j.jclepro.2018.05.223>
- Voss, C., Tsiriktsis, N., Frohlich, M., 2002. Case research in operations management. *Int. J. Oper. Prod. Manag.* 22, 195–219. <https://doi.org/10.1108/01443570210414329>
- Weissbrod, I., Bocken, N.M.P., 2017. Developing sustainable business experimentation capability – A case study. *J. Clean. Prod.* 142, 2663–2676. <https://doi.org/10.1016/j.jclepro.2016.11.009>
- Wesseling, J.H., Bidmon, C., Bohnsack, R., 2020. Business model design spaces in socio-technical transitions: The case of electric driving in the Netherlands. *Technol. Forecast. Soc. Change* 154, 1–11. <https://doi.org/10.1016/j.techfore.2020.119950>
- Yin, R.K., 2005. *Estudo de caso: planejamento e métodos*, 3. ed. ed. Bookman, Porto Alegre.
- Zott, C., Amit, R., Massa, L., 2011. The Business Model: Recent Developments and Future Research. *J. Manage.* 37. <https://doi.org/10.1177/0149206311406265>

## 6 FINAL CONSIDERATIONS

The general research objective of this thesis is to understand how business model innovation could influence sustainable urban mobility transition. To achieve this objective, we explored specific research gaps in the literature and developed three papers, each with its question and objectives, but, when analyzed together, help us fulfill the general research objective and extract final considerations about this investigation.

The first challenge presented in Paper 1 was to perform an interdisciplinary and theoretical investigation based on a systematic literature review that would bring together the perspectives of sustainable urban mobility and business models. This work identified that although the literature on sustainable urban mobility recognizes the contribution of new business models in the implementation of sustainable solutions for the mobility industry, few studies indicated solid paths that would help translate these contribution opportunities into practical initiatives (SOUZA; MELLO; MARX, 2019).

Similarly, few works driven by the perspective of business models for sustainability evidenced the opportunities of contribution towards sustainable mobility in an integrated way. Therefore, our main contribution from the first paper was to consolidate the conceptual elements that help us characterize innovative and sustainable business models oriented towards sustainable mobility based on the proposition of a theoretical framework (SOUZA; MELLO; MARX, 2019).

Once the conceptual limits and boundaries were established, an empirical investigation in the subsequent papers was conducted. In Paper 2, the main findings revealed strategic, institutional and operational barriers, and drivers that firms face when implementing sustainable business models in mobility. The main theoretical contribution of this work was to enrich the literature that investigates barriers associated with the implementation of sustainable business models, providing evidence from the case of urban mobility (SOUZA; MELLO; MARX, 2021).

Strategies for dealing with the interests of different groups of stakeholders combined with the competition with dominant transport alternatives constitute critical barriers to the value proposition of business models. The lack of specific public policies and the difficulty to access data on travel patterns are relevant barriers that result in many challenges for the value creation and delivery system of the business models analyzed. Finally, for the value capture dimension, diversifying revenue sources



proved to be the most relevant barrier organizations face (SOUZA; MELLO; MARX, 2021).

Paper 3, examines the challenges organizations face when implementing new business models at different levels, and other actors and dimensions in the socio-technical system in which these initiatives emerge. We sought to investigate which factors influence the BMI process and the stabilization of the socio-technical regime from the firm level.

The main contribution of the last paper is to reveal factors that impact the dynamics of the BMI implementation process under the lens of sustainable transitions and, more specifically, the BMI as an intermediary between technological niches and the socio-technical regime.

From this work, three insights were derived that, together with the findings from the other papers, contribute to the general research objective of the thesis. First, the proposition that the “BMI can bring complementary and incremental mobility alternatives to the current regimes”, justified by the evidence that both the challenges in implementing business models and the limited scope of value propositions – given the needs of the context in which they operate – do not seem to bring alternatives that will fully replace current traditional mobility alternatives.

Second, the proposition that “niche actors in charge of ICT mobility service-based business models have alternatives to orchestrate the critical processes that influence the stabilization of the regimes when they can mobilize different actors and resources”. In other words, mainly due to its iterative and experimental characteristics, the BMI approach seems valid in finding alternatives that bring about changes in the current socio-technical regime.

Finally, the proposition that “the stabilization process of regimes through the BMI perspective depends on commitment from specific actors from the dominant mobility regime”, given the importance of dependency relationships that are necessary throughout the implementation and scale-up of the business models analyzed.

## 6.1 IMPLICATIONS FOR PUBLIC POLICIES

Throughout the papers of this thesis, some implications for public policies are highlighted. The main one is that the organization of business models in the mobility field could benefit from mechanisms that are more appropriate to the characteristics of

the business. For example, the lack of open data policies for developing solutions that meet the population's actual demands for mobility or incentives that contribute to changing users' behavior about sustainable mobility alternatives that are necessary considering competition with the dominant ones.

Furthermore, the proposition of application areas for developing new business models oriented towards sustainable urban mobility could guide local calls for new entrepreneurs in this sector, who could already consider the specific challenges of each type of business according to the demands of each context.

However, for a successful local approach that contributes globally, we argue that it is crucial to include the local perspective in all phases of the policy-making process, from setting priorities, drafting plans and strategies, seeking resources, defining local indicators for effective monitoring to the exchange of information and knowledge accumulated between peers.

## 6.2 IMPLICATIONS FOR MANAGERIAL PRACTICE

This research highlights relevant factors to be considered when implementing business models analogous to those covered by this study, as described in the papers.

In summary, it comprehends (1) opportunities for developing new businesses in the field of mobility, (2) guidance regarding the barriers and drivers encountered, and (3) the factors that influence the dynamics of implementation at the firm level.

## 6.3 CONTRIBUTIONS TO THE SUSTAINABLE DEVELOPMENT GOALS

Mobility is considered crucial to achieving sustainable cities and communities, explicitly embedded in SDG 11, although other SDGs, albeit indirectly, target the need for more sustainable, inclusive, and accessible mobility and transport systems. The transition to sustainable mobility is imperative to decarbonize transport and meet sustainable development goals. Due to the topic's relevance, mobility could also significantly contribute to the 2030 agenda ("Sustainable Development Goals", 2023).

Specific targets of SDG 11, such as 11.2, highlight the need to expand and improve public transport systems for all, which should guarantee safety and meet the needs of people in vulnerable situations ("Sustainable Development Goals", 2023).

From a BMI perspective, this research sought to elucidate how it may contribute to the transition to sustainable mobility. We highlight application areas and critical aspects for the organization of business models that could stimulate innovation in the sector and contribute to sustainable mobility, attracting increasing attention from actors interested in this field.

#### 6.4 LIMITATIONS OF THIS STUDY

This thesis presents some limitations, mainly due to its qualitative methodology, which can generate biases of the interviewees when asked about the proposed topics.

The other limitation concerns the exclusive point of view of the actors behind the organization of the business models analyzed, not considering the perspective of other actors present in the environment where these initiatives emerge.

Including the perspective of other actors and institutions, considering their role in organizing these initiatives and their point of view concerning the evolution of business models over time, which is strongly recommended in future work.

## REFERENCES

- BANISTER, David. Cities, mobility and climate change. **Journal of Transport Geography**, v. 19, n. 6, p. 1538-1546, 2011.
- BEIRÃO, Gabriela; CABRAL, J. A. Sarsfield. Understanding attitudes towards public transport and private car: a qualitative study. **Transport policy**, v. 14, n. 6, p. 478-489, 2007.
- BOONS, Frank; LÜDEKE-FREUND, Florian. Business models for sustainable innovation: state-of-the-art and steps towards a research agenda. **Journal of Cleaner Production**, v. 45, p. 9-19, 2013.
- CARVALHO, Carlos Henrique Ribeiro de. **Emissões relativas de poluentes do transporte urbano** (in Portuguese). Boletim Regional, Urbano e Ambiental. Brasília: IPEA, jun. 2011. Disponível em: [https://portalantigo.ipea.gov.br/agencia/images/stories/PDFs/boletim\\_regional/111125\\_boletimregional5\\_cap13.pdf](https://portalantigo.ipea.gov.br/agencia/images/stories/PDFs/boletim_regional/111125_boletimregional5_cap13.pdf). Acesso em: 30 out. 2023.
- CERVERO, Roberto. Linking urban transport and land use in developing countries. **The Journal of Transport and Land Use**, v. 6, n. 1, p. 7-24, 2013.
- COHEN, Boyd; KIETZMANN, Jan. Ride on! Mobility business models for the sharing economy. **Organization & Environment**, v. 27, n. 3, p. 279-296, 2014.
- DONADA, Carole; LEPOUTRE, Jan. How can startups create the conditions for a dominant position in the nascent industry of Electromobility 2.0? **International Journal of Automotive Technology and Management**, v. 16, n. 1, p. 11-29, 2016.
- EISENHARDT, Kathleen M. Building theories from case study research. **Academy of Management Review**, v. 14, n. 4, p. 532-550, jun. 1989.
- EVANS, Steve *et al.* Business model innovation for sustainability: Towards a unified perspective for creation of sustainable business models. **Business Strategy and the Environment**, v. 26, n. 5, p. 597-608, 2017.
- GEELS, Frank W. A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. **Journal of Transport Geography**, v. 24, p. 471-482, 2012.
- KÖHLER, Jonathan *et al.* An agenda for sustainability transitions research: state of the art and future directions. **Environmental Innovation and Societal Transitions**, v. 31, n. 1, p. 1-32, 2019.
- KROMMES, Sandra; SCHMIDT, Felix. Business model analysis of electric mobility products and services. **International Journal of Automotive Technology and Management**, v. 17, n. 3, p. 316-338, 2017.
- LASMAR JÚNIOR, Eduardo Lúcio *et al.* New business models and the sharing economy: impacts and challenges for the traditional automotive industry.

**International Journal of Automotive Technology and Management**, v. 19, n. 3-4, p. 301-320, 2019.

MELLO, Adriana Marotti de; SOUZA, João Valsecchi Ribeiro de; MARX, Roberto. Public Transport in Emerging Countries: from old dilemmas to opportunities for transition to sustainable mobility through the case of Brazil. In: MIRA-BONNARDEL, Sylvie; ANTONIALLI, Fabio; ATTIAS, Danielle (eds.). **The robomobility revolution of urban public transport**. Transportation research, economics and policy. Cham: Springer International Publishing, 2021, p. 167-179.

NOWELL, Lorelli S. *et al.* Thematic analysis: striving to meet the trustworthiness criteria. **International Journal of Qualitative Methods**, v. 16, n. 1, p. 1-13, 2017.

OSTERWALDER, Alexander; PIGNEUR, Yves; TUCCI, Christopher L. Clarifying business models: Origins, present, and future of the concept. **Communications of the association for Information Systems**, v. 16, n. 1, p. 1-40, 2005.

SARASINI, Steven; LINDER, Marcus. Integrating a business model perspective into transition theory: The example of new mobility services. **Environmental Innovation and Societal Transitions**, v. 27, p. 16-31, 2018.

SNIHUR, Yuliya; BOCKEN, Nancy. A call for action: the impact of business model innovation on business ecosystems, society and planet. **Long Range Planning**, v. 55, n. 6, p. 1-13, 2022.

SOUZA, João Valsecchi Ribeiro de *et al.* Challenges to develop business models towards sustainable urban mobility: A comparative empirical investigation between Brazilian and Chinese case studies. *In: Gerpisa International Colloquim*, 28., 2020, Paris. **Anais... [...]**. Paris: Virtual Conference, 2020a.

SOUZA, João Valsecchi Ribeiro de *et al.* From niches to socio-technical regimes: exploring factors influencing business model innovation towards sustainable mobility transitions. *In: International Conference on New Business Models*, 7., 2022, Italy. **Anais [...]**. Rome, Italy: 2022.

SOUZA, João Valsecchi Ribeiro de *et al.* Implantação de modelos de compartilhamento de carros elétricos no Brasil: estudo de caso de gestão de incertezas a partir da aplicação da abordagem do learning plan. *In: Encontro Internacional sobre Gestão Empresarial e Meio Ambiente*, 22., 2020, São Paulo. **Anais [...]**. São Paulo: FEA-USP, 2020b, p. 1-17.

SOUZA, João Valsecchi Ribeiro de; MELLO, Adriana Marotti de; MARX, Roberto. When is an innovative urban mobility business model sustainable? A literature review and analysis. **Sustainability**, Switzerland, v. 11, n. 6, p. 1761, 2019.

SOUZA, João Valsecchi Ribeiro de; MELLO, Adriana Marotti de; MARX, Roberto. Barriers and drivers to implement innovative business models towards sustainable urban mobility. **International Journal of Automotive Technology and Management**, v. 22, n. 4, p. 485-505, 2022.

SPICKERMANN, Alexander; GRIENITZ, Volker; VON DER GRACHT, Heiko A. Heading towards a multimodal city of the future?: Multi-stakeholder scenarios for

urban mobility. **Technological Forecasting and Social Change**, v. 89, p. 201-221, 2013.

STEAD, Dominic. Identifying key research themes for sustainable urban mobility. **International Journal of Sustainable Transportation**, v. 10, n. 1 p. 1-8, 2013.

TEECE, David J. Business models, business strategy and innovation. **Long Range Planning**, v. 43, n. 2–3, p. 172–194, 2010.

TURNHEIM, Bruno; GEELS, Frank W. Incumbent actors, guided search paths, and landmark projects in infra-system transitions: re-thinking strategic niche management with a case study of french tramway diffusion (1971–2016). **Research Policy**, v. 48, n. 6, p. 1412-1428, 2019.

UNITED NATIONS. **Sustainable development goals**. Disponível em: <https://sdgs.un.org/topics/sustainable-transport>. Acesso em: 26 ago. 2023.

UNITED NATIONS. COP26 Explained. **Un climate change conference UK 2021**. Disponível em: <https://ukcop26.org/wp-content/uploads/2021/07/COP26-Explained.pdf>. Acesso em: 1 set. 2023.

WEGENER, Michael. The future of mobility in cities: challenges for urban modelling. **Transport Policy**, v. 29, p. 275–282, 2013.

WELLS, Peter. Sustainable business models and the automotive industry: a commentary. **IIMB Management Review**, v. 25, n. 4, p. 228–239, 2013.

**APPENDIX A – SUPPLEMENTARY INFORMATION FOR THE PAPER 2:  
BARRIERS AND DRIVERS TO IMPLEMENT INNOVATIVE BUSINESS MODELS  
TOWARDS SUSTAINABLE URBAN MOBILITY**

**Description:** the dataset below presents excerpts from the interviews used as main source of empirical evidence in the coding process for the identification of barriers and solutions adopted by the companies in the mentioned paper.

**Creation date:** 05/24/2022

**Source:** elaborated by the authors.

<b>Barriers</b>					
<b>Companies</b>	<b>Harmonizing interests of different stakeholder groups</b>	<b>Competition with dominant alternatives of transport</b>	<b>Access information about travel patterns of users</b>	<b>Proper public policies oriented to the development of new business models</b>	<b>Diversification of the revenue sources</b>
<b>BIKE BR</b>	In Brazil, the question of name right (main current source of revenue) has gained a lot from brand exposure, associating the brand with something more modern, sustainable. Companies are interested in providing mobility solution and having good relationships with local government. In many cities it has been this model: banks, health and insurance companies sponsor bike-sharing operators in response to public calls.	From the point of view of users, we need to be a practical and convenient transport system to be able to convince users to use instead of the traditional options, so operational issues are very important. Easy to use, have several ways to use. The idea is that the user has many ways to use it. Technology and station locations as close as possible is what makes them use the system, in addition to	For the company, the issue of intermodal integration is important and for the public sphere as well. The location of the stations has to be dense and has to be in the right place for people to make small trips. Actions to improve the project: technology, mesh and operation.	The public sphere is an important part of the process but involvement varies widely from city to city. The local government will always be involved, it is difficult to be a 100% private system that is really relevant. We need the support of the government in terms of provide security force to keep the system working. We are making reinforcements to hinder the theft but it is not enough, we brought the local government to contain the	The critical factor for expanding the business model is to diversify the source of revenue and this limits a little the growth of the business. Decrease reliance on single source of revenue is critical.

		sustainable aspects.		theft and vandalism.	
<b>CARSHARING BR</b>	As we essentially work with fleet management, we did not originally have the technology competence and had no interest in developing it, as we did not consider it critical to the business. In addition, we identified other players in the market that already had specific and pre-configured solutions that could meet this type of demand, and internal development or specialization is not viable. In this way, partnerships were signed with nascent companies that provide the technological solutions that support the sharing scheme. However, the limited availability of specialized companies in Brazil to develop technologies that support shared car schemes, both	In the case of organizations that offer the benefit of the individual car to people in higher positions and who wish to replace this benefit by the shared car service, for example, the challenge of convincing users about the benefits of this exchange is even greater, as there is no interest of the user to give up the exclusive use of the private car. As most users are not used to consuming shared resources with other people, awareness actions have proven to be essential.	The challenge is to obtain reliable information that allows the business model to adapt and develop products focused on the reality of end-users and the dependence on the interest of organizations in providing employee data so that we can make a proposal for a corporate mobility service suited to reality of each user.	The role of the public sphere in promoting the incentive to disseminate the electric car in the Brazilian market is highlighted. In the case of the CARSHARING business model, there is a priority interest in incorporating the electric car, mainly because the technical conditions of this product are very much in line with the types of travel normally carried out by users of the shared cars (seasonal travel and within cities).	Revenue sources are based on provision of services to the companies that offer the shared car system to their employees, based on the payment of monthly fees for CARSHARING to provide and manage the service. In some types of contracting, it is possible to obtain indirect revenue from the users who use the shared cars. In this case, the company contracting the service may allow shared cars to be used outside of conventional work hours, encouraging personal use. Thus, users pay for the period they used the shared cars through the car reservation platform and the revenue obtained is deducted from the monthly fee paid by the company to maintain the service by CARSHARING. "



	<p>software and hardware, was highlighted. The interface with companies allows, in addition to commercial issues, awareness of the importance of the shared car service with regard to saving resources, positive impact on mobility, exploration of a sustainable practice, among others. The interface with users is associated with awareness of responsibility for the consumption practices of this service and its benefits in a broader context.</p>				
<b>CARPOOL BR</b>	<p>We have contracts with specific companies, supporting corporate mobility. The idea is to provide solutions for companies to improve their surroundings. Companies need to understand that transportation is a source of improving</p>	<p>A bus with less than 45 people is very bad walking, because the capacity is not used. In São Paulo the big villain is the pollution of cars because there is only that. Sharing is very important. In a transport analysis looking at sustainability</p>	<p>Open data is a great idea, but it doesn't solve it alone. Actions that promote intelligence in public transport through information. There are many people in the private sector using public information data. There is no flexibility to map</p>	<p>In a transport analysis looking at sustainability the best solution for user is always the car. How to make it shared? If you had a shared car policy (riding in the passenger lane with more than 3 people) would be great for us. Fine and inspection</p>	<p>We use both sources of user revenue and company contracts. It has survived so far with what they do with companies. Now we are betting on this solution but still have a lot to say that we survived because of these differentials.</p>

	<p>quality of life. It's important to make companies a mobility actor. Companies have to participate in the city's mobility plan to find out how they can intervene. Now we have a little more empathy for the public-private partnership. The first time we got the local government as a partner was in a mobility event.</p>	<p>the best solution is always the car. The focus is on understanding how to make it shared.</p>	<p>demand and supply without data.</p>	<p>system should be an incentive to share a ride. If it had a subsidy scheme it would be cheaper for the government than it is for the public transport expenses.</p>	
<p><b>CYCLING BR</b></p>	<p>We are working with cycle activists and government departments (transport, innovation) to discuss the business model.</p>	<p>More than 80% have as their main criterion the safety for using a bicycle (personal accident and safety from the point of view of assault / violence). This is the main factor that limits the greater adhesion of people to use a bicycle regarding to other options. Convenience factor: getting around in the city is costly.</p>	<p>You have to know the realities of all places we want to operate: topography, experience, speed, if there is a bike path and if there are viable routes to suggest to users. The mission is to be able to bring more and more people to the transport base and, with that, improve the route suggestion.</p>	<p>Role of the government and the public sphere as a whole: provide infrastructure to enable greater use of the bike. When there is an increase in the number of cycle paths, there is an increase in the number of cyclists. We understand that the government is the main entity to provide infrastructure: lighting and public safety.</p>	<p>Major challenge is to manage the various points of interest and contact companies to monetize. Scalable product, but the revenue model is not much (depends on individual contracts) and sales force challenges within the market place we are creating. Based on this application, we are creating a B2B revenue model: exploring the user base to monetize. API licensing: to charge for a service to use</p>

					<p>the routing API functionality (bike-sharing companies or bike-sharing operators could be interested). App advertising (companies' logo, ad words, placing their brand within the platform to advertise their services). Kind of market place where companies would advertise services around to cyclists during the journeys.</p>
<b>BUS BR</b>	<p>Public transport operators understand the logic of the service offered, but we are experiencing a strange financial moment. The most accepted technology in a bus company are those oriented to mitigate cost. Operators are more supporters with reducing cost. There are some contexts in which the government is able to pressure operators' concessions to collaborate.</p>	<p>End-user: started to look more closely. Area with the objective of approaching the user audience, using them as vectors for using the application. Events, new bus technologies, want people to ride more buses. Approaches with neighborhood communities and beyond technology audiences have been actions to encourage the use of public transport,</p>	<p>There are some contexts in which the government is able to pressure operators' concessions to collaborate. To implement the application in a city we need the data of the bus travel, it is not possible to implement the service with only static information.</p>	<p>Government: in financial terms, government has not helped. However, in terms of incentives, it is different. Forums to identify technological innovations, expose ideas, providing intellectual capital to learn more about contexts, bringing entrepreneurs closer to issues of public interest / government professionals could be support initiatives. We benefit from the cities' open data</p>	<p>We have been testing to see how you can monetize. Some alternatives are being tested: provide surveys forms for third parties in the app, job ads, but other ads like discount coupons to explore service opportunities by taking advantage of the user's audience and location. There is the possibility of offering digital services and assistance to the government through the app. Use audience data to generate relevant insights. For</p>

		which is in decline.		policies (incentive), although it has to be improved.	example, where people live and work. This is a trend among apps. Advertising cannot be the main source of revenue for the app.
<b>INTEGRATION BR</b>	To implement the service, we depend on the realities from city to city - cooperation with the network of companies involved in the sale of public transport credits and with local governments. If we want to sell the public transport credit in São Paulo, we need to be accredited and approved by the city. There are cities like Votorantim, which is not a public company behind the service of credits sales for public transport, it is managed by a concession of a private company. For each city it is necessary to make this alignment of interests.	Public transport is not as easy to use as other modes. This is also why many users have been lost to public transport in Brazil.	We are working on implementing the system in São Paulo, there is a cooperation agreement in São Paulo under approval. We are facing some bureaucratic problems: 2 months stopped at that. We would do a pilot with a bus line to test and then replicate. We are right now. In fact, you don't even have to adapt the system, you have to get there and there is a cost to implement the system based on the integration of travel data. We reach a greater number of users entering by public transport.	There must be a promotion from the local government itself to encourage this practice. We would be able to make things go faster, help with the approval of the service and allow it to be made available to users.	We are working on adding services to allow users use their available credit in other operators of services related to urban mobility. Discount options to encourage inter modality is being tested. We can transform it into a revenue model but it is not a standard.
<b>RIDE HAILING CH</b>	We are now cooperating	Now many cities are	There is less supply than	Government determines	Car leasing for drivers is being

	<p>with many main engine factories to promote new energy vehicles. Especially in these cities with policy restrictions, we may advocate new energy vehicles. One of the main operation modes is the leasing of new energy car.</p>	<p>facing serious air pollution problems, some of which are caused by industry, some of which are caused by traditional fossil fuels, so today we are also building the largest new energy vehicle operation network in China. Our goal is to have one million new energy vehicles operating on our platform within a few years, which is also an opportunity to build green travel.</p>	<p>demand for travel, especially in the first and second-tier cities. In Beijing and Shanghai, it is a problem to solve. First of all, we should have a better understanding of the city, people's travel demand, when and where the peak is, and then we should have a lot of data to support this. And then we can do the fitting.</p>	<p>policies to promote new energy vehicles in cities, especially in some first-tier and second-tier cities and there are some mandatory requirements for online car hailing companies. This is an indirect benefit for the business: when the government subsidizes new energy vehicles, the overall price of new energy vehicles will be lower.</p>	<p>is practiced as a complementary source of revenue. We talk to the car factory, because our bargain power is relatively large, we can get a fair discount, which is equivalent to a centralized purchase, and there will be a slightly higher discount than the average retail consumer. Then use this discount to buy some cars, rent the cars to drivers in need through these rental companies, and then the driver will drive these new energy cars and pay the rent every month, the rest of the money is his income, the model looks like this.</p>
<p><b>CAR CH</b></p>	<p>The government has relatively strict regulations in autos, and it's not easy for producers to get admitted by The National Development and Reform Commission (NDRC) as 'qualified'. That's why</p>	<p>Making motors is very different from making cell phones or computers. It needs great input of time and investment in the whole procedure, from designing the concept car to manufacturin</p>	<p>Customers were gods when they're going to open their wallet, but they have to bear huge expenses after purchasing. We want to change the situation, so we come up with the concept of "user</p>	<p>Our country was quite supportive to the new energy car industry in the past few years and we have state subsidies and local subsidies. New energy car owners can get the license plate free. There're</p>	<p>Most income comes from after-sales service. Repairs and maintenance cost much (for new energy cars). We also want to change our profit mode. To enter the market quickly, we'll keep a low profit in early stage. But we won't make</p>

	<p>seldom new energy car producers get their qualification. We cooperated with companies like JAC to produce cars in the early phase. I think there're just 3 or 4 among more than 200 companies which have started their production and delivered their products, and there'll not be more than 6 by the end of the year.</p>	<p>g and selling. The ability to manufacture is the major criteria for being a player in the core market. There're few enterprises that have this ability so far. The whole industry is in a tense atmosphere for the appearance of negative growth for the first time in the past 20 years. It'll calm the capital market down, I believe, and stop new companies from entering. It's the self-regulation of the market. And companies are self-adjusting according to the consumer demand.</p>	<p>system". In the age of internet, a company with a "user system" should be like this: the customers attain services through the internet, for example, by using an app; users interact in online users' groups and become the host of the company; employees interact with the employers. Our priority is to enlarge the stable user group and update our profit mode with an information base comes from the groups of tens of thousands of car owners. That's similar to IT companies.</p>	<p>more restrictions for traditional fuel cars to get their license plates than the new energy ones, especially in big cities like Beijing, Shanghai and Guangzhou.</p>	<p>much profit from the after-sales services as well, and we can even make these services free. Anyway, it's too early to think about this when we're still in the stage of market cultivation. Our priority is to enlarge the stable user group and update our profit mode with an information base comes from the groups of tens of thousands of car owners. That's similar to IT companies.</p>
<b>BIKE CH</b>	<p>The relationship between the competitors is very very bad. Some industries have only for or five big companies and they and very friendly with each other. They can combine,</p>	<p>Because the four wheels market is already controlled by some players like Didi. If we want to enter now it's impossible and we focus on two wheels only. You can not</p>	<p>Yes, for bikes and e-bikes it's not complicated, many factories can do, the core competence is internet / technique, for example, know every bike position, no matter if</p>	<p>So, our shared bike when entered in this small city the government said it was good so they gave us a lot of support. In that time, we found a way, we find a lot, paper or</p>	<p>We are working with the diversification of the revenue source with a focus on products with higher added value (such as e-bikes for example).</p>

	<p>work together as one voice. But for us we all want to be the only one, we compete too hard. For example, every industry has some committee, associations or meetings, but in "two wheels" business we don't have this kind of committees. For example, our company didn't agree with some decisions in the past and it's bad for the whole industry.</p>	<p>compete in the same level with Didi. Didi occupied more the 67% of the market. In four wheel market Didi is the emperor.</p>	<p>it's used or not; but for another company, for example, it's impossible for them, only when the bike was used, they know where the bikes are. We put shared e-bike only in this District and the driver needs to respect this rule, if he doesn't respect, we can control the power of the bike or make it very heavy, it will be difficult for normal cyclists.</p>	<p>documents with the government allowing only one company, only us, an agreement, for 2 to 5 years in a lot of small cities. The agreements are mainly for 3 years or 5 years and after this you should resign them.</p>	
<p><b>CARSHARING CH</b></p>	<p>Cooperation with public and private actors has been shown to be important for the creation of more stations for shared electric cars, which is one of the main challenges for business expansion.</p>	<p>The target audience for shared electric cars is young people who seek greater convenience than public transport to get around in the cities. In order to attract this audience, we are developing partnerships and implementing stations in universities, airports, hotels and public areas so that the shared car</p>	<p>We are working towards obtaining more information about the consumer so that it's possible to offer services more customized to the users needs and have more specific consumer profiles.</p>	<p>Government offers subsidies for the purchase of electric cars, which makes it possible to expand the carsharing model, since the acquisition of vehicles is one of the main investments of this type of model, together with the construction of stations. Limiting the purchase of conventional cars and their utilization in</p>	<p>Exploring the diversification of services according to the users needs. Today we have services aimed at individuals (both for monthly and one-off plans) or customized for companies that want to outsource their fleet management (companies can save cost if they use the carsharing instead of using their own cars).</p>

		option is more convenient than public transport is today.		large cities such as Shanghai is also a policy that benefits them indirectly, as people start to see in the carsharing a viable possibility to travel by car in the cities.	
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