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Methodologies for evaluation of Brazilian urban mobility policy: a systematic review

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ABSTRACT

Brazil's National Urban Mobility Policy promotes sustainable mobility by prioritizing public and non-motorized transport in the population's travel matrix. To implement this policy, Urban Mobility Plans must not only contain guidelines and supporting instruments but also establish a systematic approach for evaluation, revision and periodic updating, requiring the adoption of an evaluation and monitoring methodology adapted to the reality of each municipality. To provide an overview of the main methods used to evaluate urban mobility policy in the Brazilian context, this article uses the methodological procedures of a Systematic Literature Review. The selection of 19 works evaluated was made in the Brazilian Digital Library of Theses and Dissertations, whose analysis allowed us to identify: (i) a predominance of research that uses the analysis of legislation, in contrast to the small number that deals with mobility in loco; (ii) the use of the Urban Mobility Law as a reference for defining the parameters for evaluating urban mobility policy in most studies; (iii) a balance in the parameters used in the studies, guaranteeing coverage of the main urban mobility issues, even with different approaches. The results have demonstrated that the evaluation of urban mobility policy must use different methods, techniques and tools, either in combination or individually, and should be conducted periodically, to effectively meet the demands and specificities of each city.

KEYWORDS: Urban Mobility Policy. Systematic Review. Evaluation methodologies.

1 INTRODUCTION

Urban mobility may be defined as an attribute associated to the movement of people and goods, which corresponds to the different responses given by individuals and economic agents to their travelling needs, taking into account the dimensions of the urban space and the complexity of the activities carried out in it (Brazil, 2013a). When planned in an integrated and sustainable way, it contributes to citizens' access to cities, improving quality of life and boosting economic development (Brazil, 2013b).

The rapid growth of the urban population, coupled with a model of urban expansion characterized by low density and sprawl, has become unsustainable for urban mobility (Pontes, 2010). These factors, together with transportation and traffic policies that favor dependence on the massive use of individual motorized transport and the construction of related infrastructure, as well as other factors, contribute to the deterioration of the population's quality of life in urban centers (Magagnin, 2023). As a result, these conditions are a cause for concern for many urban managers in municipalities of different demographic sizes.

In response to with this reality, several countries have implemented specific legislation aimed at improving better urban mobility conditions for people and goods, promoting equity in travel, and making cities more humane and healthier (Costa, 2008; Magagnin, 2008; Mondini, 2016). In Brazil, the urban mobility policy, instituted in 2003, seeks to rethink city planning, based on an urban design that promotes the distribution of activities and public facilities, reduces individual motorized journeys, and incentives for the use of active modes (walking and cycling) and collective modes of transport (Magagnin, 2008).

Despite the implementation of the urban mobility policy in 2003, the corresponding mobility law (Federal Law No. 12,587), which establishes the guidelines for the National Urban Mobility Policy, was approved by the National Congress and sanctioned by the Presidency of the Republic only in 2012 (Brazil, 2012). This law emphasizes the importance of the Urban Mobility

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Plan as an instrument for implementing Brazil's National Urban Mobility Policy. Furthermore, it defines guidelines for each sphere of government, according to its legal competencies, to contribute to the implementation of urban mobility policy throughout the national territory.

Textually, this law provides guidance for municipalities to discuss the challenges of urban mobility and plan their cities to guarantee broad and democratic access to urban space. This is achieved by effectively prioritizing collective and non-motorized modes of transport in a way that is socially inclusive and ecologically sustainable (Magagnin, 2008; Brazil, 2015). A significant challenge is the implementation of an integrated policy between urban mobility planning and urban planning, finding evaluation tools that consider the complexity of mobility systems (Pontes, 2010). In several countries, particularly in Europe, various initiatives have focused on evaluating and analyzing urban mobility policies. In Brazil, some of these initiatives focus on developing and applying models and indicators adapted to the economic, social and environmental realities of Brazilian cities (Marins, 2017).

Faced with urban dynamics and the need for actions to reduce the negative impacts of the current urban mobility pattern, it is essential that planners and public policymakers to have tools to evaluate and monitor urban mobility. Several academic studies emphasize the importance of each municipality monitoring the implementation of this policy, both during the preparation of the Urban Mobility Plan (including diagnosis, definition of goals and actions, and approval of the plan) and during its implementation, through continuous monitoring.

Brazilian researchers (Costa, 2008; Magagnin, 2008; Silva, 2009; among others) employ different methods and techniques to evaluate and monitor urban mobility, promoting different ways to make this policy effective according to the reality of each city. In these studies, the methodologies are used individually or combined with different qualitative and/or quantitative methods and techniques. To identify the most commonly used methods to evaluate urban mobility policies in different Brazilian municipalities, as well as the gaps in this research, this paper conducts a systematic literature review, which brought together 19 master's and doctoral studies developed in Brazil over the last 15 years.

2 OBJECTIVE

The core purpose of this article is to identify the main methodological procedures developed in Brazilian academia to evaluate urban mobility policy.

3 METHODOLOGY

To achieve the proposed objective, a protocol for the systematic review was adopted, which includes the review and selection of academic works that have incorporated the evaluation of urban mobility policy, through the adoption of three stages: (1) identification of electronic databases and definition of search criteria, (2) definition of parameters for data analysis and collection, and (3) analysis and synthesis of the results.

Once the theme and objective of the systematic review were defined, the first stage involved selecting the most appropriate database. As the aim was to identify studies that used

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methodologies to evaluate urban mobility policies in Brazil, the Brazilian Library of Theses and Dissertations (BDTD) was chosen. This database focuses on Brazilian research and reflects academic production on the topic. The selected keywords included the terms 'implementation' and 'evaluation' accompanied by the term 'urban mobility policy'. This approach ensured the term 'urban mobility policy' restricted the search to works related to urban policy, covering mainly legislative and management issues, while the terms 'implementation' and 'evaluation' filtered out studies that presented analyses with different focuses, mainly case studies.

The PRISMA (Transparent Reporting of Systematic Reviews and Meta-Analyses) methodology (Moher *et al.*, 2020) was used to screen the papers, using three different parameters. The initial search identified 265 papers, from which the first filter considered the titles of the documents. In this screening, papers that did not have Brazil as their spatial focus and that dealt with individual aspects of urban mobility, such as evaluating types of transport or specific infrastructures, were excluded, resulting in 33 papers. The second filter was carried out by reading the abstracts, following the previously defined criteria for the inclusion or exclusion of research, resulting in the selection of 22 papers. The last stage of exclusion involved a full reading of the documents, during wich three studies were excluded because they dealt with topics such as the behavioral analysis of participants involved in formulating public policies and analyses in the field of law, using mobility policy as the object of study. As a result, 19 papers were selected for this systematic review (Table 1).

Table 1 - Process for selecting papers for the systematic review

Keyword search	Identification	Filter by title	Filter by overview	Eligibility
"implementation of urban mobility policy"	106	11	10**	19
"evaluation of urban mobility policy	159	22*	12**	
Total	**265**	**33**	**22**	**19**
***04 papers were eliminated due to duplication; **03 papers were eliminated due to lack of adherence to the theme**				

Source: Elaborated by the authors (2024).

The survey was carried out in May 2023 and have evaluated the 19 selected papers based on a number of parameters that made it possible to systematize the data into two topics: (i) general characterization, where it was possible to identify an overview of scientific production on the evaluation of urban policy in Brazil. This included evaluating parameters such as: originating university; state; type of research - thesis or dissertation; keywords used; area of the postgraduate program; number of cities studied and their population sizes; and (ii) specific characterization, covering the following parameters: research objective; sphere of analysis (work approach - on-site analysis; legislation; management); methods, techniques and instruments used (field analysis using technical audit; document analysis; interview or questionnaire); research evaluation guidelines (parameters present in the mobility law; other indicators); classification of the research period in relation to current urban mobility legislation (Project Law 1.687/2007; Law 12.587/12); identification and classification of the parameters evaluated in the 19 studies using the classification proposed by Costa (2008).

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The identification of the parameters used in works to evaluate urban mobility policy was based on the study carried out by Costa (2008), who sought to identify the concepts that structure the sustainable urban mobility framework in Brazilian cities. This process involved bringing together professionals from different areas and cities, resulting in the development of the Sustainable Urban Mobility Index (IMUS). Its hierarchical structure comprises nine domains, thirty-seven themes and eighty-seven indicators, and each theme is associated with a sustainability dimension (social, economic and environmental). These thematic groups cover traditional aspects of urban mobility planning and aspects related to the new paradigms of integrated planning (Pontes, 2010). According to the author, due to the way it was designed and structured, the IMUS can be applied in different contexts, enabling the identification of key elements for sustainable urban mobility in a municipality, region, organization, entity or group of managers.

In the final stage, the results were analyzed and summarized by quantifying the information and creating figures and tables.

4 RESULTS

By analyzing the nineteen selected Brazilian studies on methodologies used to evaluate urban mobility policies, it was possible to obtain an overview of academic production over the last 15 years (Table 2). The analysis reveals that the first studies on this subject began to be published in Brazil in 2008, still based on Project Law 1.687/2007 (now Law No. 12,587/2012), which sought to solidify and regulate the National Urban Mobility Policy. There was a concentration of research between 2008 and 2010, and with the enactment of the Urban Mobility Law in 2012, there was an increase in publications.

Of the papers analyzed, four are doctoral theses (Costa, 2008; Magagnin, 2008; Marins, 2017; Machado, 2019), while the others are master's dissertations. These studies are linked to postgraduate programs in the areas of Transportation Engineering and Transport (55.55%), Civil Engineering (33.33%), Architecture and Urbanism (22.22%) and Production Engineering (22.22%). In addition, papers were found in the areas of Administration, Development and Environment, Public Management, Regional Development, Urban and Regional Planning, Planning and Public Governance and Social Sciences, with one paper in each of these areas.

To identify the centers of research in urban mobility, with a focus on work on the methodology for evaluating national urban mobility policy, the following universities stand out: the Federal University of Brasilia (UNB) with the largest number of papers, 4 dissertations (Silva, 2009; Pontes, 2010; Moraes, 2017; Cortizo, 2018), followed by the Federal University of Rio Grande do Norte (UFRN) with 3 papers (Braga, 2018; Lima, 2018; Dantas, 2022) and the University of São Paulo (Costa, 2008; Magagnin, 2008), the Federal University of Rio de Janeiro (Maranhão, 2017; Marins, 2017) and the Federal University of Pernambuco (Béhar, 2014; Amorim, 2019), respectively with two studies each.

In terms of the number of cities evaluated, the studies applied different methodologies to analyze urban mobility policy in different contexts. Eight studies involved analysis in a single

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city (Costa, 2008; Magagnin, 2008; Mondini, 2016; Moraes, 2017; Braga, 2018; Fernandes, 2018; Jesus, 2019; Dantas, 2022), while five involved groups of related cities, such as metropolitan areas (Pontes, 2010; Béhar, 2014; Maranhão, 2017; Lima, 2018; Pereira, 2020). Other studies analyzed municipalities of different demographic sizes.

To assess the size of the cities studied, the IBGE categorization was followed. Six papers (31.57%) dealt with cities of all sizes (Silva, 2009; Béhar, 2014; Cortizo, 2018; Lima, 2018; Amorim, 2019; Machado, 2019), while fifteen papers (78.94%) dealt with medium-sized cities, either a single municipality or together with other cities (Costa, 2008; Magagnin, 2008; Silva, 2009; Béhar, 2014; Maranhão, 2017; Marins, 2017; Moraes, 2017; Santos, 2017; Braga, 2018; Cortizo, 2018; Lima, 2018; Amorim, 2019; Machado, 2019; Pereira, 2020; Dantas, 2022). Ten studies evaluated large cities, of which only one involved a single municipality (Fernandes, 2018). In territorial terms, the states of Goiás (19 cities), Rio de Janeiro (17 cities) and Pernambuco (15 cities) stood out in terms of the number of cities studied.

Table 2 - Summary of general characterization

Author	University	State	T/D	N° cities	Small	Medium	Large
Amorim (2019)	UFPE	PE	D	4	2	1	1
Béhar (2014)	UFPE	PE	D	14	6	6	2
Braga (2018)	UFRN	RN	D	1		1	
Cortizo (2018)	UNB	DF	D	11	2	2	7
Costa (2008)*	USP	SP	T	1		1	
Dantas (2022)	UFRN	RN	D	1		1	
Fernandes (2018)	UFPB	PB	D	1			1
Jesus (2019)	Unijuí	RS	D	1	1		
Lima (2018)	UFRN	RN	D	5	2	2	1
Machado (2019)	UFRGS	RS	T	11	3	4	4
Magagnin (2008)	USP	SP	T	1		1	
Maranhão (2017)	UFRJ	RJ	D	9		7	2
Marins (2017)	UFRJ	RJ	T	15		10	5
Mondini (2016)	UFSC	SC	D	1	1		
Moraes (2017)	UNB	DF	D	1		1	
Pereira (2020)	UTFPR	PR	D	4		4	
Pontes (2010)	UNB	DF	D	22	21		1
Santos (2017)**	UNESP	SP	D	59	43	16	
Silva (2009)	UNB	DF	D	5	3	1	1
Total	**11**	**09**	**-**	**99*** **	**10 studies**	**15 studies**	**10 studies**

Technical text:
UFPB (Federal University of Paraíba); UFPE (Federal University of Pernambuco); UFRGS (Federal University of Rio Grande do Sul); UFRJ (Federal University of Rio de Janeiro); UFRN (Federal University of Rio Grande do Norte); UFSC (Federal University of Santa Catarina); UNB (University of Brasília); UNESP (São Paulo State University); Unijuí (Northwestern Regional University of the State of Rio Grande do Sul); USP (University of the state of São Paulo); UTFPR (Federal Technological University of Paraná).
T/D (Thesis or Dissertation); T (Thesis); D (Dissertation).
Small (Small city: up to 100.000 inhabitants); Medium (Medium-sized city: 100.001 a 500.000 inhabitants); Large (Large city: over 500.001 inhabitants).
*Costa (2008) developed his index based on workshops in eleven Brazilian cities, but the index was applied to only one city, so this was the value used for the general characterization.
**Santos (2017) applied questionnaires to 59 cities, 43 of which were small and 16 medium-sized, in the state of São Paulo, although the names of the cities were not disclosed in the paper.
***Sum of non-repeated cities.

Source: Elaborated by the authors (2024).

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As for the keywords used by the authors to categorize the research, 36 different terms were identified, and four papers did not provide this information (Pontes, 2010; Marins, 2017; Maranhão, 2017; Cortizo, 2018). The prominent terms included 'urban mobility' (13.55%), 'public policies' (10.16%), 'mobility plan' (6.77%), 'cities', 'sustainability' and 'transport' (5.08% each), 'sustainable urban mobility' and 'urban planning' (3.38% each); the remaining terms appeared only once.

After the general analysis of the papers, a detailed characterization of the studies was conducted to understand the research objectives and methodologies used based on different parameters (Table 3).

Table 3 - Summary of the analysis of objectives and methodologies

Author	Objective	Sphere of analysis			Method, technique and instrument			Evaluation guideline		Current legislation	
		I	II	III	IV	V	VI	VII	VIII	IX	X
Amorim (2019)	Analyzing the transformative potential of the PMU										
Béhar (2014)	Analyzing the implementation of PROMOB										
Braga (2018)	MUS monitoring										
Cortizo (2018)	Analyzing the implementation of the PNMU										
Costa (2008)	Diagnosis and monitoring of UM										
Dantas (2022)	Evaluation of PNMU implementation										
Fernandes (2018)	Evaluation of MU from a sustainable perspective										
Jesus (2019)	Analyzing the SP in the development of the MU										
Lima (2018)	Analysis of transport management by the PNMU										
Machado (2019)	Applicability of the PNMU through the PMU										
Magagnin (2008)	Computer tool for drawing up and monitoring PMUs										
Maranhão (2017)	PMU implementation barriers										
Marins (2017)	Evaluation of MUS effectiveness										
Mondini (2016)	Definition of criteria for evaluating UWPs										
Moraes (2017)	Tool to support UWM management										
Pereira (2020)	Evaluation of the implementation of the PNMU										
Pontes (2010)	Analyzing urban mobility based on the application of IMUS (Costa, 2008)										
Santos (2017)	Barriers to the implementation of the PMU										
Silva (2009)	Identifying the approach to urban mobility in DPs										
Total	-	**10**	**14**	**13**	**08**	**14**	**15**	**11**	**14**	**04**	**15**

Notes:

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Author	Objective	Sphere of analysis			Method, technique and instrument			Evaluation guideline		Current legislation	
		I	II	III	IV	V	VI	VII	VIII	IX	X

I (On-site analysis); II (Legislation); III (Management); IV (Field Analysis - Technical Audit); V (Document analysis); VI (Interview or Questionnaire); VII (Parameters focused on the urban mobility law); VIII (Other parameters or Indicators); IX (Project Law 1.681/2007); X (Law 12.587/2012).

Acronyms: IMUS (Sustainable Urban Mobility Index); UM (Urban Mobility); MUS (Sustainable Urban Mobility); PD (Master Plan); PE (Strategic Planning); PMU (Urban Mobility Plan); PNMU (National Urban Mobility Policy); PROMOB (State Urban Mobility Programme of the Pernambuco state government).

Source: Elaborated by the authors (2024).

The research objectives address the National Urban Mobility Policy (PNMU), the Urban Mobility Plans (PMU) and the evaluation of Urban Mobility in all its spheres, including the Municipal Master Plan. Of the studies, six (31.57 %) deal with the PNMU, two of which assess management based on the PNMU (Moraes, 2017; Lima, 2018) and the others evaluating its implementation and applicability of the PNMU (Cortizo, 2018; Machado, 2019; Pereira, 2020; Dantas, 2022). Five studies (26.31%) centered on the PMU, with two studies assessing the barriers to its implementation (Maranhão, 2017; Santos, 2017) and the others analyzing the PMU in different ways (Magagnin, 2008; Mondini, 2016; Amorim, 2019). Machado's work (2019) is part of both groups, as it evaluated the applicability of the PNMU through the PMU. Another five studies (26.31%) adopted a broader approach, using urban mobility as the object of study and considering its different spheres (Costa, 2008; Pontes, 2010; Marins, 2017; Braga, 2018; Fernandes, 2018). The remaining studies addressed diverse objectives: Silva (2009) evaluated mobility in Master Plans, Béhar (2014) analyzed the implementation of an urban mobility program based on its respective projects; and Jesus (2019) discussed strategic planning in the development of urban mobility.

Regarding the sphere of analysis, it was found that the majority of the studies looked at legislation (73.68%), while 68.42% of the studies assessed urban mobility management and 52.63% conducted in loco analyses. Only Costa (2008), Magagnin (2008), Pontes (2010), Béhar (2014), Braga (2018), Jesus (2019), Pereira (2020) and Dantas (2022) utilized all three spheres of evaluation. Nine studies (47.36%) addressed only one of the spheres of analysis, with legislation being the most analyzed alone, with four studies (Silva, 2009; Mondini, 2016; Amorim, 2019; Machado, 2019), followed by management, which was the focus of three studies (Moraes, 2017; Santos, 2017; Lima, 2018). Marins (2017) and Fernandes (2018) were the only authors who conducted only in loco analysis.

Field analysis was the least used technique, chosen by 42.10% of researchers (Costa, 2008; Pontes, 2010; Marins, 2017; Braga, 2018; Fernandes, 2018; Jesus, 2019; Pereira, 2020; Dantas, 2022). The majority opted for document analysis and interviews or questionnaires, with 14 (73.68%) and 15 (78.94%) studies utilizing each technique, respectively. These methods were used alone or in combination, with six studies using all three techniques (Costa, 2008; Pontes, 2010; Braga, 2018; Fernandes, 2018; Jesus, 2019; Dantas, 2022).

National and international bibliographical references, along with the elements of the

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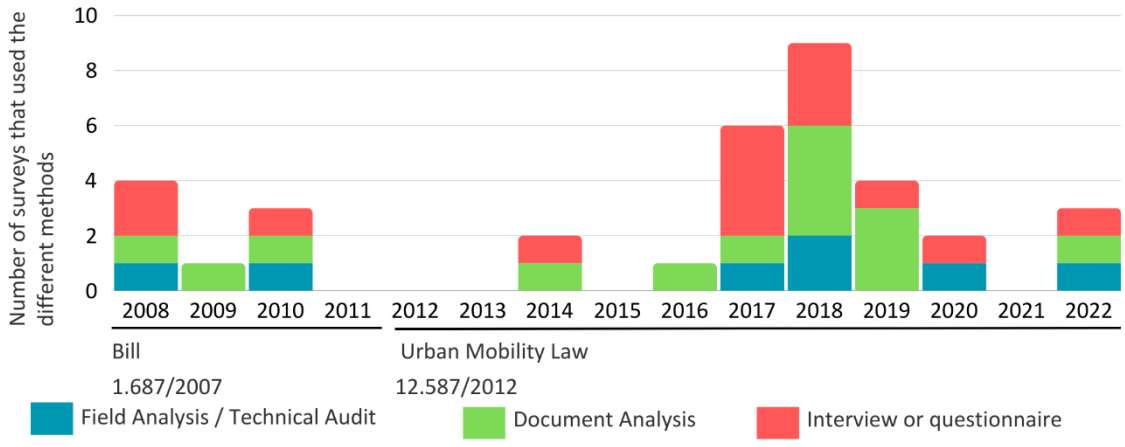
National Urban Mobility Policy (PNMU), supported the definition of the themes and indicators used by the authors to evaluate the urban mobility policy of Brazilian cities. The definitions present in the PNMU were found in most of the studies, 31.57% used both types of guidelines (Maranhão, 2017; Santos, 2017; Braga, 2018; Cortizo, 2018; Amorim, 2019; Machado, 2019), while 26.31% incorporated only the PNMU (Mondini, 2016; Moraes, 2017; Lima, 2018; Pereira, 2020; Dantas, 2022). Additionally, eight studies (42.10%) did not use the elements contained in the PNMU, as they incorporated other references.

The mobility legislation in effect at the time of the research was used as a temporal indicator, allowing for an understanding of the conceptual influences that guided the studies. This was divided between the influence of Project Law 1.687 of 2007 and the Urban Mobility Law (Federal Law No. 12,587) of 2012. It should be noted that the Urban Mobility Law was an important milestone for the implementation of urban mobility policy guidelines in the country.

The results of the chronological analysis of the methodologies reveal their distribution over time. The use of interviews or questionnaires has been consistently present, either as part of the process or as a final product, consulting experts on topics related to urban mobility. There has been an increase in the use of document analysis, while studies involving field analyses have shown a decrease (Figure 1).

Figure 1 - Classification of the methodologies used in research over the years



Source: Elaborated by the authors (2024).

Regarding the content analysis of the research in relation to the hierarchical structure adopted by Costa (2008) to evaluate the urban mobility policy, it was possible to identify that some studies clearly presented the same nomenclatures defined by the author, especially when it came to the development of indicators (Table 4). We showcase that studies that used interviews or questionnaires used some keywords present in the questions of these studies.

Table 4 - Themes used to evaluate the urban mobility policy

Domain	Qty.*	Theme	Qty.*	Authors
Accessibility	13	Accessibility to transport systems	10	1, 3, 5, 9, 10, 11, 13, 14, 15, 17
		Universal accessibility	8	1, 5, 7, 8, 9, 13, 16, 17

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Domain	Qty.*	Theme	Qty.*	Authors
		Physical Barriers	3	1, 5, 17
		Legislation for people with special needs	2	5, 17
Environmental aspects	11	Control of impacts on the environment	8	1, 2, 5, 11, 13, 15, 16, 17
		Natural resources	7	2, 3, 4, 5, 11, 13, 17
Social aspects	12	Citizen support	5	1, 5, 8, 15, 17
		Social inclusion	6	1, 3, 5, 7, 10, 17
		Education and citizenship	3	5, 15, 17
		Popular participation	11	1, 3, 5, 8, 9, 10, 12, 15, 16, 17, 18
		Quality of life	3	5, 10, 17
Political aspects	15	Integration of political actions	8	4, 5, 9, 10, 12, 15, 17, 18
		Fundraising and management	10	1, 2, 3, 5, 7, 12, 15, 16, 17, 18
		Urban mobility policy	10	3, 5, 6, 9, 12, 15, 16, 17, 18, 19
Infrastructure	10	Provision and maintenance of transport infrastructure	9	2, 4, 5, 10, 11, 14, 15, 17, 18
		Distribution of transport infrastructure	4	5, 10, 16, 17
Non-motorized modes	11	Cycling transport	11	1, 3, 5, 7, 8, 10, 11, 14, 15, 16, 17
		Walking	9	1, 5, 7, 8, 10, 11, 14, 16, 17
		Reduced travel	5	5, 11, 16, 17
Integrated planning	16	Training of managers	9	1, 4, 5, 6, 12, 15, 16, 17, 18
		Central areas and areas of historical interest	3	5, 16, 17
		Regional integration	6	1, 5, 9, 12, 17, 19
		Transparency of the planning process	3	4, 5, 17
		Planning and control of land use and occupation	9	1, 2, 5, 10, 11, 12, 16, 17, 19
		Strategic and integrated planning	9	1, 3, 5, 12, 15, 16, 17, 18, 19
		Urban and urban infrastructure planning	6	5, 8, 10, 16, 17, 18
		Master Plan and urbanistic legislation	6	1, 5, 10, 15, 16, 17
Traffic and urban circulation	13	Traffic accidents	9	1, 3, 4, 5, 7, 10, 11, 15, 17
		Traffic education	5	1, 5, 15, 16, 17
		Fluidity and circulation	6	3, 4, 5, 7, 11, 17
		Traffic operation and enforcement	3	5, 10, 17
		Individual transport	9	3, 5, 7, 8, 10, 11, 13, 17, 18
Urban transport system	17	Availability and quality of public transport	12	3, 5, 6, 7, 8, 10, 11, 13, 14, 15, 17, 18
		Modal diversification	8	1, 2, 5, 11, 12, 17, 18, 19
		Regulation and inspection of public transport	3	5, 15, 17
		Integration of public transport	8	1, 2, 5, 6, 10, 15, 16, 17
		Tariff policy	8	3, 5, 10, 11, 13,14, 16, 17
Others	13	Smart Mobility	6	1, 4, 11, 12, 16, 18
		Preparation of the PMU	4	1, 12, 16, 18
		Operational management	4	12, 15, 16, 18
		Parking lot	3	10, 14, 16
		Dissemination	3	15, 16, 18
		Data	3	12, 16, 18

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Domain	Qty.*	Theme	Qty.*	Authors
		Monitoring	3	11, 12, 16
		Load	2	10, 16
		Socioeconomic aspects	1	11
		Investments in events	1	2
		Local Displacement Profile	1	11
		Attractiveness of active mobility	2	14, 18
		Rural area	1	8

Legend:
1 (Amorim, 2019); 2 (Béhar, 2014); 3 (Braga, 2018); 4 (Cortizo, 2018); 5 (Costa, 2008); 6 (Dantas, 2022); 7 (Fernandes, 2018); 8 (Jesus, 2019); 9 (Lima, 2018); 10 (Machado, 2019); 11 (Magagnin, 2008); 12 (Maranhão, 2017); 13 (Marins, 2017); 14 (Mondini, 2016); 15 (Moraes, 2017); 16 (Pereira, 2020); 17 (Pontes, 2010); 18 (Santos, 2017); 19 (Silva, 2009).
*Number of searches identified.

Source: Elaborated by the authors (2024).

An analysis of the most global themes, referred to by Costa (2008) as ”domains”, revealed that the three most used subjects in the 19 studies were related to the ”Urban transport system” domain (17 studies), followed by ”Integrated planning” (16 studies) and ”Political aspects” (15 studies). The least addressed domains were: “Infrastructure” (10 studies), ”Environmental aspects”, “Non-motorized modes” (11 studies each) and “Social aspects” (12 studies each).

The "Accessibility" domain examined both physical and economic access to transport networks, as well as public and private spaces. Thirteen authors used this domain to evaluate urban mobility policy. The most frequently addressed topics were "Accessibility to transport systems" and "Universal accessibility," corresponding to 52.63% and 42.10%, respectively. Only two authors (Costa, 2008; Pontes, 2010) explored the topic of "Legislation for people with special needs”.

Regarding the “Environmental Aspects” domain, which evaluated the environmental impacts of the transport system, 11 studies were identified and the results for its two themes were similar findings. The theme “Control of impacts on the environment” was addressed in 8 papers, while “Natural resources” was identified in 7 of them.

The “Social Aspects” domain analyses citizen support, and availability of information to citizens, access to urban opportunities in the urban environment, expansion of information availability, public participation, well-being and overall population satisfaction. Twelve authors used this domain in their research. The theme “Public participation” was the most analyzed, appearing in 57.89% of the research, reflecting the legal obligation of public participation in urban policy. The themes “Education and citizenship” and “Quality of life” were the least explored, each addressed in 15.78% of the studies.

The “Political Aspects” domain is associated with the articulation of political actions, fundraising for urban mobility, and the regulation of public policies. Fifteen studies were identified within this domain, and their topics were similarly distributed. The themes “Fundraising and management” and “Urban mobility policy” were each addressed in 10 studies, while “Integration of political actions” was explored in 8 studies.

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The “Infrastructure” domain evaluates the planning, provision and maintenance of transport infrastructure, as well as its spatial distribution. Ten studies were identified in this domain. “Provision and maintenance of transport infrastructure” was the most frequently addressed topic, present in 47.36% of the studies, followed by “Distribution of transport infrastructure”, with 21.05%.

The “Non-motorized modes” domain focuses on the provision of infrastructure, strategies for prioritizing and encouraging non-motorized modes of transport, and actions to reduce the need for travel. Eleven studies were identified in this domain. The most prominent themes were “Cycling”, present in 57.89% of the studies, and “Walking”, with 47.36%. “Travel reduction” was the least explored theme, identified in 26.31% of the studies.

The “Integrated Planning” domain encompasses various topics, including training technicians in urban mobility, preservation of historic or cultural areas, integration between agencies and municipalities, transparency in urban planning processes, planning and control of urban development, urban infrastructure and equipment, and the development, revision and updating of urban legislation. The most prominent themes were “Training of managers”, “Planning and control of land use and occupation” and “Strategic and integrated planning”, each present in 47.36% of the studies. The themes of “Central areas and areas of historical interest” and “Transparency of the planning process” were followed by three studies each.

The urban “Traffic and circulation” domain encompasses monitoring traffic accidents, raising awareness of the humanization of traffic, traffic management and the controlling individual transportation. Thirteen studies were identified in this domain. The most prominent themes were “Traffic accidents” and “Individual transport”, which featured in nine studies each (47.36%). The least covered topic was “Traffic operations and enforcement”, addressed in three studies.

The “Urban transport system” domain addresses issues related to public transport and the diversification of transport modes. It was the domain with the most research identified, totaling 17. The most frequently covered topic was “Availability and quality of public transport”, which was present in 63.15% of the studies. This was followed by “Modal diversification”, “Integration of public transport” and “Fare policy”, each identified in 42.10% of the studies.

During the analysis and classification of the parameters used in the research, some did not fully align with the parameters defined by Costa (2008), and were categorized as “Other”. These parameters covered various topics such as “Smart Mobility”, which involves the use of technologies for urban mobility; “Development of the PMU”, related to the process of developing the PMU; “Operational management”, related to municipal management of the technical staff and the production of urban mobility projects; “Parking”, addresses the city's parking policy; “Dissemination”, aimed at promoting active mobility through marketing; “Data”, related to the collection of data and studies on urban mobility in the municipality to assist in monitoring and development; “Monitoring”, refers to the follow-up of urban mobility policies; “Freight”, dealing with the transportation of goods within the municipality; “Socio-economic aspects”, deals with the relationship between transport costs and their social benefits; “Investments in events”, deals with urban mobility projects for specific events; “Local commuting profile”, involving information about individuals’ urban mobility practices in the city;

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“Attractiveness of active mobility”, addressing changes to make active mobility more attractive; “Rural area”, concerning urban mobility in rural areas.

The analysis of the parameters revealed a balance among the domains, despite the different research approaches. None of the domains classified by Costa (2008) showed a significant discrepancy, with participation ranging from 89.47% studies in the domain with the most work to 52.63% in the domain with the least research. However, 68.42% of the research included parameters that did not align with Costa's (2008) indicators, with “Smart Mobility” being the most frequently addressed, appearing in six studies.

5 CONCLUSION

This systematic review identified a wide range of work on Urban Mobility in Brazil, given its complexity. Some research addresses the overall panorama of urban mobility policy, seeking to assess all its facets, while others focus on individual aspects, such as legislation or management. The multidisciplinary approach was predominant in this group of studies, especially evidenced by the parameters chosen for analysis.

A few points stood out in the analysis: (i) a large number of studies focused with legislation, in contrast to the small number of studies that carried out on-site analyses (field analysis); (ii) a large number of studies using the Urban Mobility Law as a reference for the development of other analytical parameters, either individually or in addition to other references; and (iii) there was a balance in the parameters selected for the analyses, with no major discrepancies between the domains, indicating that the studies, despite their different approaches, do not fail to address the main issues of urban mobility.

The cities selected reflect the Brazilian reality, with most studies focusing on medium and small-sized cities, since size not only facilitates analysis but also reflects the prevalence of such cities in the country.

The various research approaches in this systematic review highlight the complexity and diversity of the subject of urban mobility. There is no specific formula for evaluating all its aspects without difficulty, especially considering the variety of cities in a country. The results showed that the evaluation of urban mobility policy can be carried out using different methods, techniques and tools, as long as these incorporate the specificities of each city, whether physical or political, since this process must be adapted by each municipality.

None of the methodologies presented fully addressed municipal urban mobility policy. Some had gaps because they did not evaluate a particular sphere, or because their approach focused on a specific theme. It is therefore important that more than one methodology be applied within the municipal planning process, which seeks to address its problems and specificities more effectively, allowing for constant adjustments in the methodologies applied so that each one is viable for the municipality's reality at the time of analysis.

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