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Installation of Regulatory Sandbox Environment from the Perspective of the Brazilian Charter for Smart Cities.

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ABSTRACT

The development of smart and sustainable cities is becoming a real necessity for Brazilian municipalities. As such, the objective of this article was to present the concept of smart cities, as well as the guidelines proposed by the Brazilian Charter for Smart Cities. Subsequently, the Regulatory *Sandbox* in cities is presented. It is an instrument proposed in the Charter and regulated by Federal Complementary Law No. 182/2021, and can also be installed in Brazilian municipalities, through temporary Government authorization. Its institution aims to develop innovative business models and test new technologies, with a view not only to improving the quality of life of its population but also as an instrument to be used to actively participate in the construction of a smart city. In this way, the analysis of the scientific and academic production carried out about the Regulatory *Sandbox* in Brazil was decided upon. The methodology used was analytical research, through literature review. The results showed that digital transformation is a fundamental change in cities and, the institution of a *Sandbox* model is a secure way to test and validate resource-saving technologies.

KEYWORDS: Test area. Regulation. Governance.

1. INTRODUCTION

Cities are centers of economic development in which are concentrated the main offers of employment, education, public and private services, cultural activities, etc., and present, as a challenge to the Municipal Government, the generation and distribution of benefits and opportunities which result from the processes of urbanization.

Imbued with the belief that local governments have a decisive role in the process of global mobilization for Sustainable Development, the Brazilian Charter for Smart Cities was born, a democratic political document proposed by the Ministry of Regional Development, which aims to assist in the construction of even better cities for people, through the process of digital transformation.

The main question centers around the importance of understanding the concept of smart cities, beginning with the perspective presented by the Brazilian Charter for Smart Cities (The Charter) and, following, to implement and, truly, effect an environment for testing technological solutions, more specifically, the creation of a regulatory *Sandbox* by the municipalities, an institute already consolidated by the national legislation.

At the national level, in addition to the Brazilian Charter for Smart Cities, initiatives such as the National Internet of Things Plan, established by Decree No. 9.854/2019 (BRASIL, 2019a), the *Sandbox* Guide for Smart Cities and the publication of the first ABNT standards[1] for cities stand out, which demonstrate the relevance of the theme at the national level.

It appears that the promotion of technological innovation in the public sector was sometimes an arduous task before the set of standards – codes, laws, decrees, resolutions, ordinances – conceived 20, 30, 40, and 50 years ago were introduced, in a socio-technological scenario different from the current one. In this sense, it is possible to affirm that many Brazilian public managers face difficulties in the process of implementing innovations within the public sector.

[1] ISO 37120 – Cidades Sustentáveis, ISO 37122 – Cidades Inteligentes e ISO 37123 – Cidades Resilientes.

This mismatch causes disruptive, innovative solutions, with high potential for improving the public service provided, to be discarded and removed, as they do not fall within current standards. The search for the adoption of innovative technologies is directly accompanied by the need for greater interaction and cooperation between innovation and public management ecosystems.

Within this context, the *Sandbox* Environment for Smart Cities is born, a space with technical and legal conditions for solutions of local interest to be truly experienced. In addition to Public Administration, the suppliers of the tested solutions also have the advantage of finding a space to improve their product throughout the experimentation process, interacting with the municipal manager and the local population.

In this sense, the objective was to systematically analyze the importance of establishing a *Sandbox* environment in cities, with the aim of reducing the distance between the innovation ecosystem and public managers with decision-making capacity, in order to encourage public-private dialogue, leading to efficient hiring, both technically and economically.

The methodology used is exploratory, in order to allow a more comprehensive and expansive analysis, and is also applied since it analyzes the institution of a testing environment for technological solutions in municipalities and uses a literature review for this purpose.

The structure of the article consists of an introduction, where the problem and objectives are properly delimited. This is followed by the literature review according to two notions - "Contextualization of the *Sandbox* in Brazil" and "Contextualization of the Brazilian Charter for Smart Cities". The Methodology for the definition of the research criteria carried out follows, and the "Results and Discussion" of the proposed theme are presented. Finally, the final considerations obtained in the development of this study are presented.

2 LITERATURE REVIEW

2.1. *Sandbox* Contextualization in Brazil

The term "*sandbox*" is English. In the first records of the use of the term figuratively, it was for the implementation of controlled environments for code testing. Within the context of the SDLC – *Systems Development Life Cycle*, the *Sandbox* creates a valuable isolation scenario for cybersecurity, by allowing, for example, codes to be tested and validated before being effectively operationalized, which prevents incidents within the systems for which they are intended (Brazilian Agency For Industrial Development, 2021., known by its Portuguese acronym ABDI)

In 2016, however, the United Kingdom appropriated this term (ABDI, 2021), with the creation by the FCA (*Financial Conduct Authority*), the regulatory body of the United Kingdom's financial system, of the “Regulatory *Sandbox*” (Brazilian Association of Entities of Financial and Capital Markets, 2022). It translated it as a regulatory testing environment, which inspired several countries – including Brazil – to create their own sandboxes for experimenting with innovative solutions and improving current standards (ABDI, 2021).

The *Sandbox* Guide for Smart Cities, developed by the Brazilian Industrial Development Agency – ABDI (2021) describes it as follows:

> In this transition from the concept to the horizon of "regulated services", on the one hand, the spirit of *Sandbox* risk isolation system programming was incorporated; on the other, the freedom provided by *Sandbox* games; and as a background, the regulation of the financial system and the challenges of "fitting in" certain disruptive solutions, usually originated from *fintechs*, into the traditional structure of rules and resolutions that govern the British financial system (ABDI, 2021, p. 12).

Under an economic and financial bias, in Brazil, on June 13, 2019, a Joint Communiqué was published by the Special Finance Secretariat of the Ministry of Economy, the Central Bank – BACEN, the Securities and Exchange Commission (CVM), and the Superintendence of Private Insurance (SUSEP), informing of the intention to implant a Regulatory *Sandbox* model in Brazil (BRASIL, 2022).

Individually, BACEN published Resolution No. 50, of December 16, 2020, which provides for the requirements for the establishment and execution by the Central Bank of Brazil of the Controlled Environment of Tests for Financial and Payment Innovations (Regulatory Sandbox), as well as for the procedures and requirements applicable for the classification and authorization to participate in this environment (BRASIL, 2020a).

SUSEP, in turn, published CNSP Resolution No. 381, of March 4, 2020, which establishes the conditions for the authorization and operation, for a specified period, of insurance companies exclusively participating in an experimental regulatory environment (Regulatory Sandbox) that develop an innovative project by complying with previously established criteria and limits and of other provisions (BRASIL, 2020b).

In turn, CVM published CVM Instruction No. 29, of May 12, 2021, which provides for the rules for the constitution and functioning of an experimental regulatory environment - regulatory *sandbox* (BRAZIL, 2021a)

With the advent of the Federal Complementary Law No. 182/2021 (BRASIL, 2021b), which established in Brazil the legal framework for startups and innovative entrepreneurship in the Brazilian legal system, the following definition of regulatory *Sandbox* was established:

> Art. 2 For the purposes of this Complementary Law, it is considered:
> II - experimental regulatory environment (Regulatory *Sandbox*): set of special simplified conditions so that participating legal entities can receive temporary authorization from bodies or entities with sectoral regulatory competence to develop innovative business models and test experimental techniques and technologies, by complying with criteria and limits previously established by the regulatory body or entity and through a facilitated procedure (BRASIL, 2021b, p.1)

Although recent, the *Sandbox* movement in Brazil has had its first experimentation environments initiated in cities. It is now possible to affirm that in the path of de-bureaucratization and the rights of economic freedom conferred on the Brazilian population by Law No. 13.874, of September 20, 2019, sandboxes are important tools to boost the improvement of reversed technological solutions for a greater quality of life for its citizens.

This statement stems from the fact that, sometimes, technological innovation encounters barriers in the public sector in the face of out-of-date legislation with reference to

the current technological scenario, which causes innovative solutions to be removed (COUTINHO FILHO, 2020).

Regarding the need for cooperation between innovation and public management ecosystems, the aforementioned Federal Law provides:

> Art. 3. º Art. 3. These are the rights of every natural or legal person, essential for the country's economic development and growth, subject to the provisions of the sole paragraph of art.170 of the Federal Constitution
> VI - to develop, execute, operate, or market new types of products and services when the regulatory standards become outdated due to internationally consolidated technological development, under the terms established in a regulation, which will discipline the requirements for measuring the concrete situation, the procedures, the time and the conditions of the effects (BRASIL, 2019b, p.1)

So, the challenge of the Government is precisely to face "disruptive innovations" (SAIKALI, 2017), that is new technologies that, when providing services or offering something positive, end up instigating competition between consolidated companies, opening the market to constant changes in order to maintain its consumers (MARQUES NETO, 2017).

In this regard, law and state regulation are challenged. This is because this technological advance requires the adaptive capacity of Law to allow innovations in the creative processes of new sources of Law itself (PELLIN, 2021), while often, the regulatory objective is precisely to curb or slow the advance of techniques that can be considered risky for the general security of society (CABALLERO et al., 2023).

Then, the regulatory *sandbox* emerges as a state tool combined with regulation and technological innovation, used when the Government, in this case, decides to offer a testing environment in which it removes certain limiting legal arrangements, while evaluating what is being tested, which can be validated and later, produced on a large scale or not (ABDI, 2021).

As characteristics of a regulatory *Sandbox*, according to Herrera and Vadillo (2018), the following are worthy of note: a) experimentation, that is, a clinical study in which the result is not guaranteed; b) temporal limitation, with no talk of an indefinite test time limit; c) case-by-case solutions, which can be adapted according to the activity performed and/or service offered; d) flexibility, allowing the adaptation to the proposed business models and; e) exceptionality of the test environment, which must be applied in a limited way.

Thus, the proposal of the regulatory *Sandbox* brings the regulator closer to the regulation, in addition to facilitating the proposition of a feasible regulation in the face of innovative businesses, also allowing the construction of an adequate regulatory framework (COUTINHO FILHO, 2020).

It is precisely in this aspect that the regulatory *Sandbox* is able to promote innovation in cities in a sustainable manner while creating a safe and controlled environment (CABALLERO et al., 2023).

Having presented the legal framework of the regulatory *Sandbox* in Brazil, with the advent of LC No. 182/2021, and the proposal embedded in it, the Brazilian Charter for Smart Cities was born.

2.2. Contextualization of the Brazilian Charter for Smart Cities

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The Brazilian Charter for Smart Cities is a document published in 2020 and is the result of a collaborative effort by several Brazilian public managers and experts. The Ministries of Regional Development and Science, Technology and Innovation coordinated it, with the aim of disseminating the themes of urban development, environment and technologies, resulting from the New Urban Agenda -[2] Nau (BRAZIL, 2019c).

As found in the Brazilian Charter for Smart Cities, the term "smart cities" emerged approximately twenty years ago (BRASIL, 2020c, p. 27). The document, however, does not present any significant author or disseminator or term or definition of its concept, which would be extremely relevant information because it deals with the essence of the document. As a result, this makes it difficult to locate solid and reliable data (LAPCHENSK, A. F., et al., 2021, p.4)

Presenting the guiding principles, guidelines, strategic objectives, and recommendations for smart cities, the Charter focuses on the digital transformation of Brazilian cities and aims to achieve not only digital transformation but, above all, urban development. It presents the following concept:

> "Smart Cities are cities committed to sustainable urban development and digital transformation, in their economic, environmental and socio-cultural aspects, that act in a planned, innovative, inclusive and networked way, promotes digital literacy, governance, and collaborative management and use technologies to solve concrete problems, create opportunities, offer services efficiently, reduce inequalities, increase resilience and improve the quality of life of all people, ensuring the safe and responsible use of data and information and communication technologies" (BRASIL, 2020c, p. 15).

However, the document itself also highlights the need to complement the concept of smart cities. There is also no information or reference to a city classified as fully intelligent, but rather to cities with different degrees of construction, and development, in order to become intelligent (KOCA et al., 2021).

Thus, it should be noted that the Brazilian Association of Technical Standards-ABNT published, in July 2020, the standard ABNT NBR ISO 37122:2020, with the following official definition of a Smart City:

> "Smart City: a city that increases the pace at which it provides social, economic, and environmental sustainability results and that responds to challenges such as climate change, rapid population growth, and political and economic instabilities, fundamentally improving the way it engages society, applies collaborative leadership methods, works through municipal disciplines and systems, and uses information from modern data and technologies, to provide better services and quality of life for those who inhabit it (residents, companies, visitors), now and for the foreseeable future, without unfair disadvantages or degradation of the natural environment" (ABNT, 2020, p.8)

After all, it is recalled, the development process that qualifies a city as intelligent is not carried out only through a technological prism, it also comprises the rest of this definition of the

[2] New Urban Agenda was adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III), held in Quito (Ecuador) on October 20, 2016.

concept of smart cities brought by the Brazilian Charter of Smart Cities (ABREU and MARCHIORI, 2023).

In addition to offering a definition of a smart city, and serving as a guiding compass for Brazilian cities, the Charter also aims to generate actions, thus understood as the preparation of documents, academic productions, and projects.

In this context, it is important to emphasize that the Brazilian Charter expressly recommended, within the scope of the strategic objectives of Brazilian smart cities, the implementation of urban experimentation laboratories:

> "4.5.4. Urban experimentation laboratories: Encourage the emergence of innovative urban solutions, creating transdisciplinary collaborative spaces (which enable cooperation between different disciplines and knowledge) for smart cities, in the broad perspective of digital transformation in cities. To ensure that solutions are achievable, one should focus on research and experimentation in real-world environments. To this end, there is a need to articulate educational and research institutions and other sectors involved in the production of knowledge, with institutional and legal support from the Municipal Public Administration. Integrate these Laboratories to the Observatory for digital transformation in cities and other official forums related to digital transformation " (BRASIL, 2020c, p. 73).

Thus, brief considerations were made about the provisions of the Brazilian Charter and the regulatory *sandbox* as one of the strategic objectives suggested by it, namely, the implementation of urban experimentation laboratories in Brazilian municipalities.

3. METHODOLOGY

The definition of the methodology of the scientific procedure to be adopted is of profound importance to obtain valid and rationally demonstrable answers (LAKATOS, 1992).

Considering that the proposed theme is, so far, little debated and relatively recent, especially in the legal literature, exploratory research is adopted as an approach, since it allows a more comprehensive analysis, as well as the feasibility of new specific studies.

With regard to nature, it is possible to affirm that research is of an applied nature, as it turns to the analysis of a concrete factual situation (VERGARA, 1998), seeking to find a way to regulate and effectively, quickly, safely, and with less economic expenditure, test environments so that technological solutions of local interest are truly experienced.

Initially, the literature review was used together with the contextualized analysis, in order to produce an established database including both the combinations of keywords and inclusion and exclusion criteria of articles, that is, the research of knowledge on a specific subject was qualitatively delimited.

Thus, this study can be classified as bibliographic research, since it is based on journal articles on smart cities in the national context.

It is important to clarify that in order to obtain a significant number of articles and achieve a better diagnosis, specifically due to the fact that the Brazilian Charter for Smart Cities was published in July 2020, a specific period was defined for the searches between 2021 and 2023. In addition, in order to locate articles, ensuring greater accuracy in the search and quality

of the material, the limitation of peer-reviewed journals was decided upon, the use of quotation marks, a combination of keywords, connected by the Boolean operator “AND”: “smart cities” AND Brazil.

Initially, to answer this question, a simple search was carried out in the Coordination Portal for the Improvement of Higher Education Personnel (capes), with the exact term “smart cities” AND Brazil, in the last 20 years, which returned in 69 publications, the oldest dating from 2013, but becoming more numerous in 2015.

Refining the search as outlined above, with the same exact term, there was a return of 16 publications, from 2021 to 2023, within the peer-reviewed journals. For the exact term “Brazilian charter for smart cities” there was only 01 result found on the platform. Finally, the exact term “Regulatory *Sandbox*” returned 4 results.

On the SciELO platform, the term “smart cities” AND Brazil returned 29 articles, the oldest from 2015, and 11 published in the period between 2021 and 2023. For the exact term “Brazilian charter for smart cities” there were no results found on the platform. There was also no return for the exact term “regulatory sandbox.”

Narrowing the search down further, the mention of the testing spaces was also analyzed, the regulatory *Sandbox*, instituted in the Brazilian system through Complementary Law No. 182/2021. Titles, summaries, and keywords were also analyzed.

The articles were registered and classified for analysis. After excluding the duplicate articles, the main areas of study were cataloged and presented in a built framework, answering objective questions in order to understand: A) the perception of what is meant by smart cities in the national academic scenario; B) the influence of the Brazilian Charter in the construction process of this concept; C) the presentation of the regulatory *Sandbox* as one of the viable mechanisms for the emergence of innovative urban solutions and sustainable digital transformation and; D) the eventual determination of practical results resulting from the institution of this testing area, marking an "X" for the positive answers to the questions elaborated.

Thus, this study can be classified as bibliographic research, since it is based on journal articles on smart cities in the national context.

4. RESULTS AND DISCUSSIONS

This item presents aspects of the cataloged bibliographic portfolio. Subsequently, the discussion of the content found is presented.

To this end, we started from the general concept of smart cities presented by the Brazilian Charter. Some aspects were selected that mark a city as intelligent, especially under the bias of urban development and sustainable digital transformation, which seeks to offer efficient services while ensuring the safe and responsible use of data and information, and communication technologies.

In this perspective, the Brazilian Charter makes use of a series of strategic objectives, highlighting, in the present work, strategic objective No. 4, which aims at the adoption of innovative and inclusive models of urban governance, with the municipal government as manager of impacts of digital transformation in cities.

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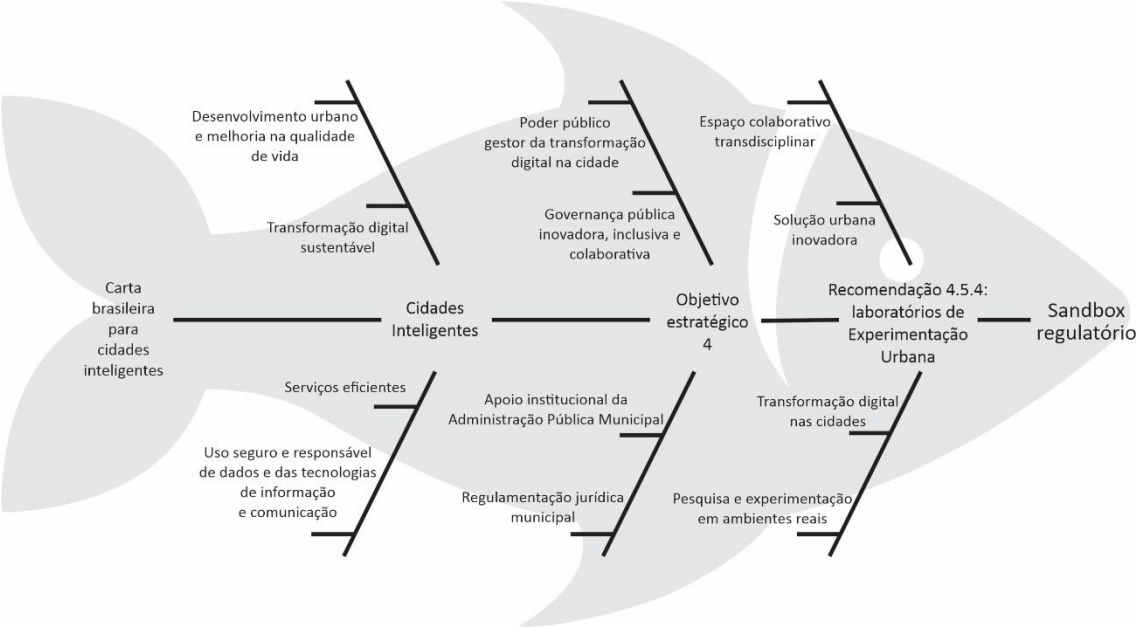
And precisely as the protagonist of the execution of urban policy, it is up to the city manager to provide institutional support and the respective legal regulations, in the field of his jurisdiction, for the institution of an urban environment of controlled and safe real experimentation, namely: the regulatory *Sandbox*.

To demonstrate this with more clarity, the following system is extracted, expressed in the form of a flowchart starting from the Brazilian Charter for Smart Cities and the regulatory *sandbox* provided for therein (Figure 1).

Figure 1 - Brazilian Charter of Smart Cities and Regulatory Sandbox.



Source: From the authors (2023).

The premises outlined above are highlighted, and following the proposal presented in this research, Chart 1 was developed, based on the articles collected.

According to the bibliographic research carried out, there is initially a discrepancy between the number of research papers published in foreign literature in relation to research published nationally on the subject. The discrepancy suggests that the object of the research "smart city" and its derivatives "Brazilian charter for smart cities" and "Regulatory *sandbox*" are scarce terms in the national literature.

It was noted that almost all research is theoretical and aims, through propositional suggestions, to contribute to the process of building smart cities, with the main focus raised, as improving the quality of life of the population and its sustainability.

It should be noted, however, that the term "smart city" has been applied in dozens of academic works related to the various dimensions that encompass it, and not only in what reflects the technology aspect. As determined, its relevance is also denoted in relation to research related to governance, public safety, urbanism, environment, sustainability, and tourism. It is possible to extract that the smart city theme permeates sectoral policies, such as urbanism, technology, transport, and the environment, among others.

Still, in the survey carried out, no research networks were identified among the existing groups. Considering that the theme is of public interest, the articulation between research groups is welcome, with some even advocating the creation of a multi-jurisdictional regulatory *Sandbox* for Latin America and the Caribbean (HERRERA and VADILLO, 2021).

Having made such considerations, Table 1 is presented, as mentioned above:

Table 1. Catalogued Scientific Articles and how they address aspects of smart city issues.

Article	Authors	Research area	A	B	C	D
A implantação de cidades inteligentes em Rondônia: uma ação do instituto federal.	FRANZIN, S. F. L. (2023)	Governança, tecnologia, sustentabilidade	X	X		
Sandbox regulatório: instrumento estratégico para promoção da inovação sustentável.	CABALLERO, P. E. F. et al. (2023)	Governança, sustentabilidade	X		X	
Sandbox regulatório e o uso medicinal da Cannabis: uma análise sob as premissas Law and Economics.	OLIVEIRA, B. B. de; ABREU, R. R. B. de (2023)	Saúde, regulação, governança			X	
Cidades inteligentes e o transporte urbano sustentável com bioenergia: um estudo de caso de Curitiba, Brasil	PASQUAL LOFHAGEN, JC; LIRA, G. S (2022)	Mobilidade, sustentabilidade, meio ambiente	X			
Análise de dados aplicada às Cidades Inteligentes: reflexões sobre a Região Nordeste do Brasil	BARBOSA and SÁNCHEZGENDRIZ. (2021)	Geografia, governança território	X			
Cidades inteligentes no Brasil: conexões entre poder corporativo, direitos e engajamento cívico.	CRUZ, L.; RHEA, J. (2023)	Governança urbanismo, direito digital.	X			
A segurança como fator-chave para a cidade inteligente, a confiança dos cidadãos e o uso de tecnologias.	PARDIM, V. I. et al. (2023)	Segurança, tecnologia, privacidade de dados.	X			
Inteligência geográfica na construção de políticas públicas: rumo à plataforma de monitoramento de áreas verdes urbanas do Estado de São Paulo.	FANTIN, M. et al. (2022)	Meio ambiente, governança, sustentabilidade e tecnologia.				
Dimensões que influenciam a percepção dos turistas sobre destinos turísticos Inteligentes.	MENDES FILHO, L., et al. (2022)	Tecnologia, inovação, turismo, sustentabilidade				
Cidades inteligentes e sustentáveis: percepções sobre a cidade de Curitiba/PR a partir dos planos plurianuais de 2014 a 2021.	SANTOS, E. L. et al. (2022)	Governança, economia, sustentabilidade	X			
Cidadania e desenvolvimento urbano sustentável sob a perspectiva do direito à locomoção nas cidades brasileiras.	GERMANO, F. et al. (2021)	Mobilidade, economia compartilhada.	X			
Cidades inteligentes e a mensuração de indicadores urbanos de economia e empreendedorismo: o caso de Passo Fundo/RS.	MÜLLER, L. et al. (2021)	Economia, empreendedorismo.	X			
Análise bibliográfica e sistemática da literatura acadêmica sobre “Cidades Inteligentes, Turismo e Competitividade.	BIANCOLINO, C. A., et al. (2021)	Turismo, economia, tecnologia	X			

Mobilidade, participação e dados: o caso da aplicação do Waze for Cities Data na cidade de Joinville.	HIROKI, S. M. Y. (2021)	Mobilidade, sustentabilidade, tecnologia				
Smart Cities: extrafiscalidade como indutora do desenvolvimento de cidades inteligentes	CARLI, F. G. et al. (2021)	Direito, sustentabilidade, governança	X			

A: Does the article conceptualize smart cities?
B: Does the article mention the Brazilian Charter for Smart Cities?
C: Does the article address the regulatory *Sandbox* institute/testing area?
D: Does the article present a practical result determined by the institution of the Regulatory *Sandbox*?

Source: From the authors (2023).

Analyzing Table 1, about the concept of smart cities (letter A), it was observed that academic studies tend to use concepts already established by international authors, with the concept of smart cities used in the Brazilian Charter for smart cities adopted in only 01 (one) of the cataloged articles, which is equivalent to 6.25% of the academic production analyzed. Exceptionally, we found a summary of a Dissertation: "*Adaptação às mudanças climáticas em núcleos urbanos: iniciativas em cidades inteligentes e a contribuição para a agenda 2030", -* "*Adaptation to climate change in urban centers: initiatives in smart cities and the contribution to the 2030 agenda*", addressing the environment, technology, and governance theme produced by MAZUTTI and BRANDLI (2021)

This shows that, although the Brazilian Charter was published in 2020, with wide national dissemination and with strong participation of various categories of civil society, and with the preparation of vast explanatory and propositional material, there has been no significant adherence on the part of the academic sector, so far (letter B).

It is noted, therefore, that there are aspects raised by the Brazilian Charter with regard to smart cities, which deserve to be better explored by the Brazilian scientific production sector since the smart city system is presented as an alternative to solving social problems arising from the urbanization process itself.

Based on the concept presented by the Brazilian Charter, the Federal Institute of Rondônia – IFRO stands out. In order to implement the first smart city in the State of Rondônia, an agreement was signed with the Municipality of Ariquemes, with the purpose of "*developing new technologies in the management of municipal needs and in the implementation of the concept of smart cities specifically in the municipality of Ariquemes-RO*" (FRANZIN et al., 2023).

To this end, this project provides for the delivery of modern, innovative, safe, and low-cost solutions, having been organized along 5 (five) development axes: education, health, entrepreneurship and innovation, citizen security, and governance.

In turn, conjugating the delimited terms in the methodological approach, the expression "regulatory *sandbox*" did not return any results from the SciELO platform. Along with the Capes platform, however, 03 (three) articles were found on the topic, totaling 18.75% of the cataloged articles (letter C).

In these, the theoretical aspect of what is desired with the construction of a testing area stands out, highlighting experimentation as an attractive alternative for the particular issue or area, since it has lower cost and less maturation time and also enables the public power to really understand what is tested there, before being validated and widely disseminated. It is,

therefore, a more dynamic regulatory process that fosters innovation in cities for the benefit of their population.

Finally, none of the cataloged articles was aimed at determining practical results resulting from the institution of a regulatory Sandbox (letter D). Only one of the articles brought, *in passing,* a brief presentation on a *case* in this sense in Brazil: *Vila A Inteligente, a regulatory sandbox that comprises an entire neighborhood in the Municipality of Foz do Iguaçu, in the State of Paraná, regulated by Municipal Decree No. 28.244/2020* (FOZ DO IGUAÇU, 2020).

However, there is a strong potential for growth, as smart cities start to establish it in their territory, thus allowing the calculation of concrete results over the next few years.

Still, in the survey carried out, no research networks were identified among the existing groups. Considering that the theme is of public interest, the articulation between research groups is welcome, with some even advocating the creation of a multi-jurisdictional regulatory *Sandbox* for Latin America and the Caribbean (HERRERA and VADILLO, 2021).

It should be noted, based on the revised bibliography, that the understanding of a smart city should not be limited to the implementation of technological innovations in order to improve the quality of life of those who inhabit it. Rather, whenever possible, it should be treated in an interconnected way with other dimensions that characterize it, such as governance, mobility, sustainability, accessibility, environment, and urbanism.

Thus, in order to be effective, such policies should not be defined in isolation, on the contrary, it is in the concept of poly-competence that the Charter suggests greater effectiveness in state action aimed at smart cities.

5. CONCLUSION

The objective was to analyze and discuss the importance of establishing a *Sandbox* environment in cities, based on the concept of smart cities presented by the Brazilian Charter for Smart Cities.

The analyzes performed are necessary, not only to understand the importance of the Municipal Government effectively making use of this instrument already provided for in federal legislation but for it to be used as an indicator in the manager's decision-making.

Equally relevant are the aspects of improving the quality of life, which includes inclusion, welcoming, managing and caring for the environment, and creating opportunities through a fertile economy, so that they are, primarily, cities for people.

It is up to public managers to verify the relevance, adequacy, and proportionality of the creation of a testing environment so that, when created, it is a true and effective tool available to the citizen in the construction of a city based on dialogue, since it is an ecosystem whose success depends mainly on popular participation.

It is suggested that future research on the theme use the Brazilian Charter for Smart Cities as a guiding instrument always appropriately adapted to the needs of a given city. It is, after all, a document that presents an articulated public agenda for smart cities within the Brazilian context. In this way, it will be possible to truly glimpse the main bottlenecks of Brazilian cities, according to their State, region, GDP, and other indicators.

Another suggestion is to promote research of qualitative and quantitative analysis of the regulatory *Sandbox* environments already instituted by the Government in several Brazilian municipalities, in order to verify their real effectiveness, in order to perceive the real needs of the citizen who inhabit or transit them.

Finally, it is hoped that this article will have contributed to the expansion of scientific production on this topic, which has wide potential for study and practical application, in addition to offering reflections on the benefits of installing a regulatory *Sandbox* environment in Brazilian municipalities.

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ANNEX 1 – Translation of titles of Articles used in Literature – For illustrative purposes only. These articles are NOT available in the English language. The translation of the titles serves only to demonstrate the content contained therein.

1. The implementation of smart cities in Rondônia: an action of the federal institute. FRANZIN, S. F. L. (2023) Governance, technology, sustainability X X
2. Regulatory sandbox: strategic tool for promoting sustainable innovation. CABALLERO, P. E. F. et al. (2023) Governance, sustainability X X
3. Regulatory sandbox and the medicinal use of Cannabis: an analysis under the premises of Law and Economics. OLIVEIRA, B. B. de; ABREU, R. R. B. de (2023) Health, regulation, governance X

4. Smart cities and sustainable urban transport with bioenergy: a case study from Curitiba, Brazil PASQUAL LOFHAGEN, JC; LIRA, G. S (2022) Mobility, sustainability, environment X
5. Data analysis applied to Smart Cities: reflections on the Northeast Region of Brazil BARBOSA and SÁNCHEZGENDRIZ. (2021) Geography, governance territory X
6. Smart cities in Brazil: connections between corporate power, rights and civic engagement. CRUZ, L.; RHEA, J. (2023) Governance urbanism, digital law. X
7. Security as a key factor for the smart city, citizens' trust and the use of technologies. PARDIM, V. I. et al. (2023) Security, technology, data privacy. X
   Geographic intelligence in the construction of public policies: towards the monitoring platform for urban green areas in the State of São Paulo. FANTIN, M. et al. (2022) Environment, governance, sustainability and technology.

8. Dimensions that influence tourists' perception of Smart tourist destinations. MENDES FILHO, L., et al. (2022) Technology, innovation, tourism, sustainability
9. Smart and sustainable cities: perceptions about the city of Curitiba/PR based on multi-year plans from 2014 to 2021. SANTOS, E. L. et al. (2022) Governance, economy, sustainability X
10. Citizenship and sustainable urban development from the perspective of the right to move around in Brazilian cities. GERMANO, F. et al. (2021) Mobility, sharing economy. X
11. Smart cities and the measurement of urban economy and entrepreneurship indicators: the case of Passo Fundo/RS. MÜLLER, L. et al. (2021) Economy, entrepreneurship. X
12. Bibliographical and systematic analysis of academic literature on “Smart Cities, Tourism and Competitiveness. BIANCOLINO, C. A., et al. (2021) Tourism, economy, technology X
13. Mobility, participation and data: the application of Waze for Cities Data in the city of Joinville. HIROKI, S. M. Y. (2021) Mobility, sustainability, technology
14. Smart Cities: extrafiscality as an inducer of the development of smart cities CARLI, F. G. et al. (2021) Law, sustainability, governance X