CHAPTER 61

Governance aspects for the development of smart and sustainable cities

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ABSTRACT
The search for sustainable development has required cities to adopt an innovative style of collaborative governance to design public policies, aimed at improving the quality of life of citizens, ensuring economic growth without compromising future generations. This article aims to demonstrate and evaluate the indicators and data on the ranking of smart cities in relation to the governance factor and its connection with public policies. For a better understanding, a conceptual analysis on sustainability will be presented, making a literature review, referencing the main concepts that make up sustainable development. The method used was documentary and bibliographic research, followed by the analysis of secondary data information obtained from the Connected Smart Cities (CSC) website. In the results section, the ranking related to the governance axis was analyzed in the following aspects: first, referring to the ranking of the top 10 smart cities in Brazil; then, the 10 cities considered smart in the Northeast region of Brazil were analyzed and, thirdly, the cities classified as smart in the State of Pernambuco. The concepts and analyzes obtained in this research demonstrated the search for a sustainability model that incorporates the idea of the urgency of transforming the environmental capacity, associated with the human capacity to sustain itself, through actions of the public power, organizations and society transforming the way cities act by providing the addition of smart cities. first referring to the ranking of the top 10 smart cities in Brazil; then, the 10 cities considered smart in the Northeast region of Brazil were analyzed and, thirdly, the cities classified as smart in the State of Pernambuco. The concepts and analyzes obtained in this research demonstrated the search for a sustainability model that incorporates the idea of the urgency of transforming the environmental capacity, associated with the human capacity to sustain itself, through actions of the public power, organizations and society transforming the way cities act by providing the addition of smart cities. first referring to the ranking of the top 10 smart cities in Brazil; then, the 10 cities considered smart in the Northeast region of Brazil were analyzed and, thirdly, the cities classified as smart in the State of Pernambuco. The concepts and analyzes obtained in this research demonstrated the search for a sustainability model that incorporates the idea of the urgency of transforming the environmental capacity, associated with the human capacity to sustain itself, through actions of the public power, organizations and society transforming the way cities act by providing the addition of smart cities. cities classified as smart in the State of Pernambuco. The concepts and analyzes obtained in this research demonstrated the search for a sustainability model that incorporates the idea of the urgency of transforming the environmental capacity, associated with the human capacity to sustain itself, through actions of the public power, organizations and society transforming the way cities act by providing the addition of smart cities. cities classified as smart in the State of Pernambuco.The concepts and analyzes obtained in this research demonstrated the search for a sustainability model that incorporates the idea of the urgency of transforming the environmental capacity, associated with the human capacity to sustain itself, through actions of the public power, organizations and society transforming the way cities act by providing the addition of smart cities.

Keywords: Governance, Smart Cities, Economical Development, Public Policy.

1 INTRODUCTION

Population growth and migration to large cities have generated numerous problems for society. The 21st century is marked by important social phenomena and, mainly, by the large concentration of people in urban environments (UN, 2012). With the increase of inhabitants in urban areas around the world, it has brought reflections on how public policies can offer more efficient and effective services to society.

In this sense, Brazilian municipalities are currently facing a series of challenges, which call into question the development of several regions, due to the concentration of the population and the limitation of resources, requiring particular attention for sustainable development and improvement in the quality of life of people . (BATAGAN, 2011).

In recent decades, the approach to sustainability has taken on a new role in the attempt to evolve society, through sustainable development, defined as “one that allows meeting their needs without compromising the ability of future generations” (BRUNDTLAND, 1987, p. 46).

With the worsening of the environmental imbalance, alternatives were established for cities to reduce their impacts and establish a direct link with society, in order to optimize the coexistence between the environment and people. In the wake of this movement, the “ *smart cities* ”, in the Portuguese translation the “smart cities”, which objectively has governance as the main element for its existence, promoting economic, social and environmental development. Well, governance is an essential part of the development of smart and sustainable cities, since it refers to the relationship between individuals, interest groups, institutions and administration service providers, with actions aimed at the community . (ALBINO; BERARDI; DANGELICO, 2015).

This article has the following research problem: how does governance contribute to the sustainable development of smart cities in the Northeast region of Brazil? In order to answer the problem, this article aims to assess the relevance of the contribution of governance aspects to the development of smart and sustainable cities located in the Northeast region of Brazil. Following, in view of the definitions presented in this study, through a literature review and analysis of organizational indicators on aspects of governance present in cities characterized as "smart cities"

In this sense, the research is justified by the description of the main difficulties in facing the challenges in the elaboration of public policies with governance solutions in Brazilian cities, as global sustainability will not be achieved without a transformation in the model of thinking, acting and planning urban spaces. .

This article is structured in five sections. In this first section, the research objective and justification were presented in the introduction. The second section addresses the theoretical foundation, segregated into topics referring to sustainability concepts; sustainable development, economic growth and the challenges of the 21st century; public policy; governance and smart cities. The third section presents the methodology. In the following section, it demonstrates the results acquired in the research. And finally, there are the conclusions of the study.

2 THEORETICAL FRAMEWORK

In this section, the concepts that will guide this study will be presented, among them, sustainability concepts; of sustainable development, economic growth and the challenges of the 21st century; of public policies, governance and, finally, smart cities.

2.1 CONCEPT OF SUSTAINABILITY

Before explaining the concepts of sustainability, it is important to record the origin of the term sustainable. According to Hoffer (2009), the term sustainable originated from the German expression " *Nachhaltend* " or " *Nachhaltig* " (longevity) from the book Lyra, by Carlowitz , in 1713, in French " *durabilité* " (durable) and in Dutch duurzaamheid and Duurzaam (sustainable).

The English term " *sustained yield* ", used since the mid-19th century, was a literal translation of the German word " *nachhaltig* ". The concept made its release in print in the book published in 1713, just over 250 years before the Brundtland Report. The " *Sylviculture oeconomica* " was the first comprehensive forestry manual, written by German Hanns Carl von Carlowitz , which dealt with instructions for growing wild trees. (GROBER, 2007 and PISANI, 2006).

According to Santos (*apud* Sgarbi *et al.* , 2008), theoretical studies on sustainability began in the field of environmental and ecological sciences, bringing to the discussion contributions from different disciplines, including Economics, Sociology, Philosophy, Politics and Law. . However, from 1960 onwards, environmental sustainability came to occupy a prominent place in the academic and political field, promoting discourse that involves issues of environment and social development in the broadest sense.

Over the years, the word sustainability has been highlighted in the national and international scenario, due to the gigantic environmental problems that have occurred all over the planet. The aggressive way of human beings with nature, increasingly seeking the exploitation of natural resources to satisfy their needs, without the perception that resources are finite and necessary for the survival of the human race.

The Latin dictionary by Castiglioni and Mariotti (1981) establishes the term " *sustinere* " (sustainable) as: to defend, maintain, assume, support, among others. According to Cavalcanti (2003), sustainability means the prospect of continuously obtaining equal or superior living conditions for a group of people and their successors in a given ecosystem.

Horbach (2005) and Dempsey *et al.* (2011) point out that sustainability is the meeting of three types of preferences simultaneously and in balance, reaching the environmental, economic and social aspects. In the view of Barbosa, Drach and Corbella (2014), sustainability is understood as a process of change through long-term social learning.

In this sense, sustainability is the solution for creating a new awareness in each individual, aimed at a gradual improvement in the environment. The term sustainability can be said to mean:

> [...] the set of processes and actions that are intended to maintain the vitality and integrity of Mother Earth, the preservation of its ecosystems with all the physical, chemical and

> ecological elements that enable the existence and reproduction of life, the meeting the needs of the present and future generations, and the continuity, expansion and realization of the potential of human civilization in its various expressions. (BOFF, 2012, p. 14).

as well :

> [...] constitutional principle that determines, with direct and immediate effectiveness, the responsibility of the State and society for the solidary realization of material and immaterial, socially inclusive, durable and equitable, environmentally clean, innovative, ethical and efficient development, in order to to ensure, preferably in a preventive and cautious way, in the present and in the future, the right to well-being. (FREITAS, 2012, p. 41).

Sustainability, according to Ayres (2008), is seen as a procedure of norms in which human beings must act in relation to nature and care for future generations. In studies by Lozano (2012), sustainability is appropriate for economic growth, based on social justice and efficient use of natural resources .

Finally, to understand the definition of sustainability, it is necessary to connect the term to its etymology. It is a concern that hovers in all social levels. A reality that allows, or even forces humanity to rethink its attitudes and design new paths. It can be said that sustainability is the ability of a process or form of resource appropriation to continue to exist for a long period of time. This leads to the expression of sustainable development.

2.2 CONCEPT OF SUSTAINABLE DEVELOPMENT, ECONOMIC GROWTH AND THE CHALLENGES OF THE 21ST CENTURY

The expression sustainable development (SD) shows a broader perspective. It emerged as a new concept that seeks to make development compatible with the economy, involving economic, social and environmental variables, indicating a path to be followed by developed and developing countries.

Concern for the environment was more intense when the First United Nations (UN) Conference on the Impact of the Environmental Development Process took place in 1972 in Stockholm, Sweden. According to Almeida (2002), during the Stockholm UN Conference, there is a growing discussion among nations on how to seek to reconcile economic activity with the preservation of the environment.

With the need to find a promising path to develop with sustainability, the planet needs urgent advances. However, it was from 1987, in Norway, that the World Commission on Environment and Development, presented the Brundtland Report, also known as “Our Common Future”, which defines sustainable development as “development that meets the needs of the world”. present without compromising the ability of future generations to meet their own needs”. (SCHRAMM; CORBETTA, 2015, p. 34-35).

The report starts from a complex view of the causes of the socio-economic and ecological problems of global society. It highlights the correlation between economy, technology, society and politics and alerts to a new ethical posture, based on responsibility both between generations and between members of today's

society. It sets goals to be achieved at national and international level, including the adoption of strategies for sustainable development and the protection of ecosystems.

On the other hand, in the understanding of Buarque (2002, p. 58), sustainable development "spreads as a differentiated development proposal" demanding new conceptions and perceptions organizing "a new attitude of society in the face of present and future challenges. "

However, for Becker (2008, p. 103), development has an adverse character, since "at the same time it is development for some, and not development for others".

According to Elkington (2001), the SD issue goes beyond an environmental or economic issue, but a social issue. In this sense, it is contextualized that economic activity, environment and society form the tripod on which the concept of sustainable development is based.

According to Almeida (2002), the great difficulty is not in creating the concept of sustainable development, but in putting it into practice, because it involves a change in the culture of the organization and its employees, in addition to demanding time and financial resources.

The expression sustainable development characterizes a development model that aims to articulate the economic, social and political progress of national States with environmental preservation, taking into account the limitation of most natural resources that society makes use of.

In this sense, the DS has become indispensable for the survival of companies and planet Earth itself. A company that aims at sustainability must be transparent and capable of evaluating its socio-environmental performance. The best way to do this is through the annual sustainability report, where it is possible to assess and monitor the trajectory of sustainability or, who knows, find the right path (ALMEIDA, 2022).

In view of this, many assume that economic interests and environmental interests are in conflict. Therefore, placing economic development and the environment on an equal footing as central parts of the same equation, supported on the one hand by organizations and on the other hand in the construction of efficient public policies, will lead to sustainable economic growth.

The debate on economic growth (EC) and economic development (ED) is broad and has different approaches to the subject. However, on one point there is no disagreement, the reduction of poverty and inequality are key factors to achieve the development of a given place. The concept of EC is understood as a continuous increase in gross domestic product, both in global terms and in per capita terms, it is a necessary, but not sufficient, condition for development to take place, as this must be understood as a multidimensional process, analyzing living conditions and not just income (RAY, 1998).

Economic growth, in Miller's understanding (2007, p.6), consists of the "increase in a country's capacity to provide goods and services". However, for May (2003, p. 6), the idea of SD consists of a normative concept that emerged in a scenario of divergences on the relationship between economic growth and the environment, intensified mainly by the publication of the Club of Rome report. , which preached zero growth as a way to avoid environmental catastrophe .

The definition of a new development model for the 21st century, reconciling the economic, social and environmental dimensions, emerged to resolve, as a conceptual starting point, the old dilemma between economic growth and poverty reduction, on the one hand, and environmental preservation of another. Divergences that exceed more than twenty years, in open hostility against the environmental movement, while the latter, in turn, saw the DE as naturally harmful and entrepreneurs as its most representative agents (CAMARGO, *et al.* , 2004).

To alleviate this impasse, the World Commission for the Environment and Development of the United Nations, prepared the document called "Our Common Future", also known as the Brundtland Report, in which the signatory governments that have committed to promoting economic and social development in accordance with environmental preservation (CMMAD, 1987).

At the beginning of the 21st century, Brazil built a period of EC induced by social inclusion policies. It is proving to be a fruitful period with regard to issues related to development, where the very concept of development is being rethought, since for centuries the dimension of economic growth was used as the main parameter.

It is in the incidence of the management of a sustainable world that organizations overlap, aiming at goals for the future of generations. Rio+20 was a reflection of twenty years of challenges for social, economic and, above all, environmental issues (AUMOND, 2012).

In the last decades, the planet has undergone profound environmental transformations as a result of an intense industrial revolution for a privileged few, which are affecting everyone more intensely, resulting in climate change, which causes natural tragedies more frequently.

In this sense, the world has been discussing the consequences of these impacts on the planet over the years and their possible solutions. These discussions were materialized in conferences in Stockholm (1972), Rio de Janeiro (1992, 2012), Paris (2015), among others. All of these were essential works for sustainable growth, such as the Brundtland Report (1984), Agenda 21 (1992), Kyoto Protocol (1997) and Agenda 2030 (2015), but with few actions for civil society, which claims for faster and more concrete practices, ignored by several governments (BRUNACCI; PHILIPPI JR, 2014).

Recently, in November 2021, the United Nations Conference on Climate Change - COP-26 took place in Glasgow, Scotland. The objectives of COP-26 highlight the quest to neutralize harmful gas emissions to planet earth, limiting global warming to 1.5˚C, another important point is the protection of ecosystems in countries affected by climate change, another A highlight are the funds to finance the established goals and, finally, unite governments and societies in order to put into practice the Paris Agreement in a more expressive way.

Governments are expected to seek to create efficient public policies in partnership with social organizations and society to obtain economic growth through sustainable development.

2.3 NOTIONS OF PUBLIC POLICIES

At first, bringing a notion of the concept of Public Policies, Almeida (2016), points out how State Policies, the involvement between powers and procedures within the governmental structure are composed of stages of studies, research, economic and social analysis, bringing the effects budgeting and planning, in the search for changes in society's diverse agendas. Complementing, Cohn (2008), infers that public policy refers to the exercise of decision-making power carried out by the State, in the face of competition to achieve the collective interest.

According to the technical material, produced by the Federal Audit Court (TCU), used in the evaluation of public policies, it is understood that: "Governance in public policies refers to the institutional arrangements that condition the way in which policies are implemented". formulated, implemented and evaluated, for the benefit of society" (BRASIL-TCU, p. 34, 2014). Furthermore, in the fabric of public policies, the interrelationship between target audiences is aimed at the same purpose. The help between these demonstrates a central question of explanation for the success or failure of a policy (HILL and HUPE, 2002). It makes clear the understanding that there is no construction of a project that seeks to meet social demands, without the population being involved directly or through representation.

Public policies are integrated into the balance of supply and demand, resulting from the innovation process. Instruments aimed at tax incentives, access to financing, policies for the improvement and protection of human capital, support for entrepreneurship, stimulus to demands and schematization of public purchases are contained in the aspects of objectives and consequences in the idea of expanding access and demands for innovation, accessibility of technicians and development of professionals in the area (LEAL and FIGUEIREDO, 2021).

Marini and Martins (2014) conceptualize that the association of governance and public policy comes from the ability to govern through a collaborative scheme seeking results in the consequence of generating collective sustainability. Furthermore, there is complexity in the execution of public policies, so it is interesting to have a good correlation between users and the government hierarchy.

Therefore, it is clear that the interference of governmental functionality is the primary part in stimulating and editing projects of common interest to the affected community. It is about politics in a collective way, so that strategies are planned and executed on a concrete basis, with social participation, being directed by the power of the State.

2.4 GOVERNANCE CONCEPTS

"Public governance proposes to reduce the distance between public power and society, offering broader purposes, where society, the final recipient of the public services and goods offered, places itself in a participatory position vis-à-vis the government" (CARNEIRO NETO *et al* . . , 2019, p. 464).

A recent study brings up the concept of Governance as a guiding function supported by a management mechanism. It involves environmental assessment actions, between scenarios and alternatives,

projecting results. The idea of governance is intended to guide policies and planning based on the demands and interests of the State. And finally, evaluate the results according to the established objectives (BRASIL-TCU, 2021).

The public power is responsible for guaranteeing transparency, efficiency and agility in the constitution of institutionally legitimized policies that stimulate competitiveness, economic development and innovation in cities so that they can be considered smart cities.

to Caragliu *et al.* (2011), a smart city is shaped by managing natural resources through integrated governance with social participation. Containing investments that seek economic growth, sustainability and quality of life.

Recently, in a study carried out through a systematic review of the literature (RSL), researchers understood that little by little aspects of governance and democracy are included in the discussion of smart cities, relating terms other than territory, technology and public policies, only (LEVY ; CARVALHO; ALOE; BEZERRA, 2021).

According to Chourabi *et al.* (2012), it is interesting to carry out a work structuring, with techniques, tools and concepts capable of analyzing local government initiatives. Factors such as management, technology, economy, environment, politics and also governance are points of reflection for the designation of smart city. In the case of Brazil, it is clear that studies on smart cities are guided by two-way parameters. One where there are technological implementations and the other which describes about installations of smart city developments. (BORJA and GAMA, 2014; GAMA *et al.*, 2012; WEISS *et al.*, 2017).

Despite the constant characteristics involved by the technological factor, there is a need to propose innovative public management for these cities, based on governance models (MADEIRA *et al.*, 2017).

In view of this, it is understood that it is necessary to bring to local administrations, government actions that seek innovations, through work with local communities. The defended discussions report that public policies can be integrated to the various segments within a geographic space. Government programs are parameter points for evaluating the impacts they cause in prominent cities.

Demonstrating the concept of Public Governance, it is indicated that the expression comes from the English, *corporate governance* , which in translation into Portuguese, refers to corporate governance. To address the Brazilian State, Corporate Governance is defined as the systematization by which institutions are managed and controlled through relationships between owners, managers and other components of the organizational structure. The practices are aligned with the interests of the organization in order to achieve the proposed objective to contribute to the continuity of the entity (INSTITUTO BRASILEIRO DE GOVERNANÇA CORPORATIVA – IBGC, 2009).

For the Securities and Exchange Commission (2002), governance is composed of a grouping of practices that seek to improve the performance of an organization to protect and facilitate access to assets, for the users directly involved. Corporate governance principles are sets of values and regulations that are

based on the idea of guiding management in meeting the demands of a company's owners. Transparency, equity, accountability and discipline are fundamental parameters (CARVALHO, 2002).

It is in line with corporate governance in the government sector, the perspective that the structure of actions is objective, with aligned responsibilities, easy-to-understand relationships between the parties involved, and also with the allocation of resources and delivery of results together with the due support to higher administration (MARQUES, 2007).

Bringing the definition established in a normative act on the governance policy within the scope of the federal public administration, which extends to other federative entities, in a generic way, thus being able to infer. Decree No. 9,203, of November 22, 2017, in its article 2, item I, points out that public governance is: “a set of leadership, strategy and control mechanisms put in place to evaluate, direct and monitor management, with a view to the conduct of public policies and the provision of services of interest to society.”

In addition, the aforementioned decree establishes, among others, public governance guidelines on the search for results for society, with the aim of finding timely and innovative solutions that are capable of adapting to resource limitations and establishing priorities. It also contains indications for modernizing public services, articulating integration processes between different spheres and levels of government; the search for evaluations of proposals for the creation or improvement of public policies, updating normative acts based on good practices, linked to legality, but with the aim of reducing bureaucracy and strengthening the population's access. Therefore, it is important to understand the need to create partnerships with the private sector and civil society.

Public administration is the functional structure for the execution of services, in order to meet the demands of the population, being an organization that is based on the practices of actions and services of policies by the government. The role of the State is necessary for the service par excellence with the development of political power (MATIAS-PEREIRA, 2018).

The TCU, in a publication of a basic governance reference applicable to public organizations, structured a relationship between governance and management, which involves 03 activities, namely: evaluating; direct and monitor, for governance; and plan, execute and control, for management. The model adopted by the body seeks to design an information mechanism that subsidizes governance instances. (BRAZIL-TCU, 2020).

In the public sector, favoring the construction of a model of public management management resulted from the decay of the bureaucratic model, as the recent objective is to make the State more efficient and able to meet the demands with better services provided to society (MATIAS-PEREIRA, 2018).

Government administrations where there are measures based on the formatting of renovating executions, manage to practice management tools and techniques arising from concepts in the literature or from concrete proposals for government policies. The need for a management that can carry out the projects,

must explore control and monitoring instruments. So that, in the face of possible adjustments, adjustments are made through real decision mechanisms and based on the established planning.

Discussing governance corresponds to terms of public policies, these as a set of actions outlined in the idea of influencing and improving the situation of a population (MARTINS, 2007). For Procopiuck (2013), administrative mobilization must articulate the application of resources in the prospect of solving collective problems.

Finally, it should be noted that the treatment given to the set of management mechanisms, based on methods of applicability in governance, are integrated in the conduction of pioneering and outstanding public policies. Characterizing modern and differentiated management practices are attitudes that demand communication, research, creativity and integration among the sharing of interests. It became clear that it is important to have a planning project, whether based on problems or a willingness to change. The construction of contemporary management policies is influenced by a government model that innovates and brings effective results to community demands, aimed at economic development and smart cities.

2.5 SMART CITIES, DEFINITIONS AND CHARACTERISTICS

When faced with the term “Smart Cities” it is possible to have a direct relationship with the technological aspects. Perhaps, in a simple questioning of society, the technology factor comes to the fore, as it has a broad focus that intelligence corresponds to machines, robots, software, and the like. However, several studies and research on the subject show that the classification of cities, as a geographic space, has the criterion of intelligence in different circumstances, and by social, environmental and management attributions.

A smart city is so called when it portrays management, policy, and technology innovation. Being a practical workshop, where risks and achievements are involved (NAM and PARDO, 2011). The expression “smart cities” appears in a study of pioneering practice in the city of Singapore, whose purpose was to become an innovative city (MAHIZHNAN, 1999). In other researches, the concept is treated as innovative technologies, applied in the urban scenario, and also in techno-centered public management (LIU *et al.* , 2010; KUIKKANIEMI *et al.* , 2011; NAPHADE *et al.,* 2011).

With the constant increase in the urban population, various social, economic and institutional demands and difficulties are accelerating. Various managements such as solid waste, traffic and transport, natural resources, environmental pollution, and socio-economic inequality tend to affect political and sustainable aspects of cities (NEIROTTI *et al.* 2014). Innovations arising from technological factors, with new advances in urban planning and customs, prospect future possibilities and availability for metropolitan cities (COURABI, *et al.*, 2012).

The technology factor in the exposed characteristics of smart cities is remarkable, being the aspect of urban development and government management. It is noticed that technology is a tool for exploring other technical sources to compose the structuring of an innovative city. Solutions that meet social and

economic needs are factors that awaken innovative and sufficient practicability. In the topic that deals with data analysis, concepts and applicability on the conditions of certification of smart cities will be addressed, which are conditional on good management practices, an instrument that relates to innovative, feasible and sustainable proposals.

3 METHODOLOGY

This article adopts scientific classifications from the perspective of answering the problem in question, together with the purpose of achieving the objectives proposed in this study. For that, Gil (2008) manages to classify the research in terms of nature, in pure or applied. In this article, it is directed towards applied research, as the practical characteristics seek to solve an obstacle within the real context. This article aims to demonstrate and evaluate the indicators and data on the ranking of smart cities on the governance factor and its relationship with public policies and sustainable development that expresses collective feelings of freedom and democracy, with which the world has passed. to question and rethink a future for the common good.

Therefore, regarding the objective, the research is related to the descriptive type, where the analyzed facts are recorded and reported, without manipulation, demonstrating the characteristics of the population or phenomenon studied. This type is the factor of explanation and interpretation of the facts found (PRODANOV and FREITAS, 2013). The results topic describes the data extracted from *Connected smart Cities* (CSC), 2021 edition, regarding the position in the governance *ranking* , presenting the respective notes and demonstrating in a practical way the evaluation of the elaborating organization.

As for the approach, this research is classified as qualitative, it studies the subjective, social and human behavior aspects, seeking to interpret the concepts, which identifies that a certain city is called Smart Cities, and to clarify their characteristics within the scope of organizations that certify them (MIGUEL, 2018). Finally, regarding the method, bibliographic and documentary research were used, which for Yin (2015), respectively, seeks to explain a case in the face of the theoretical survey of scientific publications and the type of research that is based on primary data not yet explored by science .

The investigation strategies were based on the interpretation of concepts, collection, recording, analysis and interpretation of data on how governance contributes to the sustainable development of smart cities in the Northeast region of Brazil. The study was based on three aspects: *I)* on the bibliographic research of the theme to support the analyses *; II)* in searching for secondary data, such as information on the *Connected website smart Cities* (CSC), and finally; *III)* interpretation of data from the CSC's annual report on the Governance axis.

order to achieve the objective of the investigation, the concepts of sustainability, sustainable development, economic growth, challenges for the 21st century, public policies, governance, and finally, smart cities were sought. Based on the concepts, the research investigates the interpretation of the various

authors on the subject in order to understand how governance contributes to the sustainable development of smart cities in the Northeast region of Brazil.

Based on the CSC's 2021 Annual Report, the ranking on the governance axis was analyzed in three aspects: first, referring to the ranking of the top 10 smart cities in Brazil. Then, the 10 cities considered smart in the Northeast region of Brazil were analyzed and, thirdly, the cities classified as smart in the State of Pernambuco.

To describe and demonstrate the positions of smart cities and their respective scores, data was collected from the *Connected Platform smart Cities* , version 2021. The study was commissioned by Companhia *Urban Systems* , through the annual report, which details all Brazilian cities, ranking the 100 smartest cities, on various social, sustainable and management factors. In this research, data were collected through consultations, by filtering among Brazilian cities, delimiting the Northeast region of Brazil, specifying the State of Pernambuco, from the perspective of the governance axis.

4 RESULTS AND DISCUSSIONS

To achieve the study objective of this research, it will be evaluated how governance contributes to the sustainable development of smart cities in the Northeast region of Brazil.

According to Souza and Menelau (2018), the topic of Smart Cities is on the rise among the agendas of discussions on collective demands of a society, interacting with factors of information, technology and sustainable management of cities. Smart Cities rankings arise from comparative studies, evaluating and classifying cities under different dimensions and indicators.

Connected ranking is presented. *smart Cities* (CSC), in Brazil it is demonstrated by the *Urban Systems organization* , which behaves like a company focused on planning studies supported by smart cities concepts. The studies have the purpose of dimensioning the strategy of economic development, social improvement and environmental protection in the cities. (I think here we have to talk about the origin of the ranking, I understand leaving this one)

The CSC encompasses private organizations, governments and entities through a platform in order to seek innovation and improvements for smart cities, and the harmonization between them. As its mission, the CSC provides discussion and sharing of information and ideas between organizations and social needs. There is still a search for principles of integration, innovation, collaboration, transparency and focus on people. Finally, the ranking aims to map the cities with the greatest potential for development in the country. In this *ranking* , the indicators serve to qualify the equally smart cities in Brazil, using 11 distributed axes, they are: mobility, environment, entrepreneurship, education, energy, governance, urbanism, technology and innovation, health, safety and economy.

All academic research goes through a data collection process. In the research carried out by the CSC, 75 indicators were used, all indicators used in the CSC are presented in detail on page 109 of the CSC report, 2011 edition, the highest number among all versions of the study. The Connected ranking smart

Cities is mostly carried out through secondary data collection, and thus, the new availability of surveys, data and ease of access, as a result of the evolution of the open data policy, allowed a deeper change in the 2021 edition of the study. (CSC, 2011).

According to the CSC (2021), the CSC ranking uses a weighted comparative analysis methodology, thus, the result of each city evolves with each edition according to the evolution that the municipality presented in the analyzed indicators; the evolution presented by the municipalities in close positions; to changes in the metrics of the indicators; the insertion of new indicators and the removal of indicators.

Among the bases for evaluation, it is worth highlighting the ISO 37120 and 37122, published by the Brazilian Association of Technical Standards, standards that together guide the definitions and methodologies for indicators aimed at urban management and implementation of public policies for smart cities. Directing the focus of this article, ISO 37122 – *Sustainable cities and communities – indicators for smart cities* , consists of 80 indicators, according to specific axes. Delimiting the objective of this work, the Governance axis is pointed out, which in turn has 04 indicators (CONNECTED SMART CITIES, 2021).

As a methodology applied to prepare the *ranking* , the company *Urban Systems* adopts its own method of weighting indicators, called the Market Quality Index (IQM). This is calculated from information that varies according to the nature, complexity and units of measurement. There are interspersed factors for the computation of the final grade. First, the relevance factors, where the indicators have a direct and indirectly proportional influence. Relevance weights are also followed and finally the calculation is performed. The calculation takes into account the weighted value in each segment in each city, and the relation to the minimum and maximum amounts observing the other cities.

Considering the entire universe of Brazilian cities, this classification adopts a sample of cities with more than 50 thousand inhabitants, according to an estimate extracted from the Brazilian Institute of Geography and Statistics (IBGE). For this edition, there were a total of 677 municipalities. The distribution among the population occurs in 03 divisions: from 50 to 100 thousand inhabitants, 100 to 500 thousand, and more than 500 thousand inhabitants.

On the axes, the CSC *ranking* (2021), adopts 11 sectors with the purpose of mapping the potentials of Brazilian cities, through indicators of intelligence, connection and sustainability. According to *Urban Systems*, in the 2021 version, the survey had 75 indicators. These indicators are built in an integrated manner between thematic meetings bringing together organizations, specialists, civil society and the public sector. Nevertheless, this article, with the idea of meeting the research objective, focused on the Governance axis (GOV), so only the indicators related to the axis under study will be explained here.

According to the CSC report (2021), the information treated and disclosed results from a survey of secondary data extracted from an open database, from entities and other technical institutions. In the Governance *ranking* , the composition is based on 12 indicators, which are: 1) Mayor's education; 2) Firjan Index; 3) Transparent Brazil Scale; 4) Citizen Service via app or website; 5) Advice; 6) Land use and occupation law; 7) Expenses with urban planning; 8) Risk area monitoring; 9) Health Expenses; 10) Infant

Mortality; 11) Security Expenses and 12) Education Expenses. In general, the names of the indicators are already self-explanatory .

Finally, the *ranking* is demonstrated through the consolidated report of the evaluated axes. The consultation of the result is available directly on the online platform. In this instrument it is possible to collect general data, at the level of Brazil, by region, by State, by city size and by thematic axis, and there is also access to indicators for each demonstrated city. In the last edition, Urban Systems manifested itself on an online platform, in PowerBi format , filtered in ordered tables based on the survey clipping.

Starting from the extract on Governance, the focus of this study, the CSC *ranking* is made up of 12 indicators, 05 of which are linked to the governance axis itself. Corresponding to the score on the axis in question, there is a maximum limit of 11.50 points, with weights between 0.5 point for the mayor's education; 1.0 point for the other indicators, which for now will not be explained in this research. Among the Governance indicators, there are factors such as the transparency of the municipality, social participation, and levels of municipal development and training of the municipal manager. It is important to point out that the details of the 12 indicators are not the objective of the study, but it is worth pointing out that there is this amount for the composition of the final grade for the respective axis. In this last edition there was the insertion of a new indicator, taking modalities of remote service for the population, being therefore: applications created by the city hall; applications developed by third parties based on city hall data and yet another website tool for mobile devices (CONNECTED SMART CITIES, 2021).

Table 1 below shows the ranking of the 10 smartest cities in Brazil, based on the extraction of the CSC *ranking (2021).* After that, it is possible to clarify that the 10 smartest cities in the country are located between the South and Southeast regions, with scores from 7.661 to 8.477 in the 10th to 1st place in the ranking. Therefore, in this position of the top 10 smart cities, the municipality of Niterói (RJ) is in 1st place, followed by Balneário Camboriú (SC), and Praia Grande (SP), in 3rd position. In 10th position was the State of São Paulo, with the city of Paulínia. The other positions of the top 10 are tabulated in table 1, with their respective scores for the Governance axis.

Table 1 - Smart Cities in Brazil - 2021 - Overall Ranking - Governance

Position	Municipality - UF	Spots
1st	Niterói – RJ	8,477
2nd	Balneario Camboriu – SC	8,332
3rd	Praia Grande – SP	8,035
4th	São Caetano do Sul – SP	8.016
5th	Limeira - SP	7,902
6th	Caraguatatuba - SP	7,853
7th	São Bernardo do Campo – SP	7,740

Position	Municipality - UF	Spots
8th	Blumenau - SC	7,690
9th	Vitória - ES	7,670
10th	Paulínia - SP	7,661

Source: Connected smart Cities , 2021- adapted by the authors

However, the CSC (2021) classifies the 100 Brazilian cities in the intelligence level, and according to the survey of the report in the general classification, that is, between the 1st and 100th city of the ranking in Governance, it is shown that there are 15 cities in the Northeast region. in the total amount of 100 smart cities, and among these, there are 05 municipalities in the State of Pernambuco. It should be noted that these data on the position by segregation, delimiting the Northeast region and the State of Pernambuco, will be explained in the tables below.

Table 2 shows the ranking of the 10 smartest cities, which are located in the Northeast region. In 1st place in the region is the city of Fortaleza (CE), with a score of 7.423, Salvador (BA), with a score very close to the previous one, with 7.421 and in the 3rd position is a city in the State of Pernambuco, Ipojuca (PE), with a score of 7,237. It is noted that of the 10 cities presented in this clipping, the largest amount per state was Pernambuco, contributing with 03 municipalities: Ipojuca, Recife and Caruaru, respectively in the 3rd, 4th and 8th smartest cities in the Northeast region.

Table 2 - Smart Cities in Brazil - 2021 - Northeast Region - Governance

Position	Municipality - UF	Spots
1st	Fortaleza - CE	7,423
2nd	Salvador BA	7,421
3rd	Ipojuca - PE	7,237
4th	Recife PE	6,900
5th	Porto Seguro - BA	6,829
6th	João Pessoa – PB	6,770
7th	Teresina - PI	6,760
8th	Caruaru - PE	6,632
9th	Empress - MA	6,598
10th	São Luís - MA	6,586

Source: Connected smart Cities , 2021- adapted by the authors

In terms of the best-ranked cities, in the Governance axis, and by region, the city of Fortaleza (CE) stands out, which ranked 15th in the general ranking of the country, and obtained a score of 9.9 in the aspect of Public Transparency and Service to society through an application and website.

Bringing to a specific delimitation in the State of Pernambuco, the CSC ranking (2021) discloses five smartest cities among municipalities in the State. Table 3 shows only 05 cities, because in the classification for this state of the federation, only these reached the criteria for positioning in the Governance axis, so in this table it was not possible to show 10 positions as in the two previous tables.

Table 3 - Smart Cities in Brazil - 2021 - Pernambuco State Ranking - Governance

Position	Municipality - UF	Spots
1st	Ipojuca - PE	7,237
2nd	Recife PE	6,900
3rd	Caruaru - PE	6,632
4th	Jaboatão dos Guararapes - PE	6,573
5th	Cabo de Santo Agostinho - PE	6,318

Source: Connected smart Cities , 2021- adapted by the authors

In this third frame, they are in chronological order, from the first to the fifth city: Ipojuca, Recife, Caruaru, Jaboatão dos Guararapes and finally, Cabo de Santo Agostinho. As for the grades, they were respectively 7.237, 6.9, 6.632, 6.573 and 6.318. The scores were then on average from just over 6 to over 7. Finally, transforming into percentage terms, as to the representation for the maximum score on the axis under study, it can be seen that the municipality of Ipojuca reached 63% in relation to the maximum score, and the city of Cabo de Santo Agostinho, reached 55% of the total of 11.9.

5 CONCLUSION

This research sought to assess the relevance of the contribution of governance aspects to the development of smart and sustainable cities located in the Northeast region of Brazil. As a basis for the relationship between governance and sustainability, concepts of sustainability, economic growth, economic development, challenges for the 21st century, public policies, governance and above all smart cities were discussed. In this research, the parameters that define the sustainability characteristics were demonstrated, that is, the so-called “smart cities”.

All the harmonization presented by the concepts reflects in new interpretations of the nomenclatures and linkages of the characteristics present in the classifications of smart cities. The idea of a smart city is directly linked to the technology factor that is no longer predominantly supported.

Secondly, the research focused on demonstrating the positioning of smart cities within the Northeast region of Brazil, highlighting the main positions in the *ranking* prepared by the company *Urban Systems* ,

through *Connected smart cities* (2021), among the first placed in the State of Pernambuco. Data extraction took place through the collection of data from the annual report, for the year 2021, made available on the website of the organizing company.

Integration with the influence resulting from environmental behaviors results in the search for new methods of planning and executing public policies. Decision-making by State agents requires technical information to search for better results for society.

Considering that the aspects presented in the CSC report (2021) are derived from data from public policy executions carried out by the cities listed in *the ranking* . This study explained that in the Brazilian panorama, the top 10 smartest cities are located in the South and Southeast of the country. However, directing to the objective of this research, in the Northeast region of Brazil, it was identified that the smartest city in this region was the City of Fortaleza, capital of the State of Ceará. Being the State of Pernambuco, with the largest number of cities classified in *the ranking* among the 10 smartest cities flagged in this article in relation to the Northeast region.

Although several editions of the CSC *ranking* (2021) have undergone improvements in the integration and availability of smart cities data, according to the annual report, there is still a lack of quality and access to the information that make up the factors of the axes raised in *the ranking* . As is pointed out in the results and discussions section of this article, the data is secondary. And the aforementioned annual report does not show about the exploitation by municipal administrations of the indicated data, and also the non-use of management tools for new creations of public policies and social and sustainable involvement.

For future research, it is suggested the need to investigate the use by municipal managers and public agents of this data, being able to structure indicators for monitoring public policies.

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