TOWARDS A NEW MODEL OF SMART CITIES IN EMERGING COUNTRIES

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ABSTRACT

Smart Cities are transforming the vision of city dynamics from the local level. Therefore, comprehensive planning is required, taking into account the actors, resources and components necessary for their implementation, through the development of public policies that account for the approaches defined by governments in order to improve the quality of life of their inhabitants. Consequently, it is relevant and innovative to analyze, contrast and evaluate from a theoretical model, as well as, from policy documents, the quantitative results yielded by the main global measurements in the field of Smart Cities. This article contains a quantitative, qualitative and statistical analysis, which leads to the conclusion that it is necessary to formulate and implement a Smart Cities policy, containing some enablers and pillars that support a model adapted to the dynamics of an emerging country, since its cities could be placed in better positions in global rankings, as an effect of the management of central and local governments, thus contributing to improve the quality of life of its citizens, providing effective solutions to their demands, advancing towards sustainable development, and towards the implementation of the fourth industrial revolution as a means of social and economic progress sustained over time.

Keywords: Smart Cities, Sustainable Development, Innovation, Public Politics, Conpes Documents, Public Policy Model

INTRODUCTION

For the first time in history, more than half of the planet's population lives in cities. Moreover, it is estimated that by the year 2050, 70% of the world's population, which is equivalent to more than 6 billion inhabitants will live in cities, 64.1% of people will do so in developing countries and 85.9% in developed countries, (Department of Economic and Social Affairs, 2016). A growth that has been constant, since around the year 2000, there were 371 cities with 1 million or more inhabitants. By 2018, the number of cities with at least 1 million inhabitants was 548 and by 2030, more than 700 cities will have at least 1 million inhabitants and there will be at least 43 megacities of more than 10 million, (United Nations, Department of Economic and Social Affairs, Population Division, 2018).

Colombia is no exception, according to the Mission of the Cities System of the National Planning Department (2013) it is estimated that by 2050 86% of the population will live in cities; which implies that it is urgent to rethink the way of life in the cities and especially the role of governments in their conception, planning, construction, reinvention and in the definition and implementation of strategies that provide effective responses to the changing needs and new expectations of citizens. The notion of "Smart Cities" is becoming increasingly relevant due to the processes associated with the evolution of globalization, the demands of the citizenry increasingly aware of its rights, as well as the evolution in the awareness of environmental responsibility on the part of society and governments, where it is common to find debates on environmental problems, citizens' rights, global emergencies and in general all kinds of demands for governments to provide more efficient services in real time, thus improving the

quality of life of their inhabitants (Toppeta, 2010). There is also no doubt that these types of inputs and outputs have two fundamental allies: Information and communication technologies, and citizens (Giffinger et al., 2007).

Smart cities are part of a complex and dynamic global scenario based on three megatrends that have determined the transformation of contemporary society and the digital era. Firstly, the urbanization process and therefore the rapid growth of cities. Secondly, the digital revolution and, thirdly, the power of data and information.

With respect to the growing urbanization process, this has led to the proposal of a New Urban Agenda that was approved at the United Nations Conference on Housing and Sustainable Urban Development (United Nations, 2016). Since the growth of population, cities and migration will be a global trend for years to come, the second megatrend is the digital revolution with the advent of the fourth industrial revolution, as an effect of the accelerated development of technologies that have created a hyper connectivity that has digitally and forever transformed productive processes, services and interaction between the State and its citizens. A digital metamorphosis of the city, supported by technologies such as Artificial Intelligence, IoT, cloud, big data, block chain, cyber security, robotics, chat bots, 3D simulation, augmented reality, autonomous vehicles, nanotechnology, biotechnology, drones, among other technologies.

In turn, the third megatrend corresponds to the power of data and information. Never as nowadays society has data of all kinds and in all possible forms of capture, storage and analysis, and the city, which is where the State-citizen relationship is expressed and vice versa, is no exception (in the context of an increasingly informed society, demanding for rights and a better quality of life), since the true objective of Smart Cities is to improve the quality of life of people (Castelnovo et al., 2015), without neglecting environmental responsibility, good use of resources and human dignity as a generational legacy.

The above imposes challenges and opportunities for national and local governments of emerging countries associated with the formulation and implementation of Smart cities policies and plans. Consequently, the design, formulation, implementation, monitoring and evaluation of a Smart cities policy is not a simple task, so it is necessary to establish a conceptual framework and a structured theoretical model, in order to compare the progress of national governments and cities in the global rankings of smart cities from the indexes and from the reality itself in coherence with the statistics. That is why in the first part of this document a treatment of the data that contributed significantly to the literature review and activities involving scientometrics and bibliometrics is made, with the main objective of extracting from the best articles of the last 10 years the adherence to the Keywords and their analysis around Smart cities, their concepts, in-depth analysis and trends.

With the above and as a result of related research in various documentary sources, as well as interviews and workshops conducted, the conceptual and theoretical framework of the research was founded. Subsequently, the quantitative and qualitative methodology that supports the proposed smart cities model is explained, which allows contrasting the research findings presented in the following section, where the analysis of the studied policy documents and quantitative data from the comparison of 9 global Smart Cities rankings, their correlations and through a model of dependencies and case studies, a model is proposed for the case of Colombia as an emerging country. Finally, the new research fields and conclusions are presented.

Theoretical Framework

It should be mentioned that the analysis in the field of Smart Cities was initially based on science to metrics, which studies the quantitative aspects of science as a discipline or economic activity and finds application in the establishment of scientific policies, which can include, among others, the publications made in the field of Smart Cities. Likewise, in biblio metrics, which deals with the quantitative aspects of the production, dissemination and use of recorded information, the effect of which develops models and mathematical measures that serve to make forecasts and make decisions about these processes Araujo, et al., (2002).

It is important to mention that the Smart Cities public policy field is a relatively unexplored spectrum and although there are studies that analyze the intellectual production in this field such as those of (Cocchia, 2014; Albino et al., 2015; Anthopoulos, 2015; Chatterjee & Kar, 2018; Chauhan, Agarwal & Kar, 2016; Bibri & Krogstie, 2017, Ismagilova et al., 2019), the results of several analyses indicate that a certain degree of confusion still persists around the scientific status of research on smart cities, in the line of public policy research; as there is a need for greater intellectual exchange between those who conduct research in the field, and that are promoted by national governments, as well as greater support in quantitative data, some tendency is evident in the documents to subjectivity, or are found isolated works, or not supported by approaches of other researchers. Now, although there is no exact definition of the concept of "smart cities" Angelidou (2014), it should be mentioned that for this paper the raison d'être of a Smart city is to improve the quality of life and well-being of all its citizens Zhuhadar, et al., (2017). Satisfying the needs of the city's inhabitants in a smart and comprehensive way, which implies going beyond what technology can guarantee, but taking advantage of its value to build better cities, with new forms of interaction and service offerings with quality, efficiency and opportunity; which requires taking into account the different smart city approaches, such as those focused on economic and social development, or on the intensive use of technology, or on innovation and urban and social co-responsibility and on sustainability or those approaches that advocate for a more comprehensive approach.

Smart Cities are capable of managing resources, energy sources and the environment, optimizing services and improving their profitability, their use and, encompassing social, technical, political and functional aspects, (Colado, García, Gutiérrez, Vives & Valencia, 2014). For this document, the Smart City is defined as an innovative and integral city, which manages to implement a development model that balances the political, urban, social, cultural, economic, risk, environmental and technological spheres, which is supported by agile governance, political and territorial ordering, strong social cohesion and economic development, where data, information, technologies and people are integrated to efficiently respond to the needs of citizens and to improve their quality of life (Camargo, 2020).

In this context, some countries have formulated national plans and/or strategies to promote smart cities. United Kingdom formulated in 2011 the Unlocking Growth in Cities, launching the City Deal Program; in 2013, it published a policy document to develop local capabilities, empower city authorities to provide solutions to their own problems, promoting open data, technologies, and participation in the European Union's smart cities programs (Department for Business, Innovation and Skills, 2013).

Spain, for its part, formulated in 2015, the National Plan for Smart Cities, which aims to improve the effectiveness and efficiency of local entities in the provision of public services through ICTs (Digital Agenda for Spain, 2015). Malta formulated the Smart Island Strategy (2008-2010) for the country to become one of the leading countries in the information society. Australia has implemented the "Smart Cities Plan" with the purpose that the growth of cities can respond to the challenges brought by economic expansion and new means to make commercial exchanges (Commonwealth of Australia, 2016). For its part, the United States has the Smart Cities and Communities Federal Strategic Plan, Exploring Innovation Together (Office of Science and Technology Policy - OSTP, 2017), this strategic plan provides a high-level framework to guide and coordinate federal initiatives related to the city/community in a smart way, with emphasis on local government and with the participation of stakeholders.

Also, there is the case of Hong Kong which in 2017 formulated the Smart City Blueprint, which seeks to turn it into a world-class smart city, through three policy objectives, make use of innovation and technology, enhance attractiveness for global businesses and inspire continuous city innovation and sustainable economy, (Office of the Governmente Chief Informatión Officer, 2017). In the case of Germany, the Ministry of the Interior, Building and Community developed the Smart Cities Charter in 2017, which sets out guidelines for developing digitization plans in German cities, (Bundesregierung, 2014; The Federal Government, 2014). There are also supranational proposal scenarios, such is the case of the

Smart Sustainable Cities: A Blueprint for Africa, of 2017, in the Africa Urban Agenda where it is recognized that more than 80% of the world's GDP is generated in cities, that urbanization is a global trend, and that if well managed everything can contribute to sustainable and inclusive growth. In Latin America, entities such as the IDB and ECLAC consider that the development of smart cities is a space in process, and at the same time one of the areas with the greatest potential to promote social, economic, political, sustainable, innovative, resilient and competitive development in the region.

In fact, when analyzing the case of Colombia as an emerging country, there are no documents or research that analyze the challenges and opportunities for the country in this field, and there is no public policy on the role of the national government in this process of transforming cities into smarter ones, although recently in October 2020, a document was published with recommendations for the development of smart cities and territories (National Planning Department, 2020), which is a positive step forward, but clearly not a public policy.

The importance and novelty of this research lies in encouraging the elimination of the paradigms that smart cities can only be in developed countries and that it is impossible to adapt strategies focused on the development of smart cities in emerging countries such as Colombia, a country that is a powerhouse in natural resources and faces environmental and social challenges, even more so as a result of Covid-19.

METHODOLOGY

To meet this research challenge, the methodological design included different methodologies to obtain the information and data necessary to meet the proposed objective. The research methodology followed in this study is mixed: quantitative and qualitative. Hernández Sampieri (2018) points out about the mixed methodology, that it takes strengths from both quantitative and qualitative research "[...] implies a set of processes for collecting, analyzing and linking quantitative and qualitative data in the same study [...]".

The documentary support of the theoretical framework was supported by bibliometrics that investigates the formal properties of knowledge domains through the use of mathematical and statistical methods (Pritchard, 1969; Ding et al., 2001; Diem et al., 2013; Godin, 2006; De Bellis, 2009; Durán-Sánchez et al., 2017). The best articles of the last 10 years were selected from top journals, from specialized databases, articles that were verified in the Journal Citation Reports and Scimago Journal & Country Ranking, to validate that the source or journal in which it was published had the Q1 percentile category in the year of publication of the article, all of the above implies that the findings unearth a solid hold of scientific knowledge in the field of Smart Cities. Starting from the thick corpus of articles, a series of bibliographic analyses were carried out, through first and second level tools, to arrive at a definitive corpus and the concepts presented here.

As a consequence of this review, a series of findings are presented that are valuable for the academic, scientific and political debate in this field. In order to carry out the aforementioned studies, a particular protocol was defined based on the ProKnow- C process, which indicates that the objective of the process is to select relevant articles and identify the characteristics of those publications that contribute scientifically to the topic of interest (Ensslin et al., 2012).

The design of this research is considered non-experimental, since it identifies the current situation in relation to Smart Cities in global contexts, such as the case study of Colombia as an emerging country, variables are not manipulated and it seeks to establish the relationship between the different concepts, as well as, with the enablers, pillars, components and dimensions, for this case of Smart cities (Hernández, Fernádez & Baptista, 2010). The relationship between the different concepts, as well as with the enablers, pillars, components and dimensions, for this case of Smart cities, is not manipulated. However, the conceptual model built from the theoretical and documentary support was contrasted with 10 smart cities in the world and with three Colombian cities, Bogota, Medellin and Cali.

In relation to quantitative research Galeano (2020) indicates that it is based on the measurement of external variables susceptible to be quantified, which in this case are the results of the global indexes of Smart cities that evaluate with a certain degree of objectivity the progress of each smart city with primary and secondary sources. On the other hand, qualitative research, produces and analyzes descriptive data, such as written or spoken words, and the perceptions of people or groups of people and thus the policy guidelines, in this case as a social group to study Smart Cities. In fact, Galeano (2020) deals with a semi-structured and flexible process. This definition reflects a research method interested firstly in the sense and in the observation of a social phenomenon and secondly, that it is in the environment where it occurs.

In addition to the data analysis and the construction and implementation of a model for validation and contrast of the theoretical approaches, the analysis of public policy Conpes documents of the last 10 years related to Smart Cities issues and the planning and development plans of the last two governments was used, through content analysis as a research method, which refers to the analysis of socio-cultural systems of thoughts, ideas and public policies. For this paper, content analysis is a technique of interpretation and analysis of written texts, and all kinds of data records, such as documents, transcripts, speeches, observation protocols, documents, data, among others (Abela, 2016).

Content analysis is based on reading under the scientific method, which is why it must be systematic, sustainable, objective, and valid, as indeed this research proposes. This work crossed with the data obtained from the global indicators and data in the fields of enablers and pillars, which were analyzed using the statistical software stata, are a harmonious complement between these two research techniques, which is also innovative.

In fact, Mellero Aguilar (2011) argues that the critical approach is characterized not only by the fact of inquiring, obtaining data and understanding the reality on which the research is focused, but also by provoking social transformations in the contexts in which it intervenes. According to López Parra (2011) the content of the critical-social approach has quantitative, qualitative, hermeneutic, empirical, inductive and deductive methods, among others. Therefore, the assessment of the proposals of the national government authorities emanating from their policy documents and of the local authorities in their local development and land use plans and their contrast against the theoretical framework and the proposed model, as well as against the results of the global rankings, which, having crossed them with each other, give an objective perspective of the valuation status of the Smart cities; consequently, data and information validation instruments were used, whose interpretation is performed quantitatively, qualitatively and analytically.

From a problem approach perspective, the research process combines qualitative and quantitative methods (Richardson et al., 1999), since it has a dimension in the analysis of the alignment of articles to the research context and a quantitative dimension reflected in the bibliometric analysis, in the comparison of international data and indexes and the mathematical and statistical validation of the proposed model using Stata. It should be mentioned that the research hypothesis states that the main challenges and opportunities faced by the Government of Colombia, as well as other governments of emerging countries, to formulate and implement a Smart Cities policy are strategic governance, urban planning, social cohesion and economic and technological development.

RESULTS

Proposed Model of Smart Cities Policies and Plans for Emerging Countries

According to the review of scientific papers and in line with Appio, et al., (2019), it is considered that all Smart cities models or strategies are indebted to the proposed and globally recognized classification of Giffinger, et al., (2007) about the characteristics of smart cities around six fundamental dimensions: quality of life (Smart Living), competitiveness (Smart Economy), social and human capital (Smart People), public and social services and citizen

participation (Smart Governance), transport and communication infrastructures (Smart Mobility) and natural resources (Smart Environment). In fact, these dimensions are the ones normally embraced by academia and the public sector itself, but other studies that have addressed aspects such as smart health, smart architecture, smart security systems, smart building, smart government, smart tourism, smart grid, smart transportation, smart home and smart lifestyle should also be analyzed (Caragliu et al., 2011; Pramanik, Lau, Demirkan & Azad, 2017; Peng et al., 2017; Ismagilova et al., 2019).

Furthermore, it should be mentioned that Hutchinson, et al., (2011) proposes in a pyramidal model that any smart city project should start with the physical infrastructure (Smart Environment and Smart Mobility). This is the basis for the creation of innovation ecosystems based on human and social capital (Smart People and Smart Economy), which requires articulation and coordination by public agencies (Smart Governance). All of the above with the purpose of providing better quality of life solutions to the citizens of smart cities (Smart Living).

As a result of the previous approaches and the analysis of this research, the model for designing, implementing and measuring policies and plans for smart cities in Colombia is presented and described, which can be applied in other emerging countries (Figure 1). Understanding the model as the representation of a fact proposed as the ideal to be followed, along the lines of Sesento (2008). The proposed model presents the enablers, pillars, architecture, components, dimensions and general characteristics of the structure of Smart cities policies and plans, their processes, interrelationships and the previously argued regarding all the theoretical aspects that support them, to facilitate their support and understanding.

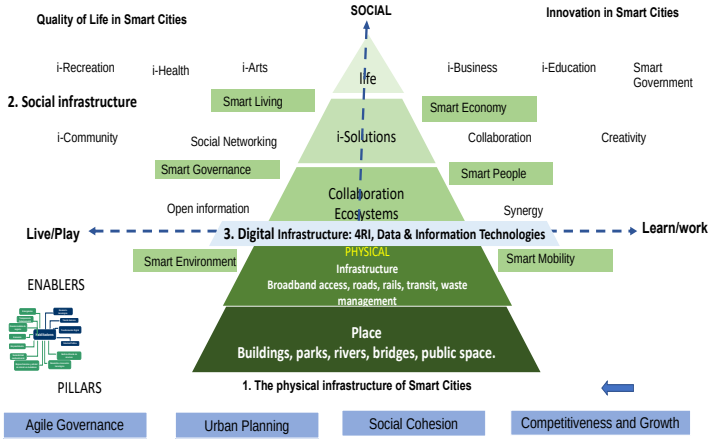

FIGURE 1
HAPICODI MODEL FOR DESIGNING, IMPLEMENTING AND MEASURING SMART CITY POLICIES AND PLANS IN COLOMBIA
Source: Own elaboration, 2020

First, it should be mentioned that public policies in general are the materialization of the State's action, they are that visible bridge between the government and the citizenry (Alba, 2017). From this perspective, a public policy for smart cities, should be ignited as that which governments decide to do or not to do (Dye, 2008). The value of leading a policy from the national government lies not only in the articulation of efforts, but it is estimated that a smarter country can be worth up to 10 points in GDP per year, since the multiplier effect of public investments is up to 10 times, (ABI, 2012). There are clear steps that cities can take, such as getting assistance to lead projects, improve planning and achieve a better understanding of the cost and benefits of a smart city (Cisco, 2014).

With respect to the perspective of approaching Smart cities from various multidimensional elements and seeking a strategy that brings them together, Bill Hutchison proposed the "Intelligent Community Open Architecture - i-COA®", (Hutchison et al., 2011)

which is a pyramidal framework of 5 levels where the first two correspond to the "hard" smart city strategies (places and infrastructure) and the top three levels (collaborative ecosystems, applications and life) correspond to the "soft" strategies. This framework, as Appio, et al., (2019) rightly states, has the value of being synthetic yet easy to visualize and focuses on the fact that the ultimate goal of smart cities is not only to connect hardware and infrastructure, but to create collaborative environments where innovation and quality of life are a constant.

For their part, Appio et al., proposed to merge the frameworks of Hutchison (2011); Giffinger, et al., (2007), with the purpose of understanding how smart cities can foster collaborative ecosystems to improve both living standards, and competitiveness, Appio, et al., (2019). So inspired by this framework, and approaches such as that studies can focus on examining the ways in which actors, groups, organizations, and stakeholders develop Smart city strategies (Paroutis et al., 2014) to address the risks and benefits associated with smart cities, from a comprehensive public policy perspective this model is proposed, (Figure 1), which requires enablers that give context and drive the 4 pillars that support smart city policies. The theoretical and empirical analysis showed that it is a model applicable to cities in Latin America and countries in the process of building smart cities, as it is not a route to follow, it is a model that allows adapting and depends on local dynamics.

The Enablers

If we want to achieve a Smart City that is capable of facing -with greater or lesser success- the problems of the contemporary city, highlighting smart designs in the fields of public policy, government, economy, development, architecture, industrial engineering, civil engineering, landscaping, among others (Bayod, 2015). The context that gives it some enablers that as catalysts accelerate or delay the action towards smart cities must be addressed, these are: the technological scenario, which responds to a changing global context in the information society; the Digital Transformation**,** which is accelerating changes in all strategies, processes and products of companies, markets, people and therefore of cities; the Human Talent, as the most important asset of countries, since people are the heart of the city; the political will and regulation, which determine the evolution of plans and projects in this field, because without an active decision, there is no concrete action, finally the city is a political space.

On the other hand, the second order enablers are: The globalized economy, which sets a course in a society dominated by information, and by knowledge, with its new business models and recently local and global emergencies such as the Covid-19 pandemic, drive changes in cities. Likewise, the implementation of policies and plans related to the efficient management of resources, urban and technological development and innovation, improvement of public services, environmental sustainability, entrepreneurship and government transparency.

The 4 Pillars of the Model

The enablers drive the Smart cities policy, which is supported by four pillars that are the anchor for the model to be established in long-term policy. These are: agile governance, urban planning, social cohesion, competitiveness and growth. For a city, in order to be considered smart, must necessarily incorporate aspects related to improved governance, planning and infrastructure, as well as their reflections in human and social capital (IDB, 2016b). The pillars are explained below, followed by the components and dimensions of the model.

Agile Governance

Cities face very complex problems from social, economic, equity, employment, mobility, security, informality and migration perspectives, among others, that can be addressed with intelligence and with State policies and government actions. Because the speed with which the world moves has rapidly transformed the way of doing things, therefore, it is necessary an

"*agile governance*", supported and supported by technologies, transforming human beings and politicians and their way of interconnecting with the city. The regulation around the cities and the technologies of the fourth industrial revolution conditions the city and if it is not flexible, dynamic, adaptable to society and the digital era, it inhibits its development.

Urban Planning

The accelerated growth of the urban population and unplanned urbanization processes generate environmental, social, cultural and economic problems that hinder the development of cities and the quality of life of their inhabitants, and if they are not solved, it is very unlikely that the city will become an intelligent one. In this context, the challenges of the contemporary city must be solved through interconnected intelligent systems, based on Information and Communication Technologies, achieving a more efficient management of natural and economic resources (Copaja-Alegre, Esponda-Alva, 2019).

Social Cohesion

The city is more than a territory or a physical space, it is in itself a complex mixture of layers of infrastructures, relationships, flows, data, links that the activity of people generates and builds or deconstructs all the time. The city is a hive of spatio-temporal and asynchronous links that reflect the undeniable need to rely on the human talent that inhabits it. Social cohesion is the dynamic capacity of a democratic society to absorb social and economic changes and conflicts through a legitimate structure of distribution of its material and symbolic resources, both at the social and economic (welfare), socio-political (rights) and socio-cultural (recognition and identity) levels, through the combined action of allocation mechanisms by the State as a whole, where government, market, family, academia, civil society and community networks consolidate synergies (Tironi, 2008:19; Tironi & Sorj, 2007). Social cohesion, legitimacy and identity circumscribe the social, cultural and human support of a Smart city.

Competitiveness and Economic Growth

Being competitive conditions being smart and being smart includes fostering a competitive economy; Competition and competitiveness are clearly a matter of urban scale, as local characteristics are currently what differentiate cities from each other (Cosgrave & Tryfonas, 2012; Giffinger & Gudrun, 2010; Giffinger, Haindlmaier & Kramar, 2010; Hodgkinson, 2011) as in fact more than 80 percent of gross domestic product is generated in cities (United Nations, 2020).

By making analysis of economy-based strategies, a transformation of specific economic sectors of the city is conferred to make it more competitive, because if it is not competitive it cannot be smart (Komninos, 2009, 2011; Bélissent, 2010; Angelidou, 2014).

Components and Dimensions of Smart Cities

Three cities coexist and interact with their own realities and dynamics, the physical, digital and social, which require three infrastructures that are integrated in a cyclical, iterative, interactive, complex and at the same time totally determinant for cities to be truly smart, such as: the physical and connectivity infrastructure, the Digital and Information infrastructure and the Social infrastructure.

The Physical Infrastructure of Smart Cities

At the Physical level corresponds to the "hard" of the city, which supports the Smart cities, from the bottom up and covers the physical place and infrastructure of the city, through

two dimensions the Smart Environment Dimension**,** which includes the use of new technologies to preserve natural resources and realize the decrease in environmental pollution, focusing on the efficient management of waste, resources and energy networks and the Smart Mobility Dimension, which focuses on improving the sustainability, safety and efficiency of the means of transport. The implementation of intelligent transportation systems, quality infrastructure, parking control, and command and control centers are its priorities. It promotes clean energy in transportation and sustainable, accurate and citizen-friendly public transportation systems.

The Social Infrastructure of Smart Cities

It corresponds to the "soft" of the city, which is juxtaposed to the physical city on which it is supported in a top-down relationship, includes an ecosystem of collaboration, behaviors, solutions and a smart life for all inhabitants and the awareness of the population and the commitment of all to achieve it.

In relation to the above, we find the Smart Economy dimension**,** where the economic, productive and competitive development of the city at an endogenous level and towards its internationalization, is supported by the stimulus to the regulatory, adaptive, creative and responsible capacity, the Smart People - Citizen dimension, refers to the search for improvement in the quality and coverage of education, regardless of socio-cultural and economic level, encompasses social and human capital and the level of qualification of women and men from different backgrounds, who are motivated to learn and participate in the co-creation of public life through Crowdsourcing, social control, social interactions and two-way communications. The Smart Governance dimension, which confers the role of the government evolved in terms of governance, where the role of the citizen and his participation are fundamental and the government is open and transparent in its actions, which relies on technology to ensure quality and efficiency in its services through the optimization of public goods and services and implementation of faster and more effective online procedures, and finally the Smart Living dimension, which refers to the quality and standard of smart living. It involves the responsible use of technology and ICTs in aspects that improve the quality of life of citizens from a multidimensional and complementary perspective focused on innovation and intelligence "i" such as health, (i-health), security, (i-security), education (i-education), and in general where housing, tourism, recreation, community life, social affairs, security and emergencies, urban planning and public infrastructure and urban equipment must be smart.

Digital and Information Infrastructure

The 4RI technologies, data, information and ICT are the great integrators between the physical city and the social city. Given the role of information and communication technologies, the new disruptive technologies of the 4RI, the interconnected systems, the data and information that are stored, managed and analyzed there impact all sectors of the daily life of people, companies and therefore the city. Consequently, given that the citizen lives, plays, relates, interacts, learns and works in a better way in smart cities, it is evident that the ultimate goal of these is to improve the quality of life in a comprehensive manner for all its inhabitants, which is reflected in the reality and perception of a citizen about his situation in the city, in the context of his culture, his identity, his development and his value system, in relation to the standards established by society, the market, governments and multilateral organizations.

Policy Documents and Smart Cities

Evaluating the importance given by recent public policies to the city and technology with a focus on smart cities is fundamental and relevant. In fact, along the lines of (Dunn, 2007) cited by (Vargas, 2009) public policy analysis is a methodology for formulating problems with

the aim of seeking solutions that incorporates five general procedures: problem structuring, forecasting, recommendation, monitoring and evaluation (Vargas, 2009).

The research focused further on the review of different documents, specifically those of the National Council for Economic and Social Policy (CONPES) maximum national planning authority and serves as an advisory body to the Government of Colombia in all aspects related to the development of the country, (National Planning Department, 2017). The interest in reviewing all the related CONPES documents in a transversal manner was focused on analyzing the characteristics of the public policy message, thus, the work focused on the discovery of regularities related to the interrelation of variables, centered on the understanding of the meaning of the texts, the actions and the reflection generated (Tesch, 1990). Therefore, the 16 documents were analyzed in a single word cloud and the most recurrent variables were coded, using for the quantitative and qualitative analysis the technological tool MAXQDA version 2020, which allows a homogeneity by establishing a logical relationship between the categories, variables and defined codes, so that it leaves no room for interpretation in its findings, with respect to the proposed model, its enablers and the four pillars, which guided the critical review of the documents.

Once the documents have been correlated, the importance and need for innovation and good service based on the intelligent use of ICTs in the public sector can be extracted, and to advance much further in the rankings that evaluate these aspects, as they are a clear representation of the generation of public value for citizens and social welfare for all, through the design, development and implementation of best practices and processes within public entities through the use of ICTs, making it clear that the field of Smart cities has not been a priority.

It is important to note, that Colombia has been making efforts to improve and implement digital tools, however it is necessary to continue with greater dynamism, because in measurements such as the World Digital Competitiveness Ranking, which measures the ability of an economy to adopt and exploit digital technologies, for the transformation of government practices, business models, (IMD World Competitiveness Center, 2018) the result for the year 2020 reflects the position 61 out of 63, a scenario that requires greater attention in the design of policies focused on digital development and its implementation.

On the other hand, the development plans and land use plans of the three cities that appear in the Smart cities rankings were reviewed. The Territorial Management Plan (POT) is a technical and regulatory instrument for territorial planning, defined as the set of objectives, guidelines, policies, strategies, goals, programs, actions and norms aimed at guiding and managing physical development and land use. The cases of Bogota, Medellin and Cali were analyzed in the light of the proposed model, compared with the global rankings. This leads to the conclusion that turning these cities into Smart cities has not been a priority, although the development plans in particular mention their intention to advance in aspects of urban planning, governance, and access to and use of technology.

Global Smart Cities Index under Model

A perspective associated with the economy, development and the impact of policies, corresponds to measurement and evaluation. Measuring the progress of Smart cities has a reading from the planning and from the city itself. Considering that one of the purposes of Smart cities is to improve the quality of life of citizens, measuring the progress in the effectiveness and efficiency with which this objective is being achieved and at the same time determining the degree of development or evolution of the city in aspects related to governance, public management, social cohesion, mobility and transportation, citizen participation, urban planning, education and, of course, technology, are decisive.

In this sense, the main indicators that determine whether a city is smart are multiple and varied, for example, having a low crime rate, a certain number of kilometers of bicycle routes per 100 thousand inhabitants, reduction in pollution, better public services, good interoperability

between public agencies and a certain number of green areas per capita, among others. The following table presents the indexes analyzed, in the same way the analysis made in all the results of the indexes in a transversal way it could be concluded that those countries that have promoted policies and national plans of Smart cities or digital agendas for the cities, have advanced more in the 9 rankings as presented in table 1.

Table 1
GLOBAL SMART CITIES INDEXES ANALYZED

No	Name
1	Cities in Motion
2	IMD
3	Millennials Cities Ranking
4	City Prosperity Index (ONU)
5	Smar Cities Ranking of European medium sized cities
6	Global Power City Index
7	Global Cities Index-2016 (A.T. Kearney) Outlook e index
8	The Global Financial Centres Index
9	Cities Opportunities PWC

Table 2
COUNTRIES WITH POLICIES AND PLANS THAT PLACE MORE CITIES AT THE TOP OF THE GLOBAL SMART CITIES RANKINGS

Country	Cities
United States	New york, boston, los angeles, san francisco,seattle,philadelphia,washington,denver,denver,london, manchester,dublin,endinburgh,glassgow
United kindom	London,manchester,dublin,dublin,edinburgh,glasgow,glasgow
Canada	Toronto,vancouver,montreal
Germany	Berlin,frankfurt,cologne,munich
China	Hong kong,beijing,shanghai
Singapore	Singapore
Netherlands	Amsterdam
Spain	Madrid,barcelona
Australia	Sydney,melbourne
Italy	Milan,bologna
Sweden	Stockholm
Japan	Tokyo,osaka
France	Paris
Belgium	Brussels
Argentina	Buenos alres
South korea	Seoul
Denmark	Copenhagen
Argentina	Buenos alres
Source: Own elaboration, 2020	

It was found that those countries with national and local policies, plans or strategies have achieved a high level in the main global indexes of Smart Cities and show an improvement in the quality of life of their inhabitants, which is why the analysis of microdata for this study was the basis for understanding the implementation strategy in the methodology, among which IESE and IMD.

IESE Cities in Motion Index

The CIMI, Cities in Motion Index is based on a weighted aggregation model of partial indicators that represent nine dimensions:

a) Human Capital
b) Social Cohesion
c) Economy

d) Governance
e) Environment
f) Mobility and Transportation
g) Urban Planning
h) International Outreach
i) Technology

Which show the city both in the present and in the future, framed mainly in two aspects: sustainability and quality of life of its inhabitants. It is prepared jointly by the Center for Globalization and Strategy and the Strategy Department of IESE Business School (IESE, 2019).

Table 3
OVERALL ICIM RANKING OF THE TOP 10 CITIES AND THE 3 COLOMBIAN CITIES, 2019-2020

	2019		2020	
City	**Postion**	**ICIM score**	**Postion**	**ICIM**
London	1	100	1	100
New york	2	94,63	2	9573
Amsterdam	3	86,7	8	77,31
Paris	4	86,23	3	85,5
Reykjavik	5	85,35	5	80,47
Tokyo	6	84,11	4	81,95
Singapore	7	82,73	9	76,71
Copenhagen	8	81,8	6	78,51
Berlin	9	80,88	7	77,46
Vienna	10	78,85		
Hong kong			10	76,04
Bogota	117	46,01	120	45,8
Medellin	134	40,67	126	43,81
Cali	148	34,04	145	37,02

Source: Own elaboration, based on IESE Cities in Motion Index 2019 - 2020 IESE, (2020-2019).

The IMD Index

This index is a holistic attempt to capture the various dimensions of how citizens may view their cities as improving by becoming smarter, based on the urban environment, the application of technologies, the perceptions of those living and working in the cities covered, while providing a realistic recognition that not all cities necessarily start from the same level of development. The IMD-SUTD Smart City Index (SCI) assesses residents' perceptions on issues related to a first pillar Structures, which corresponds to existing infrastructure in each city and the Technology pillar, which encompasses the technological provisions and services available to them in their city. Each pillar is assessed on the dimensions: health and safety, mobility, activities, opportunities and governance.

According to the IESE 2020 ranking, the top 20 cities are: London, New York, Amsterdam, France, Reykjavik, Tokyo, Singapore, Copenhagen, Berlin, Vienna, Hong Kong, Seoul, Stockholm, Oslo, Zurich, Los Angeles, Chicago, Toronto, Sydney and Melbourne. Corresponding to the following countries: United Kingdom, United States, Netherlands, France, Iceland, Japan, Singapore, Denmark, Germany, Austria, China, South Korea, Sweden, Norway, Switzerland, Canada and Australia, ratifying the postulates previously made in this regard.

Validation of the Proposed Model

Given the need to give a statistical validation to the model described above, by passing it through the statistical evaluation using SPSS and Stata statistical software, with a reliability percentage of 95%, the validity of the pillars and enablers was demonstrated, as well as, that the cities and countries with better enablers fare better in the global rankings and are located in the higher levels. Likewise, that the cities and countries with public policies that promote or are

based on the four pillars, their results in the last global measurements of these evaluated rankings, showed a positive impact. Consequently, it was demonstrated not only the reliability and validity of the proposed model, but also that both enablers and pillars are determinant for Smart cities policies, plans and projects.

Moreover, in the Colombian case the findings show the gaps that are presented in each of the pillars, which evidences, on the one hand, the gap that must be closed in each city and on the other hand, ratifies the need to formulate and implement a public policy for smart cities, also supported or referenced in the model proposed here and statistically proven. Thus, the individual causal association, enabler *vs*. global indicator of the IMD for the structure segment is presented. From the physical infrastructure point of view, all the enablers turn out to be pure predictors that in context drive the 4 pillars of the proposed pyramidal model, the related enablers clearly explain with levels higher than 99% the structure of the proposed model (See table 4).

Table 4
ANALYSIS OF SMART CITIES POLICY ENABLERS

Structures	Role in the model	Enables	Beta	Wald statistic	P value
Basic sanitation meets the needs of the poorest areas	Social cohesion	Better utilities	0,05	12,98	<0.001
Recycling services are satisfactory	Environmental	Better public	0,12	32,29	<0.001
Public safety is not a problem	Human capital smart people		0,04	13,52	<0.001
Air pollution is not a problem	Environmental	Environmental	0,07	30,11	<0.001
Provision of medical service is satisfactory	Human capital smart people	Better public services	0,07	21,94	<0.001
Finding housing with a rent equal to or less than 30%of the monthly salary is not a problem	Smart living		-0.04	6,67	0,01
Traffic congestion is not a problem	Mobility		0,02	2,08	0,349
Public transportation is satisfactory	Mobility		0,05	11,42	0,001
Green spaces are satisfactory	Urban planning pillar	Urban and technological development	0,08	19,36	<0.001
Cultural activities are satisfactory	Smart living		0,12	15,02	<0.001
Job search services are readily available	I solutions		0,05	8,49	0,004
Most children have access to good schools	Intelligent living	Human talent	0,08	22,34	<0.001
Local institutions offer lifelong learning opportunities	Smart living	Human talent	0,14	26,86	<0.001
Business are creating new jobs	Competitiveness	New business model	0,02	2,14	0,143
Minorities feel welcome	Dimension intelligent people	Human talent	0,04	10,53	0,001
Information about local government decisions is easily accessible	Governance	Political will	0,04	6,61	0,01
Corruption of muncipal offical is not an issue of concern	Governance	Government transparency	0,08	33,21	<0.001

Residents contribute to local government decision making	Governance	Government transparency	0,06	17,39	<0.001
Residents provide input on local government projects	Governance	Government transparency	0,06	15,09	<0.001
Source: Own elaboration, 2020.					

Now, when performing the multivariate analysis of the pillars, with a confidence interval of 95%, the following table shows the attributes in blue that are the Pillars of the proposed model (3 pillars are significant at more than 99% confidence, p-value<0.01), only the "Economy" indicator presents a lower but extremely satisfactory significance of 97% (p-value=0.031), under the backward method of variable selection, which generated two steps for the model with significant variables. The ordinal model calculated a model for each response category (1=A's; 2=B's; 3=C's; 4=D's). The pillar with the greatest impact on the CIMI score is Governance (Coef=0.023; p-value<0.001), followed by Urban Planning (Coef=0.018; p-value<0.001), Social Cohesion (Coef=0.13, p-value<0.01) and finally Economy (Coef=0.008; p-value<0.001) (Table 5).

Table 5
MODEL PILLAR PARAMETER ESTIMATES

Estimaciones de parametro, pilares del modelo

							Intervalo de confianza al 95%	
		Estimation	Desv.error	Waid	Gf	Sig	Limte inferior	Limte superior
Umbral	[Respuesta_icim_ordinai=1,00]	1,521	0.48	10,060	1	0.002	,581	2,461
	[Respuesta_icim_ordinai=2,00]	9,228	0.772	1,42,716	1	0.001	7,714	10,741
	[Respuesta_icim_ordinai=3,00]	16,107	1,205	1,78,663	1	0.001	13,745	18,469
Ubication	Economia	0.008	0.004	4,657	1	0.031	0.001	0.014
	Captial humano	0.014	0.004	11,177	1	0.001	0.006	0.023
	Cohension social	0.013	0.004	12,270	1	0.001	0.006	0.020
	Medioambiente	0.013	0.003	14,736	1	0.001	0.006	0.020
	Gobernanza	0.023	0.005	25,822	1	0.001	0.014	0.032
	Planificacionurbana	0.018	0.004	22,039	1	0.001	0.011	0.026
	Proyeccioninternacional	0.018	0.004	22,170	1	0.001	0.010	0.025
	Tecnologia	0.012	0.004	8,258	1	0.004	0.004	0.020
	Movillidadytransporte	0.013	0.004	11,972	1	0.001	0.005	0.020
Source: Own elaboration, 2020								

As shown in the table, the attributes in blue that are the pillars of the model (3 pillars are significant at more than 99% confidence, p-value<0.01 and one at 97%, p-value=0.031), which shows both from a statistical and data analysis perspective, the model responds to a structure that is supported by pillars that are decisive when evaluating the progress of Smart cities.

Closing Gaps

A comparison of the four pillars of the model was made by comparing the best cities in the Cities in Motion ranking *vs*. the 3 Colombian cities, which shows the gaps that must be closed in the country and at the same time, the confirmation of the position that a city should reach at least to be ranked as relatively high was statistically validated through the classification trees, under the QUEST growth method that uses the Chi- Square test for dependent variables and nominal predictors.

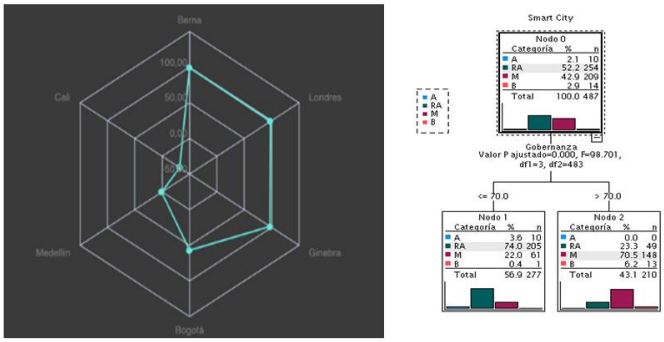

FIGURE 2
COMPARATIVE GOVERNANCE PILLAR, THREE BEST SMART CITIES *VS*. THREE IN COLOMBIA

Source: Own elaboration, based on IESE Cities in Motion Index, 2020.

When comparing the three main Colombian cities against the Smart cities London, Bern and Geneva, with higher scores in this pillar, it is evident the gap that Cali and Medellin must close, and to a lesser extent Bogota. This shows that cities with a stronger governance pillar appear better placed, and that cities should reach at least position 70 in the world ranking in the Governance pillar, to obtain a status at least relatively high.

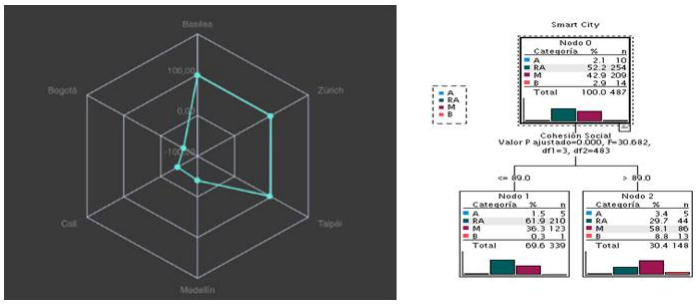

FIGURE 3
COMPARISON OF SOCIAL COHESION PILLAR, THREE BEST CITIES *VS*. THREE CITIES IN COLOMBIA

Source: Own elaboration, based on IESE Cities in Motion Index, 2020.

Once the Colombian cities and the Smart cities Basel, Zurich and Taipei, with higher scores in this pillar, are contrasted, it is striking to note the huge gap that Bogota, Cali and Medellin must close at the same time that the cities should reach at least 89th position in the world ranking in the Social Cohesion pillar, to obtain a status at least relatively high.

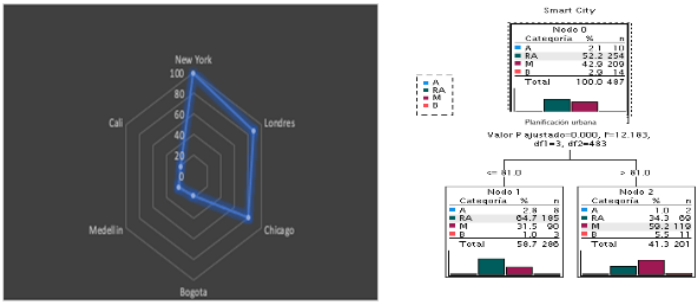

FIGURE 4
COMPARATIVE URBAN PLANNING PILLAR, THREE BEST CITIES *VS*. THREE CITIES IN COLOMBIA

Source: Own elaboration, based on IESE Cities in Motion Index, 2020.

When comparing the Colombian cities against the Smart cities New York, London and Chicago, which are the highest scoring in this pillar, it is evident the huge gap that Bogota, Cali and Medellin must close, in fact they have been losing positions in the last measurements, the strength of the major cities in their urban planning, is crucial for a Smart city, while the cities should reach at least the 81st position in the world ranking in the pillar of urban planning, to obtain a status at least relatively high.

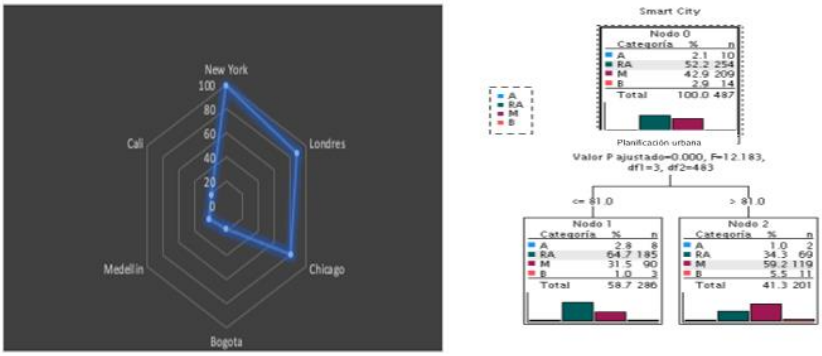

FIGURE 5
COMPARISON OF DEVELOPMENT AND COMPETITIVENESS PILLAR, THREE BEST CITIES *VS*. THREE CITIES IN COLOMBIA

Source: Own elaboration, based on IESE Cities in Motion Index, 2020.

When comparing the three main Colombian cities against the Smart cities with the highest scores in this pillar, it is evident that the three cities must implement strategies to strengthen their economy, their competitiveness and therefore their endogenous development with a global perspective, so the cities should reach at least the 71st position in the world ranking in this pillar to obtain a relatively high position.

DISCUSSION

In this field of smart cities, a topic in the background of the discussion is associated with defining whether they are a consequence of development or a precondition for endogenous development with a global perspective. Having reviewed the literature, case studies, regional dynamics and contrasted against the data, it is clear that the level of development of a country and its cities is a precondition for structuring a smart city model that, with a global perspective, understands local dynamics and improves the quality of life of its inhabitants. In fact, in the line of all the rankings analyzed, there are several measurement indicators depending on the evaluating organizations, with which Smart Cities self-evaluate or evaluate themselves and measure their progress towards the future. These include the economy, urban planning and mobility, environment, inhabitants and way of life, administration and government, and technology. This leads to reflections related to the fact that the competitiveness of a country's regions plays an important role so that efforts are oriented towards achieving sustained development that has an impact on the well-being of the population CEPAL (2010).

With respect to the proposed model, and according to Carvajal (2002), a model is constructed as a means to study reality and contributes to understanding theories and laws or to verify them. The model presented here is the result of a rigorous review of scientific literature in this field, of related policies, with a component of innovation and regional perspective and statistically validated, is a cornerstone for planning, understanding, implementing and evaluating smart city policies, plans and projects for Colombia and other emerging countries.

Finally, to formulate a policy in this field it is necessary to align with six common elements in Smart Cities: a) A holistic and global vision, understood as intelligence and technological innovation applied in all areas and spaces of the city, b) A means to improve the quality of life, in which the efficiency and quality of public services are improved, the productive sector has more opportunities for innovation, and a more sustainable environment is generated that attracts investors and is supported by human talent committed to the city and its progress. c) A new model of relationships and economy. Smart cities give way to digital, collaborative, behavioral and circular economies, where new forms of participation and citizen responsibility are created. d) The sustainable use of resources refers to the ability to make use of natural resources without causing further damage to nature. e) Technology as a disruptive factor, which favors the capture of large amounts of data to process them in real time and convert them into relevant information for all city stakeholders. f) A systemic analysis of each of the sectors, factors and resources that are required and constantly evaluated.

CONCLUSIONS

The smart city as a concept of the information and knowledge society, has promoted a deep reflection on governance and urban planning for the coming years, promoting collaboration between citizens, government, academia and business, around the construction of smart governance, flexible regulation and active participation in order to improve the quality of life of all citizens.

It is clear that a city cannot become smart through the use of technology alone. While the technological scenario and digital transformation are powerful enablers, and the intelligence of technology that encompasses all 4RI technologies, data and information, make it a fundamental dimension as it allows the integration of physical and social infrastructure. A Smart cities policy must be based on agile governance adapted to current global and local trends and realities, on urban planning with a long-term perspective and concrete actions in the short term, as well as on a strong and solid social cohesion, and on an economic scenario that fosters development and growth, in order to leverage smart cities projects.

The results of the research show that Colombia should design, formulate and implement a public policy for Smart cities as an example for other emerging countries, since the evidence shows that countries that have promoted this type of policies from the national government contribute to the consolidation of their smart cities, developing policies and plans that should be structured with the collaboration of the State as a whole, seeking to position the HAPICODI (by acronym in Spanish) model presented, (Enablers, Pillars, Components and Dimensions) for its conceptual soundness, its comprehensiveness, its mathematical and statistical validity and its impact is supported by accelerating the proposed enablers and the fundamental role of the four pillars, Components and Dimensions) for its conceptual soundness, its comprehensiveness, its mathematical and statistical validity and for the impact that is supported by accelerating the proposed enablers and the fundamental role of the four pillars, with an emphasis on the identity of cities towards modern ones, which respond effectively and efficiently to the changing needs of society, the global economy and the new changes that situations such as the current pandemic of Covid-19, imprint on a society and a city that will not be the same.

The model proposed and statistically validated with a reliability of 95% supported theoretically and through a formal research method is solid, coherent, and relevant; and the analyses presented here perfectly apply to Colombia and other Latin American countries, which can implement plans and projects that consolidate a smart city, called integral IITC, which is one where there is quality information and infrastructure, state- of-the-art technology managed by a co-responsible human talent, governed in an intelligent and collaborative manner with a cohesive society. This requires a systemic and intelligent thinking with its methods and practices attacking complex problems in a holistic way, in a responsible framework of digital, circular, collaborative and behavioral economies, which are the ones to be implemented for the development of smart cities in the face of the new global reality.

It fundamentally requires political will and a flexible regulation that accompanies policies, plans and projects in this field. Likewise, it is important to break with the paradigm of the short-term vision of governments and implement a policy that orders the planning and execution of actions for the transformation of cities to smarter ones through a diagnosis of the current situation, the design of phases for implementation, including the costing and the entity responsible for planning and execution, the formation of the team for this analysis and its implementation. As well as the constant monitoring of national and international measurements of the indexes to verify progress and measure their impact, a task that requires the articulated and collaborative work between the public and private sectors, academia and citizens for the benefit of society as a whole. Finally, smart cities must respond to State and not government policies, they are cities planned and developed under the notion of modernity and immediacy with a long-term perspective.

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