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Intelligent Ciudad



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— Bogotá D.C. —

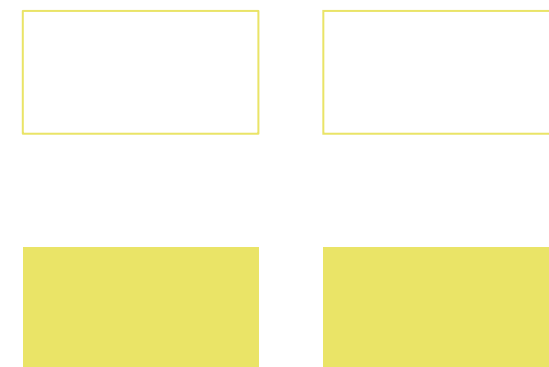
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Introduction

and provide a better response to the challenges they face. This is how the concept of Smart Cities, or Digital Cities, has emerged, associated with those that are making strategic use of technology in their economic, social and urban development policies.

This paper presents a review of international best practices in the development of smart cities, as well as a summary of the advances

of the city of the new opportunities of technological development to improve urban management.

policy recommendations and initiatives for Bogotá's progress in this area.

Chapter 2 of the document presents a review of the existing conceptual frameworks for smart cities, as well as the practices being implemented by the world's leading cities in this regard. Chapter 3 presents the main advances that Bogotá D.C. has made in recent years in its transition to a smart city. Chapter 4 summarizes the challenges facing the city as it moves forward in this process, and Chapter 5 summarizes the main challenges facing the city as it moves forward in this process.

Chapter 5 presents the respective Bogotá in this area. Based on the above, the document describes the main challenges that the city faces in order to consolidate itself as a smart city, or digital city, and

The growing concentration of population and economic activities in cities has made city-based action essential to meet the social, economic and environmental challenges of today's world. Currently, 54.7% of the world's population resides in cities, value that contrasts with the 33,6% of urban population that existed in 1960. This is why more than half of the Sustainable Development Goals to 2030 of the United Nations are related to actions in cities (INDRA, 2018).

In this context, a large number of cities around the world, mainly in developed countries, have implemented plans and initiatives that seek to take advantage of

proposes a set of

recommendations.

¹

Source: World Bank, World Development Indicators

2

Marco

conceptual

and practical international
practices.

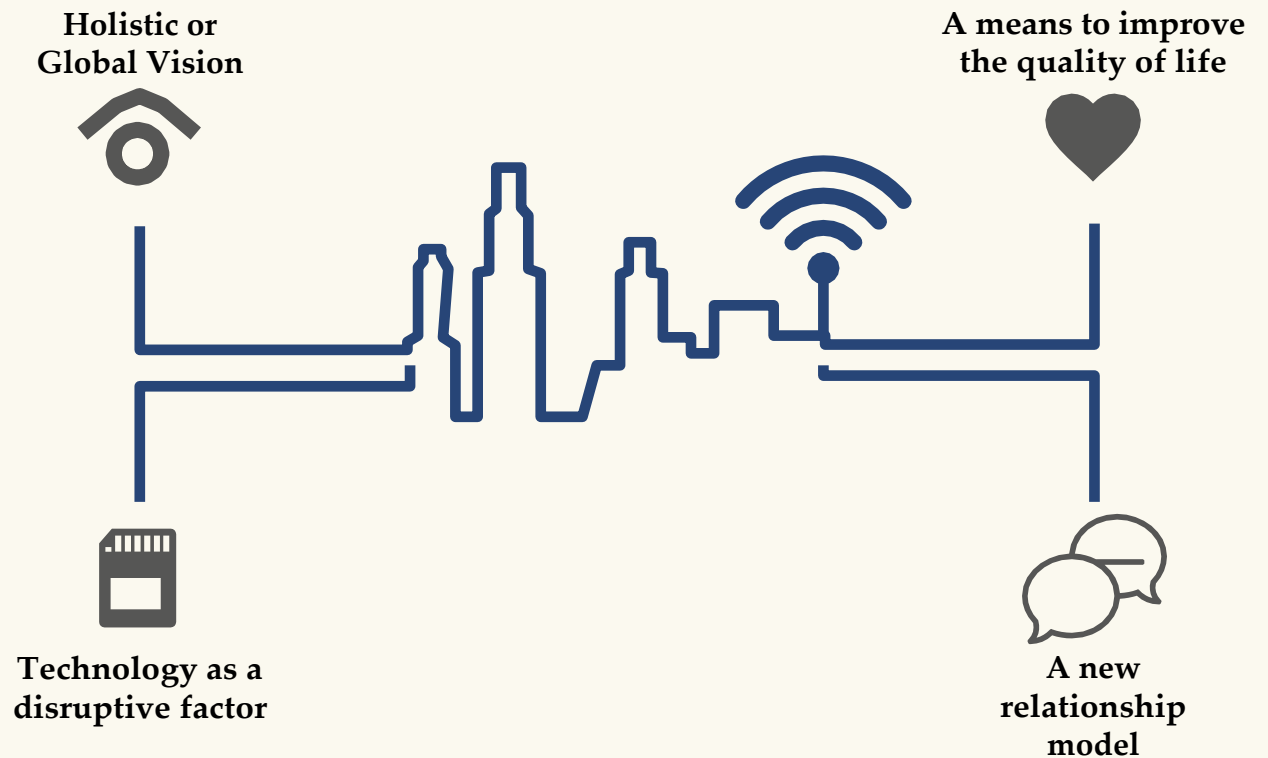
This Chapter presents a review of the international literature on definitions and scope of the Smart Cities concept. From this review, the common elements of the different conceptual frameworks reviewed are highlighted. Likewise, some models mentioned in the literature on the evolution of cities towards smart cities and on the ecosystem that makes up this type of cities are described. Finally, the conclusions of the review are presented.

2.1 Concept of Smart City.

Although the name "Smart City" is in common use today, there are different theoretical approaches to this concept, and there is no broad consensus on its definition, structure and components. However, most definitions share some common elements. Telefónica (2015) highlights some of these elements: the importance of a holistic or global vision, the development of a means to improve the quality of life for the

citizens, the use of technology is a disruptive factor and the existence of a new model of relationships (Graph 1).

Figure 1 Common elements of a smart city.



2.2 Model of Smart Cities.

2.2.1 Model of Smart Cities Council

The Smart Cities Council - SCC (2013)

proposed a general smart city model whose main characteristic is the coexistence of sectoral initiatives and cross-cutting components that allow the integration of different systems. This integration avoids the development of technology silos in the technological systems of cities, thus achieving greater effectiveness and efficiency.

According to this model, sectoral initiatives allow solving specific problems in the different areas of city management: mobility, security, public services, health, etc. They also allow the achievement of short-term results - early victories-.

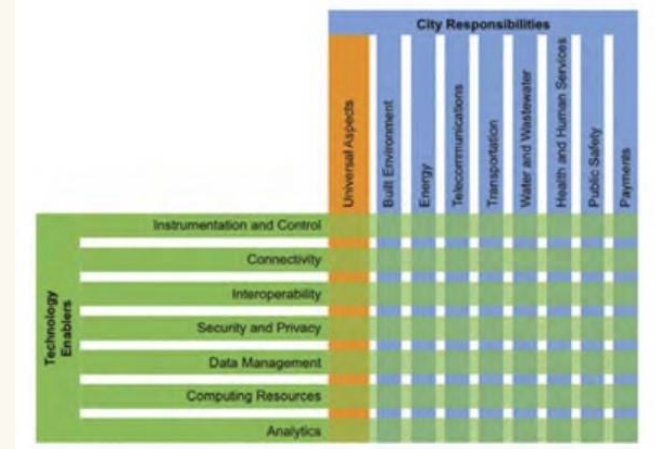
that increase public support and visibility of the overall smart city project. On the other hand, the transversal components, which have the role of articulators and integrators of the different systems, are grouped in different layers. Some of them are related to physical infrastructure (sensors, networks), others with interoperability and security standards, others with computational resources (big data), and others with management systems.

Figure 2 summarizes the configuration of the smart city model proposed by the SCC. This graphic shows the interrelationship that should exist between the so-called "responsibilities of a city" and the cross-cutting technological enablers. City responsibilities refer to sectoral initiatives in eight dimensions: the built environment, energy, telecommunications, transportation, water and wastewater, health and human services, security, and payments. For its part, this model points to the



existence of seven fundamental cross-cutting enablers: Instrumentation and control, connectivity, interoperability, security and privacy, data management, IT resources and analytics.

Figure 2 Framework of cities intelligent.



Source: SCC, 2013



According to this model, cities must articulate the planning and implementation of sectoral technological initiatives with the development of technological infrastructure, computational resources and integrating systems. This articulation allows maximizing the return on investments in technology and human capital, among others, by the cities.

Below are the definitions made by the Smart Cities Council to each of the following. one of the components of responsibilities and enablers:

A. Responsibilities

Built environment: this aspect considers all the city's constructions such as buildings, parks and public spaces. Components such as streets and utilities are not included here because they are accounted for in city responsibilities such as transportation and energy.

Energy: refers to the infrastructure to produce and transport energy, mainly electricity and gas.

Telecommunications: for the Smart Cities Council this item refers to the communications of people and companies.

Transportation: this includes all systems that allow the mobility of citizens, including sea and air ports.

Water and waste: this refers to the entire infrastructure responsible for water treatment, from water sources through distribution to use and disposal.

final to recycling and reuse.

Health and human services: all essential services required by human beings for health, education and social services.

Public safety: infrastructure, agencies and personnel necessary to keep citizens safe.

Payments: these are the heart of economic activity in cities, they are the central component of every economic flux. They have become so systematic that they pass unnoticed.

B. Enablers

Instrumentation and control is the way in which the smart-city monitors and controls its conditions, the instruments are the eyes and ears.

of the city, while the control systems manage the city's capabilities.

Connectivity: this describes how the communication devices communicate with the control centers. This responsibility ensures that all collected data is transported to the respective analysis center. Examples of this are found in wifi networks, radio frequency networks and cellular networks.

Interoperability ensures that products and services from different suppliers can exchange information and work together seamlessly, and good interoperability brings many benefits, such as variety in choices, creating city projects at various stages with the assurance that they will work properly in the end.

Security and privacy encompasses all those

technologies, policies and practices that promote safeguarding data, privacy and assets. This component is critical because it builds citizens' confidence, without confidence the city will have difficulty adopting new technologies and practices.

Data management refers to the process of storing, protecting and processing data while ensuring its accuracy and accessibility.

IT resources include computers, data storage, and the capabilities needed for smart cities. The Geographic Information System (GIS), is the most essential special capability, as it allows the smart city to know where everything is located.

Analytics creates value from the data that instrumentation provides, so you can identify new insights and unique solutions to deliver services that improve outcomes.

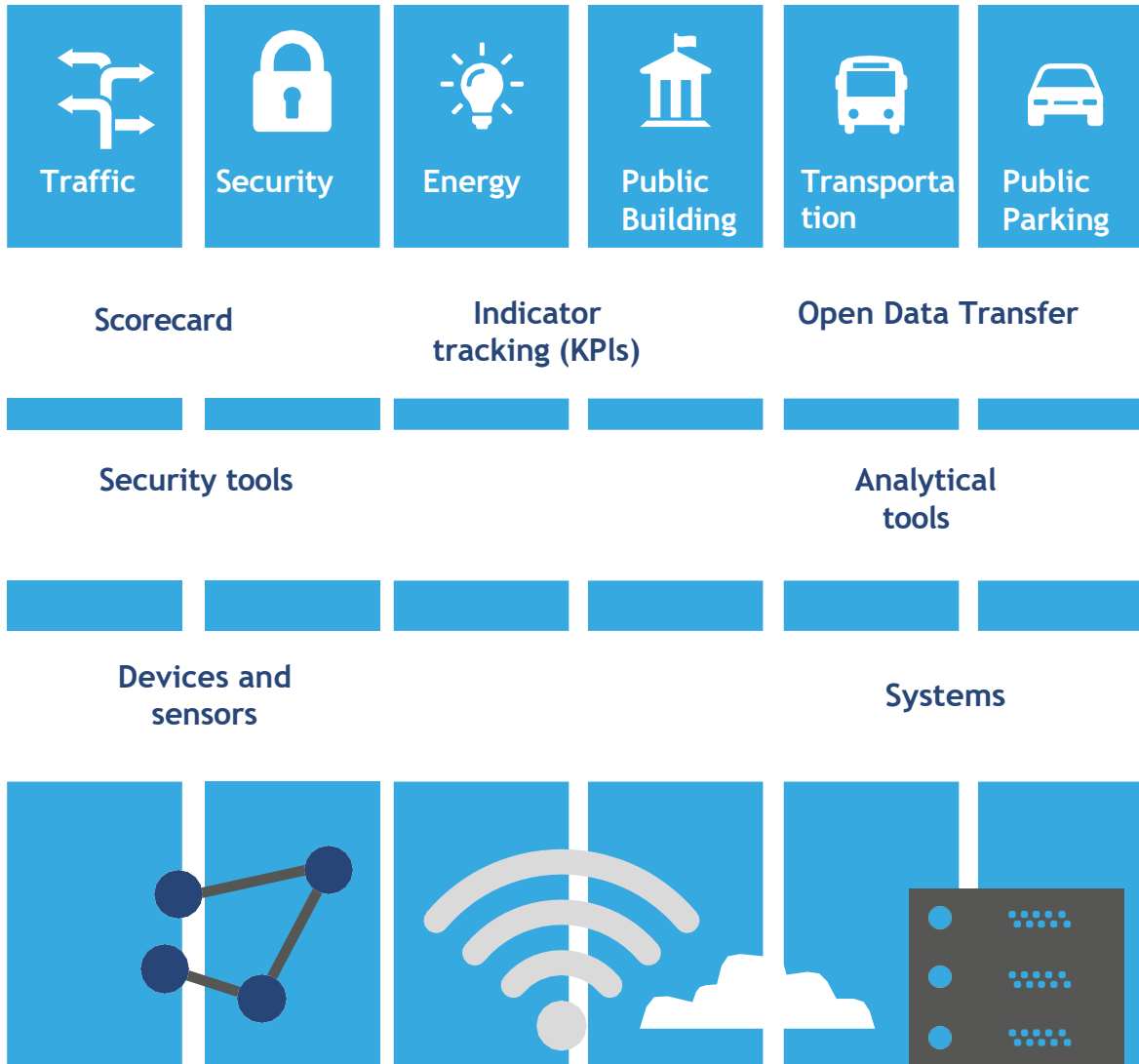
2.2.2 Modelo KPMG

KPMG (2017) also defines the framework of a smart city through the use of cross-cutting and vertical elements. The vertical elements refer to specific projects in sectors related to city development: **transit, security, energy, public buildings, transportation, and public parking**. The transversal components are the infrastructure elements, systems, analytical and security tools, and monitoring and open data applications that enable the integration of the different systems. See Gráfica 3.

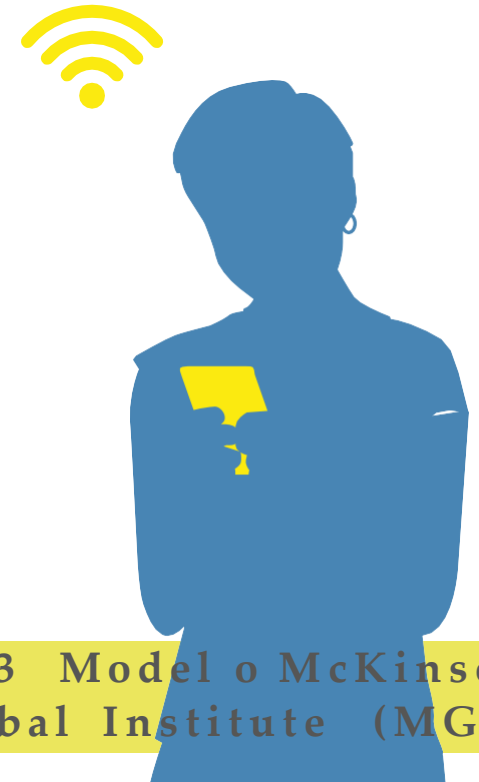


Figure 3 Technology applicable to smart projects

Services



Source: Own elaboration based on KPMG (2017).



2.2.3 Model o McKinse Global Institute (MGI)

According to MGI (2018), a city as a smart city is able to take advantage of data and technology to improve the quality of life of its inhabitants. Real-time data allows the implementation of faster and cheaper solutions, and makes it possible, for both governors, businesses and individuals, to make better decisions in everyday activities.

MGI (2018) proposes a smart cities model composed of three layers that operate on traditional, physical, and social infrastructure (Gráfica 4).



Gráfica 4 Use of smart cities and digital intelligence to solve public problems and improve quality of life.



Source: MGI (2018)

As can be seen, the first component is the technological base, and includes high-speed networks, smart equipment, open data portals and sensors, which enable the collection, transmission and storage of information about cities (such as energy consumption and traffic flow, among others).

The second component is the intelligent applications and data analytics capabilities. This component enables the use and exploitation of the information generated and transmitted in the first layer, for the development of alerts, solutions and the provision of services related to the management of cities. The tools are available in several domains:

safety, mobility, health, energy, water, waste, economic development and housing, and community and engagement

The third component refers to the adoption and use of the systems, applications and services developed. These elements can contribute to better decision making by the city's public officials and citizens. Thus, it is essential that the applications are widely adopted in order to achieve real results.

2.2.4 Model odel Inter American Bank Development (IDB)

IDB (2017) puts forward a model of smart cities similar to those described above. According to this model, the basis of a smart city has four basic elements:

(i) Connectivity infrastructure; (ii) Connected sensors and devices; (iii) Integrated operation and control centers; and (iv) Communication interfaces (Figure 5).

Figure 5 The foundation of a smart city.

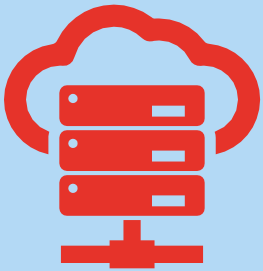


Source: IDB (2017)

The four elements of the model proposed by IDB (2017) will be explained below.

1

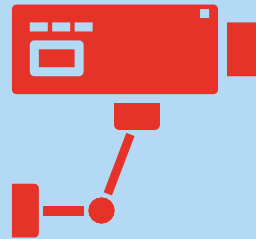
Connectivity infrastructure:



This element is fundamental given that the fixed and mobile broadband networks are the ones that support the applications and allow connectivity between people in the city. There are several data network technologies: wired, optical fiber (the fastest and highest quality) and wireless networks (Wi-Fi, 3G, 4G or radio).

2

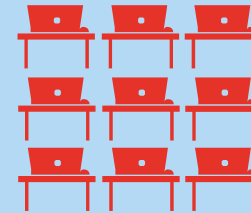
Sensors and devices connected:



Through the installation and connection of sensors and cameras throughout the city, real-time data are obtained that allow decisions to be made at the moment and in the future. Thanks to these devices, services in different areas can be improved and made more economical, from traffic control, monitoring of risk areas and agricultural areas, provision of telemedicine services, control of energy expenditure and public lighting, as well as control of water use and pollution, among others.

3

Integrated Operation and Maintenance Center (CIOC):



This is a space that integrates the technologies, infrastructure and processes of a smart city. This allows the collaboration and interoperability between sectors, as well as real-time monitoring of the city, thus improving the efficiency and transparency of all services. The most important aspect of this center is its ability to use existing information to perform predictive analysis, which allows for preventive actions to be taken.

4

Communication Interfaces:



This element depends on the previous elements and is based on applications and communication systems for citizens. In this component, mobile applications contribute to data collection and participatory city management.

2.3 Model o from Parliament oE ur o peo .

Additionally, the European Parliament (2014), defined a model of smart cities that takes into account, in addition to sectoral aspects, the human, technological and institutional components involved in their development.

According to Nam and Pardo (2011) technological factors include physical infrastructure, digital networks, and smart, mobile, and virtual technologies; human factors include human infrastructure and social capital; and institutional factors are made up by the governance, policies, regulations and directives.

On the other hand, the Parliament

The European Union identifies a set of characteristics of smart cities that are enabled by three components mentioned above: the economy

smart, smart environment, smart government, smart people, smart mobility and smart living.

Graph 6 schematically presents the components and characteristics of a smart city, according to the European Parliament, as well as the existing relationships between these elements.

Figure 6 The relationship between components and characteristics of smart cities.

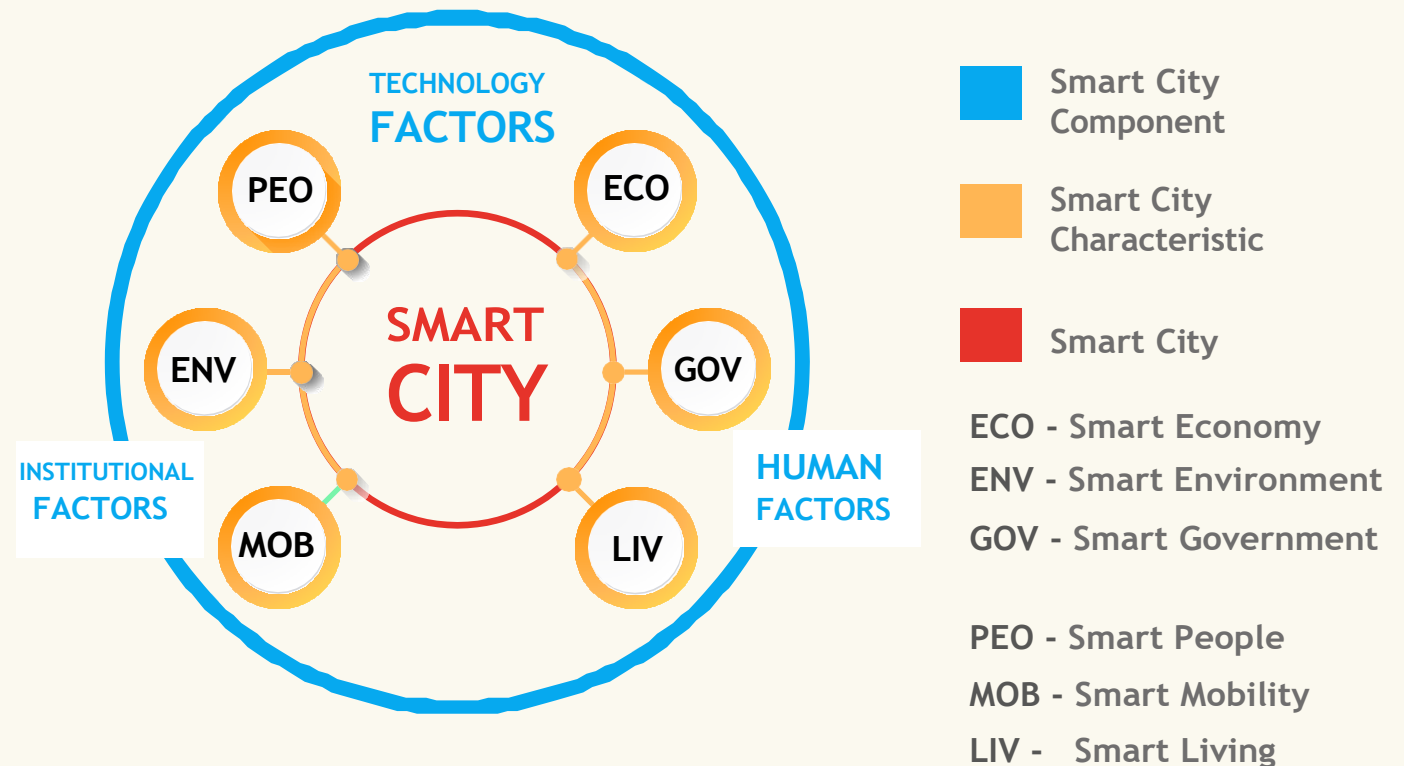
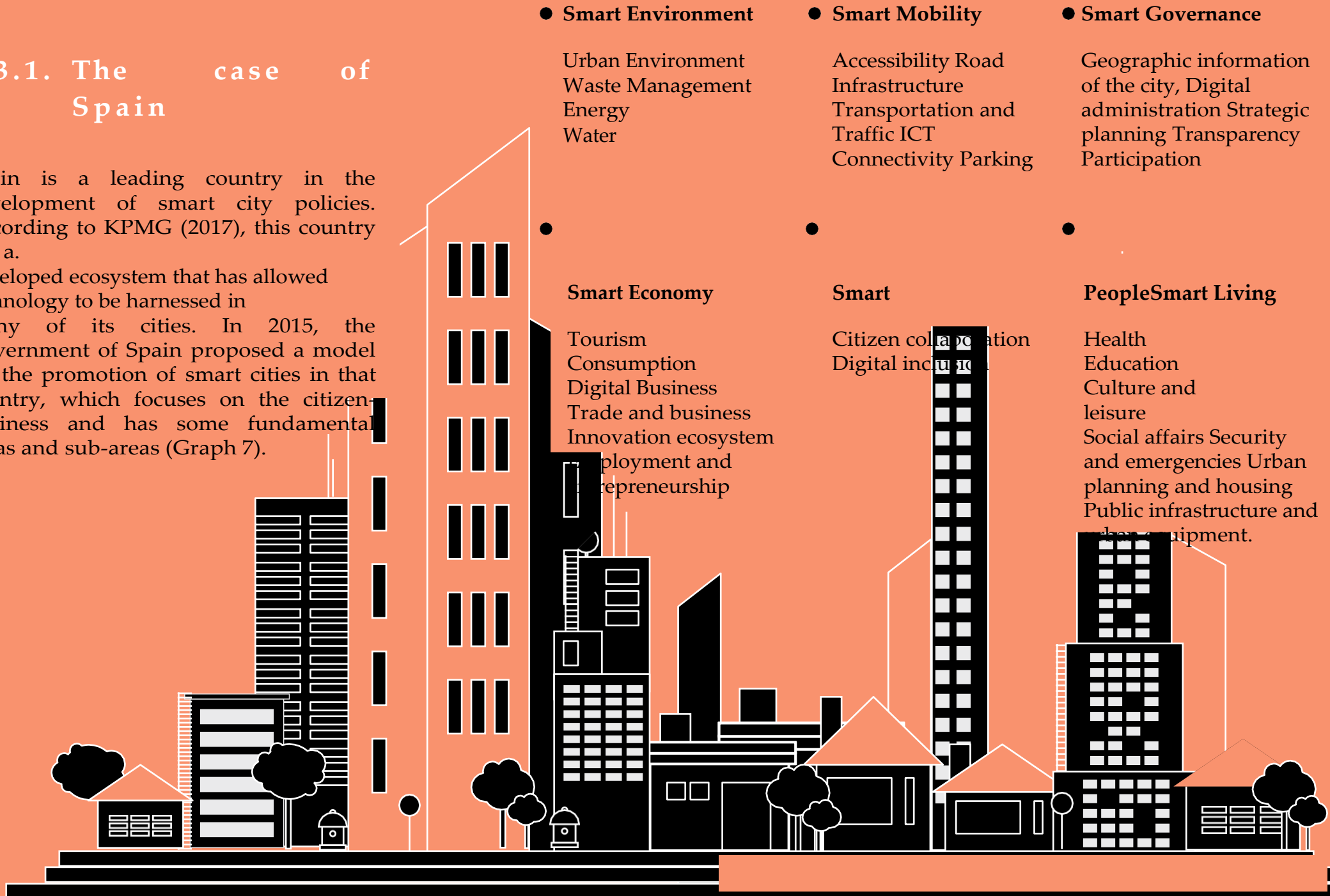


Figure 7 Spain's Smart City Model.

2.3.1. The case of Spain

Spain is a leading country in the development of smart city policies. According to KPMG (2017), this country has a developed ecosystem that has allowed technology to be harnessed in many of its cities. In 2015, the Government of Spain proposed a model for the promotion of smart cities in that country, which focuses on the citizen-business and has some fundamental areas and sub-areas (Graph 7).



The model proposed by the Government of Spain considers six sectoral aspects or areas and their respective subareas:

1

The Intelligent Environment:

Which focuses on the efficient and sustainable management of the city's resources, i.e. energy, water, urban environment and waste management.

therefore includes strategic planning, geographic information of the city, digital administration, transparency and participation.

and includes the sub-areas of citizen collaboration and digital inclusion.

4

The Smart Economy:

It is aimed at the economic and competitive development of the city, therefore, it includes the sub-fields of tourism, consumption, trade and business, digital business, innovation ecosystem and employment and entrepreneurship.

6

The Intelligent Life:

To increase people's quality of life. It includes: health, education, culture and leisure, social affairs, security and emergencies, urban planning and housing, as well as public infrastructure and urban equipment.

2

Intelligent Mobility:

It enables improved mobility, transportation and accessibility in the city, i.e. it includes road infrastructure, transportation and traffic, parking, ICT connectivity and accessibility.

5

The People Intelligent:

Seeks to enhance social and human capital

3

Smart Governance:

Seeks an open and transparent government, and

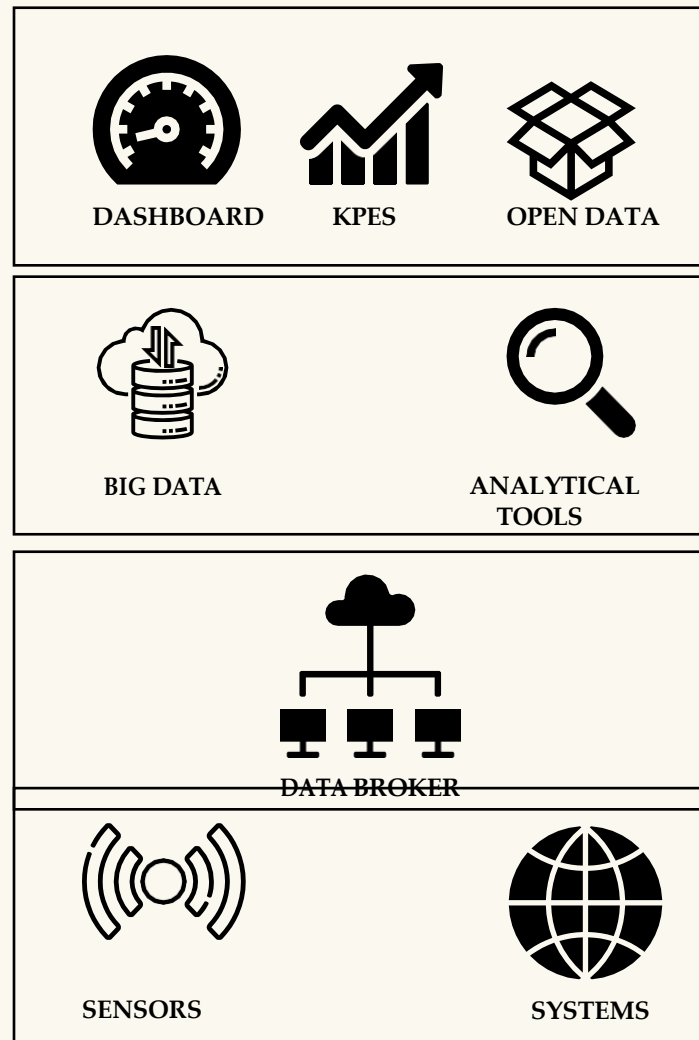
● Smart City Platform in Valencia

Telefónica (2015) points to the smart city platform of the city of Valencia as a reference case due to its open nature in which it promotes innovation.

According to this company: "Valencia is the first Spanish city to centralize municipal information in a comprehensive city solution based on the cloud services paradigm and the first European city to use FI-WARE in a Smart City platform designed to obtain data from City Hall systems and its contracts, as well as from Internet of Things (IoT) based devices and other city systems". The city's platform, called VLCi (Plataforma Valencia Ciudad Inteligente), processes data in an integrated way, achieving synergies, facilitating monitoring, and promoting innovation, service transformation, better decision making and governance.

Figure 8 presents the conceptual model of the Valencia Smart City platform.

Figure 8 Structure of the platform for the smart city of Valencia



Presentation of Information

Report generation. Dashboard management. Open data management.

Information storage and analysis

Statistical and predictive analysis. Big Data analysis. Storage of large volumes of structured and unstructured information.

Distribution of information

Handling of multiple sources and multiple sumps. Large volumes of information.

Information Acquisition

Sensor data with different technologies and protocols. Data from heterogeneous systems in batch mode. Real-time data from heterogeneous systems. Transformation of data into information.

As can be seen, this platform is structured in layers, very similar to the model proposed by KPMG.

According to Telefónica (2015), this platform classifies technologies depending on their function in relation to information: (i) Acquisition of information through sensors and systems; (ii) Information distribution system (Data broker); (iii) Storage and analysis of information through the use of Big Data and other analytical tools; and, (iv) Presentation of information through open data platforms, definition of key indicators and use of dashboards.

2.4. Evolución de las Ciudades Inteligentes

KPMG (2017) mentions the phases that cities go through to move towards a smart city (Graph 9). These phases depend on the current state of development the city is in, as well as the problems it faces and the needs of its citizens.

In the first Phase, called:

Services 1.0, cities continue to function normally and include neither smart city initiatives nor major investments.

In the phase of:

Services 2.0, city managers are aware of the need for urban transformation and therefore implement investments in technological infrastructure.

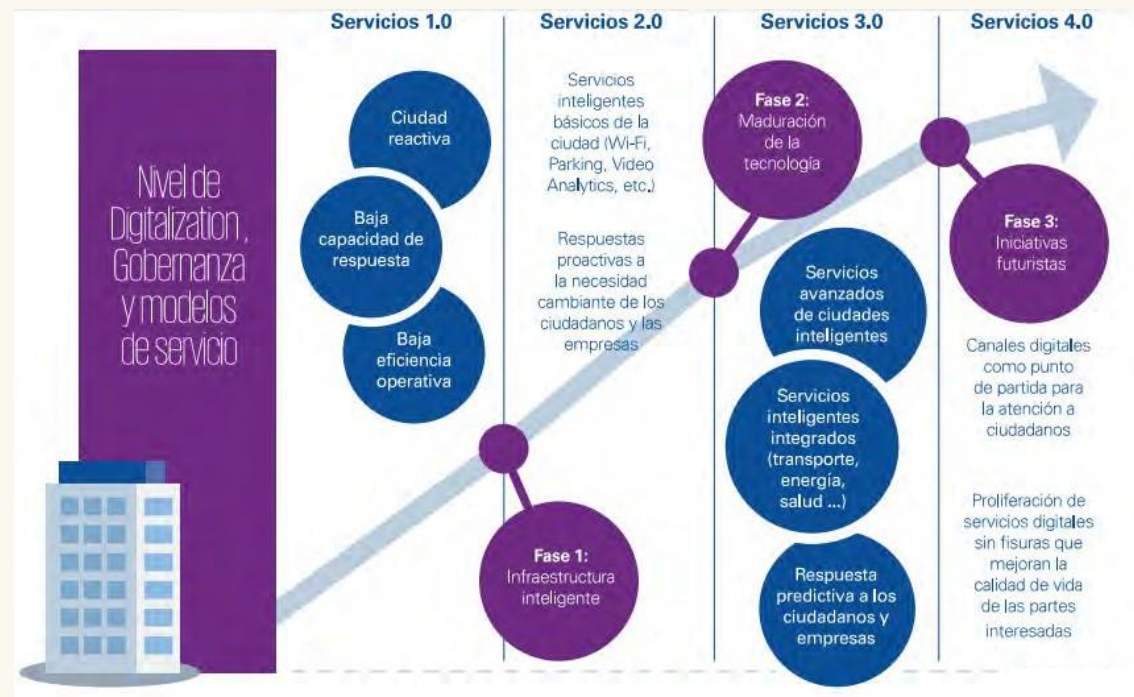
Then, in the phase of

Services 3.0, the city begins to develop advanced projects and services in areas such as transportation, energy and health.

Finally, in the phase of

Services 4.0, the city functions efficiently leveraged on technology and the proliferation of digital channels and services that contribute to the improvement of the population's quality of life.

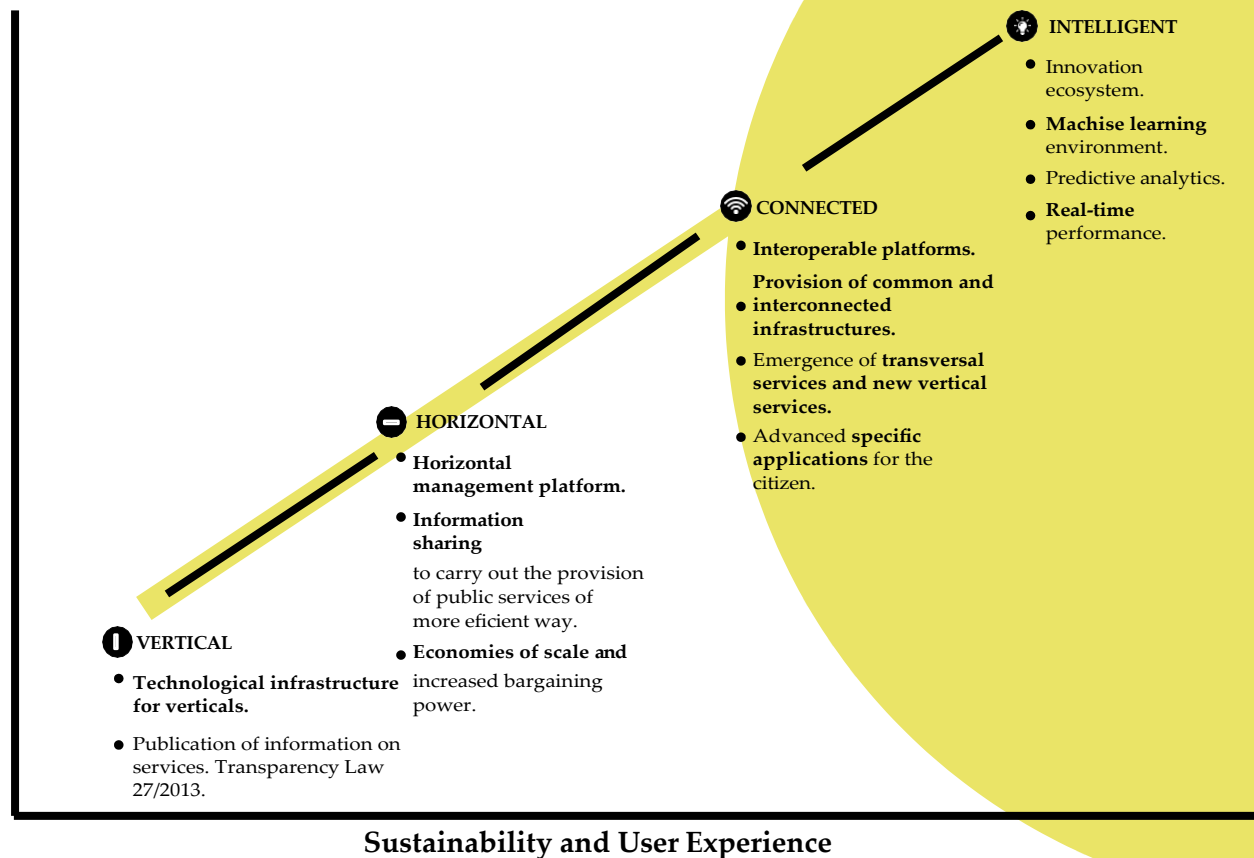
Figure 9 Model 1 of the evolution of a smart city.



Source: KPMG (2017)

In the same vein, Telefónica (2015) points out that the process of transforming a city into a smart city consists of four phases (Gráfica 10).

Figure 10 Model 2 of the evolution of a smart city.



As can be seen, according to Telefónica, the first stage in this process is the:

Vertical Phase, where technology begins to be included in sectoral or vertical urban services (water management, waste management, mobility, etc.). A good example of this is integrated transportation systems.

The second phase is the Horizontal Phase, where cities have a horizontal management platform, both for services and for physical and technological infrastructures. In this stage the different actors begin to share information, thus improving services, increasing their efficiency and integration.

The third phase is the Connected Phase, where the city is interconnected and digitized, which facilitates synergies and allows for the optimization of services and processes. One example is the LIVE project developed in Singapore. This project consists of the use of sensors, Internet of Things tools and smartphones to measure and monitor in real time, the different indicators that allow to characterize the

operation of the city by its interaction with citizens.

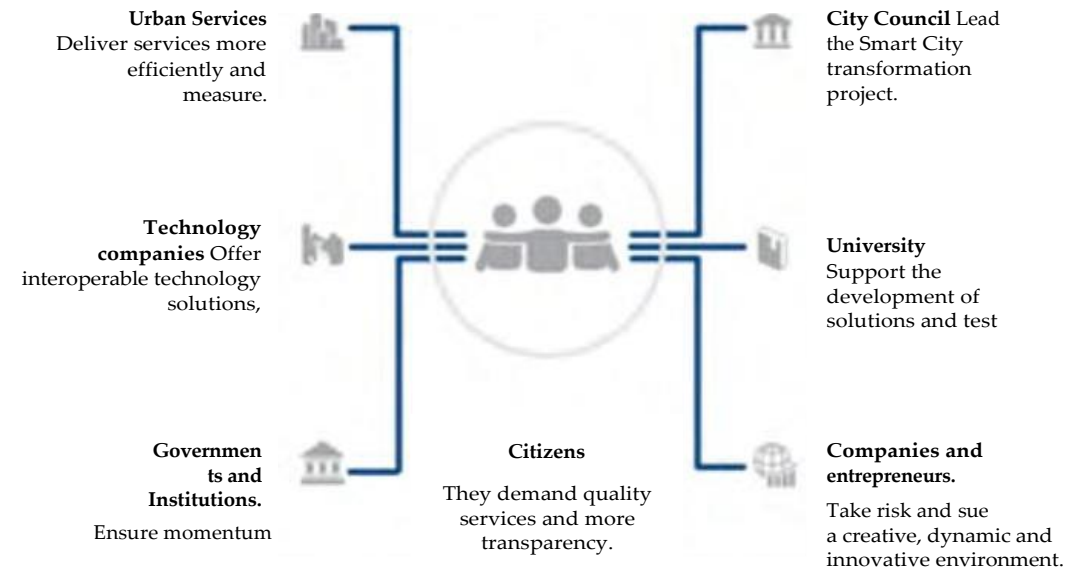
Source: Telefónica (2015)

Finally, **the fourth phase in this process is the Smart Phase.** In this phase advanced technology has already been implemented throughout the city and decisions are made predictively, thanks to the extensive statistical database. Additionally, at this stage, the city has consolidated an innovation ecosystem that makes possible the participation of different actors in the development of solutions to city problems.

2.5 Ecosystem of a Smart City.

Finally, smart cities become complex ecosystems that include a variety of actors. Telefónica (2015) mentions the main actors involved in the ecosystem of such a city (Gráfica 11).

Figure 11 Ecosystem of value agents in smart cities.



Source: Telefónica (2015)

As can be seen, according to the authors, the ecosystem of a smart city works around the citizens, who demand better services, better public management and a better quality of life. In this ecosystem, the Local Administration (Mayor's Office) leads the city transformation project. Universities support the development of solutions and pilot projects on smart cities. Companies and entrepreneurs develop solutions and applications, taking risks and demanding the existence of an environment for innovation and creativity. Urban service providers are responsible for the efficient provision of urban services. Technological companies provide interoperable technological solutions that support the smart city project, and additionally, public entities implement the different initiatives and develop favorable normative and regulatory frameworks.

According to this model, it is therefore important to implement smart city projects that incorporate communication components of the goals, projects and results, as well as to allow spaces for participation and comments from stakeholders in the different projects. Additionally, cities should take into account that companies, entrepreneurs and academia can be key in the development of projects, applications and innovative solutions to city problems.

2.6 Mejores prácticas internacionales at cities.

This chapter presents a review of international practices in smart cities, with the objective of defining a frame of reference to establish Bogotá's progress in ICT initiatives that bring it closer to becoming a SmartCity. Table 1 presents the smart city initiatives that have been implemented by 9 of the most important cities in the world.

The initiatives are grouped into five main categories: - The first one is the "Global Initiative on the Environment and Development" (GEF). The initiatives are grouped into **5 main categories**:

1. Infrastructure
2. Governance, ownership
3. Citizen empowerment
4. Digital industry
5. Sector transformation.

Table 1. International practical reviews, digital policies in cities

City Category	Infrastructure	Government	Ownership Empowerment	Digital industry	Sector transformation
Barcelona	1. Red wifi 2. Sentilo	1. Open data 2. Platform for participation	1. Market District 2. Educational programs and workshops	1. ICT Media Incubator 2. Technology Park	1. Industry 4.0 Hub
Berlin	1. Public WLAN	1. EGovernment Law 2. Open Data Strategy		1. ICT Professionals 2. Startups Events	1. Initiatives industries 4.0
Stockholm	1. Optical fiber network	1. eServices 2. Green IT		1. Kista Science City	
Helsinki		1. Urban Cleantech 2. Innovation with open data.			1. Industrial digitalization strategy
London	1. World-class mobile network.	1. Datastore 2. smartgrid services	1. Digital inclusion strategy 2. Technology internships	1. Hackathons 2. Tech Talent Development	1. Innovation in companies 2. Smart London innovation network
Melbourne	1. Zones wifi-free.	1. CityLab 2. Open Platform Data	1. Innovation competencies		
New York	1. LinkNYC 2. IoT Guidance	1. Marketplace.city	Neighborhood portals for participation.		
Santiago	1. LinkNYC 2. IoT Guidance	1. Traffic lights interconnected 2. Electronic tolls		Export services	
Singapore		1. Digital government services. 2. . Electronic payment of public transportation.		1. Fintech Regulation 2. Cashless society	

As can be seen, as part of their smart city plans, all cities have implemented Digital Government initiatives, and most of them have implemented ICT infrastructure deployment and digital industry promotion projects. Additionally, four of the nine cities reviewed have implemented citizen ownership of technology and sectoral digital transformation initiatives. Some of the initiatives presented are described below:

2.6.1 Infraestructura

platform that is designed to be a multiplatform software with the objective of collecting and sharing information between different mixed systems and integrating multiple applications to nurture and take better advantage of the information generated by the city. This platform was launched in November 2012 with the support of the Barcelona City Council through the Municipal Institute of Informatics.³

Stockholm developed an urban optical fiber network that had its genesis in 1994 through the creation of Stockab, a neutral telecommunications operator. The aim of this network is to enable businesses in this city to access telecommunications services over high-speed networks. The company deployed 1,200 kilometers of optical fiber around Stockholm with an investment of approximately 35 million euros.⁴

Additionally, in order to provide greater convenience for visitors and residents, **New York** City launched LinkNYC, which is a new communications network that is replacing traditional pay phones with kiosks or totems called links. Each link is equipped with free WIFI service, phone calls, a tablet to access city maps and services, as well as charging ports.⁵

2.6.2 Governance

On the one hand, **Berlin** issued an E-Government Act in June 2016 that seeks to develop an e-government

more friendly and secure for citizens and the economy. Likewise, this city seeks to promote efficiency, cost-effectiveness, security and modernity in ICT infrastructure.⁶

The city of **Stockholm** also has a GreenIT initiative to promote the deployment of a modern, environmentally sustainable IT infrastructure that minimizes greenhouse gas emissions. This is expected to reduce the city's operating costs by reducing energy consumption by 10% below the levels observed in 2006.

GreenIT is composed of 9 action areas: energy-efficient buildings, visualization of energy and electricity consumption, digital meetings, digital document processing, greener IT sector through environmentally friendly IT procurement, green data centers and telecommunications, standardized energy-efficient workplaces, and more efficient printing.⁷

Similarly, **Helsinki** has the Urban Cleantech initiative, which aims to

³ <http://www.sentilo.io/xwiki/bin/view/Sentilo.About.Product/Whatis>

⁴ https://elpais.com/tecnologia/2006/06/22/actualidad/1150964879_85015.html

⁵ <https://www.link.nyc/faq.html#linknycv>

⁶ <https://www.berlin.de/sen/inneres/aktuelles/artikel.630286.php>

⁷ https://www.c40.org/case_studies/c40-good-practice-guides-stockholm-green-it-strategy

The objective is to prevent the impacts of industrial activity on climate change. This strategy is part of the 5 components of specialization

Helsinki-Uusimaa region's smart city, among which are also: human health technology, digitization of industry, city welfare and smart citizenship.⁸

In the case of **London**, the Smartgrid service is a program that seeks to regulate and stabilize the distribution of energy among large customers as required, in response to the high peaks that occur at certain times and seasons. The purpose of this initiative is to adjust energy demand and supply to avoid overloads and tensions between distribution networks and substations.⁹

Additionally, in **Melbourne** the CityLab is a dedicated space for prototyping and testing ideas and services for the city directly with the community. Among its main projects are redesigning council services, holding hackathons, and centralizing and

administration of the city's open data platform.¹⁰

2.6.3. Approval and implementation of

In **London**, the Smart London plan includes, as one of its main components, reducing the skills gap so that all citizens can be part of the digital economy. The strategy includes initiatives for the development of ICT skills and skills for the creation of digital technologies and the strengthening of computer science education in schools.

For its part, **New York** City has implemented a strategy of neighborhood innovation labs, called NYCx Co-Labs, which are hubs of experimentation and education located in high-needs and high-opportunity neighborhoods. Each lab brings together local residents, government, academia, and technology experts in the identification, co-development, and testing of new solutions to local problems.¹¹ In 2017, this city launched the first Co-Lab in Brownsville, a residential neighborhood located in Brooklyn....

2.6.4. Industry Digital

The MediaTIC Incubator of **Barcelona** at focuses on supporting the scaling of high-impact technology companies. It concentrates on companies intensive in emerging technologies, such as Artificial Intelligence, Internet of Things, space technology, nanotechnology and robotics.¹²

In **Stockholm**, through the Kista Science City program, the city has formed an innovation cluster that brings together government, academia and industry under an organization called the Electrum Foundation. This foundation represents an example of the triple helix that promotes continuous improvement in the city's ICT sector.

In addition, **Singapore** has implemented the "Cashless Society" initiative that aims for 100% of transactions in this city-state to be conducted electronically. With the introduction of PayNow, the national real-time payment platform, Singapore took a step closer to a cashless society. This platform enables

⁸ [https://www.uudenmaanliitto.fi/files/17585/ROLE_OF_HELSEINKI_UUSI_MAA_REGIONAL_COUNCIL_\(corr_20160126\).pdf](https://www.uudenmaanliitto.fi/files/17585/ROLE_OF_HELSEINKI_UUSI_MAA_REGIONAL_COUNCIL_(corr_20160126).pdf)

⁹ <http://www.prnewswire.co.uk/news-releases/honeywell-launches-full-scale-smart-grid-project-to-reduce-strain-on-electrical-networks-in-thames-valley-144508835.html>

¹⁰ <https://www.melbourne.vic.gov.au/about-melbourne/melbourne-profile/smart-city/citylab/Pages/citylab.aspx>

¹¹ Source: Web site <https://tech.cityofnewyork.us/projects/nycx-co-labs/>

¹² https://emprenedoria.barcelonactiva.cat/emprenedoria/es/incubacio/incubadores/MediaTic_Incubadora_Barcelona.jsp

¹³ <http://www.kista.com/about/>

for people to send money using only their cell phone number or identification number. Since its launch in July 2017, more than 1 million residents have used it, and more than US \$650 million has been transferred.¹⁴

2.6.5. Digital Training.

From the Smart London Plan published in December 2013, **London** has implemented the Smart London Innovation Network which aims to identify and bring together different existing and emerging smart city activities in the city. This network supports SMEs and the innovation community in London with the finds of seizing market opportunities and scaling them up.¹⁵

Additionally, the city of **Barcelona**, as part of its Barcelona Digital City plan, has implemented the Industry 4.0 Hub initiative that aims to boost the digitalization of industry and the grouping of companies, technology providers, associations, research centers, universities and government to identify, develop and promote

best practices in the Industry 4.0 environment.¹⁶

2.7 Conclusion is of vision.

The review of international literature on smart city conceptual frameworks and international practices led to the following conclusions:

- **A smart city is a set of actors and components, leveraged on technology, whose articulation allows the implementation of an effective and efficient model of urban management, which contributes to improve the quality of life of citizens.**
- **Smart cities should be developed based on comprehensive approaches that include sectoral and cross-cutting technological components, rather than isolated initiatives. In this sense, the articulation between government initiatives is fundamental, as well as the development of an ecosystem vision that allows the participation and contribution of the different actors.**
- **Vertical component projects allow for the development of short-term results (early wins), which are important for the advancement and public acceptance of the overall smart city project.**
- **Smart cities are complex ecosystems that include not only vertical and transversal technological components, but also a diversity of actors. For this reason, the successful evolution of a smart city depends on the leadership of the local administration, the capacity of articulation and execution of the different public entities, and the active participation of academia, companies and entrepreneurs.**
- **Relevant to the development of a smart city project is the definition of a roadmap with components such as a long-term vision, strategic projects, milestones, and key performance indicators.**

¹⁴ <https://www.businessstim.es.com.sg/government-economy/the-cashless-journey-has-only-just-begun>

¹⁵ https://www.london.gov.uk/sites/default/files/gla_migrate_files_destination/DD1214%20Smart%20London%20Innovation%20Network%20.pdf

¹⁶ Source: Web site. <https://ajuntament.barcelona.cat/digital/es/innovacion-digital/make-in-bcn/bcn-industry-40-hub>

3

Avances en
desarrollo
de un inteligente inteligente

This chapter presents a review of the progress and main initiatives that have been implemented in the city of Bogota in recent years in its transition to a smart city. Initially, some mentions that have been made about Bogota in international comparative studies on smart cities are pointed out.

The main initiatives that have been implemented in recent years, both in cross-cutting components and sectoral aspects, are mentioned below.



3.1 Bogota at an international context.

The following are the results of some studies that allow us to compare Bogota with other cities in the world in its progress towards becoming a smart city.

The following are the INDRA developed in 2014, a global survey of

The survey included 234 cities in 42 countries. This survey asked the citizens of these cities about their perception of the services they receive from the cities, in aspects such as transportation, security, emergency care, sanitation, government services, the and their perception of cleanliness, as well as their perception of the sustainability.

Figure 12 shows the score of Bogota, with respect to the world average, in each of the aspects covered by the surveys. As can be seen, in 2015 Bogota obtained scores equal to or above the world average in the

quality of sanitation, and sustainability. In the other aspects-mobility, safety, security, emergency care, e-government, and cleanliness-the qualification was below the international average.

It is worth noting that the citizens surveyed responded that they spent an average of 65 minutes to commute from home to work, while the global average for this commuting time was 46 minutes. This result reflected the historical challenge the city has had to improve its mobility.

Gráfica 12. Rating of Bogota in the 2014 Global Smart Cities Survey.



IESE has also developed the Cities in Motion index, which analyzes how smart the world's cities are in terms of their sustainability and the quality of life they offer.

This indicator is composed of 10 dimensions:

Economy, human capital, international projection, mobility and transportation, environment, technology, urban planning, public management, governance and social cohesion.

Figure 13 shows the ranking of the first 10 cities at the top of the list and the first 10 Latin American cities. As can be seen, Bogota ranks 113th in the world and 11th in Latin America in its level of development according to the criteria of this indicator.

Figure 13 IESE City Rankings 2017

Ranking	City	Performance	ICIM
1	New York - United States	A	100
2	London - United Kingdom	A	98,71
3	Paris - France	A	91,97
4	Boston - United States	RA	88,9
5	San Francisco - United States	RA	88,46
6	Washington - United States	RA	86,1
7	Seoul - South Korea	RA	84,91
8	Tokyo - Japan	RA	84,85
9	Berlin - Germany	RA	83,4
10	Amsterdam - The Netherlands	RA	82,86
83	Buenos Aires - Argentina	RA	63,32
85	Santiago - Chile	RA	62,71
87	Mexico City - Mexico	RA	62,22
96	Medellín - Colombia	M	59,91
99	Montevideo - Uruguay	M	59,09
101	São Paulo - Brazil	M	58,94
107	Córdoba - Argentina	M	56,7
111	Monterrey - Mexico	M	55,74
112	San José - Costa Rica	M	55,74
113	Bogotá - Colombia	M	55,3

Source: Prepared by the authors based on the IESE Cities in Motion Index. IESE Business School. University of Navarra. Available at <https://www.iese.edu/research/pdfs/ST-0442.pdf>, retrieved on September 7, 2018.

On the other hand, the IDB (2017) has recognized the efforts that Bogotá has advanced in solving the problem of urban mobility, and cites as a good practice, the development of the Integrated Public Transportation System and the complementary technological developments (intelligent traffic lights, mobile applications) that have been implemented.

3.2 Politics of city smart at Bogotá.

The District Development Plan (PDD) is the management tool that promotes the social development of the city during the 4 years of its validity. This plan was approved through Agreement 645 of 2016 of the Council of Bogotá *"whereby the economic, social, environmental and public works development plan for Bogotá D.C. 2016-2020 "Bogotá Mejor para Todos" (Better Bogotá for All) is adopted.*

The 2016-2020 District Development Plan includes all initiatives to be implemented in the city. Among the main policies proposed therein are four

that promote the advancement of the city in smart and digital policies.

1

Article 48 of the PDD is entitled "Bogotá, smart city". The objective

The objective is to create guidelines for the development of an urban economic and social environment suitable for the execution of innovation activities that will allow the city to position itself internationally as an innovative city.

2

Article 49 is entitled "Bogotá, a digital city". The objective is to promote that the city has a communications infrastructure that is friendly to the public space and the environment, where the appropriation of ICTs is promoted for purposes other than entertainment, such as education, entrepreneurship, innovation and the creation of solutions to the city's problems.

3

Article 59 of the PDD includes the "Digital Government and Citizenship" program. This program promotes the improvement of administrative efficiency through the use of technology, implementing an open government model for the city that consolidates a quality, efficient, collaborative and transparent public administration, oriented to the maximization of public value, the promotion of incident participation, the achievement of mission objectives and the intensive use of ICTs.

4

The PDD stipulates the creation of the "Fondo Cuenta Distrital de Innovación, Tecnología e Industrias Creativas", whose purpose is to promote the development of innovation, new technologies and creative industries in the city through the administration, collection and channeling of resources to make expenditures and investments for the acquisition of goods, services and the construction of infrastructure works for the fulfillment of its purpose.

3.3 **Resumen of Existing initiatives.**

Graph 14 presents a review of the enabling factors and sectoral responsibilities where Bogota has implemented smart city development initiatives in recent years.

As can be seen, the City Government has implemented cross-cutting initiatives that promote the development of a smart city and a smart government in different economic sectors. These cross-cutting initiatives can be clasificared into three categories:

1. Connectivity deployment initiatives, 2. digital government consolidation actions, and 3. ICT-based citizen innovation initiatives.

For its part, the Gráfica presents the main smart city initiatives in specific sectors.

(Sector Initiatives) such as mobility, health, security, finance and gender policy, among others.

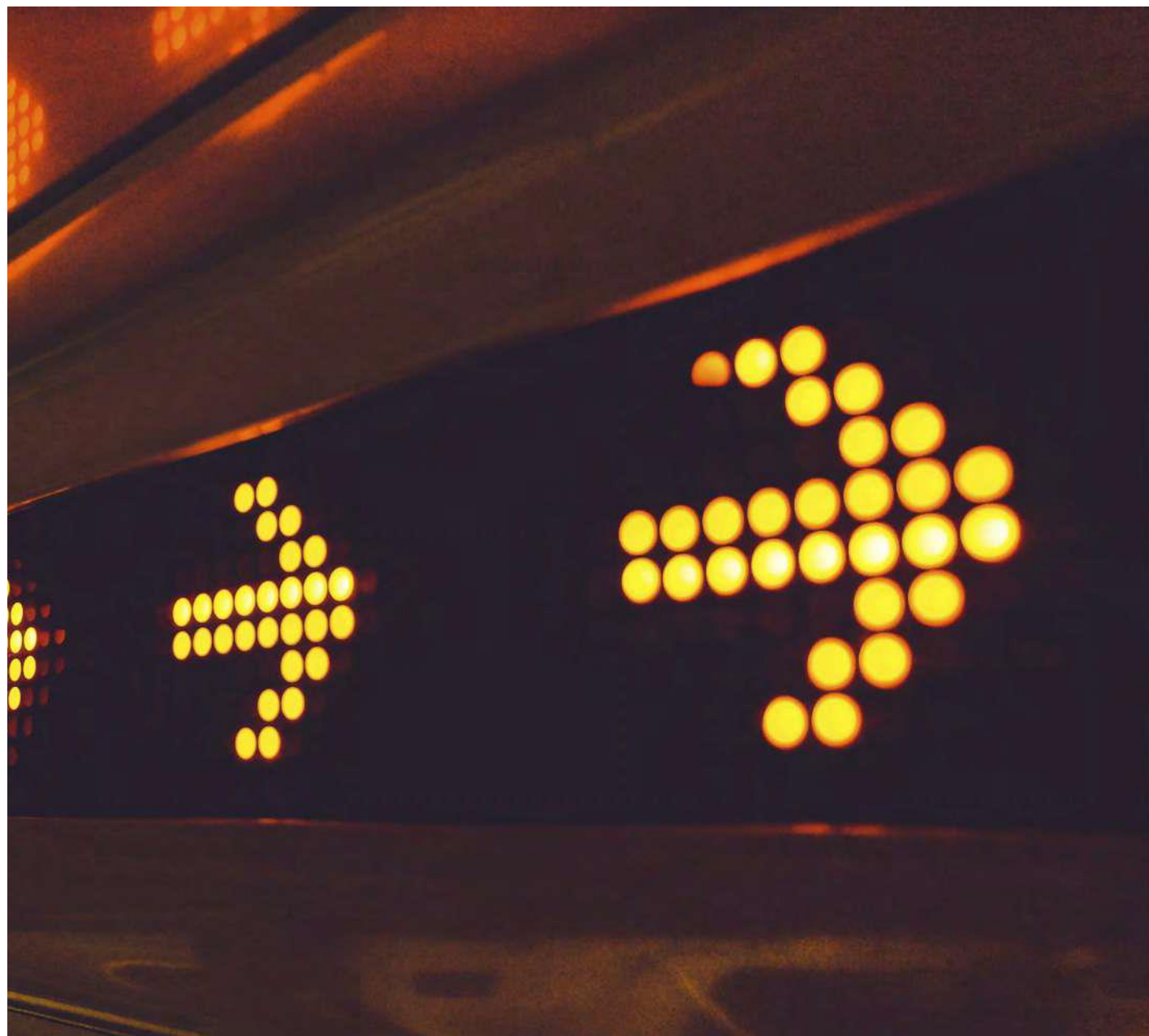


Figure 14. Initiatives in enablers and city responsibilities that have been implemented in Bogota.

Sector Initiatives

Mobility

- Traffic Signalization
- Smart Taxi

Health

- Technological
- Electronic Health Record U
- C4 Center
- Surveillance System

Finance

- District ERP
- Virtual Office

Educ.

- Technical Tools Teachers

Gender

- SofiApp

Environment

- Climate change and risks

Initiatives Transversal.

- Innovation citizen.
- Government Digital.
- Connectivity.

- Digital Innovation Labs. Open Bogota.
- Open Data.
- Spatial Data.
- Virtualization of procedures.
- Adoption of SECOP II.
- Digital Security.
- Information Systems and IT Architecture
- Regulations for the installation of radioelectric stations.

Source: Own elaboration. Smart city projects and initiatives submitted by the different District Secretariats of Bogota.

The following subchapters present the main cross-cutting and sectoral initiatives that have been implemented since the issuance of the PDD.

3.4 Initiatives Transversales

3.4.1. Reglamentación instalación radioelect

In 2017 the District Administration issued Decree 397, which updated the existing regulations on the installation of radio stations. This regulation aims to facilitate the deployment and modernization of telecommunications infrastructure in the city through the instruments of economic retribution for the use of public space, public use assets, and the fiscal assets of entities at the district level.

The main components and benefits of this Decree are listed below:

1. Protection of the integrity of public space and common use over private interests.
2. Adoption of urban planning guidelines, as contemplated in Article 11 of Law 388 of 1997.
3. No impact on people's health, according to the main national and international standards, guidelines and best practices.¹⁷
4. Issuance of a manual for station mimicry and camouflage. radioelectric.
5. Prioritization of location requests for radio stations.
6. Establishment of the economic remuneration for the location and installation of the stations.
7. Promotes the expansion of service coverage.
8. Guarantees the deployment and efficient use of infrastructure and equal opportunities in access to scarce resources, expansion and coverage will be sought for areas that are difficult to access, thus benefiting vulnerable populations.

With the issuance of the aforementioned regulations, we can see the efforts that will be made to promote a more digital city that is up to date with the latest and best technological trends, allowing it to adopt them, get the best out of them and make the most of them.

¹⁷ This is due to the fact that the drafting of this new standard took into account the principles set forth by the Ministries of Health and Social Protection, of The National Decree 195 of 2005, by means of which limits to the exposure of people to electromagnetic fields defined by the International Commission Non-Ionizing Radiation Protection - ICNIRP, as well as by the International Telecommunication Union - ITU - in its recommendation ITU-T-K-52, which are endorsed by the World Health Organization, were adopted.

and generate an optimal environment for science, innovation and entrepreneurship.

3.4.2. Systems Information and y

Bogota has been a leading city in the development of Digital Government in Colombia. In 2016, the city obtained a score of **82%** in the Online Government Index prepared by the ICT Ministry, which places it among the cities with the highest results in the country.

During 2017, through a joint work between the General Secretariat, headed by the District ICT High Council, and GPPG Consulting, a study was conducted on the current state and requirements of of enterprise architecture of the entities of the District Administration.

As part of this study, the status of the IT offices of the district entities was reviewed and a roadmap for the optimization of resources was developed.

technological, which includes the purchase of hardware and software, as well as the use of ICTs to improve the provision of services to citizens. This study also revealed the need to implement cross-cutting solutions in information systems, with the finds of solving common problems or needs in the District's entities.

3.4.3. Digital Security.

Since 2016, the Office of the Mayor of Bogota has implemented the Information Security and Privacy Model (MSPI) strategy in the different district entities, with the aim of ensuring the digital security of information from a perspective of government responsibility.

As part of this implementation, the District Administration has carried out activities for the dissemination and appropriation of the MSPI in the District's entities. This includes the design of a strategic plan for the adoption of the MSPI in the entities, as well as the development of activities of

evaluation of the effectiveness of this implementation. This process is carried out in three stages:

1.

Where are we?

Diagnosis of status current status of the information security.

2.

Where are we going?

Definition of objectives of security digital.

3.

How do we get there?

Definition of projects, strategic, tactical and operational.

This model is aligned with the information security and privacy diagnostic tool, proposed by

by the ICT Ministry. Currently, the Mayor's Office is developing a study that will provide documents and reports with the finality of strengthening the implementation of the Information Security and Privacy Model, established within the framework of the digital government strategy defined by the MinTIC.

With the completion of this study, the new information security and privacy objectives will be defined, as well as the strategic projects and initiatives that will enable continuous improvement and the achievement of objectives in the short and medium term.

3.4.4. Adoption of SECOP II.

The National Public Procurement Agency developed SECOP II, a system that offers State Entities, the private sector and citizens in general, the possibility to carry out the Procurement Process online and in real time, since it works as a transactional platform with accounts for State Entities and Suppliers.

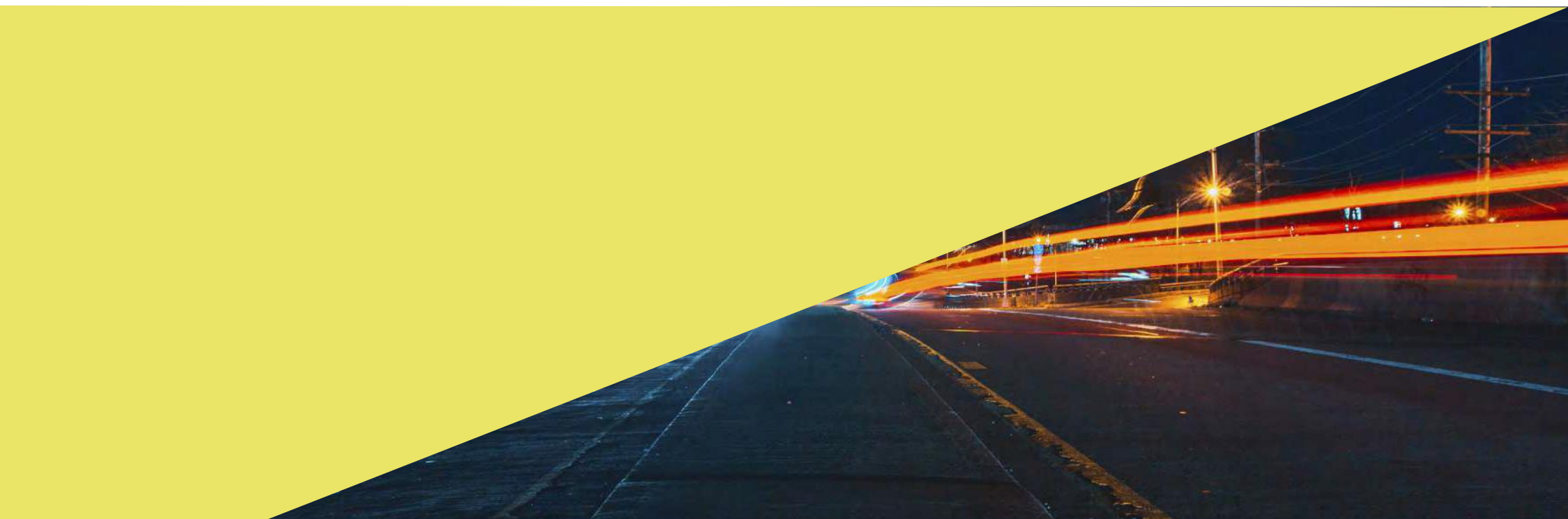
In this context, on May 4, 2017, the Mayor, in the company of his 15 Office Secretaries and the director of Colombia Compra Eficiente, signed the "**Commitment to adopt SECOP II in the Capital District, for transparent contracting**". The District Development Plan "Bogotá Better for All", contemplates in the Transversal Axis 4, the development of a policy of open government to citizens that allows consolidating a more transparent, efficient and willing to offer a better service public management.

Similarly, in Agreement No. 657 of 2016, it establishes in Article 42 that "*with the purpose of guaranteeing transparency in public procurement, the entities of the District Administration will promote the use of the Colombia Compra Eficiente mechanism*".

The firm of this commitment has as its central axis the fulfillment and development of the following 8 activities:

1. Each of the entities of the Capital District must assign a group of people in charge of the contracting processes who will receive training on the use of SECOP II and will be in charge of transmitting the knowledge to the other members of the entity's team.
2. Jointly draw up a work schedule with the dates and topics of the meetings. training.
3. The entities of the Capital District must guarantee the attendance of their and contractors to the training sessions.
4. Each of the entities of the Capital District must designate a person responsible for managing the knowledge of the use of SECOP II in the Entity to ensure sufficient knowledge for the successful deployment in all contracting processes.

5. The entities of the Capital District must carry out contracting processes in more than two selection modalities for 30% of the value of their annual contracting.
6. Colombia Compra Eficiente commits to provide the necessary personnel to train officials and contractors of Colombia Compra Eficiente.
District of the Capital District entities and accompany the first contracting processes.
7. Colombia Compra Eficiente after the termination of the SECOP II accompaniment program will not make additional accompaniments for officials and contractors of the entities that participated in this process.
8. Repeated failure to comply with the commitments stipulated in the schedule will result in the suspension of the training and support program, which will be reported to the person responsible for monitoring progress and to the director of the State Entity.



3.4.5. Virtualization of of procedures.

Between 2016 and 2017, the General Secretariat of the Office of the Mayor of Bogota carried out a diagnosis of the existing procedures in the District,¹⁸ y that should be carried out by 62 entities at the district level.

The result of this exercise was the identification and characterization of 269 procedures, which can be found in the study disaggregated by sector and nature (face-to-face or virtual). Likewise, of these 269 procedures, 119 were partially^{online19} and 33 were fully online (Graph 15).

Graph 15 Number of total, partially online and online procedures identified in the "Diagnosis of existing procedures in the District."

Sector	# of procedures	# of procedures partially on line.	# of procedures totally on line.
Treasury	45	21	7
Education	39	23	3
Mobility	35	12	3
Environment	33	29	3
Habitat	27	11	0
Planning	24	10	5
Health	19	3	2
Government	18	2	6
Culture, recreation and sport.	15	3	3
Not sectorized	5	3	0
Public management	3	1	0
Legal management	3	0	0
Economic development,	2	1	0
Safety, coexistence and justice.	1	0	1
Social integration	0	0	0
Woman	0	0	0
Total:	269	119	33

Source: Diagnosis of existing procedures in the district. Alta Consejería Distrital de TIC. April 2017.

¹⁸ Available in the documents section of the Alta Consejería Distrital de TIC or in the following link: <http://ticbogota.gov.co/documentos>

¹⁹ Results as of April 2017.

In this context, the District Administration is implementing a strategy of virtualization of procedures that aims to incorporate technological tools to reduce the barriers between it and the citizens, as well as the time and quality of service to the public. In this regard, the District Development Plan set as a goal to virtualize 15% of the most important procedures of the district entities, which represents 72 procedures according to the Single System of Information on Procedures (SUIT, for its acronym in Spanish).

The General Secretariat of the Office of the Mayor of Bogotá, headed by the Undersecretary of Citizen Services, and with the support of the District ICT High Council, is leading the actions aimed at achieving the objectives of this strategy.

The process of virtualization of procedures is divided into two parts: **The first is the preparation, through which the procedures of the entities are identified and registered in the SUIT, based on the creation of anti-bureaucratic and online government committees in each entity. As a result of this phase, the procedures and services to be intervened are prioritized. The**

The second stage is the rationalization and virtualization stage, which consists of five activities: (i) Simplify, (ii) Standardize, (iii) Eliminate, (iv) Optimize,



It should be noted that Bogotá is the only city in the country that has a roadmap to simplify and virtualize procedures. To date, out of 72 priority procedures for citizens that are included in the strategy of

virtualization, 57 of them have already been put online. These procedures were also validated directly with citizens in face-to-face surveys, citizen challenges and meetings with Bogota residents in the District's SuperCADEs.

The procedures that have been virtualized to date include the issuance of duplicate aqueduct bills, the preparation of certificates and certificates of active students, registration in the national teaching scale, consultation of tax obligations and the IDU documentation center, and the online request, consultation and downloading of the Tax Information Registry (RIT), among others. This set of virtualized procedures has benefited small and medium-sized merchants, entrepreneurs and the educational community, among others. Usage figures

The positive impact of this initiative is evident. For example, the virtualized procedures in the education sector have had a demand of 357,831 requests per year; the procedure to consult information on land before the District Cadastre has registered 172,976 requests during the last year. In addition, the procedure to review tax obligations has registered queries from more than 3 million 300 thousand citizens in the last year.

3.4.6 . Dates Spatial

The "**Mapas Bogotá**" platform is a resource designed by members of the Integrated Spatial Data Infrastructure for the Capital District - IDECA, so that the interested public can get to know the city in detail, through the publication of basic information and consultation of aerial images over time.

This tool offers 6 major functionalities:

1. locate,
2. identificate,
3. compare and know,
4. measure distances,
5. consult the 8 tourist areas of Bogota and
6. the consultation of thematic maps in 7 major categories such as: Cadastre, mobility, protected areas, planning, National Police quadrants, education and health.

This web application, like the physical maps, offers street plans, avenues and transportation routes within each area, as well as identifying through symbols and conventions, places of interest such as libraries, museums, parks, churches, shopping centers, among others.



Mapas Bogotá

3.4.7. Data Open

In Colombia the Law of Transparency and Access to Information, defines open data as *"all those primary or raw data, which are in standard and interoperable formats that facilitate their access and reuse, which are under the custody of public or private entities, which fulfill public functions and are made available to any citizen, freely and without restrictions, so that third parties can reuse them and create services derived from them".*²⁰

The District Administration has strengthened Bogota's open data platform.

(datosabiertos.bogota.gov.co)

whose objective is to promote transparency, access to public information, competitiveness, economic development and impact generation.

social through openness, reuse of public data, and the use and appropriation of ICTs in accordance with Colombia's On-Line Government strategy.

This platform has been consolidated through an initiative of the Administration that has promoted the publication of relevant and quality information, in structured and easy-to-understand formats, by district entities.

The purpose of this is to make relevant public information available to users so that both they and the entities can use it in different ways, depending on their interest: generate reports, reports, statistics or research, perform social control, and develop business opportunities (e.g. applications), among others.

The information contained in the platform is public and must be available to any citizen and for any finish. Currently this platform has **263 datasets from 49 district entities.**

Likewise, in order to promote the use of available information, the District ICT High Council has developed 7 events for the creation of technological products based on open data (Datajams) aimed at encouraging the development of applications and solutions to the city's challenges. These events have been held in the localities of Suba, Teusaquillo, Tunjuelito and Engativá.



²⁰
Law 1712 of 2014. Article 6, paragraph J.



3.4.8. Bogotá Open

¿CÚAL ES TU IDEA PARA BOGOTÁ?

3.4.8. Bogotá Open

The District Administration has implemented the Bogotá Abierta platform.

(bogotaabierta.co)

This is a tool for citizen participation and co-creation aimed at bringing citizens closer to the District Government and thus encouraging their participation in the development of strategies and solutions to the city's problems.

Since its inception in 2016, this platform has been conducive to citizen innovation and has

empowering the people of Bogota in the solution of the city's challenges, through technology, generating governance, identity and appropriation of the public sphere.

This digital platform allowed collective participation in the construction of the District Development Plan "*Bogotá Better for All 2016-2020*". Thanks to this, Bogota citizens became proponents of plans, programs and projects for the construction of such plan.

As a result of this process, during a period of 5 months, the District Administration collected 21 thousand contributions.

more than **40,000** citizens interested in contributing to the solution of the problem. **22** challenges proposed. In addition, a total of **953 thousand** visits to the platform were registered.

Since then, the platform has been one of the main instruments of the District Administration for the construction of targeted policies. Likewise, the Administration intends to use this platform to encourage citizen participation in the construction, agreement and validation of the new Land Management Plan, which will be the city's main technical and regulatory instrument for the next few years.

3.4.9. Digital libraries

The District ICT High Council has implemented the Digital Laboratories strategy, whose objective is to promote the implementation and operation of physical or virtual spaces in Bogota that bring together different ICT tools and methodologies to help companies, citizens and entities to innovate through the intensive use of technology.

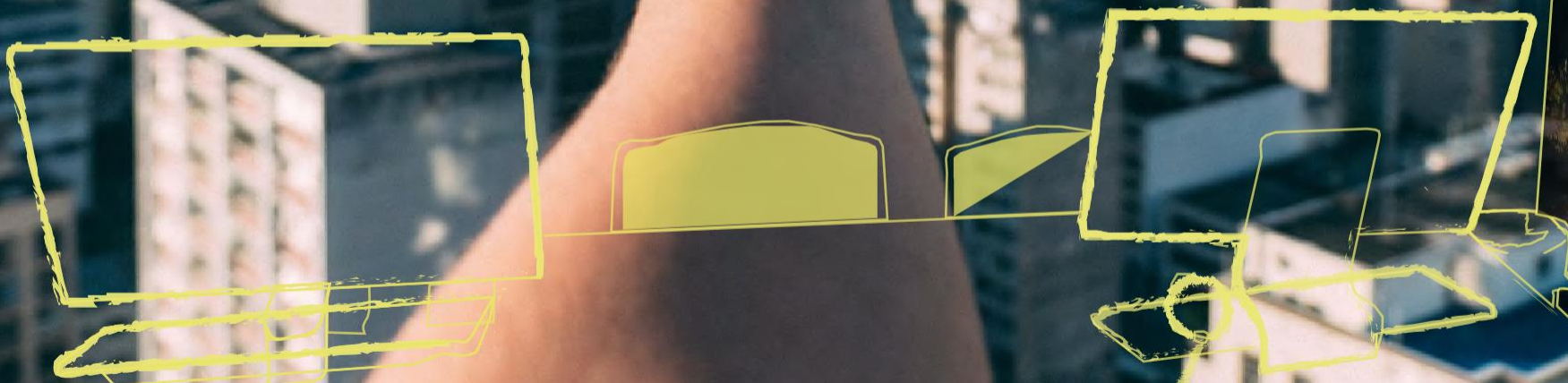
This initiative, based on the Vive Labs model promoted by the Ministry of ICT and Colciencias, aims to promote the development of

strengthening the local IT industry, generating competencies and capacities for its use, and promoting the improvement of the basic indicators of ICT ownership and use in the city.

To date, as a result of this initiative, Bogota has four digital laboratories in different locations:

(i) the Vivelab Bogotá managed by the Universidad Nacional de Colombia, **(ii)** the Laboratorio Digital Bogotá operated by the Universidad EAN, **(iii)** the Laboratorio de Formación Digital de Ciudad Bolivar, and **(iv)** the first audiovisual content laboratory located in the Nueva Cinemateca Distrital.

In addition, a fifth digital laboratory is being implemented at Corporación Maloka.



3.5 SECTORAL INITIATIVES

The following are the specific sectoral projects that have begun to be implemented, within the framework of the PDD 2016-2010, and that aim at the development of Bogota as a smart city.

3.5.1 . Mo vilida d

Excessive traffic and the time spent by citizens in traffic is one of the most common difficulties in large cities around the world. Bogota has historically had high levels of traffic congestion. Graph 16 presents the results of the INRIX Global Traffic Scorecard 2017, which ranks Bogotá as the sixth city in the world with the highest level of traffic, among a total of

1,360 cities.

Gráfica 16. Position of Bogota in the INRIX Traffic Scoreboard 2016.

City	2017 INRIX Traffic scorecard Rank (2016).	Hours spent in the trafico
Los Angeles	1 (1)	102
Moscow	2 (2)	91
New York	3 (3)	91
Sao Paulo	4 (4)	86
San Francisco	5 (5)	79
Bogotá	6 (6)	75
London	7 (7)	74
Atlanta	8 (8)	70
Paris	9 (9)	69
Miami	10 (10)	64
Medellín	18 (26)	57
Cali	30 (39)	49
Bucaramanga	—	49
Pasture	—	49
Villavivencio	—	49
Barranquilla	—	49
Pereira	—	49
Neiva	—	49
Santa Marta	—	49
Cúcuta	—	49

Source: Own elaboration based on INRIX Global Traffic Scorecard. Available at <http://inrix.com/scorecard/>. Retrieved August 29, 2018.

● Traffic Signalization Project

In response to the aforementioned problems, the current administration of the In response to the aforementioned problem, the current District Administration proposed from the beginning to generate plans, programs and projects aimed at reducing congestion indicators and travel times in the city. As part of this, an intelligent traffic light system was implemented, which is planned to be fully operational in 2019.

The traffic light project will replace the traffic lights at **1,384** existing intersections in the city, to which 60 more will be added to complete **1,444**. With the implementation of these traffic lights, it is expected that time savings of up to

30%,²¹ it city which will reduce its congestion levels and improve its international rankings in this area.

²¹

Cities such as Sao Paulo and New Delhi have achieved savings of between 15 and 25 percent in travel time for citizens.

Another advantage of the new traffic light system is the ability to collect information from vehicles, pedestrians, cyclists and other road actors, which will allow better management and prioritization depending on the flujo of each of them. By reading traffic in real time, traffic light timing will be regulated in such a way that it can respond to the dynamics of the city.

Additionally, during the implementation process of the new traffic lights, the District Administration will prepare and put into operation a large automated center for the operation of the system, which will be associated with the City's *Traffic Management Center*. This center will allow the prevention and immediate attention of traffic incidents.

Another favorable point is the continuity in the provision of their services, since these traffic lights are equipped with batteries to prevent power outages from affecting their operation.

● Smart Taxi

On the other hand, with technological change and the development of digital platforms, in recent years platforms have emerged that connect suppliers and demanders of goods and services, specifically drivers and passengers in the mobility sector.

These platforms, such as Uber, Cabify, Beat or Lyft, allow generating new transportation services and increasing the use of existing assets, which contributes to the efficiency of the system and economic growth. However, digital platforms in the transportation sector have also posed a regulatory challenge for governments, as they have become disruptive forces in traditionally consolidated markets.

With the objective of contributing to the modernization and adoption of technology in the traditional urban transportation sector in Bogota, in the current context of technological disruption, in 2018 the District Government designed and implemented the strategy to improve the traditional cab system, called '**Taxi Inteligente**' (Smart Taxi).

This is a comprehensive strategy whose main objective is to provide greater security to users and cab drivers. It consists of replacing the old taximeter for charging, service requests and real-time tracking.

The "*Smart Taxi*" strategy will generate multiple benefits for Bogota residents: advance knowledge of the total cost of the fare, which will not be changed during the trip, verification of driver data and location in real time, mailbox for complaints, suggestions, claims and compliments, all centralized in the Integrated Regional Urban Mobility Information System (SIMUR).

In addition to the above benefits, this strategy will have a positive impact on traffic in the city. Since more than 35 thousand cabs will be connected, new data on speed and road conditions in the city will be collected, which will serve as input for decision making by private agents and for the design of new public strategies in this sector.

3.5.2. Health

- **Modernization of physical and technological infrastructure.**

As previously mentioned, the District Development Plan incorporated in its article 18 the initiative *"Modernization of the physical and technological infrastructure in health"*. This program is intended to improve the quality of health care services in Bogotá, as well as to advance in the implementation of the virtual medical record.

This initiative will facilitate the access of citizens, through any platform, to services such as telehealth, and the resolute attention. This will allow the improvement **of the district health system in aspects such as efficiency, relevance and targeting of patients**, especially those belonging to the subsidized regime and the uninsured population.

- **Unified Electronic Health Record.**

One of the most important initiatives for the modernization of the district health system is the implementation and unification of the Electronic Health Record - EHR. As a preliminary stage to this implementation, in 2016 the District Government achieved one of the greatest advances in the public health scheme of

the city:

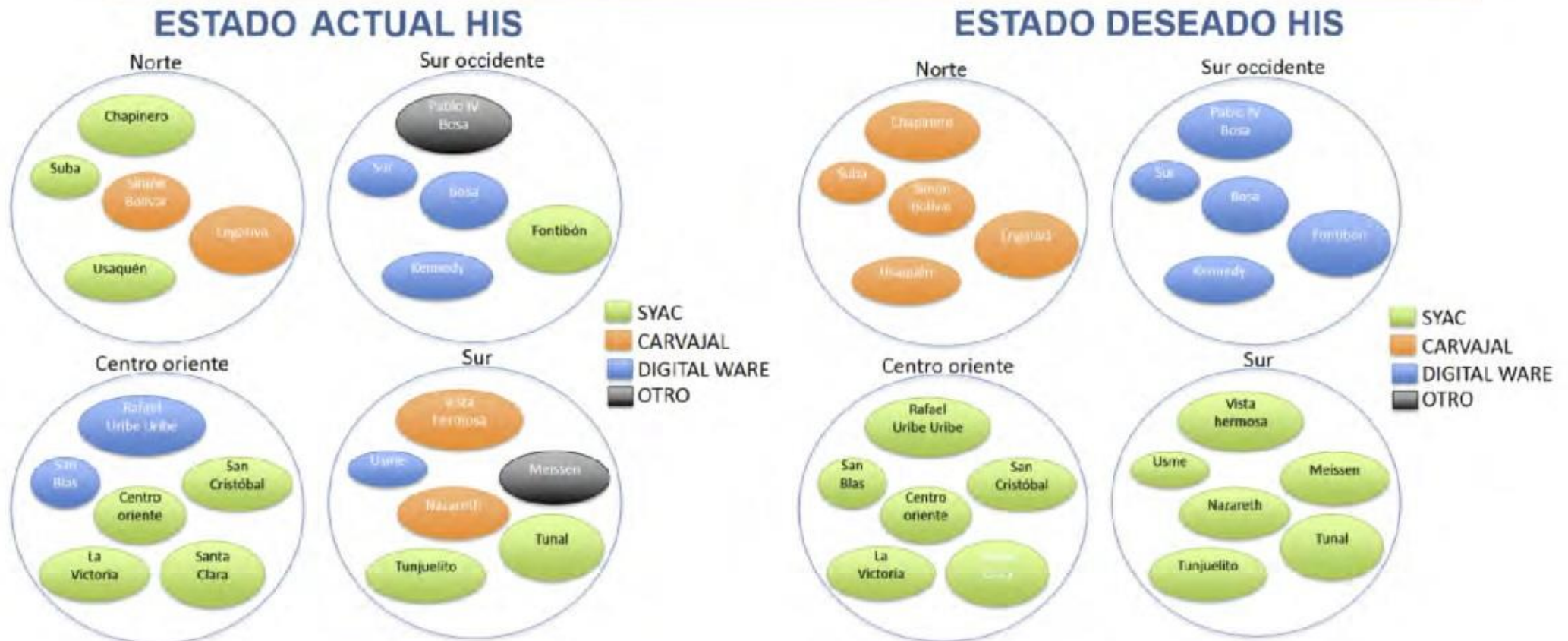
The modernization and unification of the different district hospitals into 4 large sub-networks - South, Southwest, North and Center-East; this to achieve the decongestion of the clinical centers and the optimization in the provision of services.

In Colombia, Law 1438 of 2011 established the obligatory nature of the EHR in Colombia, as well as the different conditions that

The system must have the same, including portability and interoperability. Based on this, in 2014 the District Council approved Agreement 576 of December 2014 *"Whereby the Electronic Health Record system is implemented in the Capital District"*. The objective of this Agreement is to implement an Integrated and interoperable Information System that allows to have a Unified Electronic Health Record that includes: consolidation of administrative and financial information, appointment scheduling and services, as well as the proper management of emergencies for the Integrated Health Services Network.

Figure 17 illustrates the current state of the Hospital Information System (HIS) in the city, compared to the desired state. With the regrouping and unification of the Electronic Health Records in the four sub-networks, optimization will be achieved in the scheduling of appointments, patient transfers and timely delivery of medical formulas.

Gráfica 17. Comparison between the current health system and the desired system.



Source: Electronic Health Record. District Health Secretariat of Bogota, Salud Capital. August 3, 2016.
 Available at: <http://www.saludcapital.gov.co/DSP/COVES/2016/Agosto/Presentaciones/2.%20HCEU.pdf>.
 Retrieved August 31, 2018.

The First Phase 2016-2017 consisted of the unification of the HIS and the updating of versions, starting the process of training and implementation of the HIS within each of the four Health Services Networks. Likewise, the District Health Secretariat carried out activities to reorganize the connectivity infrastructure and technological platforms, through a diagnosis of the state of the technological infrastructure. This resulted in a baseline of IT needs.

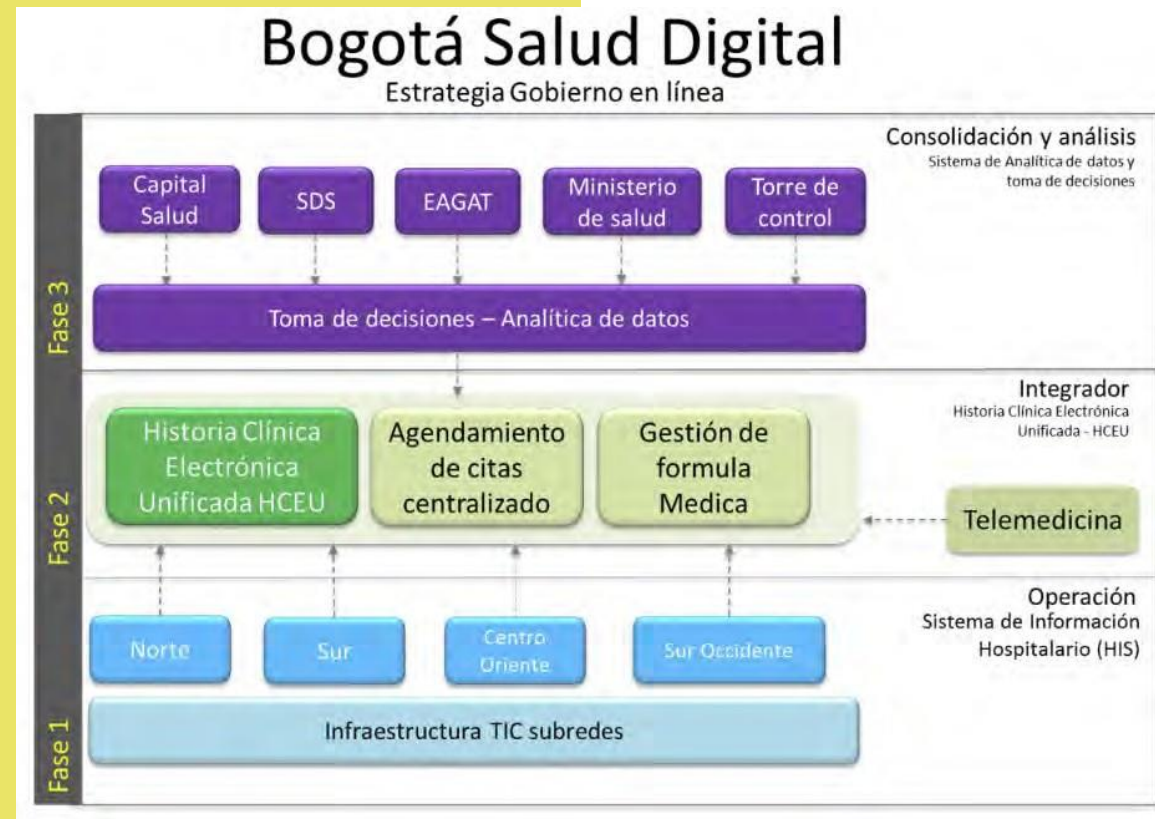
The Second Phase 2018 consists of the structuring of preliminary studies and specifications to advance the public bidding process that will result in the contracting of the interoperability scheme of the Unificated Electronic Health Record, centralized appointment scheduling, and medical formula management.

Finally, in the **third phase** of this project, a decision-making process based on data analytics will be developed, with the objective of making available and producing services that allow the consolidation of clinical information of the population served by the different

public and private health care providers of the district network.

Graph 18 presents a summary of the phases of the project to implement and comply with Agreement 576 of 2014, as well as the processes that will be carried out in order to have health services with greater accessibility and timeliness for users.

Graph 18. Stages of implementation and services Bogotá Digital



Source: Electronic Health Record technical sheet. Unificada. Secretaría Distrital de Salud 2018.

3.5.3. Security

- **Safety and coexistence for all.**

The PDD 2016-2020 incorporated within its priorities the strengthening of citizen security, mainly under a focus on prevention and the fight against crime. In response to the PDD guidelines, the District Administration has implemented the "Security and coexistence for all" program, which aims to improve security and coexistence in the city through crime prevention and control.

The goal of the Security and Coexistence for All program is to strengthen the operational capacity of the authorities involved in the management of security in the city, improve the confidence of the people of Bogota in the authorities and promote the co-responsibility of citizens in the management of security and coexistence. It also aims to address flagels such as micro-trafficking in school environments and crimes in the mass transportation system, among others.

In the context of this program, the city

launched the operation of the Command, Control, Communications and Computing Center - C4, attached to the District Secretariat of Security, Coexistence and Justice.

With the implementation of the C4 in 2016, the integration of 7 entities directly related to security and emergency response in Bogota was achieved:

- 1 **Single Security and Emergency Number - Line 123.**
- 2 **Emergency and Urgent Care Regulatory Center - CRUE.**
- 3 **Special Administrative Unit of the Fire Department.**
- 4 **Secretariat of Mobility.**
- 5 **District Institute of Risk Management and Climate Change - IDIGER.**
- 6 **Metropolitan Police of Bogotá.**
- 7 **Automatic Dispatch Center - CAD.**

Likewise, and with the objective of strengthening the technological infrastructure of video surveillance during the 2016-2018 period, the number of existing cameras in the city was multiplied by 6, going from **267** to **3,254**.²³

The expansion of the city's surveillance system is leveraged on an investment of more than **\$600 billion**,²⁴ which, together with the unification of centers for the visualization and monitoring of cameras and the interconnection of the Transmilenio surveillance system with the Chapinero Citizen Security Operational Command COSEC, become the materialization of the city's intelligent security policy.

This expansion and integration of the city's security systems is expected to reduce joint response times to emergencies, as well as facilitate prevention, reaction, investigation and prosecution processes.

²² Article 29 of the District Development Plan

²³ District Secretariat of Security, Coexistence and Justice

²⁴ Corresponding to the 2018 budget of the District Secretariat of Security, Coexistence and Justice.

3.5.4. District Finance

● District ERP

In the context of the initiatives for the virtualization of procedures and IT architecture of the district entities, and taking into account the objective of implementing transversal solutions in IT systems, we have developed the following

information, the General Secretariat and the

Secretariat of Finance have agreed on the need to implement a new District Enterprise Resource Planning System (ERP) that is comprehensive, multi-entity and unique, in line with current needs for cloud operation and aligned to standards and best practices, so that it can replace the current ERP called SI CAPITAL.²⁵

Based on this project and the District Administration's virtualization strategy, progress will be made in complying with articles 47 and 125 of the PDD entitled "**Improve and strengthen the city's tax collection**" and "**Promote the use of private capital linkage mechanisms**" and "Digital Public Administration,

respectively.

● Oficina Virtual de la Secretaría de District Treasury

On the other hand, the District Finance Secretariat launched its new Virtual Office, which allows ICA, property and vehicle taxpayers to comply with their commitments.

tax, apply for certificates, update the

data, and receive notifications, avoiding unnecessary paperwork and travel.²⁶ As a result, between October 2016 and October of 2017, the use of electronic means for tax payments in the city grew by **22%**.

3.5.5. Education

Since September 19, 2018, the District Secretariat of Education made available to all teachers in the District, the enablement of institutional email. In addition to email, there are a series of benefits such as access to the Office 365 suite, which allows the download of Microsoft applications and programs, as office on up to 5 devices.

Initiatives such as this one are intended to generate greater and better access to ICT, as well as better communication between managers, teachers and students.

3.5.6. Gender

Another of the PDD programs that has been strengthened through the use of ICTs is the Integrated Women's Protection System.

Victims of Violence - SOFIA.²⁷ East

The objective of the program is to guarantee women's right to a life free of violence, as well as all the conditions to make Bogotá a safe and accessible territory.

Within the framework of this program, in 2017 the District ICT High Council together with the District Secretariat for Women designed and developed the mobile application **SOFIAPP**, which seeks to strengthen the strategy for the prevention of violence against women in Bogotá. This is a free application for iOS and Android; it includes questionnaires, tests, maps, tips and care routes that allow the identification of risks and situations of violence, as well as direct communication to access protection and justice measures.

²⁵ Resolution District Systems Commission number 002 of March 5, 2018 available at <http://ticbogota.gov.co/sites/default/files/marco-legal/Resolucion002de2018-CDS.pdf>

²⁶ <http://www.shd.gov.co/shd/Bogota-estrena-oficina-virtual>

²⁷ Article 30 of the District Development Plan

The main benefits offered by this
The following are the main applications for women in Bogota:

(i) The possibility of accessing Line 123 through speed dial and the district's purple line to obtain specialized guidance and counseling information, and, (ii) access to a network of support or emergency contacts for dangerous situations.

3.5.7. Change Climate change

In line with the "Bogota, Smart City" program, the District Institute for Risk Management and Climate Change - IDIGER developed the Bogota Alert System - SAB, which consists of five components: **risk analysis, observation networks, data capture and processing, pre-response decisions, and alert dissemination;** together, these components allow for the monitoring of various variables related to the reduction and management of climate change conditions.

risk in the city.

All the information generated by the SAB is available to be consulted by any citizen, so that he/she can know about rainfall in real time, landslide-prone sites, riverbed levels, forecasts, torrential floods, thunderstorms and earthquakes, among others. Also, depending on the level of criticality of the information, it is disseminated to the community through traditional media, community media, social networks and cell phones.

The observation networks are composed of elements that together allow the evaluation and monitoring of meteorological phenomena. This system has stations that permanently transmit data to the SAB platform, which in turn transmits it to the community.

Likewise, the weather radar reports real-time information on cloudiness related to rainfall, which allows estimating the areas of the city in which rainfall is expected.

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This information, together with historical rainfall information, susceptibility analysis and other scientific information, provides the public with updated information on the hydrometeorological and environmental conditions of the capital city.

4

Reto sparaat

consolidation

di n t l i g e n t d e e u n a c i u d e d

Based on a review of international literature and practices, and a summary of the city's progress in technology adoption, this chapter presents the main challenges facing Bogotá D.C. to accelerate its transition to a smart city.

Graph 19 presents the success criteria for the development of a smart city, identified by INDRA (2018) based on lessons learned by a high number of cities.

As can be seen, the **first aspect** is the definition of a clear long-term vision that is shared by the different stakeholders and recognizes existing resources and capabilities. The **second criterion** is the progressive implementation of the vision, based on the development of initiatives with short-term impacts and that configure cycles of prioritization, development, deployment and impact measurement. The **third aspect** consists of encouraging the active participation of citizens in all stages of the implementation cycles of initiatives, with the aim of making them part of as well as recipients of the services. The **fourth component** is the development of

vision of a digital city through active collaboration approaches with the private sector: companies, economic actors and entrepreneurs, among others. The **fifth criterion** also highlights the importance of the active participation of the city's public officials, through collaboration and shared work schemes. Finally, the **sixth component** is the exploitation of synergies with other nearby or similar cities, and the exchange of experiences, knowledge and resources.

Figure 19 Success criteria for the development of a digital city.



Source: INDRA

In view of the above, the following are the main challenges faced by Bogotá D.C. to accelerate its transition to a smart city:

⇒ Consolidation of an integrated smart city project.

Bogota needs to move forward in the consolidation of a Smart City project that incorporates a long-term vision and a set of common objectives and goals that facilitate communication and monitoring. This project should be managed from a central instance that articulates the different entities responsible for initiatives.

⇒ Articulation e integration of initiatives.

The city is challenged to move towards greater articulation of existing smart city initiatives. Cross-cutting initiatives can incorporate common criteria, standards, and components to consolidate the city's

smart city platforms that can be used by sectoral entities in the development of high-impact technological projects that are articulated with other technological adoption initiatives.

Likewise, in the implementation of technology projects, for the fulfillment of sectorial responsibilities, open standards criteria and interfaces that allow the present and future articulation with other existing technological systems in the city should be evaluated.

⇒ Development of strategic projects.

The district administration has the opportunity to implement and consolidate transformative technological projects that allow for an effective and timely response to existing city challenges in sectors such as mobility, security, and the environment. These projects should incorporate early results that will make the smart city project visible and engage citizens and economic stakeholders in the

support for its development.

⇒ Strengthening the smart city ecosystem.

Bogota D.C.'s progress towards a world-class smart city will require the promotion and development of a local innovation ecosystem in technologies and services for the city government.

For the development of this ecosystem, it is essential to link the private sector, the technology industry, digital entrepreneurs, academia and civil society. Likewise, the city must advance in the development of enabling conditions for the strengthening of Science, Technology and Innovation.

⇒ Monitoring and measurement.

In addition to the consolidation of a Smart City Project, Bogota has the challenge of incorporating measurement and monitoring mechanisms that allow for the continuous follow-up of the project and the implementation of measures to achieve the objectives of the different initiatives.

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