PROJETO BRASÍLIA INTELIGENTE

PLANO DIRETOR

Intelligent Brasilia Project

Master Plan

This text is the result of the joint construction of the Master Plan for the Intelligent Brasilia Project carried out by the agencies linked to the Federal District Government.

In this next stage, the debate will be broad, with representatives from companies, the academic community, and civil society.

We want to direct actions to make our cities increasingly intelligent, in order to better serve our citizens. For this reason, your participation is essential, pointing out problems as well as possible solutions.

Summary

1. INTRODUCTION

The Strategic Plan - Federal District 2019-2060 has right at its beginning the Governor's Letter in which the smart city theme is pointed out as one of the priorities:

> "The concept of the smart city is already being worked on. **The citizen will have all the public services provided in** an **efficient way and at their** fingertips, by means of phone applications. **This work must be carefully planned so that the evolution is constant and focused on efficiency**. Ibaneis Rocha (our emphasis)

The Master Plan of the Intelligent Brasilia Project is then built with the purpose of accelerating the adoption of technologies to make the cities of the Federal District, smart, humane and sustainable. The work aims to give concreteness to the planning process determined in the Strategic Plan, as well as meet the determination of the District Law No. 6.620 of June 15, 2020, in its Article 13:

> "The projects inserted in CHISC's Science, Technology and Innovation Master Plan (HUMAN, INTELLIGENT, SUSTAINABLE AND CREATIVE CITY) must be based on applications aimed at the efficiency of public services and utilities to citizens and tourists, having as reference the Sustainable Development Goals - SDGs published by the United Nations Organization - UN".

For the preparation of the Plan several meetings were held within the Federal District Government - GDF, as well as with the actors of society, and a diagnosis of the current situation was made, where it can be seen that we already have many initiatives underway, however, there is little coordination between them. It is also verified that the District Decree No. 40,015/2019 already institutes CeTIC-DF (private corporate data center of the Federal District) as a datacenter and the GDFNet network as an official, private and exclusive corporate metropolitan network of the Federal District; and that Decree No. 40,253 of 2019 institutes the digital governance policy of the GDF and places the sharing of service capacity as one of its principles. However, we still have much to evolve in the proposal of centralized data management and taking advantage of synergies between systems.

In the initial discussions, the division of themes proposed in ISO 37.120, 37.122, and 37.123 was adopted. However, it was found that the division into 17 themes was excessively segmenting and hindering the discussions, which then became

held in seven groups: Governance and Economy; Environment; Social Development; Urban Planning and Mobility; Education, Sports and Culture; and Health. Besides the ISO standards, the Primer on Cities, prepared by the Federal Government, guided the discussion, as well as the initial version of the Brazilian Charter on Smart Cities, which was in public consultation during the discussion period.

The use of a broad concept of smart city, coupled with the adoption of the 2030 Agenda for Sustainable Development and the New Urban Agenda of the United Nations (UN) led to a broad debate about what we want for the Federal District. Technology has always been seen as a tool that can be used to improve the quality of life of citizens, as well as to improve the efficiency of the Public Administration.

Brasilia is part of the G20 *Global Smart Cities Alliance*, whose principles have been adopted in this document:

- Equity, inclusion and social impact;
- Openness and interoperability;
- Security and resilience;
- Privacy and Transparency; and
- Operationalization and Financial Sustainability.

2. METHODOLOGY

For the preparation of the Master Plan, working groups were created composed of the most diverse organs of the GDF, as shown in Annex I. But the work was extended and incorporated members of academia, ICTs (Science, Technology and Innovation Institutions), entrepreneurs and their associations and CODESE/DF (Council for Economic, Sustainable and Strategic Development of the Federal District).

The first stage began with the search for the collection of ISO 37.120, 37.122 and 37.123 indicators. The Planning Company of the Federal District - Codeplan already had previous work in this area and the project Brasília/DF in data already makes available to the public[1] the ISO 37.120 standard indicators. It was found that most of the ISO standard indicators for smart cities are not available in the Federal District and that there is a need to evolve in the process of monitoring data and using them for decision making.

The second stage consisted of a debate on what the Strategic Objectives of the Smart Brasília Project would be, and eight strategic objectives were agreed upon to guide the Project. This stage also involved discussions on how to prioritize the smart city initiatives, and the collection of proposals for initiatives to compose the Project was started.

The third stage was centered on a survey of smart city initiatives. The purpose was to map the various ongoing initiatives in order to discuss how to create conditions to strengthen them and generate synergies between them.

The fourth stage focused on identifying what was called by the group "structuring initiatives", which are already existing initiatives considered central to a smart city project. Based on this identification, discussions began about how to structure a consistent project that would unite the different initiatives to establish a unified vision for the other areas of the GDF and especially for the population.

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[1] http://brasiliadfemdados.codeplan.df.gov.br/

The fifth stage comprised a discussion process with the population to identify what their main needs were, as well as to seek information on how smart city technologies could help them.

3. SMART CITY CONCEPT

There are several concepts of smart city, some more specific, others broader. In the Federal District, District Law 6.620/2020 deals with the human, intelligent, sustainable and creative city. Because of its breadth and the interest in the alignment with the federal proposal, we adopted in the work the proposal of the Brazilian Charter for smart cities:

> "INTELLIGENT CITIES are cities committed to sustainable urban development and digital transformation, in its economic, environmental and socio-cultural aspects, that act in a planned, innovative, inclusive and networked way, promote digital literacy, collaborative governance and management, and use technologies to solve concrete problems, create opportunities, provide services efficiently, reduce inequalities, increase resilience and improve the quality of life for all people, ensuring the safe and responsible use of data and information and communication technologies."

Our discussions were conducted around a central question, "*how can we use digital technologies to improve citizen's lives and make public management more efficient?*"

In this sense, it is of interest to make the centers of Brasília and RIDE less unequal. To take initiatives to other places besides the Plano Piloto (downtown), to identify the economic vocations of the RA's, to map the existing projects or those being created (technological, economic and solidarity-based), to map what resources are available in public or private policy, for the creation of a training and effective development of the idea or project. As a form of intelligent growth of the city beyond the Center, to encourage the diversity of housing in condominiums, also accessibility; improvement of infrastructure, favoring active mobility (cyclists and pedestrians); urbanization of public spaces; digital access to knowledge and culture; libraries and public squares active and connected, cultural events, promotion of innovation and not least the greater role of the population in the councils of

management of public portfolios (urban planning, housing, environment, security, health, education, etc.).

Furthermore, to think of Smart Brasília is to privilege social entrepreneurship as a supplier and commercial and cultural partner of the public service, allowing cheaper products, development of local technology, and job generation; guaranteeing connectivity for the leaderships and productive initiatives of each Regional Government, either through accessible public spaces where they can develop the latent entrepreneurship, or through equipment acquisition programs, spaces such as *coworkings* or *lan house* type computing rooms. Low-income people need to receive the equipment and have access to the internet just like they receive Bolsa Família (extension of the program).

To manage water resources with environmental and socioeconomic responsibility, having water supply systems that are resilient to climate change and efficient sewage treatment systems; to implement green infrastructure projects starting from the watershed, arriving at punctual solutions; integration of environmental and urban planning, generating new forms of planning and projects; creation of monitoring tools that make it possible to identify disorderly occupation and improper discharge of effluents.

The Federal District is under Goiás territory with pre-existing places, it has "layers" from different times, with different architectural, urban and landscape forms. With the experience of having been the "headquarters" of a city projected and implanted "from scratch", Brasília has since the beginning a relationship with time that is different from other cities, being one of its main peculiarities. Besides, it has inhabitants from different origins, each one bringing and sharing their city experiences and cultural contributions. Every day, the city alternates and changes the relations between spaces and inhabitants, through shifts of work, leisure, rest, etc., thus articulating different notions of time.

3.1 Brasília Intelligent Vision

The term *smart cities* emerged in recent decades when the Information and Communication Technology (ICT) industry saw business opportunities in cities. For years, companies have invested resources in order to offer solutions that apply existing and developing technologies at the urban scale. As the term became more popular and a broader, multidisciplinary discussion took place about the use of technology to better manage cities, the concept extended to address urban complexity: smart cities and human, sustainable, creative cities, among others.

In a number of countries, the public authorities are now leading the discussion at the national level, and some municipalities around the world have invested in the development of smart city plans. The use of technology has been explored as a strategy to improve the delivery of urban services. As academia began to study the topic and civil society began to follow more closely the evolution of the theme, questions of privacy and data security to be ensured with the adoption of new technologies were raised.

The Brazilian Charter for Smart Cities[2] consolidates a national public agenda on the theme of digital transformation in Brazilian cities. The Charter community states in the document that the smart cities they aim for are: (i) diverse and just, (ii) alive and for people, (iii) connected and innovative, (iv) inclusive and welcoming, (v) safe, resilient and self-regenerating, (vi) economically fertile,
(vii) environmentally responsible, (viii) articulating different notions of time,
(ix) articulating different notions of space, (x) aware and acting with reflection, and (xi) attentive and responsible with their principles.

As a result of the joint construction of a smart city vision for Brasília, the pillars of the vision and the concepts related to each one were defined.

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[2] Available at: https://www.gov.br/mdr/pt-br/assuntos/desenvolvimento-regional/projeto-andus/charter-brasileira-para-cidades-intelligentes

Brasília for the People	A fair, friendly city that respects diversity and acts to reduce the various aspects of socio-spatial inequalities.

- Brasília is a big city, an important political and economic center of the country, but it should not lose its human scale. Mobility has a great influence on how we occupy the city. We need a more efficient and sustainable transportation system, sidewalks and bike lanes that take people where they need to go, well marked and better positioned pedestrian crosswalks. We believe that by making our urban mobility smarter we will be able to work more efficiently in the occupation of public places.

- Every Smart City project must have as a priority the development of actions to eliminate the digital divide, so that a significant portion of the citizens are not deprived of the benefits resulting from the project, since more and more services will be virtual. The Plan must include actions to ensure quality Internet access.

- Brasília should make better use of its installed infrastructure and provide well-located housing, avoiding walled condominiums. It should provide for densification through renovation, promote diversity of use, favoring active and visually permeable first floors. This, not only in the Plano Piloto, but in all the Administrative Regions.

- A city alive and for people has public spaces that provide diverse activities and uses, welcoming varied user profiles, considering the gender issue, better welcoming women in urban space and allowing the exercise of tolerance. To provide and favor urban encounters is to promote the experience of the streets and the cities from an inclusive, egalitarian and infrastructural perspective, thinking about the quality of public spaces and the offer of different activities.

- Brasília should be welcoming for the elderly and people with disabilities, charming for children, shaded for street workers and pedestrians, safe

and attractive for active commuting, offering meeting places and public spaces for socializing.

In order for Brasília to become a city for the people, we must pursue the following objectives:

1. To make the nuclei of Brasília and RIDE less unequal, taking initiatives to other places beyond the Pilot Plan, avoiding reinforcing socio-spatial segregation.

2. Pursue smart urban development that encourages a diversity of housing forms.

3. Digital access to knowledge and culture, with public libraries in activity, with computer and internet, cultural events and promotion of innovation. Use of various public equipment, such as schools, as cultural equipment also open to the community.

4. Implementation of connected public squares throughout the Federal District.

5. Valuing the bicycle as a healthy and sustainable means of transportation, through the implementation of the projected network of bike lanes, ensuring safe intersections.

6. District strategy to guarantee the accessibility of sidewalks, with improved infrastructure, favoring active mobility (cyclists and pedestrians) and urbanization of public spaces.

Brasília Conscious	An inclusive and welcoming city, which acts with reflection, always responsible with its principles.

- According to the concept of collaborative urbanism, the citizen is not only the consumer of services, but also fundamental in the co-creation of projects and public policies. Participation should not only be part of city planning and management, but also in interventions on the territory.

- To guarantee the participatory process in planning, it is necessary to develop an effective methodology to include and welcome the various actors that interact in the territories. It is up to the various secretariats, municipalities, and

public companies that make up the working groups, to seek practical solutions to attract the population.

- Social participation in the decision-making processes of the city's urban planning, such as PDOT and PLANDHIS, needs to happen with intense and effective popular participation. Without digital and social inclusion it is not possible to advance in urban development.

In order for Brasília to become a conscious city, we must pursue the following objectives:

1. To guarantee the protagonism of citizens in the management councils of sectorial public policies, such as urban planning, housing, environment, health, security, education, and mobility.

2. Guarantee vulnerable populations their basic rights, from the perspective of the Right to the City. The population of the Federal District must have access to housing, basic sanitation, education and quality health care, with decent and accessible public transportation.

3. To promote the local development of the Federal District's cities with projects fostered by the government and developed by the community.

4. Use technology and face-to-face activities to integrate Public Administration entities such as Regional Administrations with the local population, facilitating the resolution of issues in real time.

5. Adapt the instruments of legislation, management, and taxation to contemplate collaborative platforms that broaden the participative process, allowing for example participative budget initiatives.

6. Use, whenever possible, collaborative mapping tools, public debate, and information sharing, to promote more transparent public management.

Brasília Resilient	A safe, resilient, self-regenerating and environmentally friendly city responsible, planning and preparing to respond promptly to climate, demographic, health, political, and economic challenges.

- Ecosystem services include all the benefits and goods provided by nature to support human activities through the provision of resources and regulation of the environment providing socio-cultural welfare, which when absent are related to impacts such as the spread of disease, food shortages, droughts and floods. Such services are anchored in the ecosystem integrity resulting from the linkage between ecological support processes, which originated them, whether cultural, provisioning or regulation.

- The integration of the agencies responsible for the environmental portfolio and for the territorial and urban planning portfolio (SEDUH, SEMA, and IBRAM) is of utmost importance, aiming to structure a multi-scalar network of green infrastructure, protecting and promoting the so-called *hotspots* of multifunctionality throughout the territory.

- The integrated planning of the territory should develop and implement means to measure the effectiveness of the network in promoting ecosystem services, as from its protection and promotion to make effective decisions about land use and occupation. We need to innovate our form of urban expansion, considering that the phytophysiognomies of the cerrado are effective nature-based infrastructures, as addressed at the *Climate Adaptation Summit* 2021. New strategies for planning and design of nature-based infrastructures (green infrastructures) are required to respond at scale to the urban-rural challenges of today. These challenges include the identification of contaminated areas, the preservation and proposal of large areas of biodiversity, water management, and the planning and design of future sustainable urban development regions. Responses to these problems, besides integrating the environmental and urban agendas, can add other essential perspectives to landscape planning according to site specificities and related Biomes. This includes not only the transition to low-carbon cities, but also urban settlements that are resilient to water, drought, and other categories of risk, and that protect and perpetuate the integrity of

ecological support processes and the related ecosystem services that sustain society. This perspective on landscape planning demands transdisciplinary approaches, through cooperation between scientists, planning professionals, and users, in the search for solutions to a common problem, whenever possible, incorporating innovations in urban planning and design, including experimental design guidelines, monitoring and evaluation protocols.

- An environmentally responsible city must have in harmony all the environmental services of the territory where it is located: (1) protection of its source, ensuring water security and preventing scarcity (ecosystem services), in accordance with the National and District Water Resources Policy, taking advantage of the programs of ANA in the domains of the Union, of ADASA in the management of DF water resources and of the river basin committees, ensuring CAESB the necessary tooling for an efficient and effective service; (2) correct and adequate urban drainage for each urban sector, using landscape strategies (Nature-Based Solutions - NBS) rather than large works (such as canalization or rectification) and stimulating the dialogue between the parks and gardens and hydraulic works agencies; (3) maintenance of the water - energy - food nexus in the circular economy relationship based on ecosystem services and the promotion of sustainable business, taking advantage of the synergies of the watershed committees, the potential for sustainable energy generation from the most diverse sources, such as solar and wind, and the technical expertise of EMBRAPA and EMATER - DF and other agencies.

In order for Brasília to become a resilient city, we must pursue the following goals:

1. Manage water resources with environmental and socioeconomic responsibility, having water supply systems that are resilient to climate change and efficient sewage treatment systems.
2. Implement green infrastructure projects starting from the watershed scale and reaching to point solutions.

3. Creation of monitoring tools that enable the identification of disorderly occupation of the territory in real time and improper discharge of effluents.

4. Create a platform that unifies hydrological data, water quality of water bodies, and effluent discharge parameters.

5. Consolidate the monitoring of the territory by means of remote sensing tools by spectral indices; creation of an inter-institutional unified center for territorial monitoring.

6. Use a multidisciplinary platform to evaluate critical points where efforts and resources should be applied in a prioritized manner, during the course of infrastructure implementation.

7. To value and protect the remaining cerrado areas in the territory based on their role in supplying infrastructure demands, such as water supply and natural soil drainage.

8. Encourage housing supply through the occupation of empty or underused private or public land, taking advantage of existing infrastructure and services rather than urban expansion, especially those disconnected from the existing urban network, in view of the close relationship between housing supply and territorial resilience.

9. Promote agile relocation programs for populations in irregular or environmentally sensitive areas, especially in the form of social renting.

Brasília Connected	An innovative, economically fertile city that uses technology to improve people's well-being.

- The evolution of digital data mapping models, especially in infrastructure services such as energy production and distribution, water consumption data, and drainage flow estimation, can result in better control and planning of land use, considering the carrying capacity of the territory, as well as help in decision making about technology implementations for infrastructure improvement, aiming at a more sustainable future of the city. Such an initiative would involve utilities

public services with the mapping of data and technologies and the University of Brasilia with studies and mappings that are already being carried out, among others.

- The creation of a transdisciplinary platform will allow the evaluation of the consequences and influences among the axes and disciplines, in order to treat the city as a complex organism, where it is possible to evaluate, for example, the influence of sanitation implementation on the rates of hospital admissions due to waterborne diseases.

In order for Brasília to become a connected city, we must pursue the following objectives:

1. Identify the economic vocations of the city and map the projects in development or already consolidated based on technology, creative and solidarity economy, relating them to what resources are available in public policy or private initiative, to create a training and effective development of the idea or project. Through the support of development institutions, *hackathons* can be held, taking advantage of the knowledge of technical schools and laboratories, pre-accelerators, incubators, and accelerators.

2. Ensure connectivity for the leadership and productive initiatives of each Administrative Region, either through accessible public spaces where latent entrepreneurship can be developed, or through equipment acquisition programs. Spaces like *coworkings*, computer rooms, equipment acquisition programs and connectivity at prices that are more adequate to the condition of each city.

3. Do not restrict entrepreneurship mentoring to lectures and theory, but hold workshops where coaches and entrepreneurs can develop solutions and products from their entrepreneurship projects.

4. Privilege social entrepreneurship as a supplier and business and cultural partner of the public service, enabling cheaper products, local technology development, and job creation.

5. Exploration of *open source* solutions and technologies under development for smart city projects, adapting them to the reality of the Federal District.

Brasília Living Heritage	A city that articulates different notions of time and space, promoting its historical and cultural heritage, material and immaterial, and whose strategies consider the urban, the peri-urban, the rural, the natural, and the regional.

- The Conjunto Urbanístico de Brasília - CUB is recognized as a World Heritage Site. This means that its condition of "articulator of different notions of time" cannot be neglected in processes aimed at its urban development. Being a "heritage city" is a condition that "permeates" the discussions about the Pilot Plan. Our role as public agents, and especially as promoters of the preservation of this heritage, is to ethically manage the possible changes in the heritage object, in order to contemplate the evolution that the city demands, without compromising its testimonial role and its message to the next generations.

- One of the most transformative aspects of the digital revolution can be situated in the emergence of new spatial dynamics, of disruptive character, which pose the possibility of new experiences of space, new spatial patterns, new articulations in space between economic, social, and cultural segments. Such articulations, which inaugurate new territorial scales, expand the boundaries of the city conceived in government plans and challenge instruments as settled as they are anachronistic, whether in the field of planning, management, financing, or taxation.

- The preservation of the architectural, urbanistic and artistic heritage - which characterizes the city's contribution to the formation of the national and world urban culture, listed at district and federal level and recognized as a cultural heritage of humanity - must observe the norms internationally established by the United Nations for the preservation of recognized world heritage sites, when preparing the necessary physical interventions for its preservation or adaptation to new urban scenarios, exploring the possibilities posed by the development of new

technologies, for the incorporation of new temporal concepts of urban use (incorporation of the ephemeral nature of uses), for the adoption of less invasive technologies in the building adaptation to the new functions, in order to preserve the authenticity and the characteristics of the heritage asset, be it urban, architectural or artistic. The international norms and the guidelines defined by the Unesco missions for the preservation of the CUB, which place the need for greater clarity in preservation criteria (what is essential to be preserved and what is not), should be observed to consolidate the inclusion of the cultural and historical perspective in the delineation of the city's economic and social development guidelines;

- The deployment of telecommunications infrastructure needs to be adapted to heritage constraints, reducing the negative visual impact on urban areas with more compact, hidden or camouflaged support infrastructure in the urban landscape.

In order to make Brasília more and more a living heritage, we must pursue the following objectives:

1. Maintain and conserve the built elements as a record and testimony of the different times of Brasília: Indigenous remnants of the territory; remnants of the expropriated Goian Farms; modern urbanism of Lúcio Costa's Plano Piloto and the most significant specimens of modern architecture (monumental, residential, and commercial); remnants of the pioneer camps of candangos; integration of the urban central area tumbledown with satellite towns with characteristics that refer to distinct regions of the country, such as the Maranhão square of São Sebastião, Ceará characteristics of Ceilândia, and the colonial heritage of Planaltina.

2. Approve and implement a preservation plan to ensure the permanence, authenticity, and integrity of our urban culture, exploring the possibilities inherent in its urban matrix, and ensuring greater access to these spaces.

3. To guarantee an active day and night life in the central areas of the cities, with security and leisure offers, commerce and services, valuing the characteristics of the different shifts and bringing the notion of time to the planning, design, and management of cities.

4. To promote spontaneous cultural manifestations and local festivities, making Brasília an increasingly lively city.

5. Build georeferencing tools, creating databases for the management of heritage assets or spaces and buildings of special landscape and cultural interest.

6. Consider the possibilities that technological development brings for preservation, such as the use of sensors in maintenance integrated into an intelligent monitoring system.

4. THE SMART CITY ACCOMPANIMENT

As we saw in section 3, a smart city encompasses the most diverse aspects of our lives. How do we evaluate whether the steps we are taking are in the right direction?

We opted to use international standards, which have already been widely debated and which, in addition to allowing us to monitor them, allow us to make an international comparison. Due to the completeness of the existing work, the ISO standards were selected, which have also been internalized by the Brazilian Association of Technical Standards (ABNT).

ABNT NBR ISO 37120:2017 (Sustainable development of communities - Indicators for urban services and quality of life) defines and establishes methodologies for a set of indicators to guide and measure the performance of urban services and quality of life. The indicators relate, among others, to sectors such as economy, education, energy, environment, governance, finance, health, sports and leisure, transport, telecommunications, and innovation and urban planning.

ABNT NBR ISO 37122:2020 (Sustainable cities and communities - Indicators for smart cities) specifies and establishes definitions and methodologies for a set of smart city indicators. ABNT NBR ISO 37122:2020, together with ABNT NBR ISO 37120, is intended to provide a comprehensive set of indicators to measure progress toward a smart city, as depicted in Figure 1.

Figure 1 - Sustainable community development - relationship between the family of Standards for city indicators

ISO 37123: 2019 (Indicators for resilient cities) is still being internalized within ABNT. It is a standard that defines and establishes definitions and methodologies for a set of indicators for resilience in cities.

As already mentioned, Codeplan already monitors the indicators of the ABNT NBR ISO 37120:2017 standard. It is considered desirable that the work be extended and that systematic monitoring of standards 37122:2019 and 37123:2019 be done as well.

The Ministry of Science, Technology and Innovations - MCTI, based on a methodology created by the International Telecommunication Union (ITU), with the purpose of establishing technological standards for cities, in 2019, began to evaluate the indicators from the Brazilian context and is developing the "Brazilian Sustainable Smart City Maturity Model" that will enable any Brazilian city to have a diagnosis even if it is not very developed. This initiative will be followed with the purpose of a possible evolution in the indicators to be used in the Federal District. In addition, due to the great disparities between the regions of the Federal District, whenever possible we will seek to work with data segmented by Administrative Region.

5. BRASÍLIA IS ALREADY INTELLIGENT

The Federal District already has a large set of initiatives that improve the lives of citizens using ICTs. This mapping presents, in summary form, the existing initiatives and has served to enable us to harmonize the knowledge among all the participants of the Working Groups, as well as to compose a portfolio that should be disseminated to the population.

Following the activities, the main purpose is to work on the integration and creation of synergy between the existing initiatives and their databases.

5.1 Infrastructure
5.1.1 CeTIC-DF

CeTIC-DF is an integrated set of Information Technology and Communication solutions, including hardware and software, which aims to provide a secure environment to host the various systems of the Federal District Government. It is currently composed of three data processing centers: Data Center - DC Codeplan, DC Vale do Rio Doce and DC SIA.

It is, therefore, data centers for the private use of the agencies and entities of the Federal District, responsible for large-scale storage and processing of the main applications of the Direct and Indirect Administration of the Federal District, comprising the structuring systems, databases and corporate ICT services. It is relevant to highlight that Decree No. 40,253 of 2019 institutes the GDF's digital governance policy and places the sharing of service capacity as one of its principles.

5.1.2 GDFNet

This is the metropolitan high-speed communication corporate network for the bodies and entities of the Direct and Indirect Administration of the Federal District. Most of the GDFNet infrastructure is made up of optical fiber.

Through this optical network, the GDFNet network serves about 350 public addresses such as hospitals, schools, police stations, Na Hora, prisons, among others, and currently has about 550 kilometers of its own optical network.

The expansion of GDFNet with the connection of more public addresses adds security to the services and expands the possibility of new digital services.

5.1.3 INTEGRATED OPERATIONS CENTER OF BRASILIA (CIOB)

The Federal District has an integrated operations center in Brasília. It brings together the actions of 22 bodies, institutions, and agencies of the Federal District focused on public safety, mobility, inspection, services, and health.

In complex cases, such as popular demonstrations and incidents that impact the dynamics of the Capital, the CIOB is essential to minimize and even prevent damage to the population. By being in the same space, the institutions are better able to provide timely responses.

Who is part of the CIOB:

- Casa Civil (general coordinator);
- Secretariat of Public Security - SSP/DF (executive secretary);
- Secretary of Health - SES;
- Secretary of Finance - SEFAZ;
- Housing Secretary - SH;
- Secretary of Works and Infrastructure;
- Secretary of Transportation;
- Secretariat of Cities - SECID;
- Secretariat of Communication - SECOM;
- Military Police of the Federal District - PMDF;
- Civil Police of the Federal District - PCDF;
- Military Fire Department of the Federal District - CBMDF;
- Department of Transit of the Federal District - DETRAN;
- Department of Roads and Highways - DER;
- Inspection Agency - AGEFIS;
- Companhia Urbanizadora da Nova Capital do Brasil - NOVACAP;
- Companhia Energética de Brasília - CEB;
- Companhia de Saneamento Ambiental do Distrito Federal - CAESB;

- Companhia do Metropolitano do Distrito Federal - METRÔ-DF;

- Urban Transportation of the Federal District - DFTRANS;

- Urban Cleaning Service - SLU; and

- Brasília Ambiental Institute - IBRAM.

5.1.4 BIOTIC - INTELLIGENT NEIGHBORHOOD

The Brasília Technology Park (BIOTIC) was created to become the main pole of scientific, technological and innovation development in the Federal District, with the potential to leverage the regional socioeconomic matrix, generating new businesses and high skilled jobs, and to become a national and international hub for business, technology and innovation. The project will enable the installation of several companies, as well as research institutions and innovation centers.

Located between DF-003, the National Park and Granja do Torto, in an area of 121 hectares. The urban design of the subdivision created 6 real estate units, where the Technology Park is being implemented.

5.2 Portals, Applications and Digital Solutions
5.2.1 HEARINGS

The GDF has a fully computerized ombudsman system that allows citizens with internet access anywhere to register praise, suggestions, requests, information, complaints and denunciations. In addition, it is also possible to consult the number of manifestations, the average time of service, the number of citizens being served, the type of manifestation, and the age group of the citizens.

This system has received two national awards for innovation in the public sector:

* 21st Innovation in the Public Sector Contest of the National School of Administration;

* Excellence Award in Electronic Government, promoted by the Brazilian Association of State Entities of Information Technology and Communication - Abep and the Ministry of Planning, Development and Management.

5.2.2 E-GDF

The resource is a great ally of citizens to solve various problems with efficiency and convenience. The e-GDF app offers services to query IPVA, IPTU and the status of GDF social benefits. In the Ombudsman section, you can open and

follow up on requests made to the Government. The Health tab also allows you to follow up on protocols opened at public hospitals.

The e-GDF app is also integrated with the Department of Social Development (SEDES), since users can consult some of the department's programs, as well as follow the status of the request to the Full Plate Program, and consult the granting and release of eventual benefits provided by the Organic Law of Social Assistance.

5.2.3 TRANSPARENCY PORTAL

The Transparency Portal is a tool for society's participation in controlling the application of public resources. In the portal, it is possible to view the expenses, investment, and collection of public administration, the situation of each regional administration, information on contracts with companies, and the annual statement of the payroll of public servants, for example.

5.2.4 FULL CARD

GDF provides families in vulnerable situations with the Prato Cheio card. The aid is intended for the purchase of food basket items and bread and milk, as a way to ensure food for families in a situation of food and nutritional insecurity in the Federal District, especially in this period of the Covid-19 pandemic. The physical delivery of food was replaced by a debit card managed by the Banco de Brasília - BRB. With the digitalization of the process, it was possible to achieve procedural and logistical savings on the public management side; at the same time, greater freedom was given to citizens in the use of resources and the local economy was fostered with the sale of food in a decentralized manner and in places close to the families.

5.2.5 DEMAND MANAGEMENT MODULE (FOR SCHEDULING IN THE CRAS)

The Secretariat of Social Development (SEDES) has implemented the Demands Management Module, an integral part of the Integrated Social Development System (SIDS), through which the demands for assistance in the CRAS are registered and classified based on vulnerability indicators in order to prioritize assistance. In this way, it becomes possible to systematically consolidate service data - both from

This data is extremely valuable to support the management and the teams in terms of decisions and planning.

The CRAS offer **social assistance services**, through which citizens can get a second copy of their ID, senior citizen card, eventual benefits, and other social assistance services related to the Family Full Protection and Assistance Service (PAIF). Therefore, citizens interested in scheduling a service can do so through the following channels: the website or the 156 service channel.

5.2.6 GEOPORTAL

The Geoportal of the Spatial Data Infrastructure of the Federal District - IDE/DF (www.geoportal.seduh.df.gov.br) makes available, for online consultation or download, georeferenced data of the territory and population of the Federal District. Under the responsibility of the State Secretariat for Urban Development and Housing (SEDUH), it gathers the most varied information, ranging from the bicycle path network, to deed plots, areas subject to regularization, public works, infrastructure networks, data from the master plan for land use planning, among others. The information made available by the portal for consultation on the Internet serves both the government professionals to prepare new projects or prepare technical opinions and the population that can consult online the information of their interest.

5.2.7 LIVE FLOWER APPLICATION

Through the mobile platform, women under urgent protective measures who are threatened by their aggressor can contact the security forces. This way, a team from the Military Police of the Federal District will be dispatched to the location where the victim is.

5.2.8 WI FI SOCIAL

The Social Wi-Fi is a project of the Secretariat of Science, Technology, and Innovation that offers free internet (public internet connection) to the population of the Federal District, at no cost to the government or to the user, through Wi-Fi signal, in places with a large movement of people.

With a view to the digital inclusion of the socially vulnerable population, it is suggested that the provision of free internet to the population of the Federal District, through Wi-Fi signal, can be expanded and made available also in the social welfare equipment of the SEDES, which have wide capillarity in the Administrative Regions of the Federal District.

5.2.9 METRO-DF APPLICATION

The Metro-DF has an application with various information that facilitates access to information about its operation.

In the application, you can: Consult the arrival time of trains at any station in real time; find out which is the closest station; plan your route: know how and when you will arrive at your destination.

It is proposed to integrate the SEDES with the Metro application in order to insert the map of the location of social assistance units and community restaurants. This way, the population would have quick access to information about the location of the equipment, as well as the relationship of proximity to public transportation and distribution in the territories.

5.2.10 DIGITAL RECHARGE OF THE MOBILITY CARD

Through the application "BRB Mobility" or through the website mobilidade.brb.com.br it is possible to recharge the mobility card - Bilhete Único, digitally, in addition to checking balances and statements of use, thus avoiding the need to go to the recharging stations or to go to the ATMs.

5.2.11 DF AT THE POINT

The GDF makes the DF NO PONTO site available to the population, where it is possible to see the lines, bus locations, departure times, a map with all the bus stop locations, and several other features.

5.2.12 BRASÍLIA IN DATA

This is a tool that gathers the indicators mapped by Codeplan and other organs of the Federal District Government, in accordance with ISO 37120, which

establishes the criteria for indicators for municipal services and quality of life. The goal is to make Brasília an innovative global city, according to the certification of the World Council on City Data (WCCD), a platform that presents a set of urban data from all cities present in the Global Cities Network.

5.2.13 CAESB SELF-SERVICE

The Companhia de Saneamento Ambiental do Distrito Federal - Caesb has the application Caesb Autoatendimento, through which it is possible:

- Request an Account Review;

- See the second copy of the bill, with bar codes for payment;

- Change Expiration Day;

- Report a Leak on the Street;

- Report Hydrometer Leakage;

- Consult Notices of Lack of Water;

- Report Lack of Water in your Property;

- Request Sewer Unblocking;

- Track your Water Consumption;

- Track Protocol Status;

- Verify the Bathing Map of the Paranoá Lake; and

- Consult the Leak Hunting Primer.

5.2.14 APP CEB DISTRIBUTION

The Companhia Energética de Brasília - CEB has the APP CEB DISTRIBUIÇÃO application, through which it is possible:

- Signal Lack of Power;

- Request Power Reconnection;

- Request for a 2nd Invoice copy;

- Consult Invoices and Consumption;

- Track Services;

- Change Expiration Date;

- View CEB Notices; and

- Contact CEB.

5.2.15 AGENDA DF

The Government of the Federal District has concrete actions to speed up and connect citizens even more with public services.

An example of this is the AGENDA DF site or the phone number 156. Through them, it is possible to schedule blood donations, make complaints and follow up on them with Procon, issue a second copy of the IPVA document, among several other services available to citizens.

5.2.16 REGULARIZATION PORTAL

The Regularization Portal is a tool to provide transparency to regularization processes in the Federal District. Through it, any interested party may consult information about the Regularization Areas of Social Interest (Aris), the Regularization Areas of Specific Interest (Arines) and the Isolated Urban Land Developments (PUIS), thus classified in the Master Plan for Land and Urban Planning of the Federal District (PDOT) of 2009.

The search is made through a map, divided by Administrative Regions (RA), which also allows the overlapping for identification of the regularization areas. Once the user selects the RA, all the existing processes for the determined polygon are listed, as well as some areas identified by the technical team with no process initiated yet.

By clicking on the individual process, it is possible to find out the agency or the interested party (in the case of private land) responsible for the project, the process number, the urban planning guidelines for the area, and information related to the project approval acts, in addition to the phase in which the regularization process is, and its current status.

5.2.17 PROJECT APPROVAL CENTER - CAP Web

Currently the Project Approval Center - CAP makes available to the external user a digital tool, by means of which the interested parties can open processes, follow their progress, file documents as well as

how to apply for the fees for the procedures of Project Qualification and Construction Licensing.

Implemented in 2018, CAP Web was completely redesigned in 2020 to become a system with the capacity to meet all demands from the interested party and CAP. The system is fully compatible and adapted to SISCAP, which controls all the processes that take place internally in this Center. SISCAP, in turn, is integrated to SEI, making the attachment of documents much faster and efficient. CAP attaches approximately 906 files per day to the Electronic Information System (SEI).

CAP Web was implemented so that interested parties can, online, file documentation with CAP in order to initiate a new process or progress in existing processes. Even if the records have not been initiated by CAP Web, the interested party can file any documentation using this platform.

The objective of CAP Web is to promote user interaction with the system through a tool that is increasingly effective and with a simple and practical language.

5.2.18 CIVIL CONSTRUCTION WASTE MANAGEMENT SYSTEM (RCC)

The Urban Cleaning Service (SLU) manages a digital system for authorizing the collection, transportation, and final disposal of construction and bulky waste in the Federal District, as well as the issuing of the Waste Transport Control (CTR).

5.2.19 DIGITAL SERVICES CHARTER - GOV.BR

The digital services offered by the agencies are also available on the Gov.br portal, offered by the federal government. The measure is part of the government's digital transformation policy. In total, 300 digital services from GDF have already been catalogued and will be available on the single Gov.br platform.

5.2.20 InfoHealth Portal

The Portal is a health information site, which is divided into three main blocks:

- Situation Room: makes available data and information about the production of the various health services, availability of beds and supplies, bed occupancy rate for COVID-19, monitoring the number of reported cases of dengue and other diseases, number of births and deaths, etc.

- Citizen's Health: offers information on the location and opening hours of Health Units, drug stock in pharmacies, and waiting lists for ICU beds.

- Health Management: this block, with access restricted to SES-DF managers, provides health service performance indicator monitoring dashboards, among other information, to facilitate decision making for improving the services offered to the population.

5.3 OTHER SOLUTIONS TO IMPROVE THE CITIZEN'S QUALITY OF LIFE AND THE ENVIRONMENT

5.3.1 AIR QUALITY MONITORING

The GDF has four air quality monitoring equipments, the function of which is to determine the concentration of air pollutants listed as priorities by the legislation in force, with a focus on evaluating and following up the evolution of the concentrations, relating their effects on health, and pointing out the need to take action to reduce emissions, grounding public policies and technical studies.

5.3.2 CITinova Project

CITinova is a multilateral project carried out by the Ministry of Science, Technology and Innovations (MCTI) to promote sustainability in Brazilian cities through innovative technologies and integrated urban planning. With

financed by the Global Environment Facility (GEF), this project is implemented by the United Nations Environment Program (UNEP) and executed in partnership with Agência Recife para Inovação e Estratégias (ARIES) and Porto Digital, Centro de Gestão e Estudos Estratégicos (CGEE), Programa Cidades Sustentáveis (PCS), and Secretaria de Estado do Meio Ambiente do Distrito Federal (SEMA-GDF). SEMA-GDF is responsible for implementing the targets under the responsibility of the Federal District.

The Project is composed of three major action fronts:

Component 1 - Integrated Urban Planning Component 2 -
Investment in Innovative Technologies Component 3 -
Platform for Sustainable Cities.

The main objectives are to develop innovative technological solutions and offer integrated urban planning methodologies and tools to support public managers, encourage social participation, and promote fairer and more sustainable cities.

The pilot projects, developed in the Federal District and Recife, for public management are focused on water, solid waste, energy, climate change, and mobility. The results obtained will serve as a model to be replicated, on a large scale, by public managers from all over the country.

5.3.3 INTEGRATED RECYCLING COMPLEX

The Integrated Recycling Complex - CIR was inaugurated on December 2, 2020, located in the Federal District's Railroad Yard, which has two sorting centers and a commercialization center. It is a structure built in a place given by the Secretary of Patrimony of the Union - SPU to the Central Cooperative - Centcoop, where the DF Government, through SEMA and SLU, will do a shared management for 48 months so that the Cooperatives can in the future run this enterprise alone. Other resources will also be provided by BNDES, for the purchase of more equipment needed for the operation of the

complex, as well as resources for technical assistance and training of the collectors in this period.

The Complex, at its maximum capacity, will allow the generation of approximately 750 (seven hundred and fifty) jobs for recyclable material collectors, contributing to the expansion of DF's integrated solid waste management infrastructure, focusing on social, productive, and economic inclusion of recyclable material collectors, which are premises of sustainable development.

5.3.4 RECICLOTECH

It is a pioneering project developed in partnership with the Foundation for Research Support of the Federal District (FAP-DF) and the Secretariat of Science, Technology and Innovation of the Federal District (SECTI-DF) that provides reverse logistics, reconditioning and recycling of electronic materials through circular economy poles (PEC) and training of young people and adults in information technology. All of Reciclotech's work is governed by the following goals and indicators: reconditioning and donating equipment; training in technology areas; and holding electronic waste events. The program counts on some actions such as the Drive Trhu for electronic waste and the Voluntary Delivery Points (PEV) for electronic waste.

5.3.5 PAPA-RECICLABLE (Voluntary Delivery Places - LEVs)

They are surface containers with a capacity of 2.50 m³ and a raised opening to prevent removal by animals and unauthorized persons. This equipment is intended for the collection of recyclable urban solid waste (paper, plastic, cardboard, metal, Styrofoam) and may be used in a complementary manner to the selective collection service in the door-to-door or supplementary mode, ensuring the expansion of selective collection to locations where it did not previously reach. The objective of the recyclable collection containers, besides making selective collection universal, is to raise the awareness and guide the population to collaborate with urban cleaning and the separation of recyclable materials. Educational information about the materials to be deposited, as well as orientation regarding clarification of doubts, complaints, and other information have been included in the equipment.

5.3.6 PAPA ENTULHO - Delivery Points for small volumes

Service for receiving small volumes (up to 1m³) of civil construction waste, pruning, bulky waste, recyclable material, and used cooking oil.

5.3.7 PAPA - Dumpster - Semi-underground Container

Service of installation and collection of organic and undifferentiated residues in semi-underground containers (garbage collector).

5.3.8 PMDF DRONES

Use of drones of the Military Police of the Federal District - PMDF as an alternative to the use of Military Police helicopters, due to the operational cost, assisting in the monitoring of events or crowds in demonstrations or large events. Actions such as monitoring highways, overflying accident sites, monitoring areas where illicit activities take place or where smuggled products are hidden, planning operations and crime prevention through ortomosaic of rural properties are just some of the several functionalities of the Drone in the follow-up of public security and customs repression.

5.3.9 DRONES CBMDF

Use of drones from the Military Fire Department of the Federal District - CBMDF to inspect closed properties in the Industry and Supply Sector (SIA). One

A survey conducted by the regional administration indicated about 150 spaces with possible breeding grounds for mosquitoes in the region.

5.3.10 VEM DF

VEM DF is a pioneering pilot project for sharing electric vehicles for public fleets. Created by SECTI, it is composed of 16 cars. The project also includes the installation in the Federal District of 40 electro stations (recharging points). The electric stations, in addition to supplying the fleet, can be used by cars from any other manufacturers, without charging for recharging.

5.3.11 ELECTRIC BUS

The GDF has six electric buses. These reduce the emission of greenhouse gases and preserve the environment. Silent, air-conditioned, and with a low floor, the electric buses offer more comfort and safety to users than a conventional vehicle. Electricity recharging takes four hours and is done at the company's yard in Piracicabana.

5.3.12 VARIABLE MESSAGE PANEL

The GDF has approximately 40 solar-powered variable message signs that are used to pass on relevant warnings to drivers and assist with educational and health campaigns.

6. EXISTING GAPS (briefly)

As seen in section 5, there are several solutions to improve citizen service in the Federal District, however, in a generic way, we can say that each solution was developed to address issues of a particular theme and without concern for the integrated management of the Federal District.

In summary, we can state that

- The solutions are verticalized and heterogeneous;
- There is low data integration;
- There is data redundancy in the various databases of each system;
- The use of available data for decision making is extremely limited (difficult to establish correlations);
- There is a great diversity of solutions that are not interoperable;
- The culture of cooperation among the Secretariats and other agencies is incipient; and
- There is no general guideline for seeking to create a unified/harmonized environment for ICT solutions in the Federal District.

Technological evolution currently provides us with countless possibilities for using data to make decisions and carry out planning. The use of *Big Data*, Artificial Intelligence and Data Analysis technologies has the potential to reduce management costs, speed up decision making, as well as provide more transparency to citizens. The integration of data, associated with management and analysis is of fundamental importance for us to make intelligent use of all the information that public management has.

7. SMART CITY PLATFORM[3]

To introduce the concept of smart cities it is necessary to take into consideration the diversity of hardware and software, the volume of data to be managed, scalability, privacy policies, among others. In this sense, the technological integration of ICT solutions is a fundamental requirement, which in practice means meeting the interoperability requirements of the systems. One of the most feasible ways currently for promoting interoperability occurs in the middleware layer that precisely performs the communication between the lower layers (communication and device) with the upper layers (support and application).

In general terms, the architecture adopted for the platform should provide for integration with multiple databases and with data processing and analysis systems. All the knowledge generated from the interpretation of data should feed the management and planning of different public policies. This integration creates conditions for the deployment of ICT solutions to eliminate silos and generate benefits, materialized in gains in efficiency in public management and in the improvement of the quality of life of citizens.

A fundamental requirement is the adoption of a platform that uses internationally accepted standards already validated in other cities. Functional and non-functional requirements must be met:

Functional Requirements - Data Management, Application Execution Environment, Sensor Network Management, Data Processing, Data Access, Service Management, Software Development Tools, Definition of a City Model, etc.

Non-Functional Requirements - Interoperability, Scalability, Elasticity, Security, Privacy, Context Sensitivity, Adaptability, Extensibility, Configurability, etc.

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[3] Based on the text Midleware Requirements and Platforms for Smart Cities. Available at: https://smartmetropolis.imd.ufrn.br/wp-content/uploads/2016/05/RT1-WP5.pdf

7.1. Middleware Requirements for Smart Cities

A middleware platform consists of a software layer that resides between the application layer and the supporting infrastructure (communication, processing, sensing), providing standardized access to the data and services provided by the objects through high-level interfaces, and promoting the reuse of generic services, which can be composed and configured to facilitate application development more efficiently. Considering that smart cities represent an application domain of the IoT paradigm[4] , a smart city middleware platform should inherently have the same requirements as IoT-oriented platforms, plus additional requirements specific to this application domain.

The fundamental requirements for IoT-oriented middleware platforms often mentioned in the literature are: (i) interoperability; (ii) device discovery and management; (iii) dynamic adaptation; (iv) context science; (v) scalability; (vi) handling large volumes of data, and; (vii) security.

7.1.1.   Interoperability

Interoperability between the various devices, services, applications, system, with the platforms available in the environment is one of the indispensable requirements for a middleware platform for IoT. The integration and communication of a large number of heterogeneous devices, services, applications and systems, both in terms of hardware and software, protocols, data formats, among others, is one of the main challenges for the realization of this IoT paradigm.

7.1.1.1.   Forms of Interoperability

There are different forms of interoperability for Smart City systems, each of these represent different degrees of complexity in their implementation and have specific characteristics. Depending on the application needs, such as, for example, the tolerated delay between the event of a

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[4] *is the infrastructure that interconnects objects of different uses (things) to the digital network to provide services in everyday life, industry, urban sectors, etc. The objects use sensors and electronic software to collect and transmit data over the Internet (National Plan for the Internet of Things).*

event   e   a   realization   of   action   of   response,   a   given   form of interoperability of interoperability may or may not be appropriate.

Figure 2 presents the main forms of interoperability in line with the ITU model cited above.
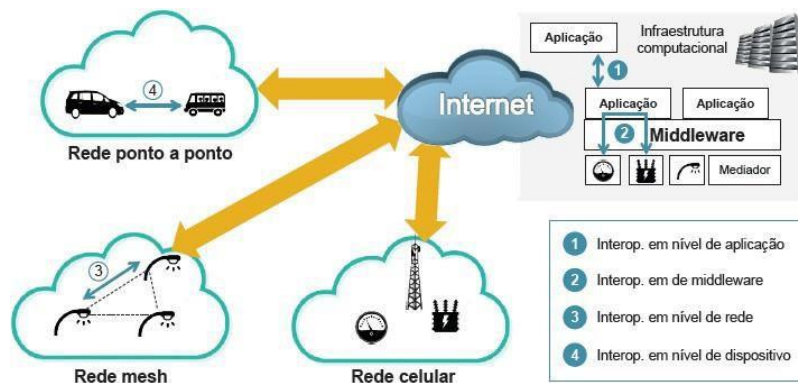
Figure 2 - Main forms of interoperability according to the ITU model

7.1.1.1.1.   Application Layer

The minimum form of interoperability between two systems occurs at the application level. In this case two totally separate solutions can still interact by exchanging information through open APIs (Application Program Interface). For example, a carsharing platform can send information about running routes to an urban mobility solution to optimize the timing of traffic lights. So for this kind of interoperability to be possible it is important that applications implement open interfaces.

7.1.1.1.2.   Middleware Layer

The use of middleware has proven to be one of the most feasible ways to promote interoperability. Middleware is software that mediates communication between devices and applications, standardizing heterogeneous interfaces in order to facilitate and speed up development and foster interoperability.

7.1.1.1.3.   Network layer

There are many communication network technologies and in many scenarios it is necessary to rely on different solutions since the characteristics of the applications demand particularities such as area coverage, power consumption, and bandwidth that cannot be met by a single approach. However, if each system

Using a proprietary network solution, infrastructure costs become prohibitive. Thus it is essential to share the available network infrastructure to provide connectivity for the devices, and to do this it is necessary that they follow widely adopted connectivity standards.

7.1.1.1.4. Device Layer

It is also possible for two devices to interoperate directly. This approach is less common since it requires the application to be executed, even partially, in an embedded form. In general the devices have limitations such as processing capacity, memory, and power consumption that are not favorable for running the final application. However, some applications may require this approach.

For example, autonomous vehicles may require direct communication to avoid collisions with each other. If this communication were to be mediated by a centralized application running in the cloud, the time delay in exchanging information would prevent actions from being taken properly. In cases like this interoperability needs to occur at the device level.

7.2. Interoperability through open IoT platform adoption

As seen, one of the most feasible ways today to promote interoperability occurs at the middleware layer, which precisely performs the communication between the lower layers (communication and device) with the upper layers (support and application).

7.2.1. Device Discovery and Management

When talking about smart cities, it is necessary to note that there are a diversity of objects (Sensors, actuators, cell phones, etc.) through unique addressing schemes and other supporting mechanisms based on ubiquitous standards and protocols, are able to interact with each other and cooperate to achieve common goals. Often, these devices are changing, entering or leaving the environments in which they are located. That said, the topology for communication infrastructure is dynamic and often unknown as the

devices can be integrated into the environment and used in an opportunistic and unplanned manner. Given this situation, device discovery and management is also a key requirement for a middleware platform.

7.2.2. Dynamic Adaptation

The high dynamics of devices in the IoT environment requires middleware platforms to promote strategies for dynamic adaptation (or dynamic reconfiguration), i.e., making changes to the structure and/or behavior of a system while it is running in order to ensure its availability and quality. These changes must respect some important properties, mainly that the adaptation does not cause error or inconsistency in the operation of the system.

Dynamic adaptation is a fundamental requirement since devices can become unavailable for various reasons, such as failure, power capacity, unavailability of network connection, user mobility, among others.

7.2.3. Context Science

In an IoT environment, devices are not only highly dynamic with respect to entering and exiting the environments, but also even more dynamic with respect to varying contextual information, i.e., any information that can be used to represent a person, place, or object considered relevant to the environment in question. An IoT environment is context-sensitive by nature, and in general, changing contextual information associated with a given IoT device should generate reaction according to the context. Thus, knowing, examining, and reacting according to contextual changes, past and present, in order to try to anticipate possible actions in the future, are extremely important characteristics for an IoT environment.

7.2.4. Scalability

A major challenge to be addressed in the context of IoT refers to the huge amount of physical devices across the network. IoT infrastructures need to be

scalable enough to handle the increasing number of heterogeneous devices and requests, and to keep running smoothly even in situations of intense use.

Middleware platforms for IoT must be scalable, allowing the allocation and release of computing resources as demand dictates, while keeping the system as a whole in an operational state and at a satisfactory performance level.

7.2.5. Handling large volumes of data

The exponential growth in the number of devices in an IoT environment creates not only scalability issues, but also results in a dramatic growth in the volume of data provided and transmitted over the network. This scenario requires middleware platforms to be able to handle these large volumes of data. Thus, handling big data is another indispensable requirement for IoT middleware platforms, so that they can keep up with the demand for data collection and analysis, and consequently provide answers, decisions, and/or actions in an efficient manner.

7.2.6. Security

Integrated devices often have the function of collecting data (private or otherwise), and this data can be transported over networks with poor security. Therefore, a middleware platform must have, without a doubt, adequate security to preserve the integrity and privacy of this data, as well as to protect the devices and resources that are exposed to the network. Thus, some techniques such as *tamperproofing* and code obfuscation are used to provide security to the devices. For resources, blocking open and unused ports and the use of protocols, be they security, authorization, and/or authentication, are used.

8. GENERAL OBJECTIVE AND STRATEGIC GOALS

General Objective: To establish conditions for the Administrative Regions of the Federal District to be committed to sustainable urban development and digital transformation, in its economic, environmental, and sociocultural aspects, acting in a planned, innovative, inclusive, and networked way, promoting digital literacy, collaborative governance and management, and using technologies to solve concrete problems, create opportunities, provide services efficiently, reduce inequalities, increase resilience, and improve the quality of life for all people, ensuring the safe and responsible use of data and of information and communication technologies**.**

Strategic Objective 1: To develop an intelligent project that takes into account the peculiarity of a "state city", the country's capital and a hub for business and political tourism.

Strategic Goal 2: Establish smart city actions that impact people's employability and business development.

Strategic Objective 3: Use Public-Private Partnership models. Private Financing, greater agility and risk sharing.

Strategic Goal 4: Boost communication of smart city initiatives.

Strategic Objective 5: Improve the coordination, articulation, and integration of current and future initiatives.

Strategic Objective 6: Develop an innovative project relying on GDFNet CeTIC-DF and existing infrastructure.

Strategic Objective 7: To lead a model that can be replicated in other Brazilian cities.

Strategic Objective 8: Attract investment and aid from international or federal organizations.

ESTRATÉGIA – BRASÍLIA INTELIGENTE

Perspectiva **MARCO LEGAL E ECONÔMICO**

Perspectiva **SERVIÇOS E APLICAÇÕES**

Perspectiva **PLATAFORMA TECNOLÓGICA**

Perspectiva **INFRAESTRUTURA** (sensores, telecomunicação e CPD)

Atrair investimentos e ajuda de organizações internacionais ou federais

Desenvolver um projeto inteligente que contemple a peculiaridade de uma "cidade estado", capital do país e polo de turismo de negócios e política

Estabelecer ações de cidade inteligente que impactem a empregabilidade das pessoas e o desenvolvimento empresarial

Utilizar modelos de Parcerias Público Privadas. Financiamento Privado, maior agilidade e compartilhamento de riscos

Liderar um modelo replicável em outras cidades brasileiras, em especial na RIDE

Impulsionar a comunicação das iniciativas de cidade inteligente

Melhorar a coordenação das iniciativas atuais e futuras

Desenvolver um projeto inovador apoiando-se na GDFNet, CeTIC-DF e infraestrutura existente

Figure 3 - Strategic Objectives of the Intelligent Brasilia Project

9. GOVERNANCE OF THE INTELLIGENT BRASÍLIA PROJECT

A smart city requires the participation of all public administration bodies in the process. The search for integration and construction of synergy among the actions is fundamental. Three instances of Project Governance are proposed: Superior Council, Executive Secretariat and the Working Groups.

The High Council will be responsible for formulating the guidelines, coordinating, integrating, and harmonizing the Smart Cities initiatives, being based on the Quadruple Helix, with government, universities, industry/business, and civil society, and will be composed of:

- A representative of the Secretariat of Science, Technology and Innovation (SECTI);
- A representative of the Secretariat of Economy (SEEC);
- A representative of the Secretariat of Public Safety (SSP);
- A representative of the Secretariat of Government (SEGOV);
- A representative of the academy;
- A representative of the industries/companies; and
- One civil society representative.

The Executive Secretariat will be responsible for operationalizing the decisions of the High Council, providing technical-administrative support to the three instances, and will be exercised by the Undersecretariat of Smart City Technologies.

The Working Groups will address the thematic actions, present technical solutions, and conduct discussions on the verticals proposed in the ISO standards, which have been grouped into seven groups:

1. Public Safety;
2. Health;
3. Environment, Water and Sewage, Solid Waste, and Energy;
4. Social Development and Food Security;
5. Urban Planning, Housing and Mobility;
6. Education, Sports and Culture; and
7. Governance, Economics, Finance, and Telecommunications.

10. PRIORITIZATION OF INITIATIVES - IMPACT X EFFORT MATRIX

There are thousands of technological solutions for smart cities. At the same time, there are diverse needs identified by government technicians and citizens. How to select the best solution? How to prioritize the initiatives?

To answer these questions, we propose the use of the impact X effort matrix, with some adaptations. We briefly explain below the methodology proposed for evaluating the initiatives to be executed within the scope of the project.

10.1. Impact Matrix.

The impact matrix has the objective of valuing the initiatives according to their degree of impact on the strategic objectives.

The final score for each initiative will be given by adding the weights of each initiative in relation to the Strategic Objectives. After weighting the results, the impact matrix will result in the prioritization of the initiatives.

Figure 4 shows an illustration of the Impact Matrix. It is important to highlight that each initiative will have its impact evaluated in relation to the Strategic Objectives of the Intelligent Brasilia Project, which represent the core of what is intended.

	Iniciativa 1	...	Iniciativa n
Atrair investimentos e ajuda de organizações internacionais ou federais			
Estabelecer ações de cidade inteligente que impactem a empregabilidade das pessoas e o desenvolvimento empresarial			
Utilizar modelos de Parcerias Público Privadas de compartilhamento de riscos			
Impulsionar a comunicação das iniciativas de cidade inteligente			
Liderar um modelo replicável em outras cidades brasileiras			
Desenvolver um projeto inteligente que contemple a peculiaridade de uma "cidade estado" capital do país e polo de turismo de negócios e política			
Melhorar a coordenação das iniciativas atuais e futuras			
Desenvolver um projeto inovador apoiando-se na GDFNet e infraestrutura existente			
Resultado Final			

Pesos

Muito Alto (5)　　Alto (4)　　Médio (3)　　Baixo (2)　　Muito Baixo (1)

Figure 4 - Impact Matrix.

In addition to the Impact Matrix, the analysis must take into consideration the cost of

initiative, whether it is a "QuickWin" or whether the initiative is already underway.

Initiatives considered "QuickWin" are prioritized, since quick results are considered positive and can generate energy to strengthen the Project.

Ongoing initiatives are also naturally considered a priority, because they already have efforts from the proponent teams and public resources employed. The proposal is not to interrupt or slow down ongoing initiatives, but to have prioritization parameters that serve the overall planning.

Iniciativa	Responsável	Impacto	Custo	Qw	EC
Iniciativa 1		1,6	5		
...		3,0	3,0		
Iniciativa n					

Muito Alto (5)　　Alto (4)　　Médio (3)　　Baixo (2)　　Muito Baixo (1)

Impacto: Contribuição do projeto para o atingimento dos objetivos estratégicos
Custo: Estimativa do custo econômico do desenvolvimento dos projetos
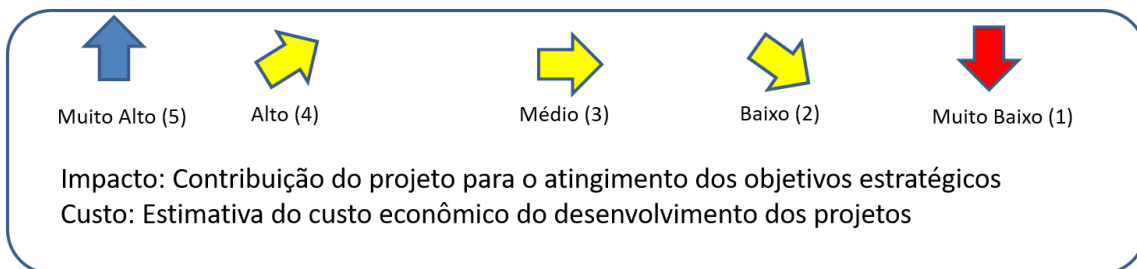
Quick Win: Projeto que pode ser implantado em curto prazo e traz benefícios rápidos

Em curso: iniciativa já em andamento ou em planejamento

Figure 5 - Impact and Cost Analysis.

11. SMART CITY POLICIES

The G20 Global Smart Cities Alliance has been working on a set of policies to serve as a model for partner cities. Based on this initial work, policy proposals are presented to compose a general Smart Cities Policy for the Federal District. Whenever possible and applicable to the Federal District, the policy recommended by the G20 Global Smart Cities Alliance has been fully adopted.

11.1. ACCESSIBILITY OF DIGITAL SERVICES

According to the demographic census of 2010, from the Brazilian Institute of Geography and Statistics (IBGE), approximately 1/3 of the Brazilian population at the time, had some form of disability, be it hearing, mental/intellectual, motor or visual. These people need more attention and differentiated treatment, either because of their vulnerabilities or specific needs.

Article 2 of Law No. 13,146 of July 6, 2015, which establishes the Brazilian Law for the Inclusion of the Person with Disabilities (Estatuto da Pessoa com Deficiência-EPD) presents the legal definition for "person with disabilities" as follows:

> "Art. 2. A person with disability is considered to be one who has a long-term impairment of a physical, mental, intellectual or sensory nature, which, in interaction with one or more barriers, may obstruct his or her full and effective participation in society on an equal basis with others. (BRASIL, 2015)."

Therefore, the Smart City needs to minimize the unequal conditions faced by this part of the population in relation to the rest of society by implementing accessibility to all its environments and resources.

The definition of accessibility is given by art. 3, clause I, of the EPD, which defines it as being the possibility and condition of reach for use, with safety and autonomy, of spaces, furniture, urban equipment, buildings, transportation, information and communication, including their systems and technologies, as well as other services and facilities open to the public, for public or private use, both in urban and rural areas, by people with disabilities or reduced mobility.

The smart city cannot limit itself to reducing or eliminating physical barriers, but needs to make constant efforts to eliminate other barriers invisible to the eye, such as those that prevent or hinder the full use of digital technologies. Less than 1% of Brazilian Web Sites are Accessible for People with Disabilities .[5]

To this end, article 63 of the EPD states that websites maintained by companies with headquarters or commercial representation in Brazil, or by government agencies, must guarantee accessibility for use by people with disabilities, that is, their pages and applications must allow autonomous use by all people.

Therefore, for Brasília to be considered a smart city, the developers of the websites and applications of the agencies of the Federal District Government must be aware of the fact that the browsing experience is variable, since each person with disabilities has different needs. People with blindness or low vision often use screen-reading software, while users with reduced mobility, for example, navigate using keyboard buttons or voice commands.

For people who are deaf or hearing impaired, an alternative to make the portals more accessible are tools that translate Portuguese into Brazilian Sign Language (LIBRAS).

To this end, it is recommended that the accessibility guidelines defined by the E-MAG Electronic Government Accessibility Primer and the accessibility chapter of the World Wide Web Consortium (W3C) be implemented.

11.2.   ONLY DIG ONCE

11.2.1.   Background

Digital connectivity - or 'smart infrastructure' or 'digital infrastructure' - is the infrastructure of the 21st Century. It underpins every aspect of the modern economy and every aspect of smart cities. This includes cellular - 2G, 3G, 4G and 5G - and Wi-Fi,

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[5] https://revistagalileu.globo.com/Tecnologia/noticia/2019/10/menos-de-1-dos-sites-brazilian-accessible-for-people-with-disabilities.html

Cable-based technologies (including full-fiber technologies), the Internet of Things (IoT), and emerging non-terrestrial networks such as low-Earth orbit satellites.

This importance is only likely to grow and therefore requires a strategic approach to expanding digital connectivity. As technology plays an increasing role in all aspects of our lives, economies and societies, reliable and broad connectivity is essential. Similarly, as innovation is accelerated by new and enhanced technologies - including 5G and IoT - the demands for connectivity will increase.

Furthermore, economic recovery due to COVID-19 can be led by digital infrastructure - as a central pillar for economic investment that drives growth. In the near term, connectivity will continue to play a central role in the response - and recovery - from disease. Connectivity enables remote working and learning, e-commerce, digital public service delivery, as well as providing daily and critical communications.

Digital infrastructure is an enabler for many (if not all) of the Sustainable Development Goals - and especially relevant to the associated priority of 'leaving no one behind'.

All major construction projects must have connectivity, and existing buildings must also be connected. In addition, all construction must conform to the needs and realities of network implementations - including wireless and wired connectivity. This is the overall intent of this 'Only Dig Once' policy.

11.2.2. Introduction

Recognizing that connectivity is a foundation for the economy, the 'Only Dig Once' policy seeks to ensure that this connectivity (both wired and wireless) is delivered in a strategic manner.
The 'Only Dig Once' policy has three major areas:

- **New construction and development:** ensure alignment between the public and private sectors, builders, utilities and providers

connectivity to install piping (and connectivity) during the construction phase. This will ensure that all future developments will be connected, ensuring that connectivity is provided only once.

- **Existing** buildings **and other assets:** seek coordination between utilities and connectivity providers during road and street construction work and other large infrastructure projects - thus reducing the need for multiple excavations; and enabling pipe and connectivity installation in an efficient manner.

- **Delivering multifunctional connectivity:** Pipelines have historically played a key role in delivering wired connectivity. However, with next-generation wireless connectivity (including 5G, IoT and new Wi-Fi technologies), pipelines will play a key role in providing the necessary power and connectivity infrastructure - in addition to continuing to enable wired connectivity. A 'Only Dig Once' policy will drive and support the implementation of these essential pipelines.

A 'Only dig once' policy is relevant for all stakeholders: reducing inconvenience and disruption to citizens, speeding up the rollout of connectivity providers, and reducing the administrative burden for cities and local authorities. It also significantly reduces the cost of connectivity deployments - with road and highway works often accounting for the majority of deployment costs.

Unlike other policies, a 'Only Dig Once' policy can also provide great opportunities to measure success - including through reductions in street works (and associated work such as repossessions), a drop in citizen complaints, and an increase in the amount of connected properties to help address digital inclusion.

Specifically, the benefits of a 'Only Dig Once' policy are:

- Support and expand ongoing digital connectivity services;
- Reduce recurring business and traffic disruptions caused by construction work;

- Reduce entry barriers for connectivity providers, including an alternative network of providers;

- Optimizes the planning and deployment of underground space assets;

- Obtain lower re-entrenchment and repair costs;

- Reduce the depreciation of roads, utilities and other assets; and

- Relieve the workload of the road crew in the long run.

Overall, a 'Only Dig Once' policy highlights the central role of the city in ensuring the delivery of connectivity - and that no one is left behind, or excluded, from the enabling potential of technology (including in tackling 'digital debt'). The city is a key orchestrator here, working in collaboration with the private sector as well as other public agencies.

Connectivity can support, enable and catalyze all of the city's priorities, and a 'Only Dig Once' policy also has the potential to accelerate the achievement of those priorities. With both aspects in mind, a 'policy review' process can be a useful task. A city can then identify and align the various actors, roles, responsibilities and policies relevant to the provision of connectivity.

11.2.3.   The fundamentals of digital infrastructure

1. The Federal District will determine whether to install:
   a. Ducts (either single or multiple for resiliency and trenching accompanying the infrastructure); or;
   b. Pipelines and connectivity infrastructure in partnership with connectivity providers - or through a public network; and,
   c. Determine the most appropriate mechanism (e.g., franchise agreement, framework agreement, open access, etc.) to meet these requirements - and to achieve all the necessary results.

2. In addition, the Federal District should also require that all new public and commercial properties develop actions to have the above elements included at the beginning of any plan (including incorporating this requirement into any development or planning approval process). All other

City building efforts should also be evaluated with the availability of pipelines - and connectivity - in mind. Planning and building permits should be premised on developers showing 'what' will be built, but also 'how' - including provision for utilities, including connectivity and/or pipelines.

3. The servicers leading the digital connectivity efforts in the city will specify the type, size, and number of pipelines to be installed during any of the above activities. This could be a set of standardized requirements for any connectivity installation to support developers in costing proposals with precision, or agreed upon in the context of each of the above activities.

4. The GDF will identify a list of 'notifiable activities' during which the above elements must be installed through standardized requirements. These activities may include new construction, preparatory work for future developments of all types, installation of other utilities or other street works, other major infrastructure projects, or any other work that requires excavation of any public or private land (or carriageway) - or where shared trenches have been opened during the course of other works.

5. Authorization processes should be the same for all utility providers, with connectivity providers not subject to separate or particularly onerous requirements. This process should be centralized for convenience. The city should also consider accelerated or flexible permitting requirements for providers providing key connectivity - in accordance with the city's allocations.

6. A GIS record of all pipelines (including underground and above-ground infrastructure) should be developed and maintained by the city, in collaboration with connectivity providers and other stakeholders (including other utility providers and organizations that install street lighting).

7. This registry will also play a role in identifying areas underserved by pipelines (and therefore connectivity). This data will be shared with all connectivity providers (and other relevant stakeholders) - through

open data (as best practice - or upon request, at zero cost in other instances) and made public where possible - to encourage more network implementation.

8. The city should also be looking at future-proofing connectivity facilities. This could include focusing on all-fiber facilities for providing wired connectivity (as well as backhaul[6] for wireless networks), as well as identifying the role of passive connectivity for future wireless networks (including extensive small cell deployment for 5G connectivity and the utility of erased fiber in extending networks).

9. Digital infrastructure is not just a city preserve. Extensive, high-quality digital infrastructure can only be delivered through meaningful collaboration and engagement with the private sector. The city should explore an appropriate approach based on its needs and priorities - whether with public funding, private funding, or a combined approach.

11.2.4. Relationship to a Broad Policy for Cities, Strategies and Initiatives

Digital connectivity - both wired and wireless - is the fundamental basis of a smart city. It enables digital transformation, digital delivery of public services, and will enable future developments such as 5G, autonomous vehicles and other innovations. It is also a central aspect of digital inclusion, ensuring that no individual or community is excluded from the Digital Economy - or the broader benefits that connectivity can enable.

1. The Federal District recognizes the importance of digital connectivity in delivering economic, environmental, and social benefits to citizens, businesses, and society at large;

2. Social participation is essential to help achieve the necessary digital infrastructure results;

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[6] Backhaul is part of a telecommunications network that is intended to link the backbone and peripheral subnets. Reference: https://transmitter.com.br/qual-a-diferenca-entre- backbone-and-backhaul/

3. The public servants leading digital connectivity efforts in the city should have a cross-cutting mandate in the GDF. They must have the authority to ensure that connectivity is a central element in any planned new, or remodeled, construction;

4. The Federal District should optimize underground asset space planning and implementation, including working with connectivity providers, utilities, and other agencies working to build or improve the state of existing underground infrastructure;

5. The Federal District will use (or collect, if not available) local connection data to identify the availability and affordability of high-quality digital connectivity - wired and wireless. This data can be used to inform digital inclusion efforts and more broadly strategic partnerships with connectivity providers;

6. Officials should also consider the merits of public versus private ownership of pipelines, digital connectivity, and ancillary infrastructure. Public, private, and mixed models should be evaluated - depending on local needs and priorities;

7. The Federal District should continually evaluate its connectivity requirements for the future of its assets. In particular, the connectivity requirements of essential functions such as traffic signals, Closed Circuit Television - CCTV, parking lots, on-street parking, air quality, hospitals, schools, etc. should be considered; and

8. The Federal District should also look to make other pipelines available within its portfolio. This includes pipelines managed by public or other transportation providers (including pipelines in surface and underground rail networks, and serving electric vehicle charging points) and pipelines serving CCTV, traffic systems, and other aspects.

11.2.5.   Governance, Accountability and Compliance

1. The Federal District must establish an appropriate governance process to drive the deployment of digital connectivity, with the participation of the population, providers, and other stakeholders;

2. The installations should not impact existing services, the work of utilities or other connectivity providers and should aim to minimize any disruption to citizens and other stakeholders;

3. Connectivity and pipeline providers should conduct site surveys before starting connectivity installations; and

4. If the public connectivity network is available, sharing (costly or not) with private providers will be evaluated.

11.2.6.   Ecosystem engagement for trust and value creation

1. The Federal District will aim to develop a "connectivity ecosystem", with providers who will be considered partners and collaborators in improving the lives and livelihoods of citizens;

2. The GDF will identify strategic assets that can accelerate or simplify network deployment, including leveraging public assets as nodes in a wired network or to host a wireless infrastructure, minimizing the need for digging;

3. Connectivity providers should recognize the importance of openness and collaboration with the GDF. Commercial sensitivities are recognized, but providers should aim to provide visibility to the city regarding local network planning and implementation;

4. The GDF should work with connectivity providers to understand their facilities. In particular, there should be a strategic approach to the use of pipelines. This may include balancing pipeline space between wholesale providers able to connect many properties over the long term, with ensuring space for more targeted, smaller-scale providers; and

5. Connectivity is an essential component in every walk of life. Smart cities are about people, not technology, and local community engagement is a crucial aspect of their success. In addition to exploring the costs and benefits of digital infrastructure with communities, this engagement can also

ensure that no one is left behind by the potential that connectivity (and smart cities more broadly) can offer.

11.2.7.   Relations with industry, utility and supplier stakeholders

The costs of implementing connectivity can be considerable. These networks - often led by the private sector - require significant upfront investment, with civil works in particular representing a notable proportion of any connectivity program. A 'only basement once' policy could increase efficiency, improve asset planning and management, reduce costs and simplify connectivity deployments - as well as minimizing conflicts with other service providers or services and reducing disruption to citizens and businesses.

1. Connectivity providers should be proactive in identifying opportunities to expedite network deployments, both in the context of a 'only dig once' policy and more broadly. This may include identifying public assets of strategic relevance for network deployments, sharing network plans as early as possible to identify areas of alignment with planned city works, and building collaborations with private developers in order to remain alert to potential installation opportunities;

2. Developers should be encouraged to strategically incorporate connectivity - and other utilities. For example, building an underground pipeline to accommodate all services or the provision of piping for telecommunications and electricity. Ownership of any underground piped duct would be passed on to the relevant authority upon completion of the development who will manage access for an appropriate fee based on cost. In addition, all new connections in a development could be located in a single area to allow collaboration between utility and connectivity providers;

3. Public servants should work with developers to support them in community recognition and the social outcomes of a 'only dig once' policy. This includes considerable reductions in disruption achieved by avoiding remodelling facilities, limiting traffic disruptions, greater ease of installation when combining with existing work or open trenches, and the considerable commercial opportunities associated with accelerating network deployment (and increasing your customer base);

4. The GDF should explore the range of funding mechanisms used to drive digital infrastructure deployments. This includes self-funded pipelines, developer financing, rental fees and rights-of-way, building a central fund for pipeline maintenance (or for future-proofing connectivity infrastructure), and private sector financiers - such as fund managers and institutional investors seeking long-term returns on investment.

The GDF should also identify other opportunities to build a strong and productive partnership with connectivity and utility providers. This could include encouraging the presence of all known asset owners during excavations for other purposes, or when conducting trial excavations during the course of any development. This would assist providers in understanding the presence, condition, and status of any of their assets (including ground conditions).

11.2.8. Technical measures to support 'only cave once' digital infrastructure

The following factors can be considered in developing any technical measures required in the implementation of the 'only basement once' policy:

1. **Capacity**: sufficient ducts must be installed, and these ducts must have sufficient inner diameter to accommodate cables from future users and to be segmented to allow the duct to be shared or cables added in the future. Similarly, the wireless infrastructure must have room for expansion.

2. **Segmentation**: Users of the pipeline need to have the appropriate level of separation from each other for business, safety, or operational reasons. This may include the use of double pipe, multiple pipe, division within the pipe, or other approaches for resiliency.

3. **Access**: vaults (or chambers) and hand holes need to be placed to provide access to the duct and the ability to pull fiber. The vaults need to be spaced to minimize the cost of extending the duct into buildings and other facilities that can be served by fiber. In many installations, chambers are installed at least every 100 m - although shorter distances are preferable whenever possible.

4. **Costs**: materials beyond those likely to be required will add costs, as will the incremental labor to construct them. Beyond a certain point, trenches need to be widened or deepened to accommodate the pipeline. The GDF should also consider installing additional empty pipelines for resilience - and consider the potential role of protected, empty trenches (that cannot be built) for future pipeline provision.

5. **Robustness:** materials, construction and placement standards need to reasonably protect the users fiber in a duct and not unduly complicate maintenance and repairs. 100 mm PVC ducts are used in many installations, buried > 450 mm.

6. **Architecture**: sweeps, bend radius, and vault or chamber sizes need to be appropriate for all potential fiber sizes. The installation should also consider the location of other utilities. For example, minimize the location of digital infrastructure in duct near high voltage utilities due to the risk of interference - and proper separation from water pipes to minimize water risks.

7. **Life cycle management**: properly installed ducting has a significant life span. And if the ducts are not in use, they can be blocked off at each chamber to minimize any potential damage (e.g. dirt or water) traveling between segments. As noted earlier, the city should keep an accurate record of all connectivity assets on a GIS-based platform - and also keep records of which pipeline is being

used by each provider. This accurate information will minimize the risk of the pipeline being damaged during any subsequent street works.

8. **Broader considerations**: when upgrading, connectivity facilities should go to the perimeter of properties - with the final part installed only with landlord permission. Similarly, the GDF should encourage providers to make efficient use of all infrastructure assets - within the scope of any broader regulations. The GDF and connectivity providers will also need to work together to identify approaches or policies with respect to interconnection to public and other assets - including interconnection rates, standards, and any tagging points between these assets.

More broadly, the city must also be aware of the ancillary and enabling infrastructure needed to provide connectivity. This includes ensuring access to power supplies and any energy infrastructure.

11.3. PRIVACY IMPACT ASSESSMENT

11.3.1. Background

Cities around the world are growing at an incredible rate, with residents migrating to take advantage of the economic opportunities and amenities they provide. City governments are responding to their continued growth, in part by deploying "smart city" technologies and solutions that enable more citizen-centric services and progression to more sustainable, inclusive, and open cities. To achieve these goals, cities and communities of all sizes must ensure that the data of individuals and their communities generated by these technologies is adequately protected.

Data collection occurs in the day-to-day operation of the city, from paying a utility bill, to browsing a web page and, increasingly, when walking down city streets, using public transportation or driving on a city-maintained road. The use of smart city technologies - such as sensors, connected devices and always-on data streams that manage transportation systems, support real-time infrastructure maintenance, automatically manage

public services, enable governance, transparency and open data, and emergency support services in public areas - can provide real benefits for governments and communities.

While well-intentioned, they can also create risk of harm to individual privacy and increase the fear of surveillance that negates the benefits of city life and actively discourages individuals from engaging with public spaces.

The increasing changes and complexity of emerging technologies, business systems, laws and regulations, as well as increased public scrutiny, require cities to take appropriate measures to proactively and methodically incorporate privacy and data protection into their activities. While privacy is traditionally understood as a broader concept encompassing different rights, data protection involves the protection of the individual in relation to the collection, use and processing of personal data.

Cities must balance their own need to use and share data to conduct business with the broader public welfare and individual privacy interests in a way that builds and maintains public trust. Without public trust, the benefits of smart city technologies will ultimately be unsustainable. Cities must invest in policies and practices that help individuals, local communities, and technology providers maximize the benefits of responsible data use while minimizing privacy risks for individuals and communities.

By implementing Privacy Impact Assessment (PIA) policies, cities can establish a consistent method to identify, assess and address privacy risks.

11.3.2. Goals

The Federal District must work to strike a fair balance between collecting information to provide services and protecting public privacy, especially when deploying technologies for a smart, innovative city. Privacy Impact Assessments (PIAs) are essential tools for evaluating

privacy. PIAs consist of a set of processes to identify and manage privacy risks throughout the data lifecycle, from collection to disposal.

Conducting a PIA prior to the acquisition or use of technologies in a smart city can increase transparency and accountability; support public trust; mitigate potential privacy harms or disparate impacts before they occur; improve compliance and reduce legal risk; and enable more reliable and consistent decision making about data and technology by district public servants, their partners, and the public.

The Federal District's PIA Policy should identify the issues to be addressed and the processes to be followed in identifying and mitigating privacy risks. Specifically, an AIP Policy should:

- Articulate specific purposes for data and technologies, as well as potential privacy risks and mitigation measures, and assess them against values, priorities, and legal rights in relation to the city and community members;

- Be integrated throughout the data design and life cycle (including intersections with the city's procurement, data security, accessibility, and public records obligations);

- Address all data collected by a technology or service, not just data considered "personal" or "personally identifiable" at a given point in time;

- Facilitate communication and cooperation on privacy practices internally and externally, and create a clear understanding of when the city should reconsider a specific technology or notify its communities, partners, and technology vendors;

- Encourage innovation by supporting ethical decision making and optimizing beneficial uses of data while minimizing adverse consequences for individual privacy and society as a whole; and

- Incorporate meaningful and inclusive opportunities for public engagement and decision-making about data and technology practices.

11.3.3.   The Basics of Privacy Impact Assessments

Key procedural components to support the specific objectives of API policy, and its overall goal of maximizing social benefits and minimizing risks to individuals and communities.

11.3.4.   Organizational values and risks

a) The Federal District must explicitly identify the public values, priorities, and privacy principles against which specific technologies or services will be evaluated during the AIP process.

b) Cities must explicitly identify the legal standards and the regulatory authority for performing AIP.

c) PIAs should take into account considerations beyond legal compliance when assessing risks and benefits, including ethics, equity, and public engagement. These considerations should include not only the impact on individuals, but also on groups.

11.3.4.1. Scope and time

a) An initial assessment (or other threshold analysis to determine if a full PIA is required) should be conducted:

i.   As early as possible in the development or acquisition of any new technology [and privacy protections built into a technology's acquisition criteria or development path]. Re-building a system to reduce privacy risks after it has been designed or implemented has proven to be more expensive.

ii.   When planning changes to existing processes and systems, including project updates that may include new data activities or changes in scope.

b) A complete or updated AIP must be performed when required by Federal District regulation or policy or when the initial assessment indicates that:

i.   New technologies, new purposes or new processes for data that can personally identify individuals be introduced.

ii.   Significant changes in policies, business processes, or systems are planned and may affect the physical or logical separation of personal information from other information within a system.

iii.   Sensitive data may be processed, or the technology or service may enable high-risk data processing (such as scoring/profiling of individuals, systematized monitoring, large-scale processing, merging or matching of data from multiple sources, targeting children or vulnerable individuals, risk of physical harm, or the use of new technologies or the new application of existing technologies).

iv.   When the technology or system enables automated or assisted decisions that may have legal or equally significant effects on individuals

c) When necessary, a PIA should be conducted prior to the acquisition or deployment of a data collection technology in the city's environment or in GDF decision making.

d) PIAs should be used to evaluate all data collected by a technology or service, not just data that is legally considered "personal" or "personally identifiable" at the time it is collected.

e) A PIA should be only one part of a comprehensive privacy program. It should be alongside methods such as no data collection, privacy training, regulation and auditing, and publishing PIAs within each GDF agency.

11.3.4.2. Tools and Components

a) GDF agencies should develop and conduct a preliminary initial assessment or other threshold analysis to reveal whether additional review is needed, such as the completion of a full PIA (or an ethical impact assessment for non-personal data).

b) Initial assessments should contain a preliminary evaluation of the privacy risks generated by the system, product, or service and may include high-level data flow diagrams or preliminary data and usage characteristics.

c) If it is determined that a full PIL is required, it should include the following components (see "Fundamentals of a PIA" below):

i. A privacy risk assessment - Conducting a privacy risk assessment helps an organization identify the privacy risks generated by the system, product, or service and prioritize them in order to make informed decisions about how to respond to the risks.

ii. A risk response determination - In determining how to respond to assessed risks, the GDF should refer to its organizational values and risk tolerance. Response approaches include:

- **Mitigation** (risks are mitigated to an acceptable level of residual risk through technical and policy measures, such as data minimization);

- **Transfer / sharing** (risks are shared with other parties, such as through contracts or insurance; consent mechanisms are a form of risk sharing with individuals. Individuals must be able to reasonably understand the relevant risks before being asked to provide consent);

- **Evasion** (GDF agencies may choose not to use certain technologies or perform certain types of data processing where the risks outweigh the benefits; or

- **Acceptance** (GDF agencies may choose to accept risk where the probability or impact of adverse consequences are low, and the benefits are optimal).

iii. Selected requirements and controls that allow the GDF

- **Meet applicable legal obligations** (Organizational level privacy requirements are a means of expressing the legal obligations, privacy values and policies to which the GDF intends to adhere. Organizational-level privacy requirements can be derived from a variety of sources, including legal environment (e.g., laws, regulations,

cultural policies or values; relevant standards; and privacy principles) and

- **Address the risks** determined to be mitigated.

d) The GDF should consult local data protection authorities and other privacy and data protection experts for expert guidance, templates and tools for conducting PIAs and privacy risk assessment.

11.3.4.3. Roles and Responsibilities

a) A designated senior server, such as a Chief Privacy Officer (CP) [supported by a dedicated privacy team] should be responsible for:

i. Develop appropriate models, resources, and components for initial assessment and API tools;

ii. Define the standards and resource qualifications allowed for conducting a PIA;

iii. Reviewing the initial assessment or otherwise determining when a PIA is needed (including further review of existing PIAs);

iv. Conducting and approving PIAs, including providing requirements and recommendations to mitigate privacy impacts;

v. Maintain contact with other district servers to resolve privacy and security issues raised during the course of the API; and

vi. Determine the GDF's response to identified privacy risks.

b) Officials of the agency / department / project should be responsible for:

i. Provide adequate information and documentation about the proposed technology and its use (e.g. technology functionality, business case, proposed purposes, costs for ongoing privacy and security protection, etc.);

ii. Completing the initial assessment and assisting in the completion of a full PIA, when appropriate;

iii. Implement the data management and use plan and all appropriate safeguards identified in the AIP as necessary to mitigate the risks associated with the proposed technology;

iv.   Ensure that the API policy is communicated to staff and that staff are given sufficient time and resources to participate in the API process; and

v.   Authorize and approve PIAs, as appropriate, prior to the implementation of privacy-affecting technologies.

c) A senior executive or servant, such as a manager or chief technology officer, must have the authority to oversee compliance with the AIP Policy, including:

i.   Ensure that the PIA Policy is communicated to all employees, implemented and enforced;

ii.   Ensure that information is shared and accessible as much as possible, while respecting privacy and security requirements;

iii.   Provide adequate budget and organizational structure to enable the designated senior privacy server and other personnel to routinely conduct PIAs;

iv.   Develop and implement appropriate accountability measures (e.g. escalation procedures, staff training and awareness, reporting systems, and capture for potential privacy-related complaints or threats),

v.   Monitor the effectiveness and results of the API policy; and

vi.   Review the alignment of AIP schedules with smart city project schedules.

d) Other servers and external stakeholders should be consulted when appropriate given the nature of the specific technology or service, such as:

i.   An executive representative to advise the AIP program and advocate the department's position;

ii.   The CP or other IT specialists to assist in technology systems design and data security risk assessment and mitigation;

iii.   Attorneys or legal counsel to ensure compliance with legal standards, including applicable data protection regulations;

iv.   Open Data District civil servants to identify the circumstances under which data can be disclosed (intentionally or by law);

v.   District public servants in bidding and procurement;

vi. Employees of state agencies or companies for additional interests in the data or technology;

vii. External experts on the subject;

viii. Technology partners; and

ix. Members of impacted communities.

11.3.4.4. Monitoring and record keeping

a) All initial assessments and AIPs must be fully documented in writing and be maintained according to the city's record retention schedule.

b) Any technologies determined to be exempt from AIP review must also be recorded and documented in writing.

c) AIPs can be classified and categorized if there are multiple AIPs.

d) The GDF should create a secondary AIP process aggregated and run every three years to assess how systems and data interact to prevent data once considered non-personal from, over time, becoming identifiable; by assessing all data generated by an IoT technology or service together, cities can prepare their assessments to a greater degree.

e) A senior public servant assigned to privacy should review the AIP policy annually (or sooner if necessary) and update it as needed.

f) GDF Secretariats, Departments, divisions or projects and any partners or service providers should assess their own degree of compliance with the API Policy, [e.g. by conducting internal audits, program reviews or program evaluations].

g) In the event that the city receives a privacy complaint or experiences a privacy breach, a designated senior privacy server shall investigate and make recommendations as necessary to remedy the situation.

11.3.4.5. Transparency and engagement

a) To the extent possible, cities should make all AIPs available to the public in an easy-to-use, publicly accessible website.

b) The GDF should develop and implement appropriate activities to enable organizations and individuals to have a reliable understanding and engage in a dialogue about how data is processed and the associated privacy risks.

c) The GDF should develop additional mechanisms (e.g., notices, internal or public reporting) to communicate data processing objectives, practices, and privacy risks associated with smart city technologies, informed by relevant PIAs.

11.3.5.   Key Issues in a Privacy Impact Assessment

A PIA must in a clear and understandable way:

1. Identify the GDF departments, divisions or projects and any partners or service providers that will use or be responsible for the technology.

2. Describe the technology to be designed or acquired and a general description of its functionality, the type of data it is reasonably likely to generate, and the sources and accuracy of any personal information collected, including reasonably foreseeable surveillance capabilities outside of GDF's proposed use.

3. Describe the purpose and proposed use of the technology, including its intent, value, and benefit to individuals, the community, and society at large [and any data or research that demonstrates these benefits]. Describe the problem that the technology seeks to solve and whether there are less invasive alternatives.

4. Describe GDF's authority to collect, use, and disclose personal data relevant to the proposed technology, as appropriate.

5. Describe any public values, principles, legal standards, and organizational risks against which the technology is being evaluated.

6. Assess and describe the potential privacy risks associated with the proposed use of the technology, [including the likelihood of such risks occurring and the severity of the potential impact on individuals and communities.

7. Describe the GDF's risk response to identified risks, given organizational values and risk tolerance (e.g., risk mitigation, risk transfer/sharing, risk avoidance, or risk acceptance).

8. Describe a clear use and data management policy for the proposed use of the technology, including:

a.   How and when the technology will be deployed or used and by whom (including, as appropriate, descriptions of who has ownership or licensing rights to the data and on what terms).

b.   Any additional rules that will govern the technology (including legal standards that must be met before the technology is used, such as for purposes of a criminal investigation).

c.   How the data will be securely stored and destroyed or de-identified.

d.   How long data will be retained in identifiable and non-identifiable forms.

e.   How access to data will be monitored and controlled, [including access logs and audits].

f.   Whether technology or data will be shared, and if so, under what conditions (including routine sharing, such as with partners or service providers, other government entities, researchers, public records requests, or open data and in exigent circumstances).

g.   What training and accountability measures will help ensure that all personnel operating the technology or accessing the data use it only in accordance with GDF policy.

h.   What safeguards are in place to ensure the confidentiality, integrity, and availability of data (including protection against threats such as ransomware, malware, or IoT vulnerabilities).

i.   Any other legal, organizational, physical, and technical safeguards intended to mitigate potential privacy risks associated with the use of the technology.

9. Describe any community involvement undertaken and any plans for future community involvement, any comments received and responses

given city and city conclusions about potential neighborhood and disparate impacts that may result from the acquisition and use of technology.

10.   Describe any emergency or civil defense legislation that may change the way data is used or the processes governing it.

11.   Describe how the potential impacts of technology on civil rights and liberties and potential disparate impacts on marginalized communities were taken into account and mitigated.

12.   Describe the availability of funding for ongoing privacy and data protection costs related to the operation of the technology (such as staffing, legal compliance, auditing, data retention, and security costs).

11.4.   Cyber Liability

Cities face increasing threats from cyber attacks. In 2016, a quarter of US cities faced attempted cybersecurity attacks every hour. Three years later, governments reported 163 successful *ransomware* attacks with over $1.8 million in ransomware paid and tens of millions of dollars spent in recovery costs, a nearly 150% increase in reported attacks as of 2018.

The technologies used in creating smart cities pose both societal benefits and cybersecurity risks. The convergence of Information Technology (IT) systems with Operational Technology (OT) systems provide multiple 'entry points' for cyber attackers targeting the city, and the disparate technology platforms and devices used by cities can create hidden vulnerabilities. This is exacerbated by the lack of common standards governing critical, interconnected devices, resulting in the use of devices from multiple vendors with different communication and security protocols.

The added value of enhanced government services offered by advanced technologies drives the adoption of IoT devices globally. This explosive growth of interconnected devices exponentially increases exposure to cyber attack - and the number of such devices in the world is expected to jump from 8.4 billion in 2019 to 20 billion by the end of 2020. How

as a result, governments face a growing challenge to increase their preparedness for cybersecurity and resilience, while recognizing that the alternative can result in more than just data loss, financial impact, and reputational damage risks. Instead, the societal costs may include a cascading effect across government systems, resulting in the complete disruption of emergency response services and transportation to power grids, education, and more.

In addition to increasing services to citizens, cities are also dealing with a new reality of a highly distributed, anywhere workforce. The traditional approach based on monitoring networks in cybersecurity silos is not effective in these highly distributed environments where everything connects to everything. The result of these major technology initiatives being undertaken by cities is that the overall cyber attack surface continues to grow and government systems are becoming more vulnerable to attack.

Cities offer a plethora of services dependent on critical, dispersed, and varied digital infrastructure. These systems, often referred to as OT systems, have traditionally been in isolated networks and contain sensitive, often legacy hardware and software controlling infrastructure that can have significant physical implications if disrupted. Increasingly, these areas of critical infrastructure are adopting IoT, cloud, and third-party digital integrations. Due to this combination of factors, such systems are high-risk areas.

As governments become more sophisticated in their responses, we have seen several cities appoint a Chief Information Security Officer (CISO) position or similar. This responsible person, regardless of position, evaluates, directs, and monitors the design and deployment of effective smart services information security and is accountable for security breaches. Regardless of whether the city has a specific CISO position, having a robust cybersecurity accountability model sets the foundation for an enhanced cybersecurity position and therefore a more cyber city.

11.4.1. Definitions

11.4.1.1. What is Cyber Security?

Preserving the confidentiality, integrity, and availability of information in Cyberspace. Cyberspace is a complex environment resulting from the interaction of people, software, and services on the Internet through technology devices and networks connected to it that do not exist in any physical form.

11.4.1.2. What is cyber resilience?

Cyber security plays a key role in mitigating the impact of a cyber disruption by protecting the confidentiality, integrity, and availability of data and data-enabled infrastructure. However, security alone is not enough. Cyber resilience goes one step further, ensuring that Information and Communications Technology (ICT) systems continue to deliver services in the event of a cyber incident.

11.4.1.3 O that é security security e resilience in a smart city context?

For cities, cyber resilience can be understood through their ability to be ready, respond, and reinvent themselves. Efforts to build cyber resilience are essential to survive and even thrive in the face of cyberattacks or physical disasters.

The convergence of physical and digital infrastructure, the resulting interoperability, and the interconnection between city systems and data is an ongoing effort in many cities. The security objectives of a smart city - confidentiality, integrity, availability, security and resiliency - must be based on both traditional IT objectives (protecting data) as well as those of Operational Technologies or OT (ensuring the security and resiliency of systems and processes). These combined security objectives can help cities maintain a more secure and resilient operating environment.

The responsibility for cyber security in this context may include a single person for both Information Technology (IT) and Operational Technology (OT) or one person for each domain (IT and OT).

11.4.2.   Goals

1. The Federal District is committed to ensuring the cybersecurity and resiliency of all information and physical infrastructure, including but not limited to physical and cloud infrastructure, devices, networks, data, applications and users.

2. The purpose of this policy is to provide an *accountability* model for cyber security to ensure that a senior servant (or multiple senior servants) have the oversight, *accountability*, responsibility, authority, and resources to make decisions about cyber security and protect the Federal District from potential harm, including but not limited to brand degradation, operational disruption, financial loss, legal liabilities, and the loss of public trust as a result of cyber attacks.

The Information and Communication Security Policy of the Federal District Government (PoSIC/GDF) establishes guidelines, principles, responsibilities and objectives for Information and Communication Security in GDF. It seeks to align the existing policy to the growing risk arising from new technologies that are increasingly present.

11.5.   Open Data

11.5.1.   Background

Open data has been the foundation of the smart city movement for many years. Smart city technologies rely on open data from city authorities and urban services for much of their core functionality - without access to traffic data or GIS data, many applications simply wouldn't work. But the need for open data extends beyond functionality into the governance environment itself. Open data enables

more responsibility in government and are crucial to establishing open markets for technology in urban services.

11.5.2. Policy

The Federal District has a duty to maximize the potential of the data it generates and collects. Making administrative and operational data openly available can increase quality of life, improve economic, social, and environmental outcomes, and create more resilient communities and public services.

Specifically, open data should:

a) Provide a common and reliable evidence base to inform decision making in the GDF and improve sharing with all levels of government and non-government organizations.

b) Strengthen public understanding of and trust in GDF operations and other information about their communities and raise the level of external scrutiny and accountability.

c) Generate economic opportunity for individuals and businesses that benefit from the knowledge and functions created by open data.

d) Empowering GDF public servants to be more effective and enabling them to identify opportunities to improve services and quality of life.

e) Encourage the development of innovative technology and data analysis solutions by a broader group of *stakeholders.*

f) Anticipate and capture the benefits of new digital technologies, such as the Internet of Things and Artificial Intelligence, while proactively managing any potential drawbacks and risks.

11.5.3. The Basics of Open Data

a) The GDF must open the data by default and do so via the Portal http://www.dados.df.gov.br/.

b) The data should be timely, comprehensive, and the processes that generate it clearly documented: open data is relevant only if it adds value and is readable for the user of the information.

c)   Open data must be published in a machine-readable format.

d)   Barriers to use should be minimized and ease of use maximized. Datasets on the Open Data Portal should be made freely available (subject to cost considerations, below), without registration and license requirements, and without restrictions on use (i.e., under an open data license).

e)   When planning or modifying data collection systems or projects, or implementing new digital technologies (e.g., IoT), GDF agencies, in collaboration with the Comptroller General, should consider which datasets and associated metadata can be published as open data.

f)   This applies equally to systems, projects, and technologies provided by third parties acting on behalf of, or commissioned by, GDF agencies.

g)   All parties that provide the public with any of the GDF's open data, or provide an application that uses the GDF's open data, must explicitly identify the source and version of the data, and a description of any modifications made.

The following factors should be considered when determining transparent monetization and pricing of open data:

a)   When costs are incurred by the city through providing open data in a value-adding format (e.g., after significant pre-processing) or in high volume (through heavy API calls) to a third party who will then derive an economic benefit from that data.

b)   Whether the community benefit is delivered along with the economic benefit to third parties (e.g., a commercial parking application that relies on open data generates profit, but also reduces congestion).

c)   Whether the proposed applications comply with broader GDF policies (for example, government data may be used to enhance location-based advertising of products and services to a for-profit organization).

d)   Who is the third party and the possible negative effects of charging for open data. A discounted fee can be applied to local startups as an incentive to create data value. Non-profit organizations that use open data in the interest of social equity should not be charged.

11.5.4.   Relationship with policies, strategies and initiatives of the GDF

City open data initiatives must support and build, rather than destroy, digital trust in communities. They need to increase trust in the marketplace and the broader ecosystem. Specifically, privacy, security, liability, accountability, and ethical concerns around open data and its use need to be taken into consideration, especially as digital technology becomes increasingly embedded in physical and community infrastructure. This implies a growing need to build coherence with a broader set of activities related to data and technology.

1.   Open data policies should be integrated into broader ICT security and privacy policies, to ensure that the release of specific data attributes cannot cause harm to the privacy or security (of individual members) of public or private sector organizations, or put critical infrastructure at risk.

2.   Policies should build on GDF-wide data governance policies and regulations, so that open data practice adheres to and extends to the general public, important aspects of data management protocols and processes (e.g., broader data classifications and publication approaches).

3.   Open data should be considered as part of economic, urban and digital planning or smart city strategies and their supporting policies.

4.   All GDF data infrastructure projects must commit to publishing as open data by default and use only permission-based access as a last resort for sensitive data attributes,

where anonymity or de-identification is not possible or practical (e.g., primary registries extracting and linking data from multiple sources to create reliable, high-quality reference points for physical, economic, and social assets).

5.   Open data publishing should be considered in the design and implementation of the GDF's broader data infrastructure.

11.5.5.   Governance and Process for Accountability and Compliance

The Comptroller General should establish processes to identify datasets to be published on the Open Data Portal from the perspective of community need. These processes should assess potential utility, uptake and ultimate value. They should be informed by inputs and therefore meet the needs of stakeholders across government, communities, academia, business, and data consumers in general.

The Comptroller General should establish processes to identify datasets to be published from a technical perspective. These processes should consider minimum data quality standards (e.g., completeness, accuracy, timeliness, and permanence), as well as potential privacy risks, to encourage reliability and reuse.

The Comptroller General should manage relationships with the Secretariat and other agencies and provide guidance (e.g., how to prioritize data against defined guidelines) to ensure efficient and value-focused open data publishing. To improve the quality and overall impact of open data publication, activities may include:

a)   Direct the open data managers of the secretariats and other agencies to make the data collections and their accompanying metadata available on the GDF city open data portal, according to the GC's policies and operational procedures.

b)   Direct the open data managers of the departments and other agencies to ensure that the data made available to the public follow GDF's policies and standards of privacy, security, retention and public disclosure.

c)   Develop a catalog listing the data assets of each department and other agencies. These data catalogs should be combined into a master data catalog and, with metadata, made publicly available. Consideration should be given to using international standards (e.g. DCAT2) so that open data catalogs can be linked to provide larger, federated, common data assets.

d)   Set publication targets and follow-up plan for open data in each Secretariat and other bodies on a regular cycle (e.g. annually). The achievement of these targets can be part of the performance evaluation of each GDF body or open data manager.

e)   Publishing an Open Data Handbook to document - and provide guidance and templates on - the management and publication of open data. This document or series of documents can cover a variety of data governance function areas, such as building and managing data inventories, descriptions of the data ingestion process, and guidance on standards and classifications.

f)   Maintain and update a broader set of open data policy materials, including interpreting, updating, and modifying an Open Data Policy and supporting procedures.

g)   Develop and maintain an open data classification framework (including its relationship to broader data classification systems) and processes and support its use by other organizations.

h)   Evaluate incoming requests through established community feedback mechanisms so that datasets can be prioritized for release and incorporated into the work program for the team.

i)   Publish an annual Open Data Plan, which can serve as a schedule for data publication and as a description of the strategic improvements to be made to CGDF's operations and assets. As such, it may contain:

i.   A proposed publication schedule for datasets to be published on the portal in the coming year.

ii.   A plan for the coming year to improve public access to open data and maintain data quality.

iii.   Proposals to improve the GDF's open data management processes and data infrastructure to advance the goals of the open data policy.

iv.   Proposals for experimentation and innovation - e.g. the publication of derived (aggregated or anonymized) datasets where full datasets cannot be published as open, or experimentation with synthetic "differential privacy" approaches to enable open publication of high-value datasets.

v.   Costs associated with providing open data infrastructure and operations for the next fiscal year, as well as benefits and use cases to prove the value of open data.

11.5.6.   Ecosystem engagement for trust and value creation

1. CGDF can introduce a simple data request service on the open data portal, inviting all participants to advocate for the release of open data.

2. Creating a permanent mechanism to solicit and act on feedback from the broader data community (e.g., input into a broader policy discussion, open data publishing practice, and, in more advanced cases, crowdsourcing of datasets) should also be considered.

3. The power of blogs and well-illustrated (visualized) case studies to create impactful open data value should not be underestimated. Publication rights can be extended to other organizations and individuals to strengthen the sense of community contribution.

4. Recognizing that the broader cross-section of the public lacks the technical expertise needed to use open datasets, CGDF should actively explore non-technical ways in which the public can interact with open data, such as collaborations with app developers and platforms that share data and insights with the public.

5. Value and outcome-based use of open data assets can be accelerated by creating opportunities for members of the public, departments and offices, student groups use open data to explore a specific challenge (e.g. air quality). While the effort to attract a sponsoring department able to clearly articulate demand and action the insights based on open data should not be underestimated, hackathons and longer open innovation competitions can be highly effective in bringing the potential of open data to wider attention.

11.5.7. Relations with key data stakeholders

1. The Chief Privacy Officer - the authority on issues or questions regarding the privacy risk of Open Data and mitigation of the risk of privacy damage.

2. The Open Data Manager - for authority and decisions on broader issues of governance, data management and quality, as well as issues related to analytics.

3. The Undersecretary for ICT - for the approval of work plans related to data and technology infrastructure and plans for their development.

4. Data Managers of Secretariats and other agencies (where applicable) - CGDF, through guidance, training, and methods listed in this policy, will assist data advocates in ensuring departmental compliance with open data publishing standards and delivery against targets.

11.5.8.   Technical measures to support open data practice

The GDF must use open industry standards to ensure the quality, interoperability and discovery of open data. Technical maturity will vary across Secretariats and other agencies. Understanding this maturity and introducing appropriate technical measures to make data as accessible and usable as possible by government and others working with its data will serve to increase the value generated from it.

1. The GDF should conduct periodic assessments of data availability, quality, interoperability and discovery as part of its Open Data Plan. This could be done first at the Secretariats level and over time for systems of high interest to the public.

2. For data quality assessment, the city should consider a data quality matrix to establish:

a)   Ownership and authority - there is a custodian responsible for the overall quality of the original data to be made available for reuse.

b)   Accessibility - metadata is provided and machine-readable formats are used.

c)   Accuracy - common data fields (e.g. dates, times, location) are used and limitations and gaps in the data are explained.

d)   Completeness - the data makes sense as a complete data set and should not require other data to make sense.

e)   Descriptiveness - the accompanying metadata should describe how the data is trusted and how the data was created and processed. Ideally, a schema should identify ranges and values in each field to show temporal and geographic coverage, granularity, and limitations for the assets described.

3. From an interoperability (and data quality) standpoint, especially looking at the more abundant use of IoT data:

f)   A variety of standardized data formats can be applied to increase the ease of reading open data by software applications. In general, these formats should be non-exclusive and non-proprietary. The following structured data formats of different types should be used:

i.   The tabular data should be published as CSV.

ii.   Geospatial data should be published as GeoJSON or KML.

iii.   Other non-tabular structured data should be published in an open standard, where available (e.g. JSON, XML, RDF, GTFS).

iv.   Real-time data or data used in real-time services should be made available through a well-documented API.

4. To facilitate discovery, metadata attached to open datasets should include:

a)   Title, description of the dataset, name of the publishing entity, the classification (open), a link or copy of the open data license under which the data can be used, as well as a description of the format and timestamp.

11.5.9.   Data Platform and Infrastructure

From **a technical point of view**, the open data portal should be harmonized with the overall data infrastructure of the GDF. In this way, government workflows (e.g. planning approvals) and digital services, and the data they use, operating in this infrastructure can incorporate open data publishing. This practice will establish a flexible and cost-effective data infrastructure across the city and promote the development and alignment of strategic investments and services related to open data.

The main elements of such an infrastructure are:

a)   Identified data sources, their owner and current usage.

b)	A data pipeline to ingest the source data, model it using a standard schema, classify it and determine an authorization schema, link and compare it to other sources and check its quality, optionally turn it into an event stream to log the history and changes, document and provide schema and metadata for it, and offer it for distribution to the data portal.

c)	A data portal that automatically creates the information products (files and APIs) to publish and use the data.

In addition, there are **basic business requirements for design, functionality and content** that the Open Data Portal itself must meet. This will transform it from a catalog of trusted data into a platform that drives activity and the value of data use:

a)	Designed through a user-centered process, supported by inclusive user research.

b)	Comply with accessibility standards to ensure inclusion and ease of access for all.

c)	Strong search functionality (file type, category, data editor, time to return). Advanced search techniques for attributes contained in supplied datasets (e.g. by Google) will be a clear requirement in the near future.

d)	Well-indexed and categorized datasets (e.g. economy, population, environment).

e)	A published open data schedule with clear labeling. In advanced cases, dataset alerts can be incorporated.

f)	Interactive interfaces for previewing and viewing data and performing basic selection and analysis.

g)   Well-documented query and streaming APIs and other services to help developers deploy applications quickly, durably and reliably, and to account for the increase in big data feeds.

h)   Blogs and other forms of content creation to attract a technical and non-technical audience and provide tangible evidence of impact for open data reuse.

12. THE PROJECT FOR THE NEXT 4 YEARS

The Intelligent Brasilia Project intends to strengthen existing initiatives, propose new initiatives and generate synergy among them. The intention is to develop management tools with a unified vision of the services provided to the population to enable decision making based on data.

In order to select the initiatives to be carried out in the coming years, the technical areas were asked to present their proposals, which were debated and in some cases adjusted and integrated.

More than 40 proposals were collected and will be presented in 6 thematic groups:

GOVERNANCE and ECONOMY	SOCIAL DEVELOPMENT	URBAN PLANNING/MOBILITY
SECURITY	ENVIRONMENT	EDUCATION, SPORTS AND CULTURE

12.1 Initiatives proposed by GDF's technical areas

12.1.1 Brasília Technology Park - BioTIC

Abstract: More than a large real estate development, actually a technology city: BIOTIC is being created within the Brazilian capital to provide an ecosystem of business, generation and cooperation between companies, universities and research centers. BIOTIC is a Technology Park, created to be an Innovation District, focused on innovation in Biotechnology and Information and Communication Technology (ICT) applied to the sectors of nanotechnology, agriculture, health and energy, among others. Designed with the highest standards of environmental sustainability, the venture has the capacity to install 1,200 companies and

potential for generating 25,000 direct jobs.

Objectives: To create an Innovation District capable of delivering to the population of the Federal District an environment that promotes technological innovation based on 5 pillars: Innovation: Environment suitable for the development of technology-based companies with high potential for innovation and growth.

Relationship: Catalyst of technology and knowledge transfer between companies, universities, and research centers.

Development: Enabler of lasting development policies in science and technology with an economic base.

Business: Business model with economic sustainability.

Structure: Environment of coexistence and synergy between resident institutions, increasing opportunities for access to innovation, recruitment of specialized personnel, and acquisition of technology.

Actors involved: SECTI-DF, FAPDF, TERRACAP, Secretariat of Economic Development (SDE), BRB, DETRAN, Open University Foundation of the Federal District (FUNAB) and DER .

Budget Forecast: R$ 5,000,000.00

Status: BIOTIC was launched in October 2016, began operations on June 21, 2018, with the opening of the park governance headquarters building that features

10,000 m2 and already houses several institutions and companies. To ensure the viability and

economic sustainability of the project, a Real Estate Investment Fund - FII is being

launched, having as its horizon the full implementation of the project in 12 years.

12.1.2 Metrô-DF Application

Summary: To make life easier for those who use the subway in Brasília. The goal is to offer a better quality service to the user.

Goals: That the user can accomplish with the application:

- Consult the arrival time of trains at any station in real time;

- Consult the status of Metro operations at any time and find out whether the service is normal, at reduced speed, or at a standstill;

- Receive notifications about any important event in the metro, which may impact your trip. Metrô-DF will be able to communicate directly with all its users, in case of need, in an agile and efficient way;

- Know all the details of each subway station, what services are offered, nearby points of interest and map of the surroundings. Also see which stations have public services, shared bikes, and ATMs available;

- Knowing which station is closest to the user;

- Plan your route, know how and when you will arrive at your destination;

- Make suggestions, criticisms, complaints, using the ombudsman system OUV-DF integrated into the application, which also has the feature to make reports or complaints completely anonymously. If you make a manifestation in which you identify yourself, Metro-DF will answer your demand by e-mail or through the OUV-DF site (https://www.ouv.df.gov.br);

- Be able to find out about fare pricing, hours of operation, lost and found, and other important information; and

- View the complete network map.

Rationale: Metrô-DF will be able to communicate directly with all its users, in case of need, in a fast and efficient way and users will be able to make suggestions, criticisms, complaints, using the ombudsman system OUV-DF integrated into the application, which also has the feature of making complaints or claims completely anonymously. If you make a manifestation in which you identify yourself, Metro-DF will answer your demand by e-mail or through the OUV-DF site.

Actors: METRÔ-DF, SEMOB, TCB, BrB and DETRAN.

Budget Forecast: Internal Development

Status: Already in use, it was released on 11/29/2019 and is undergoing updates.

12.1.3 Evolution of the Metrô-DF application
Summary: Based on the information that the users have from the METRÔ-DF Ombudsman and other communication channels such as social media, make the application closer to the user's needs. Example: Use data from the Tourism Secretary to compose the application, to know, for example, the location of theaters, cultural centers, festivals and their programs.
Goals: Increase the range of resources to users, being an application that goes beyond the needs of mobility, meeting the user in its complexity.
Actors: METRÔ-DF
Budget Forecast: No Cost
Status: Already in progress, ongoing duration.

12.1.4 Three-Dimensional Modeling of Urban Projects
Summary: This initiative encompasses several training initiatives for technical staff for three-dimensional visual representation of urban projects in different scenarios.
Objectives: To improve communication of the projects within TERRACAP and also with other government entities and the population itself, as well as to allow analyses and simulations of urbanistic parameters.
Actors: TERRACAP
Budget Forecast: R$ 40,000.00/year, TERRACAP itself.
Status: A team is already in training

12.1.5 Passing on online information about the operation of the Metro-DF to the Integrated Operations Center of Brasília - CIOB
Summary: To create a new data interface relative to train traffic in subway stations, in real time, with the same data as the application in order to make it available to the Integrated Operations Center of Brasília - CIOB of the Public Safety Secretariat of the Federal District - SSP/DF, to assist in the performance of issues related to public safety.
Objectives: To assist in the performance of mobility issues related to public safety.
Actors: Metrô-DF and SSP/DF
Budget Forecasting: Internal development.
Status: Start: 2021 End of implementation: 2022 Duration of the implementation process: 2 years

12.1.6 Atlas of the Federal District Online
Summary: Dissemination of territorial knowledge of data and information about the Federal District.
Goals: Transform the publication (Atlas of DF 2020) into an iterative virtual platform with continuous updating.
Justification: To provide the dissemination of territorial knowledge and improve the disclosure of data and information of the Federal District to citizens and to the national and international scene.
Actors: Codeplan, International Affairs Office, and Setur.
Budget Forecast: R$ 70mil
Status: Term of Reference elaborated.

12.1.7 Metro ticket sales by application
Summary: Sale of subway tickets through an application by means of a partnership with BRB.
Objectives: To facilitate the purchase of tickets for users and companies.
Actors: METRÔ-DF and BRB
Budget Forecast: Internal Development
Status: Start 2021

12.1.8 Intelligent Transit
Summary: Deploy an intelligent traffic light management system in Brasilia (Plano Piloto) and in Guará.
Objectives: To improve the flow of vehicles; to reduce the travel time of public transportation and avoid unnecessary traffic interruptions.
Justification: Tests performed in the city of São Paulo showed an increase in average speed between 20 and 30% in the monitored stretches, in addition the permanence index was analyzed, which represents the average total time that vehicles traveling in the region stay in the studied area, and the results were similar. Considering that travel time is one of the factors that reduces the quality of life, it is expected that the solution will improve the mobility of the citizens of the Federal District.
Budget Forecast: R$ 15,000,000.00
Status: Conceptual elaboration ready

12.1.9 Northwest Shopping Center
Summary: Project for the implementation and management of a commercial complex involving a shopping mall, hotel, corporate floors and commercial rooms, which is in the modeling and study phase. Project for a partnership with private enterprise, for the implementation of the commercial complex in the Northwest, a business plan that generates continuous revenue, collection, and taxes.
Objectives: A partnership project with private enterprise, for the implementation of a commercial complex in the Northwest, a business plan that generates continuous revenue, collection, and taxes.
Actors: Terracap, investors, private initiative.
Budget Forecasting: Under study and analysis.
Status: Expected start: 2021 - duration: 20 years.

12.1.10 Game Tourist Circuit
Abstract: Development of a gamified application for tourist visitation in the Federal District.
Objectives: Facilitate access to tourist attractions, produce user engagement with the city's visitation, generate feedback on user visitation and displacement between tourist attractions in order to seek improvements for the public as well as produce relevant information for management.
Actors: Project under development through a partnership between Codeplan and the University Center of Brasília (Uniceub). Possible: Setur, Secult, Seldf.
Budgetary Forecast: The development cost is estimated to be between R$ 120 to 150 thousand reais. However, there is no forecast for maintenance costs as of yet.
Status: Conceptual design ready and initial cost research performed.

12.1.11 Geocoding of the Federal District's public schools
Summary: By a zip code system, the student is allocated to the closest school. Reduction in school transportation costs.
Goals: Reduction in school transportation expenses.
Actors: State Secretary of Education of the Federal District
Budget Forecasting: Internal development.
Status: Ongoing. Already 40,000 students have been allocated.

12.1.12 Olympic and Paralympic Center Management System - COPs
Summary: Manage the modalities offered by the COPs.
Goals: Improve the distribution of resources, modalities, vacancies and services provided to the community.
Justification: The management of sports activities and other services offered by SELDF are done in an isolated way, and without standardization among the various units linked to sports. With this, it can generate a bad distribution of services provided.
Actors: A partnership relationship can emerge with the Secretary of Education and the Secretary of Health.
Budget Forecast: R$2,170,000.00 million.
Status: Conceptual design ready, initial cost survey completed

12.1.13 Recovery of APP of springs, water courses and recharge areas in DF's Hydrographic Basins.

Summary: Signed the Contract CGEE - Center for Strategic Studies and Management - and Environmental Balance No. 003/2020 - Recovery of APP of springs, water courses and recharge areas in 80 hectares of the Descoberto and Paranoá River Basins, under the CITinova Project. The initiative aims to promote water security in important areas of water recharge of aquifers with a focus on the Federal District, from the recomposition

of vegetation with different techniques.

Objectives: Identify , through geospatial information, priority areas for forest recomposition, aiming at increasing water availability in the Descoberto and Paranoá watersheds; survey the environmental situation of the areas indicated for native vegetation recomposition in the prioritized watersheds; implement integrated social engagement and mobilization actions, with obtaining terms of commitment from each person responsible for a benefited area; implement, as a strategic tool, the integrated management of the territory, aiming to guarantee an intelligent process of social participation, in synergy with the actions for the recomposition of native vegetation, seeking integrated, diversified and sustainable development, supporting the structuring of territorial governance; establish methods and techniques to be used for the recovery and the strategies of involvement of the population to be benefited; implement actions for the recomposition of native vegetation (acquisition of inputs, land and soil preparation, planting and necessary replanting, including labor); implement maintenance and monitoring actions of the degraded or altered areas; disseminate the SDGs 6 and 15 in the actions.

Actors: Secretary of Environment of the Federal District - SEMA DF, CITinova/GEF Project, Ministry of Science, Technology, and Innovations - MCTI.

Budget Forecast: R$2,576,319.36. CITinova Project.

Status: January 2020/March 2022. Running, with replication potential.

12.1.14 Technologies for the remediation of the area contaminated by the dump

Summary: SEMA had the initiative to seek resources from MCTIC, made possible by the CITINOVA Project in partnership with the Global Environment Fund (GEF), to perform the diagnosis of contamination in the area of the old dumpsite and propose remediation techniques. After this stage, the GDF will have subsidies to make the right decision regarding the appropriate technology to remediate the area of the old dump of the Structural. These studies will provide subsidies for the elaboration of the Management Plan for the

Contaminants in the area.

Objectives: To carry out an environmental diagnosis of contamination in the area of the dump and adjacencies and to propose the best techniques for remediation.

Rationale: The area of the old dump of Estrutural was used for many years as a waste destination of the Federal District, however, there was no official data from the Federal District Government about the contamination situation in that area. Therefore, it was necessary to contract studies to support the decision making about the management of contamination and remediation of the site.

Actors: SEMA and IBRAM

Budget Forecast: R$ 1,326,734.83 (only for the diagnosis and indication of techniques; there are no resources forecast for the remediation).

Status: Project started / planned completion May/2021

12.1.15 Urban Cleaning Monitoring System (SIMLUR)

Abstract: In order to obtain greater control over the services provided by contractors, the SLU implemented a georeferenced monitoring system of its services. The system aims to analyze the planned x executed data of each service. The executed data refer to the GPS signal sent by the contractor, while the planned data are vector files referring to the circuits, whether collection or sweeping.

Objectives: To monitor and supervise the execution of urban cleaning services.

Actors: Urban Cleaning Service - SLU

Budget Forecasting: Internal development.

Status: The system is already up and running, however some adaptations are necessary.

12.1.16 Selective Collection Application

Abstract: The application aims to inform the population close to the collection time that the collection truck is in the vicinity of the region, so that the citizen can place their selective waste at the location established for collection.

Objectives: To inform and mobilize the population about selective collection

Actors: Urban Cleaning Service - SLU

Budget Forecast: Internal Development

Status: The project has not been implemented yet, it is currently in the process of being adapted.

12.1.17 Technological platforms for the promotion of Environmental Education

Summary: Development of platforms that enable the dissemination of information about the proper disposal of waste, voluntary delivery sites, initiatives to exchange waste for discounts, union of people interested in donating waste, and

others interested in receiving for reuse and/or recycling, etc.

Objectives: To inform the population about proper waste disposal.

Actors: SEMA and SLU

Budget Forecast: Under development.

Status: Under development.

12.1.18 Water Priority Use Optimization Program - POUPA DF

Summary: Program created by Decree No. 39.514/2018 to promote initiatives to contribute to the sustainable use of water in the public administration, to promote the availability of water in quantity and quality for multiple uses, ensuring water security for the entire population of the Federal District. The goal is to perform a diagnosis of the sanitary water installations in the buildings; leak detection; preparation of an intervention plan; acquisition of water-saving equipment; performance of the necessary services; training and

sensitization of public servants; monitoring of actions. GGG

Goals: To promote the progressive reduction of water consumption through planned actions; to consolidate a culture of efficient water use in public buildings; and to promote water conservation in public buildings through the use of rainwater and the reuse of grey water.

Actors: Environment Secretariat of the DF - SEMA DF

Budget Forecast: Under development.

Status: Ongoing initiative, starting in 2018.

12.1.19 E-collection System
Summary: System created for the management of data related to the selective collection of the agencies that make up the GDF (Solidary Selective Collection Program). The system launched in 2018 needs evolutionary improvements and can be integrated to the District System of Solid Waste Monitoring to be developed.
Objectives: To monitor the results of the Solidary Selective Collection Program.
Actors: Casa Civil, SEMA and SLU.
Budget Forecasting: Internal development.
Status: Started in 2018, ongoing.

12.1.20 Install paper bins
Summary: To install equipment for the disposal of hand garbage by pedestrians in transit through the city's streets and public places, in order to reduce the irregular disposal of waste.
Justification: Currently, there are more than 10,543 collection garbage cans (waste garbage cans or paper garbage cans) of various materials and models installed. Of this total, 880 units are in poor condition and need to be replaced and several locations of the Federal District need the installation of equipment, thus the initiative intends to install 21,086 units of paper bins throughout the Federal District.
Actors: Urban Cleaning Service - SLU
Budget Forecast: The cost of the equipment is dissolved in the contract to provide various other services.
Status: The first stage of installation is already up and running and is an ongoing initiative until all the planned equipment is installed.

12.1.21 Research using structured water for irrigation
Abstract: Conducting two experiments of irrigation with structured water (water subjected to static magnetic induction), in the Descoberto and Paranoá Watersheds, in order to analyze the possibility of greater hydration of crops, observing the occurrence of changes in cell metabolism, thus providing more energy for plant growth, which become more resistant to pests in the field, besides reducing the consumption of water and pesticides. Through magnetizers for high water flow with low cost, higher intensity and magnetic efficiency that enable the increase of productivity in conventional irrigation systems. Initiative in execution.
Objectives: To determine and quantify the changes in chlorophyll content and macro and micronutrient content in all crops; to evaluate the effects of magnetically treated water on the lettuce crop (number of leaves, fresh mass, yield and bromatological quality), on the corn crop (thousand-grain weight, ear diameter and length, yield and bromatological quality), and on the radish crop (yield, root diameter, root fresh mass, leaf fresh mass, and bromatological quality), in a field environment.
Actors: Secretary of Environment of the Federal District - SEMA DF, CITinova/GEF Project, Ministry of Science, Technology, and Innovations - MCTI.
Budget Forecast: R$ 100.000,00 / Global Environment Facility.
Status: January 2019/December 2021

12.1.22 Incentive to the Reverse Logistics of Packaging
Summary: To encourage the reverse logistics of recyclable packaging through the exchange of recyclables for discounts at commercial establishments and/or public rates, through mechanisms for the participation of the business sector, manufacturers, importers, distributors, and traders, actors responsible for the cost of the reverse logistics of packaging, for the development of equipment for the receipt of packaging, platforms for information about the project, and return logistics.
Objectives: To encourage the participation of the productive sector and the population in the return of packaging to the productive chain.
Justification: The recycling percentages in the Federal District are still far below the goals foreseen in the District Plan for Integrated Management of Solid Waste (PDGIRS) and the main actors responsible by law, have little participation in the process, leaving the costs of collection, sorting, and return of packaging to the Public Power and the Organizations of Collectors of Recyclable Materials.
Actors: SEMA and SLU

12.1.23 Recycling Credits

Summary: Develop an integrated system for generating and purchasing recycling credits: A market for recycling credits or certificates currently exists in Brazil. Companies in the packaging sector resort to this mechanism for proof of their reverse logistics obligations. The model is under full development in Brazil as one of the strategies for financing the reverse logistics of packaging, however, it needs some adjustments and interaction between the different platforms to ensure the traceability of the material, as well as unification of the acceptance/approval of the systems by the different authorities of the

environmental control and licensing.

Objectives: To implement the reverse logistics of different production chains.

Justification: The recycling percentages in the Federal District are still far below the targets set in the District's Plan for Integrated Solid Waste Management (PDGIRS) and the creation of a reverse packaging logistics certification system will encourage the participation of more companies through the possibility of selling recycling credits.

To promote the certification of the reverse logistics of post-consumption packaging, encouraging the return of materials to the recycling industry through the possibility of selling credits to other entities in the chain that have not met their targets, thus increasing the recycling rates in DF.

Actors: The Secretary of State for the Environment of the Federal District (SEMA/DF) and the Urban Cleaning Service (SLU) are in negotiations to establish terms of commitment with partner institutions.

12.1.24 Agroforestry System (SAF) with mechanization
Summary: Implementation of 20 hectares of SAF with mechanization in the Descoberto and Paranoá Watersheds. Among the actions for the development of this initiative are the planting of SAFs, acquisition of three specific implements for SAF, training of producers and extension technicians, and monitoring of the plantations.
Objectives: To increase the water capacity of the region where the SAFs were implemented, to increase soil biodiversity, and to introduce good agricultural practices in the field.
Actors: Secretary of Environment of the Federal District - SEMA DF, CITinova/GEF Project, Ministry of Science, Technology and Innovations - MCTI. hh
Budget Forecast: R$ 730.000,00. Being R$600,000 / Global Fund for the Environment. R$130.000,00 for a new phase in 2021 (parliamentary amendment).
Status: In execution, evaluation for possible expansion. January 2019/December 2021

12.1.25 Observatory of Good Urban and Environmental Practices
Summary: Identify and disseminate good practice actions within relevant themes for urban and environmental areas.
Objectives: Repository. Map of Best Practices. Virtual Platform. Partnership Network. Dissemination Events.
Justification: To identify and give visibility to successful experiences, seeking to build knowledge that can provide subsidies to public policies that positively impact the improvement of the following aspects: territorial planning; land tenure regularization; housing deficit; mobility; infrastructure; basic sanitation; environmental conservation and quality; environmental licensing; water management, and clean energy.
Actors: Codeplan. Possible Actors: Sema, Seduh
Budget Forecast: R$15,000.00 to develop the online platform.

Status: Conceptual design ready and initial cost survey completed

12.1.26 System for periodic compilation of information about DF's GHG

Summary: To build an integrated system capable of receiving Greenhouse Gas (GHG) emissions data from the enterprises and feed a database that will enable the State agencies to generate reports on these emissions in a timely manner.

periodic.

Objectives: 1) Systematize GHG emissions according to appropriate methodology;

2) Provide a user-friendly system that the user himself can enter the data;

3) Publish an annual GHG inventory of the Federal District, and

4) To serve as a tool for decision making and public policy making.

Rationale**:** Global climate change is already a reality, and will continue to be one of the main challenges for humanity. Among the causes of temperature increase are mainly anthropogenic, linked to economic activities that generate greenhouse gas emissions (GHG), such as those involving the burning of fossil fuels, agricultural activities, land use change, and deforestation.

The inventory of anthropic emissions by sources and removals by sinks of greenhouse gases is a tool that allows us to know the total emissions, identify the sectors that emit the most and enables the construction of specific public policies for each sector. However, the development of inventories usually happens in long time intervals and gives us a view of the past. In this sense, the development of a system that allows the monitoring of these emissions in a faster way is imperative as a subsidy to the development of mitigation plans and adaptation to climate change.

Actors: State Secretariat of Environment - SEMA (Managing Agency) Secretariat

of Science, Technology and Innovation - SECTI (partner)

Secretariat of Economy of the Federal District - SEEC (partner)

Budget Forecast: R$ 1.000.000,00

Status: Conceptual design ready and initial cost research performed.

12.1.27 Beneficiation and valorization of solid residues

Abstract: Technologies applicable to the processing and valorization of solid waste: research and lines of funding for the implementation of technologies that enable the processing of recyclable or compostable materials, aggregating

value to the residues collected in the DF and reducing the amount of landfilled residues.

Objectives: To add value to recyclable and compostable waste, generating jobs and income.

Justification: Some types of waste have a low sale value in the recycling market and its processing will add value, making the segregation of this waste by the collectors more attractive, reducing the amount of rejects, thus extending the life span of Brasilia's landfill.

Actors: SEMA and SLU

12.1.28 District Solid Waste Monitoring System

Summary:

To develop a system that enables the creation of a database on the generation, collection, treatment and environmentally adequate disposal of the different types of waste generated in the Federal District, as well as to enable the follow-up of the actions foreseen in the District Plan for Integrated Management of Solid Waste (PDGIRS), crossing the foreseen targets with the results obtained by the different responsible bodies. (INDICATOR)

The information about waste management in DF is currently dispersed in different agencies and private institutions, making it difficult to monitor and plan adequately. This action is foreseen in the PPA/2020.

Objectives: To monitor, in an integrated way, the management of solid residues in the Federal District, as well as the reach of the goals foreseen in the PDGIRS.

Actors: SEMA, SLU and ADASA

12.1.29 Air Quality Monitoring and Forecasting System for the Federal District

Abstract: To implement an integrated air quality management system, through air quality modeling applied to health surveillance, aimed at contributing to actions to prevent and mitigate the impact of air pollution on

health of the population of the Federal District.

Objectives: To produce the Federal District's Emission Inventory of Atmospheric Pollutants;

Modernize the Air Quality and Weather/Climate Monitoring Network in DF;

Operationalize the Atmospheric and Air Quality Models;

Implement the health impact analysis system;

Definition of the Action Plan for Critical Air Quality Episodes in the Federal District.

Justification: Air pollution is configured as the environmental risk factor of greatest relevance in the world, being among the 5 main risk factors for death, contributing to more than 7% of global mortality. The current monitoring structure of the Federal District does not offer conditions for the institutionalization of a protective air quality management strategy focused on the mitigation of public health impacts. Integrated air quality management systems based on high resolution local emissions inventory, monitoring network, and modeling are essential to ensure sustainable economic growth in the region, committed to reducing air pollutant emissions allied to the concept of smart cities.

Budget Forecast: R$ 25 million

Status: The conceptual design is ready and the initial cost estimate is done.

12.1.30 Water consumption telemetry system
Summary: Project implemented so that the telemetry reading is done by means of an electronic device that captures the hydrometer consumption four times a day and transmits the data, using the cell phone network, to Caesb's data servers. At the Company, the data are translated so that the client can follow his consumption on a daily basis, controlling the excess use and identifying possible leaks. Another project, ambitious and unprecedented, is the installation of more than 2,000 telemetry hydrometers in the North Lake Peninsula, for the first time in the Brazilian sanitation sector IoT instruments are used on such a large scale.
Goal: Improve tracking of water consumption by both the Company and customers.
Actors: Caesb

12.1.31 Urban Video Surveillance Project - PVU
Summary: The PVU exists since 2013 and the cameras help in the monitoring of traffic, demonstrations, resolution of police incidents, aid in police investigations. The project is constantly being modernized and the next step is the implementation of image analysis software, smart cameras and increased capillarity of optical fiber (together with GDFNet). The idea is to have a faster response to the occurrences registered by the cameras and an intelligent monitoring of the city.
Objectives: Video surveillance is the foundation and the cervical column when it comes to smart city implementation. The objectives include real-time monitoring of incidents, facial recognition, traffic control, and movement within the urban perimeter, among other uses.
Actors: SSP
Budget Forecast: R$ 9,975,277.67. (MJ/SENASP Conventions 880.807/2018 and 882.008/2018 - Source 132 and GDF - Source 100)
Status: The PVU began in 2013 and is an ongoing initiative that is improving as new technologies emerge in the industry. Term of reference under elaboration.

12.1.32 Confirmation of deliveries of Food Baskets by electronic means

Summary:

Provide drivers who deliver emergency food baskets to homes with an authentication device (either tablet or cell phone), in order to reduce the amount of paper printed with signatures, as well as the time spent by the server checking and downloading all requests.

Goals: Reduce printing and speed up.

Justification: To make it less bureaucratic to confirm the receipt of the food baskets delivered by the GDF, besides the economy with the reduction of paper printing, which currently are 750 sheets per day, it will reduce filing space, because they are physically filed taking up a lot of space.

Actors: SEDES, SEEC, SECTI

Budget Forecast: R$ 7,000.00

Status: The conceptual design is ready and the initial cost estimate is done.

12.1.33 Electronic Single Registry (CRAS)

Summary:

Make the Unified Registry directly available to users through the Internet, without the need to go to the CRAS every time to do it.

Objectives: To facilitate the access to the registry through an application that gathers information and makes available to the user a more convenient and agile tool, without loss of efficiency.

Actors: SEDES, SEEC, MDS

12.1.34 Social Internet

Summary: Provide Internet access for the low income population of Sol Nascente, Sunset and Structural City.

Goals: Give digital citizenship to the low-income population; facilitate students' access to digital content, and make it possible to generate additional income using Internet tools.

Rationale: In the "Network Readiness index" Brazil ranks 59th among countries. With the rapid digital transformation underway, we run the risk of creating/widening the digital divide, which prevents citizens without internet access from accessing digital services. The project aims to reduce the problem in areas of low income and low internet penetration.

Budget Forecast: R$ 6,000,000.00

Statuss: The conceptual design is ready and the initial cost estimate is done.

12.1.35 SEJUS' Videoconference Network

Summary: To enable the transmission and reception of video conferences in the social and educational services of SEJUS.

Objectives: To improve the data transmission/reception bandwidth of the Internship Units and Guardianship Councils; to modernize the active network equipment in the Internship Units and Guardianship Councils; to adapt and certify the structured cabling infrastructure in the Internship Units and Guardianship Councils; acquisition of equipment with multimedia devices - camera, microphone and sound.

Justification: To reduce travel costs and allow for improved service at the Detention Centers and Guardianship Councils.

Actors: Guardianship Councils and Detention Facilities

Budget Forecast: R$ 3.2 million

Status: The conceptual design is ready and the initial cost estimate is done.

12.1.36 Worker's APP

Abstract: To build trails of formative knowledge and qualification of workers, allowing the design of labor history and training for occupation of new job openings.

Objectives: 1. Improve the insertion of the worker in the labor market.

2. Designing knowledge and worker empowerment tracks.

3. Develop the worker's formative itinerary.

4. Anticipate the demands of the market and productive sectors for labor.

5. Saving on the professional qualification of the worker.

Actors: Civil House, Secretariat of Social Development, Secretariat of Science, Technology and Innovation, and Research Support Foundation.

Budget Forecast: R$ 3.000.000,00

Status: January 2021

12.1.38 Automated indicator survey

Summary: Hire an automated platform to survey the indicators of smart city.

Objectives: To evaluate the Federal District's stage of development in the areas indicated by ISO standards and to compare performance to other cities.

Rationale: Measuring is essential, because you can't improve or control what you don't measure. Therefore, we must always have indicators to understand where we are, where we want to go, and what we need to do to get to the desired stage.

Budget Forecast: R$ 70,000.00

Status: Term of Reference under development.

12.1.37 Smart City Platform
Summary: Deploy smart city platform ("midleware") that allows the integration of existing solutions, facilitates the deployment of new solutions and enables the generation of information dashboards, as well as train the technical staff for the use of the platform.
Objectives: To enable an integration mechanism among the several solutions that already exist in the Federal District; Create a mechanism for sharing physical devices in standardized ways; Building data flows and rules in a visual way, enabling rapid prototyping and validation of IoT application scenarios; Processing of events at time processing applyingrules defined by the developer; Standardized generation of monitoring and control panels for the systems.
Rationale: There are many technological solutions existing in GDF. One of the main challenges is to integrate these solutions in order to share information among them. Smart city platforms are systems that specialize in this integration, and also enable physical equipment such as cameras and sensors to be used by various solutions, provided they are authorized.
Actors: SECTI
Budget Forecast: R$ 2 million
Status: Term of reference in elaboration.

12.1.39 Citizen relationship management

Summary: Establish the integration of the entry channels for citizen demands, with the creation of automated processes for forwarding demands in order to facilitate citizen access to GDF services. The existence of different "entrance doors" to the demands, with different service flows causes increased bureaucracy to meet the demands and difficulty in monitoring the levels of service offered to the population. An omnichannel model, besides allowing an improvement in communication with the citizen, will reduce the administrative burden of the executing agencies.

Gestão de Relacionamento com Cidadãos
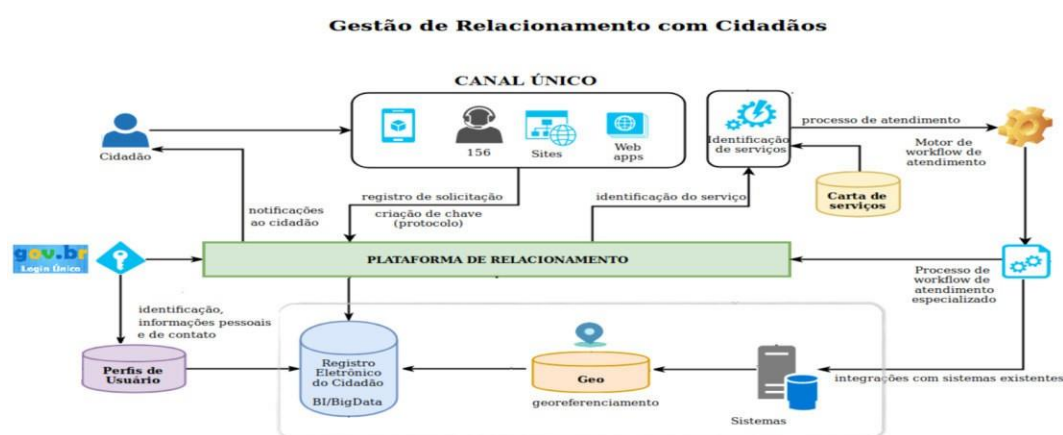
Objectives: To make it easier for citizens to access GDF services.

Create standardized workflows for forwarding demands to the various agencies / companies.

Enable the centralized follow-up of demands and monitoring of

service levels.

Rationale: The existence of different "entry doors" for the demands, with different service flows causes increased bureaucracy to meet the demands and difficulty in monitoring the levels of service offered to the population.

An omnichannel model not only makes it possible to improve communication with the customer, but also to

citizen, it will reduce the administrative burden of the executing agencies.

Budget Forecast: R$5.8 million.

Status: Term of reference in elaboration.

12.1.40 Entrepreneurial mapping
Abstract: Georeferencing to identify the address of new businesses informed by entrepreneurs, for evaluation of locational feasibility carried out by the regional administrations. This information would subsidize the possibility of creating a layer of enterprises in the Geoportal, being possible to identify the shortages and saturation of economic activities by location.
Objectives: Identify opportunities to open new businesses. Map economic activities developed or lacking in the Federal District by region. Creating an entrepreneurial layer in the geoportal.
Rationale: To guide the entrepreneur in the choice of economic activity according to a demand of each Generate information for the GDF in the elaboration of public policies for employment, income generation, and entrepreneurship.
Actors: Commercial Board of the Federal District
Budget Forecast: R$ 500.000,00
Status: Conceptual design ready and initial cost survey completed.

12.1.41 Virtual Brasília Platform

Abstract: The Virtual Brasilia platform will be a point of integration and unification of governmental Geoservice information of the GDF, presenting urban, geographic, environmental and social data. These will be provided in a faithful, transparent, standardized and real-time way, enabling monitoring of territorial and environmental dynamics.

Fully implemented there will be thousands of sensors distributed throughout the DF territory, which will subsidize part of the platform's database, as happens in developed cities, thus intensifying the updating of open information for the best decisions and information to the population.

The transparency and interconnectivity between agencies will show the citizen the government's concern in generating value to all users, who will be able to visualize the reach of government actions.

Objectives: To have in its construction a collaborative environment, which takes advantage of already existing resources;

Create a standardization of data interoperability;

Identify the collection of new data that is born in a format suitable for the site;

To allow a panoramic view and ideal location for studies and information subsidy that can guide the decision making process.

Justification: Given the amount of existing government sites and the lack of a way to check whether the geoinformation has not already been produced previously, the need arose to have a centralized, responsive site with the existing information on the various sites of government agencies in a precise and reliable manner.

The existence of the platform will allow for better governance, the dissemination of information to the population and to public administrators, aid in equipment management, and real-time monitoring of the information available from various public institutions in the Federal District.

It is expected that when implemented this platform will be able to reduce errors of planning managers, recalculate urban logistics decisions that require integration in the sea of cross-cutting information in various strategic organs of the

DF as CAESB and CEB.
Actors: State Secretariat for Urban Development and Housing - SEDUH/DF, Federal District Development Agency - TERRACAP, State Secretariat for Science, Technology and Innovation - SECTI/DF, CODEPLAN, CAESB, CEB, and Secretaries for further integration.
Budget Forecast: The total cost of the project is R$17,344,600, of which R$2,909,600 (16.78%) in GDF technical staff hours and R$14,435,000 (83.22%) in financial resources for contracting services).
Status: The project is scheduled to take between 4 and 5 years.

12.1.42 Brasília +Inteligente
Summary: Contests for projects to develop systems to improve public management and make Brasília more intelligent. The most commonly used contracting modalities in public service present great difficulties for contracting of startups - which are considered to be a source of innovation.
Objectives: To develop companies (up to medium-sized) in the DF and region (RIDE); To solve real problems presented by the public administration; Encouraging public tendering (provided for in Law 8,666) as a means of contracting the development of ICT solutions; Perform system development contracting with a pre-fixed value; Enable the hiring of startups;
Rationale: The most commonly used procurement modalities in public service present great difficulties for hiring startups - which are considered as a source of innovation. In the public procurement modality, the opportunity opens up for smaller companies to participate in supplying the public sector. At the same time, the goal here is not only to design a system, but a solution that best meets the needs of public management. The invitation to tender does not present all the details of the desired solution. Instead, the problem is presented and the proposals show different solutions to address the issue.
Budget Forecast: R$ 8 million (2 million/year).
Status: The project is with conceptual elaboration done and cost proposal ready.

12.2 Impact and cost matrix

After evaluating the proposed initiatives, in relation to the Strategic Goals, we obtained the prioritization matrix of the initiatives from the effort x benefit point of view, represented in figure 8.
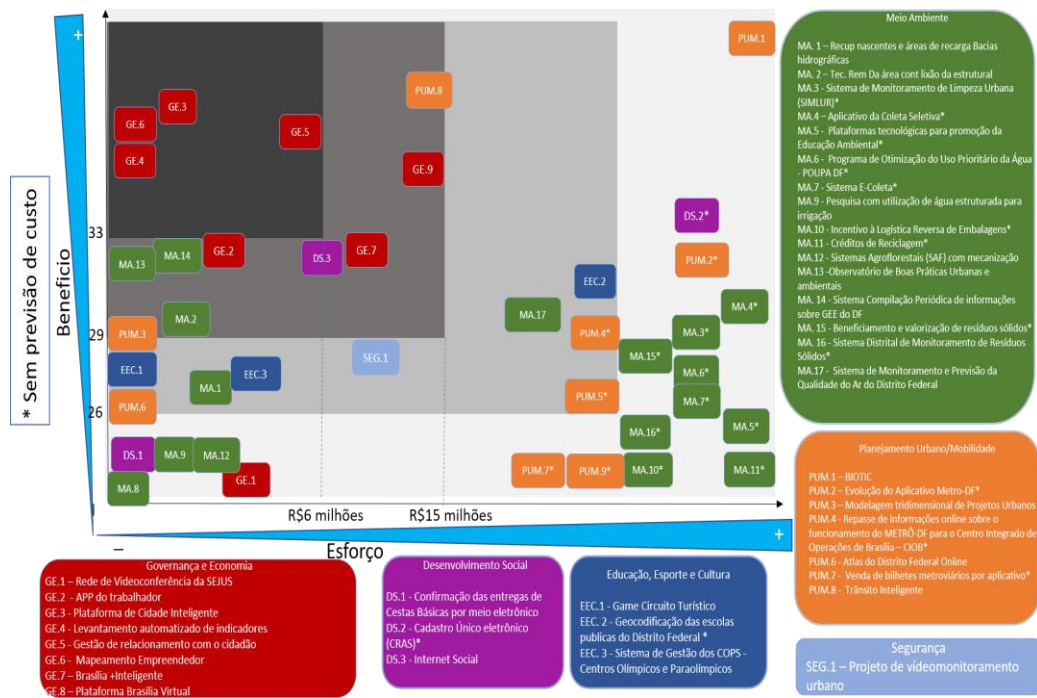
Figure 8 - Effort x benefit matrix

13. THE INNOVATION ECOSYSTEM IN THE INTELLIGENT BRASÍLIA PROJECT

13.1. THE INFORMATION TECHNOLOGY SECTOR IN THE FEDERAL DISTRICT

The Federal District is the sixth unit of the Federation in number of jobs in the IT sector[7] . However, according to a study by Codeplan,[8] is the first unit of the Federation in percentage of formal jobs in the IT sector - 2.17% and with a growth trend.
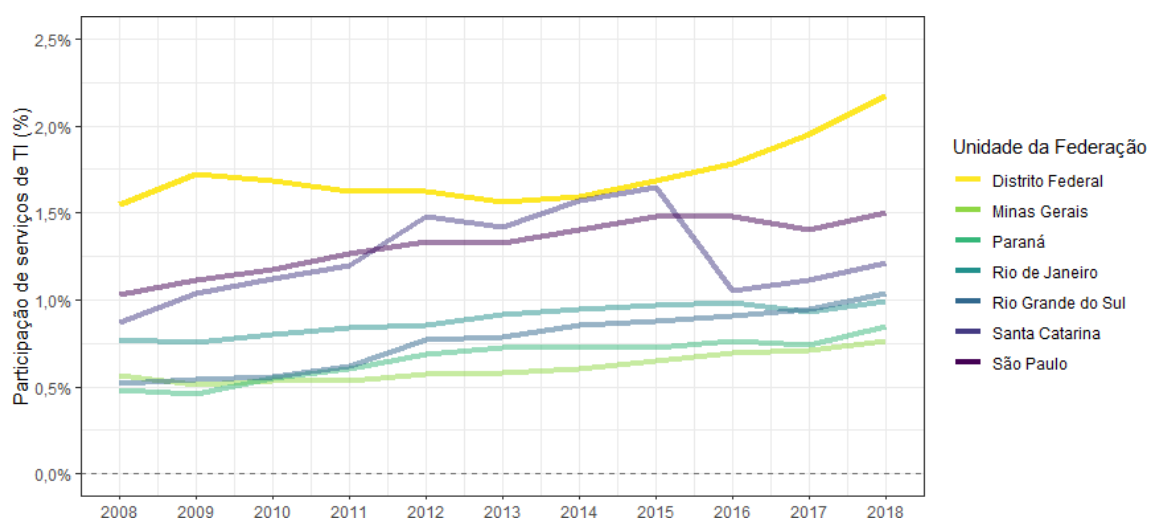
Figure 13 - Share of IT services in total formal jobs, by Federal Government (Selection of the 7 Federal States with the largest shares in their economies)

The Codeplan study also shows that there is a high concentration of jobs (79%) in three major areas: (i) Custom software development; (ii) Technical support, maintenance and other information technology services; and (iii) Information technology consulting.

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[7] SOFTEX (2019). OVERVIEW OF THE BRAZILIAN INFORMATION TECHNOLOGY SECTOR IN THE LAST TEN YEARS.
[8] CODEPLAN (2019). The Information and Communication Technology Services - A view from the Federal District.

Figure 14 - Number of jobs and share of IT services - 2018 data for the Federal District

Codeplan also highlights in the same study, that proportionally the Federal District is the federation unit with the highest number of graduates in Information Technology in Brazil.
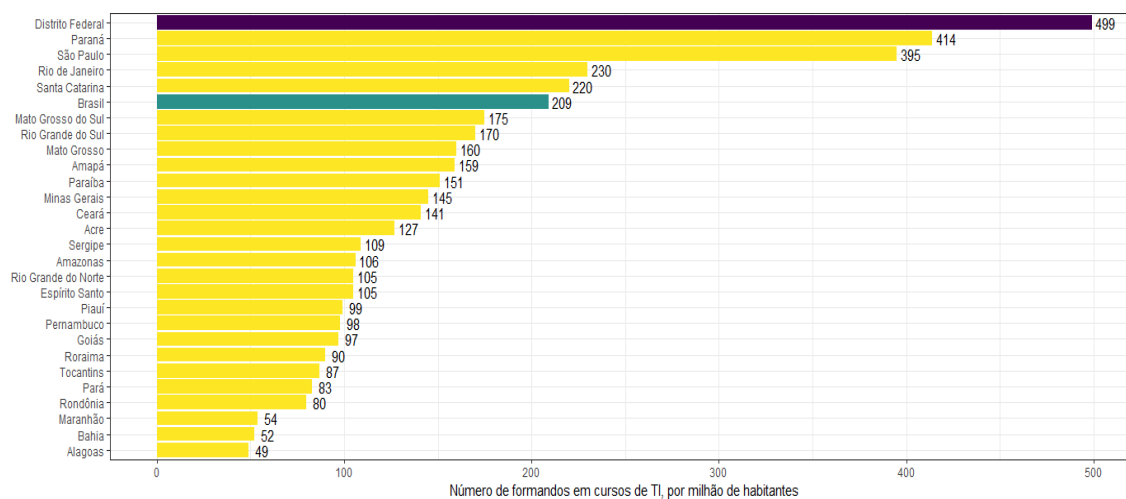
Figure 15 - Number of IT course graduates, per million inhabitants.

According to the specialized technology website tiinside[9] the banks' investment in technology grew by 48% in 2019, reaching a total budget of R$24.6 billion. Banco do Brasil and Caixa Econômica Federal, both among the five largest

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[9] https://tiinside.com.br/18/06/2020/investimentos-de-bancos-em-tecnologia-crescem-48-em-2019-e-orcamento-total-chega-a-r-246-bilhoes/

Brazilian financial institutions have their headquarters in Brasilia, as do their main Data Processing Centers. The Federal Government, and its various foundations and autarchies also based in Brasilia are among the largest consumers of technology in Brazil.

As studies by Softex and Codeplan have shown, the Information Technology sector is already robust in the Federal District and an important part of our economy. The current contracting model has generated jobs in the sector and a large number of companies specializing in labor outsourcing. However, in general, there is no product development or competitive companies in other segments than the supply of skilled labor.

13.2.   The Innovation Ecosystem

An innovation ecosystem comprises a set of factors that stimulate innovation, either in existing companies or by generating *startups*. In modern economies, these environments are increasingly stimulated, as they generate qualified jobs and higher average income. In Brasília, we have a system in formation, with robust growth in recent years.

UnB is the 4th largest federal university in the country, home to PCTec-Unb (UnB's Scientific and Technological Park) and CGDF (Center for Support to Technological Development), which manages the Multincubator Program.

Besides UnB, which is a national reference, the innovation ecosystem of the Federal District has several support and training structures, according to a study by abstartups[10] :

13.2.1.   Support Structures

a. Workspaces (Coworkings and flexible workspaces):
   - ✓ BR offices
   - ✓ CoPilot
   - ✓ CDT/UnB (PCTec)
   - ✓ Share With Me
   - ✓ Space 365

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[10] https://abstartups.com.br/wp-content/uploads/2020/10/M2019_centro-oeste.pdf

- ✓ Manifesto
- ✓ Multiplicity Space Collaborative Office
- ✓ IesbLab
- ✓ Sebraelab
- ✓ Biotic
- ✓ Alphaville ParqueTec Innovation Center
- ✓ Logo Coworking
- ✓ Coworking Cup
- ✓ Ei - Space at the Assis Chateubriand Foundation
- ✓ Repubblica Anticafe and Coworking
- ✓ Indie Warehouse
- ✓ The Brain - 4 units
- ✓ Atmosphere Space
- ✓ Cyber Office Coworking
- ✓ Open Coworking
- ✓ Ground Zero
- ✓ Ipe coworking
- ✓ Smart Office
- ✓ Fast Office Brasília
- ✓ Nube Hub
- ✓ Connect UDF
- ✓ Impact Hub Brasilia
- ✓ MakerSpace at Thomas Jefferson House
- ✓ Calango Hacker Club
- ✓ Owl Labs - Unieuro

b. Legal Support (Law firms and lawyers that relate to startups)
- ✓ Braz Tower
- ✓ Vieira e Serra Lawyers
- ✓ Brunella Santos Associated Lawyers
- ✓ Azevedo Sette Advogados
- ✓ Minaré Braúna Lawyers

c. Accounting support (Opening, closing and hiring companies is much easier with reliable advisors. Accounting firms and accountants that relate to startups)
- ✓ FG Accounting
- ✓ Accounting Agency
- ✓ NTW Accounting
- ✓ Roit Accounting

13.2.2. Training Structures

a) Incubators
- ✓ CDT/UNB - Center for Support to Technological Development at Unb
- ✓ Connect UDF
- ✓ IBTI International Incubator
- ✓ IESB Lab
- ✓ Business Incubator - UniCEUB
- ✓ University Incubator and Accelerator
- ✓ Catholic University of Brasilia
- ✓ Owl Labs - Unieuro

b) Accelerators (Provide financial investment and mentoring)
- ✓ Everyday
- ✓ Logo Coworking and Accelerator
- ✓ Ace Brasilia

c) Technology Parks
- ✓ Biotic.
- ✓ Technological Park of the University of Brasilia (PCTec/UnB)
- ✓ Alphaville ParqueTec

d) Mentoring Programs (Provides advanced mentoring, access to resources, but no financial support):
- ✓ Fluid Network
- ✓ Founder Institute
- ✓ Hey Community
- ✓ Multiplicity Space
- ✓ Indie Warehouse
- ✓ Sebraelab (will start yet)
- ✓ Dojo - ASTEPS
- ✓ Connect UDF
- ✓ Oops - out of papers
- ✓ (UDF University Center)

The Start BSB Program promoted by FAP/DF aims to contribute to establishing the bridge between academia and the market in the Federal District in order to boost innovative entrepreneurship and accelerate the development of the

innovation ecosystem of the DF and its surroundings, enabling the development and exchange of knowledge and technologies.

The Inova Tech, a SECTI and FAP-DF qualification program, has qualified 500 people this year and has another 6,000 openings.

13.3. The use of Purchasing Power and other Government instruments as a tool to foster innovation and business competitiveness

The competition in the technology segments exceeds the companies' capabilities. All over the world, companies in the technological segment receive support in the most varied ways. The contribution of public resources in scientific and technological development reduces the need for investment in RD & I of the companies. The Technological Orders, Public Procurement and the use of technological bonus are several of the instruments used to support companies so that they can develop. The real competition occurs not only between companies, but also between the countries / states and municipalities that support them.

Major icons of the technology market, such as Cisco, Huawei, Samsung etc. have received and receive support from the governments of their countries, states and municipalities to grow and to remain competitive. Recently the dispute for the supply of 5G telephony technology has been widely reported, with representatives from China and the United States vehemently defending opposing positions, in favor of companies from their countries.

In the Federal District, as already mentioned, there is a large market for information technology professionals. However, the most common form of contracting, which is software on demand, has been ineffective in strengthening the development companies to compete in other markets. The development of individual competencies of the employees of the sector, project management competence in the companies, occurs, but little is developed in the competence to create and launch new products in the market.

It is proposed as a guideline that the Federal District Government starts to stimulate the purchase of technological solutions from companies in the region, in a format that gives them

support to develop products to be offered in other markets. The acquisition of technological solutions must be favored, to the detriment of internal development, which routinely causes maintenance problems and evolution difficulties.

The Innovation Law (LAW No. 10.973, OF DECEMBER 2, 2004) already brings several mechanisms to stimulate innovation in companies, such as technology bonuses, technology orders, and the use of the State's purchasing power. There is, therefore, already federal legislation that disciplines the subject.

The Ordinance No. 20 of June 14, 2016 of the Federal Government provides guidelines for hiring information technology solutions. District Decree No. 40,015, of August 14, 2019 provides for Information and Communication Technology Master Plans and also addresses procedures for acquiring technology.

Taking into consideration the federal and district regulations, the strategy related to the acquisition of technological solutions in the scope of the Federal District would have as guidelines:

1. Analyze the existence and feasibility of adopting software that meets the needs of the requesting area in the Brazilian Public Software Portal (https://softwarepublico.gov.br/);
2. Analyze the existence and feasibility of adopting free software or hardware that meets the needs of the requesting area;
3. Analyze similar projects carried out by other agencies or entities of the Public Administration;
4. Consult the Undersecretariat for Information Technology and Communication of the Secretariat of Economy of the Federal District about joint hiring or joint planning for developing a solution that can meet the need;
5. Analyze the feasibility of hiring a proprietary technological solution.
   5.1. Seek the design of solutions that enable supplier companies to develop or evolve solutions in order to create competitive products in the market
   5.2. Preference in the acquisition of solutions developed in RIDE of up to 10% of the value of similar solutions.

14. CONCLUDING REMARKS

Information and Communication Technologies have brought huge efficiency gains, whether in public or private management. But at the same time that these technologies bring gains in speed and information processing capacity, they make it possible to generate an enormous amount of information.

However, the existence of data does not mean better decision making. For a proper use in the planning and management of cities, data must be integrated, classified, processed, and the population must have access.

Building intelligence in public management presupposes policy integration, interconnected systems, and organized data. This is not just about the adoption of digital tools. But, above all, it is an effort by public management to work in an integrated way, seeking solutions for the citizen that are transparent, efficient, and useful.

Appendix I - list of agencies participating in the elaboration of PDTCI

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Annex II - ISO 37120 / 37122 and 37123 Smart City Indicators

ISO Smart City Indicators - Distrito Federal - Economy		
Area	**Standard**	**Indicator**
Economy	ISO 37120:2018	5.1 City unemployment rate
		5.2 Assessed value of commercial and industrial properties as a percentage of the total assessed value of all properties
		5.3 Percentage of population in full-time employment
		5.4 Youth unemployment rate
		5.5 Number of enterprises per 100,000 inhabitants
		5.6 Number of new patents per 100,000 inhabitants per year
		5.7 Annual number of visitor stays (overnight stays) per 100,000 inhabitants
		5.8 Air connectivity (number of non-stop commercial flight departures
		5.9.1 Average family income (US$)
		5.9.2 Annual inflation rate based on the average of the last 5 years
		5.9.3 City product per capita (US$)
	ISO 37122:2019	5.1 Percentage of municipal service contracts that have open data policy
		5.2 Survival rate of new businesses per 100,000 inhabitants
		5.3 Percentage of the labor force employed in technology sector occupations information and communication technologies (ICT)
		5.4 Percentage of the labor force employed in occupations in the education, research and development
	ISO 37123:2019	5.1 Historical disaster losses as a percentage of city product
		5.2 Average annual disaster loss as a percentage of city product
		5.3 Percentage of properties with insurance coverage for high-risk hazards
		5.4 Percentage of the total insured value in relation to the total value at risk within city
		5.5 Job concentration
		5.6 Percentage of the labor force in informal jobs
		5.7 Average net family income

ISO Smart Cities Indicators - Federal District - Education		
Area	**Standard**	**Indicator**
Edu...	ISO 37120:2018	6.1 Percentage of the school-age female population enrolled in schools (key indicator)
		6.2 Percentage of students with complete primary education: survival rate (key indicator)
		6.3 Percentage of students with complete secondary education: survival rate (key indicator)
		6.4 Student/teacher ratio in primary education (core indicator)
		6.5 Percentage of school-age population enrolled in schools (indicator for support)
		6.6 Number of individuals with complete higher education per 100,000 inhabitants (support indicator)
	ISO 37122:201	6.1 Number of public school network individuals with professional proficiency in more than one language
		6.2 Number of computers, laptops, tablets or other learning devices digital available per 1 000 students

		6.3 Number of graduates in higher education in the areas of Science, Technology, Engineering and Mathematics (STEM) per 100,000 inhabitants
	ISO 37123:2019	6.1 Percentage of schools that teach emergency preparedness and disaster risk
		6.2 Percentage of population trained in emergency preparedness and mitigation disaster risk
		6.3 Percentage of emergency preparedness publications provided in alternative languages
		6.4 Educational interruption

ISO Smart Cities Indicators - Distrito Federal - Energy		
Area	Standard	Indicator
Energy	ISO 37120:2018	7.1 Percentage of electrical and thermal energy produced from wastewater treatment, solid waste and other liquid waste treatment processes, and other waste heat resources as a share of the city's total energy mix for a given year
		7.2 Electric and thermal energy (GJ) produced from wastewater treatment per capita per year
		7.3 Electric and thermal energy (GJ) produced from solid waste or other liquid waste treatment processes per capita per year
		7.4 Percentage of the electric energy consumed in the city produced by decentralized energy generation systems
		7.5 Storage capacity of the energy network, relative to total consumption of the city's energy
		7.6 Percentage of public lighting points managed by a public lighting system telemanagement
		7.7 Percentage of public lighting points that have been refurbished and newly installed
		7.8 Percentage of public buildings in need of renovation/refurbishment
		7.9 Percentage of buildings in the city with smart energy meters
		7.10 Number of electric vehicle charging stations per electric vehicle registered
	ISO 37122:2019	7.1 Number of different sources of electrical energy that supply at least 5% of the total power supply capacity
		7.2 Power supply capacity as a percentage of demand peak electricity
		7.3 Percentage of critical facilities served by off-grid energy services

ISO Smart Cities Indicators - Distrito Federal - Environment and Climate Change		
Area	Standard	Indicator
Environment and Climate	ISO 37120:2018	8.1 Concentration of fine particulate matter (PM 2.5) (core indicator)
		8.2 Particulate matter (PM 10) concentration (core indicator)
		8.3 Greenhouse gas emissions measured in tons per capita (indicator essential)
		8.4 Percentage of areas designated for natural protection (supporting indicator)
		8.5 NO2 concentration (sulfur dioxide)
		8.6 SO2 (sulfur dioxide) concentration (support indicator)
		8.7 O3 (ozone) concentration (support indicator)
		8.8 Noise pollution (supporting indicator)
		8.9 Percentage variation in number of native species (supporting indicator)
	ISO 371	8.1 Percentage of buildings constructed or renovated, in the last 5 years, in compliance with green building principles

Area	Standard	Indicator
	ISO 019	8.2 Number of remote stations for real-time air quality monitoring per square kilometer (km2)
		8.3 Percentage of public buildings equipped for monitoring the quality of water indoor air
		8.1 Magnitude of urban (atmospheric) heat island effects
		8.2 Percentage of natural areas within the city submitted to ecological evaluation of its protection services
		8.3 Territory in the process of ecosystem restoration as a percentage of the area city total
		8.4 Annual frequency of extreme storm events
		8.5 Annual frequency of extreme heat events
		8.6 Annual frequency of extreme cold events
		8.7 Annual frequency of flood events
		8.8 Percentage of city area covered by tree canopy
		8.9 Percentage of the city's surface area covered with materials with high albedo index, contributing to urban heat island mitigation

ISO Smart Cities Indicators - Federal District - Governance			
Area	Standard	Indicator
Governance	ISO 37120:2018	10.1 Percentage of women elected as a function of the total number of elected officials in the management of the city (core indicator)
		10.2 Number of convictions of city employees for corruption and/or bribery by 100 000 inhabitants (support indicator)
		10.3 Percentage of voter participation in the last municipal elections as a function of the total number of eligible voters (support indicator)
		10.4 Percentage of registered voters as a function of population of voting age vote (support indicator)
	ISO 37122:2019	10.1 Annual number of online visits to the municipal open data portal per 100,000 inhabitants
		10.2 Percentage of urban services that are accessible and can be requested online
		10.3 Average response time to calls made through the call center system non-emergency calls from the city (days)
		10.4 Average downtime of the city's IT infrastructure
	ISO 37123:2019	10.1 Frequency with which disaster management plans are updated
		10.2 Percentage of essential urban services covered by a plan documented continuity
		10.3 Percentage of city electronic data with back-up storage secure and remote
		10.4 Percentage of public meetings aimed at resilience in the city
		10.5 Number of intergovernmental agreements aimed at planning shocks as a percentage of total intergovernmental agreements
		10.6 Percentage of providers of essential services that have a documented continuity

ISO Smart City Indicators - Federal District - Health			
Area	Standard	Indicator
H	37120 ISO 37120:2018	11.1 Average life expectancy (core indicator)
		11.2 Number of hospital beds per 100,000 inhabitants (core indicator)
		11.3 Number of doctors per 100,000 inhabitants (core indicator)
		11.4 Under-five mortality rate per 1,000 live births (key indicator)
		11.5 Number of nursing and midwifery personnel per 100,000 inhabitants (support indicator)
		11.6 Suicide rate per 100,000 inhabitants (supporting indicator)

Area	Standard	Indicator
	ISO 37122:2019	11.1 Percentage of the city's population with unified electronic medical records, accessible online by healthcare providers
		11.2 Annual number of remote medical consultations per 100,000 inhabitants
		11.3 Percentage of city population with access to real-time public warning systems on air and water quality conditions
	ISO 37123:2019	11.1 Percentage of hospitals equipped with back-up power generators
		11.2 Percentage of population with basic health insurance
		11.3 Percentage of population fully immunized
		11.4 Number of outbreaks of infectious diseases per year.

ISO Smart Cities Indicators - Federal District - Housing		
Area	Standard	Indicator
Housing	ISO 37120:2018	12.1 Percentage of urban population living in inadequate housing (indicator essential)
		12.2 Percentage of population living in affordable housing (key indicator)
		12.3 Number of homeless per 100,000 inhabitants (supporting indicator)
		12.4 Percentage of dwellings without registered land titles (indicator of support)
		12.5.1 Total number of households (profile indicator)
		12.5.2 Unemployment rate (profile indicator)
		12.5.3 Persons per household (profile indicator)
		12.5.4 Private area (per square meter) per person (profile indicator)
		12.5.5 Secondary residence rate (profile indicator)
		12.5.6 Percentage of rented residential dwellings as a function of total households (profile indicator)
	ISO 37122:2019	12.1 Percentage of households with smart energy meters
		12.2 Percentage of households with smart water meters
		12.1 Capacity of emergency shelters per 100,000 inhabitants
	ISO 37123:2019	12.1 Capacity of emergency shelters per 100,000 inhabitants
		12.2 Percentage of structurally vulnerable buildings and high-risk hazards
		12.3 Percentage of residential buildings not complying with codes and construction standards
		12.4 Percentage of damaged infrastructure that was "better rebuilt" after a disaster
		12.5 Annual number of flooded residential properties as a percentage of total of residential properties in the city
		12.6 Percentage of residential properties located in high-risk zones

ISO Smart Cities Indicators - Distrito Federal - Social Development		
Area	Standard	Indicator
Social	ISO 37120:2018	13.1 Percentage of population living below the international poverty line (key indicator)
		13.2 Percentage of population living below the national poverty line (indicator support)
		13.3 Gini coefficient of inequality (support indicator)
		13.4.1 Annual population change (profile indicator)
		13.4.2 Percentage of the population who are foreigners (profile indicator)
		13.4.3 Demographic data (profile indicator)
		13.4.4 Percentage of population who are new immigrants (profile indicator)
		13.4.5 Percentage of residents who are not citizens (profile indicator)
		13.4.6 Number of university students per 100,000 inhabitants (profile indicator)

Area	Standard	Indicator
	ISO 37122:2019	13.1 Percentage of public buildings accessible by people with disabilities special
		13.2 Percentage of the municipal budget allocated to actions of support, devices and assistive technologies for citizens with special mobility needs
		13.3 Percentage of crosswalks equipped with traffic signals accessibility
		13.4 Percentage of the municipal budget allocated to programs aimed at reducing digital divide
	ISO 37123:2019	13.1 Vulnerable population as a percentage of the city's population
		13.2 Percentage of population enrolled in social assistance programs
		13.3 Percentage of population exposed to high risk of natural disasters
		13.4 Percentage of neighborhoods with regular, open neighborhood association meetings
		13.5 Annual percentage of the city's population directly affected by hazards natural

ISO Smart Cities Indicators - Federal District - Public Safety		
Area	**Standard**	**Indicator**
Public Safety	**ISO 37120:2018**	15.1 Number of fire departments per 100,000 inhabitants (core indicator)
		15.2 Number of fire-related deaths per 100,000 inhabitants (indicator essential)
		15.3 Number of natural disaster-related deaths per 100,000 population (key indicator)
		15.4 Number of police officers per 100,000 inhabitants (core indicator)
		15.5 Number of homicides per 100,000 inhabitants (core indicator)
		15.6 Number of volunteer and part-time firefighters per 100,000 inhabitants (support indicator)
		15.7 Response time of the emergency services from the first call (support indicator)
		15.8 Property Crimes per 100,000 population (supporting indicator)
		15.9 Number of deaths caused by industrial accidents per 100,000 inhabitants (support indicator)
		15.10 Rate of violent crimes against women per 100,000 inhabitants (indicator for support)
	ISO 37122:2019	15.1 Percentage of city area covered by digital surveillance cameras
	ISO 37123:2019	15.1 Percentage of the city's population covered by an early warning system on various dangers
		15.2 Percentage of emergency responders who have received emergency response training disasters
		15.3 Percentage of local hazard warnings issued by national agencies annually, which are received in a timely manner by the city
		15.4 Number of hospital beds in the city destroyed or damaged by disasters natural per 100,000 inhabitants

ISO Smart Cities Indicators - Distrito Federal - Solid Waste		
Area	**Standard**	**Indicator**
		16.1 Percentage of urban population with regular solid waste collection (household) (core indicator)
		16.2 Total municipal solid waste collection per capita (core indicator)
		16.3 Percentage of municipal solid waste that is recycled (core indicator)

Area	Standard	Indicator
		16.4 Percentage of municipal solid waste disposed of in landfills (key indicator)
		16.5 Percentage of municipal solid waste treated in generation plants energy from waste (core indicator)
		16.6 Percentage of municipal solid waste that is biologically treated and used as compost or biogas (supporting indicator)
		16.7 Percentage of urban solid waste disposed of in open air dumps (support indicator)
		16.8 Percentage of municipal solid waste disposed of by other means (indicator of support)
		16.9 Generation of hazardous waste per capita (tons) (supporting indicator)
		16.10 Percentage of hazardous municipal waste that is recycled (indicator for support)
	ISO 37122:201	16.1 Percentage of waste collection centers (containers) equipped with telemetry
		16.2 Percentage of the city's population that has door-to-door garbage collection with individual monitoring of the quantities of domestic waste
		16.3 Percentage of the city's total amount of waste used to generate energy
		16.4 Percentage of the total amount of plastic waste recycled in the city
		16.5 Percentage of public garbage cans that are equipped with sensors
		16.6 Percentage of the city's electrical and electronic waste that is recycled
	ISO 37123:2019	16.1 Number of available, active, temporary waste management sites for debris and rubble per square kilometer

ISO Smart Cities Indicators - Distrito Federal - Sports and Culture		
Area	Standard	Indicator
Finance	ISO 37120:2018	14.1 Area in square meters of indoor public recreation space per capita
		14.2 Area in square meters of public outdoor recreation space per capita
		17.1 Number of cultural institutions and sports facilities per 100,000 inhabitants
		17.2 Percentage of the municipal budget allocated to cultural facilities and sports
		17.3 Annual number of cultural events per 100,000 inhabitants (e.g, exhibitions, festivals, concerts)
	ISO 37122:2019	14.1 Percentage of public recreation services that can be booked online
		17.1 Number of online bookings for cultural facilities per 100,000 inhabitants
		17.2 Percentage of the city's cultural collection that has been digitized
		17.3 Number of books available in public libraries and electronic books per 100 000 inhabitants
		17.4 Percentage of the city's population that is an active user of public libraries

ISO Smart City Indicators - Federal District - Telecommunications		
Area	Standard	Indicator
Teleco	ISO 37120:2018	18.1 Number of Internet connections per 100,000 inhabitants (supporting indicator)
		18.2 Number of cell phone connections per 100,000 inhabitants (indicator of support)
	ISO 37122:201	18.1 Percentage of city's population with broadband access sufficiently fast
		18.2 Percentage of city area under a white zone/dead spot/uncovered by telecommunications connectivity

Area	Standard	Indicator
	ISO 37123:2019	18.3 Percentage of city area covered by Internet connectivity provided by municipality
		18.1 Percentage of emergency responders in the city equipped with specialized communication technologies capable of operating reliably during a disaster event

ISO Smart Cities Indicators - Federal District - Food Security		
Area	**Standard**	**Indicator**
Food Safety	ISO 37120:2018	20.1 Total urban agricultural area per 100,000 inhabitants (core indicator)
		20.2 Amount of locally produced food as a percentage of total food supplied to the city (support indicator)
		20.3 Percentage of the city's population undernourished (support indicator)
		20.4 Percentage of the city's population that is overweight or obese - Mass Index Body Mass Index (BMI) (supportive indicator)
	ISO 37122:201	20.1 Percentage of annual municipal budget allocated to agriculture initiatives urban
		20.2 Total food waste collected annually sent to processing facilities for composting per capita (in tons)
		20.3 Percentage of city area covered by online mapping system food suppliers
	ISO 37123:2019	20.1 Percentage of the city's population that can be served by the reserves of food from the city for 72 hours in an emergency
		20.2 Percentage of the city's population living within one kilometer of a market

ISO Smart Cities Indicators - Distrito Federal - Transportation and Urban Mobility		
Area	**Standard**	**Indicator**
T	ISO 37120:2018	19.1 Kilometers of public transportation system per 100,000 inhabitants (indicator essential)
		19.2 Annual number of public transport trips per capita (core indicator)
		19.3 Percentage of passengers who commute to work by alternative means to the private car (support indicator)
		19.4 Kilometers of bicycle and bike lanes per 100,000 inhabitants (supporting indicator)
		19.5 Traffic fatalities per 100,000 inhabitants (supporting indicator)
		19.6 Percentage of population living within 0.5 km of public transportation available at least every 20 minutes during peak and off-peak hours peak (support indicator)
		19.7 Average travel time (support indicator)
		19.8.1 Number of private cars per capita (profile indicator)
		19.8.2 Number of two-wheeled motor vehicles per capita (profile indicator)
	I S	19.1 Percentage of city streets and roads covered by city alerts and information real-time online traffic
		19.2 Number of users of economy-based mobility systems shared per 100,000 inhabitants
		19.3 Percentage of vehicles registered in the city that are low emission vehicles
		19.4 Number of bicycles available through municipal bicycle services bicycle sharing per 100,000 inhabitants
		19.5 Percentage of public transportation lines equipped with a system accessible to real-time audience
		19.6 Percentage of the city's public transportation services covered by a system unified payment
		19.7 Percentage of public parking spaces equipped with parking systems electronic payment

		19.8 Percentage of public parking spaces equipped with parking systems real-time availability monitoring
		19.9 Percentage of traffic lights that are intelligent
		19.10 City area mapped by interactive real-time street mapping systems as a percentage of total city area
		19.11 Percentage of vehicles registered in the city that are autonomous vehicles
		19.12 Percentage of public transportation lines equipped with Internet connectivity for users, offered and/or managed by the municipality
		19.13 Percentage of roads conforming to autonomous driving systems
		19.14 Percentage of the city's bus fleet powered by clean systems
	ISO 37123:2019	19.1 Number of available evacuation routes per 100,000 inhabitants

ISO Smart City Indicators - Distrito Federal - Urban Planning			
	Standard	**Indicator**
to Urban	ISO 37120:2018	21.1 Green areas (hectares) per 100,000 inhabitants (core indicator)
		21.2 Percentage of area of informal settlements in relation to the total area of the city (support indicator)
		21.3 Jobs/Housing ratio (supporting indicator)
		21.4 Proximity to basic services (supporting indicator)
		21.5.1 Population density (per square kilometer) (profile indicator)
		21.5.2 Number of trees per 100,000 inhabitants (profile indicator)
		21.5.3 Density of urbanization (profile indicator)
	ISO 37122:2019	21.1 Annual number of citizens engaged in the urban planning process each year 100 000 inhabitants
		21.2 Percentage of building permit applications submitted per system electronic
		21.3 Average time for building permit approval (days)
		21.4 Percentage of the city's population residing in medium or high population density
		21.1 Percentage of the city area covered by updated risk maps and publicly available
		21.1 Percentage of the city area covered by updated risk maps and publicly available
	ISO 37123:2019	21.2 Permeable public areas and spaces and sidewalks constructed with porous and draining materials as a percentage of total city area
		21.3 Percentage of city area in high-risk zones where reduction measures were implemented
		21.4 Percentage of city departments and utilities that perform risk assessment in your planning and investment
		21.5 Annual number of flooded critical infrastructures as a percentage of critical infrastructure in the city
		21.6 Annual expenditure on water retention measures as a percentage of budget of prevention measures in the city

ISO Smart City Indicators - Federal District - Water and Sewage		
Area	**Standard**	**Indicator**
		22.1 Percentage of urban population served by sewage collection and removal systems (core indicator)
		22.2 Percentage of the city's sewage that receives centralized treatment (core indicator)

		22.3 Percentage of city population with access to improved sanitation (core indicator)
		22.4 Sewage treatment compliance rate (supporting indicator)
		23.1 Percentage of city population with potable water supply service (core indicator)
		23.2 Percentage of city's population with sustainable access to a source of water suitable for consumption (core indicator)
		23.3 Total domestic water consumption per capita (liters/day) (core indicator)
		23.4 Drinking water quality compliance rate (core indicator)
		23.5 Total per capita water consumption (liters/day) (supporting indicator)
		23.6 Average annual number of hours of water supply interruption per household (supporting indicator)
	ISO 37122:2019	22.1 Percentage of treated wastewater that is reused
		22.2 Percentage of biosolids that are reused (dry matter mass)
		22.3 Energy derived from wastewater as a percentage of the city's total energy consumption
		22.4 Percentage of the city's total wastewater used for energy generation
		22.5 Percentage of the sewage collection network that is monitored in real time by a sensor system
		23.1 Percentage of drinking water whose quality is monitored in real time by remote stations
		23.2 Number of environmental water quality monitoring stations in real time per 100,000 inhabitants
		23.3 Percentage of the city's water distribution network monitored by intelligent systems
		23.4 Percentage of the city's properties that have smart water meters
	ISO 37123:2019	23.1 Number of different sources providing at least 5% of total water supply capacity
		23.2 Percentage of the city's population that can be supplied with drinking water by alternative methods for 72 hours