Barcelona City Council Digital Plan

Government measure concerning ethical management and accountable data: Barcelona Data Commons

The Open Digitisation Programme from Barcelona City Council's Office for Technology and Digital Innovation

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Executive Summary

In September 2016, Barcelona City Council embarked on a major digital transformation process announcing that public services must be provided through digital channels from the outset, following new guidelines based on citizen guidance and the use of open standards and open software and in accordance with an ethical data strategy that focuses on privacy, transparency and digital rights.

The decision taken by the municipal government is based on the "Barcelona Digital City" Plan, approved in the "**Transition Towards Technological Sovereignty**" government measure in October 2016 and the new Spanish Act 39/2015 on Common Administrative Procedures for Public Authorities. This Act states that, by 2020, digital channels must take priority in the provision of public services in Spain. The Barcelona Digital City Plan establishes a radical improvement in digital public services as one of its main objectives, with the aim of providing services to city residents on a 24/7 basis that are of higher quality and better adapted to their needs.

This document establishes the defining plan for the programme and all the actions and tasks that make up **the responsible and ethical use of data strategy**, developed as part of Barcelona's Digital Transformation Plan (DTP). This plan is led by Barcelona City Council's Commission for Digital Technology and Innovation. The document describes the programme's scope, its relation to the DTP, its objectives and the implementation schedule for each task and action. The programme for open digitalisation is completed by free software and agile service development, published in a government measure in October 2017.

Through this government measure and the action plan it contains, Barcelona becomes **the first Spanish city to develop a Municipal Data Office**, making it possible to structure informed public policies using information provided by data, the proper treatment of that data and its resulting analysis. The responsible and ethical use of data is a key element of Barcelona City Council's Digital Transformation Plan, especially the Open Data and Data Commons strategies, data-driven projects and interoperability based on open-data formats.

This government measure provides a global vision of the City Council's data-management plan and the proposed changes for putting it into practice. It explains the governance mechanisms for this data management, the fundamental values for ensuring data sovereignty, privacy and security, and also presents the actions geared towards internal and external data enhancement, a practical approach based on establishing specific projects with a roadmap, a budget and a schedule.

Ethical and responsible data management, together with the use of free software tools indicated in the previous government measure of October 2017, ensure universal access and improved transparency. We are also laying the foundations for new initiatives based on making the best use of data, which will strengthen the administration and make it more independent.

The Code of Practice provided in an appendix to the government measure of October 2017 establishes the more technological directives aimed at putting the lines of action into practice, along with the measure's requirements for the responsible use of data.

This measure is accompanied by an directive concerning the Municipal Data Office, which defines the governance model and the roles and responsibilities of the people in charge of planning and supervising data management in the City Council.

The agile transformation programme, which contains the responsible and ethical use of data strategy, is continually evolving. Therefore, the general provisions of this government measure will be updated and put into practice as the programme is applied. Our aim is to continue moving forward and do much more than this government measure proposes, given that it only establishes the principles of a process of continual improvement.

1 Introduction and justification

Information and information technology (IT) resources are critical features of the social, political and economic welfare of Barcelona residents. In regard to local administration, they make it possible for the City Council to provide the general public with high-quality services, generate and disseminate knowledge and facilitate growth and improved productivity.

For the City Council, it is important to maximise the quality and security of its data and information systems; to develop and apply the coherent management of information resources and management policies that aim to keep the general public constantly informed, protect their rights as subjects, improve the productivity, efficiency, effectiveness and public return of its projects and to promote responsible innovation. Furthermore, as technology evolves, it is important for public institutions to manage their information systems in such a way as to identify and minimise the security and privacy risks associated with the new capacities of those systems.

Information management technologies also provide significant opportunities for local government. The far-reaching integration of IT with local responsibilities and their processes, together with the digital economy and combined with the increasing interconnection between technology and public services, has changed the way we share information and the use and perception of technologies, and has definitively transformed the general public's expectations and the way they use technology. In order to respond to the general public's expectations and to facilitate innovation, Barcelona City Council must continue to transform, with the aim of assimilating and adopting the digital re-volution, while also maintaining its human team, and producing world class, safe digital services from the unequivocal perspective of public service.

The **responsible and ethical use of data strategy** is part of Barcelona's Digital Transformation Plan (**DTP**), which establishes the roadmap designed by the Commission for Digital Technology and Innovation and its policies for modernising data management and use within Barcelona City Council. The strategy is being put into practice in the shape of a plan that involves various programmes, which are described here. Although the programme was specifically conceived as a conceptual framework for achieving a cultural change in terms of the public perception of data, it basically covers all the aspects of the DTP that concern data, and in particular the open-data and data-commons strategies, data-driven projects, with the aim of providing better urban services and interoperability based on metadata schemes and open-data formats, permanent access and data use and reuse, with the minimum possible legal, economic and technological barriers within current legislation.

Information technology is at the centre of almost everything, and the City Council and its manager's offices, institutes, companies, consortiums, etc. must continue to identify ways to apply emerging technologies, which basically make it possible to improve general governance and to provide more and better services, while also reducing costs. The provision of high quality services means that the City Council has to change its methods for purchasing, building and providing IT.

2 Objectives of the measure

This measure establishes the general policy for the governance, planning, procurement, management, analysis, use, protection, access and preservation, as long as necessary, and the reuse of municipal data to add value to municipal digital information throughout its life cycle, as well as aspects arising from this in terms of human resources, IT infrastructures and resources, economic management and support services.[1]

The strategy of responsible data management is defined with the aim of helping to guide the transformation of the municipal government's IT systems by means of the institutionalisation of more agile approaches, which should faci-litate a speedy adoption of the technological changes in such a way that security, techno-logical sovereignty, privacy and information and data management are reinforced, along with all municipal services and programmes.

This measure aims to ensure the City Council is able to establish a general infrastructure and harmonised processes in order to manage, use and (partially) disseminate data, which is known as **data commons**,[2] and that it is also able to promote, implement and supervise projects that capitalise on and enhance data in an agile, uniform way (e.g. in terms of data interoperability and standardisation) through the Municipal Data Office, and ensure the responsible management of data in accordance with current legislation, together with the Data Protection Officer.

[1] Although this measure refers to various aspects of IT resources, such as privacy, confidentiality, information quality, disclosure and statistical policy, these concepts will be treated and developed in later directives. Units must apply the policies of this measure, and the directives and guidelines in a coherent and constant way.

[2] Already under way at http://ajuntament.barcelona.cat/digital/en/digital-transformation/city-data-commons.

2.1. Goals

The main objectives of this measure are:

• To define the Municipal Data Office's objectives, mission, responsibilities and authority.

• To identify the structure and mechanisms for data governance, in its broadest sense, in Barcelona City Council.

• To define the main governing bodies for the City Council's actions regarding data, centred on ethical use, data sovereignty, the social aspect, guaranteeing privacy and security, permanent access and the reuse of data.

• To ensure responsible data management throughout its life cycle, respecting the FAIR data principles (findable, accessible, interoperable and reusable).

• To define the data architecture, with its data lake repository and City OS, as well as the IT infrastructures needed to use it.

• To improve the internal and external use of the City Council's data, in order to add value and transform it into a real asset for high corporate enhancement.

• To develop the procedures and mechanisms for processing data as systematically and automatically as possible, respecting current legislation and without endangering the privacy, confidentiality and security of that data.

In order to achieve the programme's objectives, certain steps are clearly necessary. Firstly, for promoting and directing our vision of data commons, we have to be able to propose and offer **innovative solutions and visions** concerning information for the general public. In order to do this, we have to ensure a certain level of internal alignment, in terms of available technology and data. We then have to **explain our vision and establish a clear dialogue** with the city's stakeholders in order to jointly promote our vision of **data commons**, with rules that must be established. Finally, we have to be able to show specific examples of the application of this vision for the common good of city residents, in order to ensure their support for our work.

This measure also presents **current emblematic projects**, through which these objectives are starting to be achieved, along with the structures, responsibilities and projects they require.
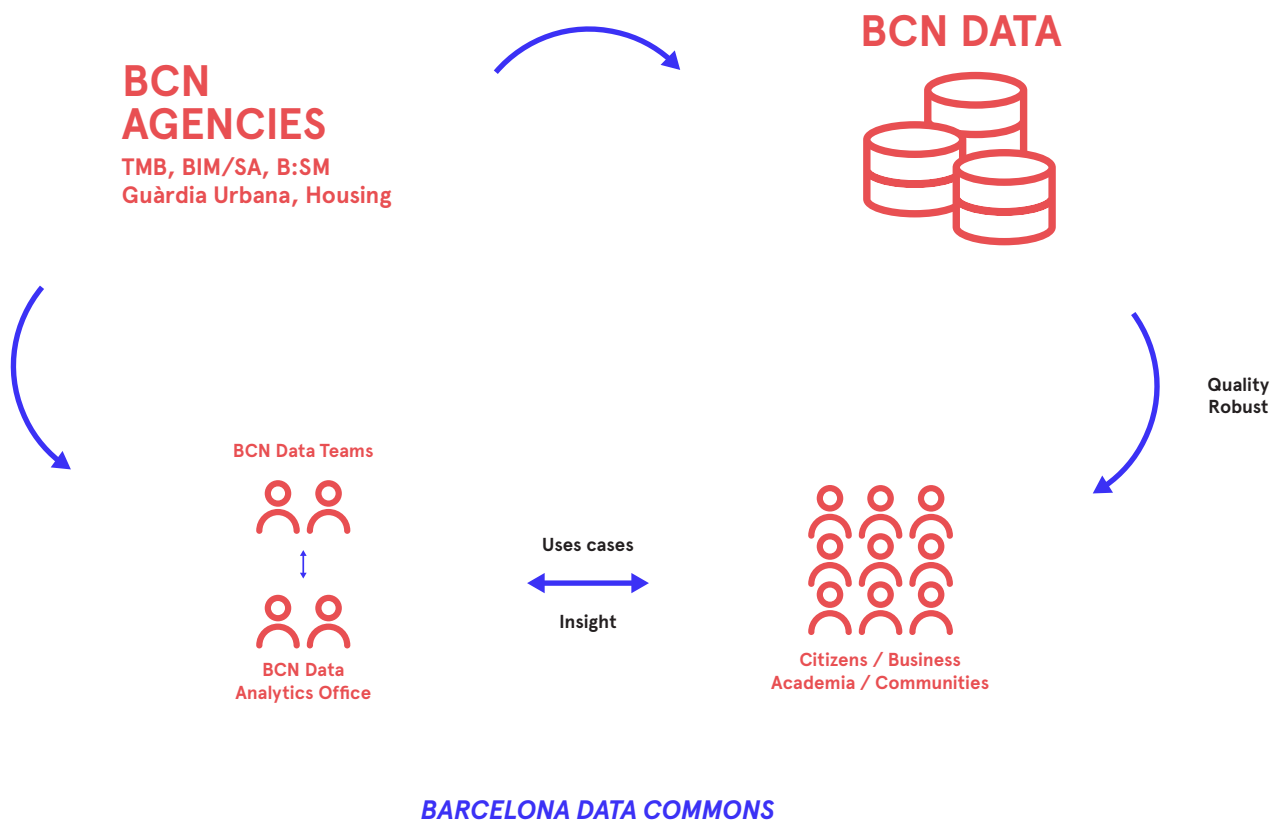
2.2. Barcelona Data Commons

The current situation of municipal data has to be transformed in order to turn it into a public asset, or **data commons**, with defined governance and rules that are created from the perspective of data as a common asset. The public and private perception of data has to change from that of an asset that offers a competitive advantage to one of a social "infrastructure" that must be public in order to ensure common well-being, and which is exchanged on a *quid pro quo basis*. The more data there is, the higher its quality, and the more confidence there is in the exchange and privacy rules for this common asset, the better all the stakeholders taking part will be able to perform.

In regard to this *data commons* perspective, the aim of this measure is to establish the architecture, processes and operational standards based on application programming interfaces (API), which make it possible to group data sources into a common **data lake**. This involves document-configuration processes for the datasets, as well as a mapping of the wealth of general data present in the Administration and an assessment of its quality. It also involves getting this infrastructure prepared for (partial) opening to external social stakeholders, with the aim of providing support to the proposed vision for the data-commons framework.

In order to promote and direct this concept of data commons, the City Council has to be able to propose and offer innovative solutions and ideas concerning data relating to the general public. In order to do this, we have to ensure a certain level of internal alignment in terms of available technology and data. We then have to explain our concept and establish a clear dialogue with the city's stakeholders in order to jointly promote our concept of data commons, with rules that we must jointly establish with the general public. Finally, we have to be able to show specific examples of the application of this data com-

mons concept to city residents, in order to ensure their support for our work. This also has to be achieved while recognising the need to return the control of this data to the city residents who produce it, so that they can decide what they want to keep private and what they want to share, and with whom and under what conditions. This vision, based on the concept of the general public's data sovereignty, will take the form of experimental projects, such as DECODE (see below) and in the integration of new technologies, such as distributed registries or blockchains and data encryption.

BCN AGENCIES
**TMB, BIM/SA, B:SM
Guàrdia Urbana, Housing**

BCN DATA

BCN Data Teams

**BCN Data
Analytics Office**

Uses cases

Insight

Quality
Robust

**Citizens / Business
Academia / Communities**

BARCELONA DATA COMMONS

2.3. The Municipal Data Office and the Chief Data Officer (CDO)

Barcelona recognises the opportunity for demonstrating the proper use of data when making informed decisions, as well as for defining, analysing and resolving the challenges currently facing big cities, and the need for responsible and ethical management of this data. By using this measure, it therefore establishes the mission and objectives of the new Municipal Data Office (MDO) led by a Chief Data Officer (CDO), while also providing it with the necessary (human, technical and economic) resources to make use of the data pertaining to the city and its residents that is kept by the city. Barcelona is therefore following the example of major North American cities, such as Chicago, New York and Boston, with their respective Chief Data Officers, and more recently other European cities, such as London and Paris, which, by designing a new strategy and vision, consider data to be part of the city's own infrastructure.

In this case, through this government measure and the action plan it contains, Barcelona becomes the first Spanish city to recognise the importance of data, the first one to appoint a CDO and the first one to create its own data-lake and data-commons structures. This should make it possible to produce informed public policies by using the information provided by the data, its correct treatment and the resulting analysis, and by opening up this data to the civil and industrial sectors, as far as possible, in order to strengthen the local economy and the actions of civil society.

3 Context

3.1. Current situation

The City Council currently manages a lot of data including many kinds of information content that need to be properly identified and supervised, in order to ensure compliance with the inherent functions of public service, while respecting, and not infringing, the regulations concerning privacy, confidentiality, security, transparency, access and reuse that current legislation requires. Furthermore, we have to be able to work on and manage this data in a sustainable and appropriate way, in order to provide it with added value and a social aspect, transforming it into a real asset for city residents and for the municipal council itself. In the City Council, data is often kept in "informative silos" or in vertical piles, which means it cannot be easily shared between departments. This has had a major effect on the organisation and it is something that this measure aims to change.

From a cultural point of view, in recent years, the municipal organisation has gradually assumed the fact that municipal information is an asset of common interest to the City Council and city residents. Permanent access to the data, whether it is public or restricted or confidential, empowers the communities that have access to it, because it allows them to take duly informed decisions and means that they can be freer.

For city residents, municipal data is a source of wealth that can help to break the cycle of poverty and can form a basis for sustainable human development. Access to public content is a basic democratic right that helps to reduce the digital gap and empowers city residents to decide and act freely in their social, work and leisure activities, from an individual and collective viewpoint. Correctly managing and disseminating this data must make it possible for city residents to have more formed opinions and a desire to participate in local affairs, guarantee a return on public investment in society, facilitate control of the Administration by city residents, accelerate access to knowledge, foster collaborative work, encourage innovation, which enriches education and stimulates the economy, increases productivity and helps to find new solutions to tackle the challenges facing new societies, which are constantly changing, in order to increase competitiveness and promote the progress of knowledge at a global level.

For the City Council, in the broadest sense of the concept, the data that we generate, collect, receive, store, process and share also has a high intrinsic value. This places us in a privileged position that we need to know how to make the most of in order to share it with everyone. It is necessary to manage these information resources systematically and intelligently, taking into account their entire life cycle, in order to successfully transform them into an asset and to construct the necessary tools and services to get just-in-time data and make it available to the departments and people who need it, beyond the limits imposed by right of access. For the City Council, the benefits of this systematic process are also numerous: efficiency and responsibility are increased, the institution's profile is raised and our knowledge is increased. It is a permanent and continual source of knowledge, because it is preserved properly, it guarantees the institution's reputation, it improves transparency and accountability, it

promotes reuse for the benefit of everyone and helps to improve productivity.

From an architectural point of view, the City Council now has to rethink and develop flexible infrastructures, content and data, interoperable procedures and services that make it possible to change the data model and strategy in order to share it with all the interested communities, applying general criteria and protocols and adding specifications according to the various departmental businesses and objectives.

The infrastructures have to include facilities, technology and the expertise of human teams. We have to see data from a broader perspective, referring to all information resources, including protected and open data, true digital and digitalised data, and even subscription or licensed electronic resources. The procedures have to standardise vocabulary, apply metadata standards and guarantee interoperability within the worldwide digital data ecosystem. In addition to providing traditional information and assistance services, they must be flexible in order to address other emerging needs in a knowledge society that is changing so rapidly.

These strategies must be able to define a data-classification model that takes into account legal and security aspects at each stage of the data's life cycle, the tools for creating digital objects and assigning descriptive, administrative, technical and preservation metadata, as well as assigning univoc and persistent identifiers and they also have to ensure that the data and its metadata can be understood by humans and by machines, i.e. in order to guarantee open-access information that is easy to find, to share and which is machine readable. This is a change of model, where the new value is default access to municipal data. It is necessary to systematically apply data evaluation and selection procedures in order to also create a preservation policy that is sustainable in the long term, to plan the transfer to an analytic repository, or if necessary, definitive placement in a secure and verified repository so that the data is permanently accessible, to apply controlled vocabulary and standards, and with clear licences of use that are machine readable in order to enable individual or mass reuse, always

stating the original source, and disclosing the existence of the data to city residents so that they are aware of its existence and that they have right of use.

This has important legal consequences, such as those imposed by the new general data protection regulation (**RGPD**), which will be obligatory for all public institutions from May 2018. It must be stated that the City Council is working on a plan for adapting to the RGPD and that it has taken measures to that end. Dispersion of data services could cause security problems in the future (data dispersion can also mean unauthorised access to personal information by contractors and other players, although at this time, no leaks of any kind have taken place). For this reason, when what we want to do with the data internally is discussed, there are also architectural problems that must be tackled. These problems include the need for a unified point of access with sufficient technical capacity to manage large quantities of information, but also an interoperability standard for sharing data among services, systems and applications (i.e. a unified API policy).

In terms of governance, there is a need for a body, a municipal data department, that spearheads the new model, promotes the paradigm shift within the organisation and assigns responsibilities in order to ensure that data is managed as a real asset during its entire life cycle, which will generate added value. This government body has to carry out high-level supervision and be empowered to take decisions concerning possible data conflicts in public tenders. Furthermore, it will have to oversee a change in the City Council's mentality, aimed at achieving a data-based focus in order to inform and take decisions concerning the city's problems.

Finally, in regard to exchanging data, the City Council has played a discreet role until now. It has maintained an open-data portal, but the portal had low standards, and there was a lack of decisive political support for opening up data. In regard to contracting, there is basically no concern about contract data, as it is not considered to be an internal asset.

3.2. Data-strategy motivations

The conceptual plan must address the motivation for this programme. We live in a digital world, where access to technology makes it possible to transform many aspects of society. In particular, technology enables the scalability of processes and services. This factor, along with an ever-increasing availability of data for measuring practically every aspect of people's lives (the so-called **big data**), could threaten the levels of freedom enjoyed by the citizens who live in our societies. Furthermore, although the inherent scalability offered by these technologies has positive consequences for efficiency, it may also lead to an increase in existing inequalities.

As a public administration, the City Council is uniquely placed to ensure that this does not happen. It must promote an agenda that is explicitly geared towards ensuring the digital rights of city residents while also acting as a facilitator for generating well-distributed wealth. This wealth can be created through innovation and exploiting data, which has been described as "the new 21st century petroleum":

However, like petroleum, data must be refined using appropriate processes and skills, which not all social stakeholders have to the same degree. Therefore, a policy that merely defends "open data" in the name of transparency, and allows certain stakeholders access without any clear strategy or regulations, may lead to a society that is even more unequal. Although data must be made public, we shouldn't forget that people's capacities in terms of economic power, knowledge and infrastructure are not evenly distributed throughout the population. Therefore, as a public body, we must clearly change the current model of merely demanding that the data is opened up "naturally".

From a general perspective, public administrations must be the ones to spearhead this vision. We have sufficient power to promote our vision, as we have part of the critical infrastructures, major economic capacity, the communicative range and, to start off with, a significant body of data. A cultural change in this direction can therefore be achieved by encouraging the other stakeholders to come on board and follow the City Council's lead.

Furthermore, based on this government measure, it is necessary to define a framework that covers all the necessary actions concerning data, in order to ensure continued and permanent access under the FAIR data principles promoted by European bodies and especially by the Research Data Management Working Group.

Finally, it must be taken into account that the City Council acts as a protector of city residents' data. It is therefore very important to make this data available to them, so that it is accessible to city residents and so that a verifiable and trustworthy relationship can be built up. However, for this to become a reality, it is not enough for the data and the protocols to be transparent. City residents must also have the tools and knowledge to be able to verify them. In a world that is becoming more and more digitalised, this means that the City Council must promote activities that help to train city residents in digital knowledge. In order to do this, it is necessary to make people more aware of the importance of exercising digital rights and to also provide the general public with tools that allow them to understand the implications, possibilities and dangers behind a totally digitalised world, where a huge amount of data on human activities is available.

4 Essential values of the programme

The current ubiquity and volume of this data and how easy it is to obtain, along with the possibilities of data science, are opening up many perspectives in terms of providing services. However, it also makes it easy to segment the population and identify people and put them under surveillance. This poses many questions and challenges for society in general and public administrations in particular. The virtual dimension and the sovereignty of city residents in this area is a subject of interest because of the repercussions these aspects can have on the analogue world. Administrations have to be prepared and make an effort to design a consistent strategy in this area. This must make it possible to ensure democracy, people's full rights and their confidence in public institutions.

4.1. Essential values

Municipal data is a strategic asset and a valuable resource that enables local government to carry out its mission and its programmes effectively. Appropriate access to municipal data significantly improves the value of the information and the return on the investment involved in generating it. In accordance with the "Barcelona Digital City" plan and its emphasis on public innovation, the digital economy and empowering city residents, this data-management strategy is based on the following considerations.

Within this context, this new management and use of data has to respect and comply with the essential values applicable to data. For Barcelona City Council, these values are:

• **Shared municipal knowledge.** Municipal data, in its broadest sense, has a significant social dimension and provides the general public with past, present and future knowledge concerning the government, the city, society, the economy and the environment.

• **The strategic value of data.** The council must manage data as a strategic value, with an innovative vision, in order to turn it into an intellectual asset for the organisation.

• **Geared towards results.** Municipal data is also a means of ensuring the administration's accountability and transparency, for managing services and investments and for maintaining and improving the performance of the economy, wealth and the general public's well-being.

• **Data as a common asset.** City residents and the common good have to be the central focus of the Municipality of Barcelona's plans and technological platforms. Data is a source of wealth that empowers people who

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[3] *Accesible en* http://www.slideshare.net/Barcelona_cat/pla-barcelona-ciutat-digital.

have access to it. Making it possible for city residents to control the data, minimising the digital gap and preventing discriminatory or unethical practices is the essence of municipal technological sovereignty.

• Transparency and interoperability. Public institutions must be open, transparent and responsible towards the general public. Promoting openness and interoperability, subject to technical and legal requirements, increases the efficiency of operations, reduces costs, improves services, supports needs and increases public access to valuable municipal information. In this way, it also promotes public participation in government.

• Reuse and open-source licences. Making municipal information accessible, usable by everyone by default, without having to ask for prior permission, and analysable by anyone who wishes to do so can foster entrepreneurship, social and digital innovation, jobs and excellence in scientific research, as well as improving the lives of Barcelona residents and making a significant contribution to the city's stability and prosperity.

• Quality and security. The city government must take firm steps to ensure and maximise the quality, objectivity, usefulness, integrity and security of municipal information before disclosing it, and maintain processes to effectuate requests for amendments to the publicly-available information.

• Responsible organisation. Adding value to the data and turning it into an asset, with the aim of promoting accountability and citizens' rights, requires new actions, new integrated procedures, so that the new platforms can grow in an organic, transparent and cross-departmental way. A comprehensive governance strategy makes it possible to promote this revision and avoid redundancies, increased costs, inefficiency and bad practices.

• Care throughout the data's life cycle. Paying attention to the management of municipal registers, from when they are created to when they are destroyed or preserved, is an essential part of data management and of promoting public responsibility.

Being careful with the data throughout its life cycle combined with activities that ensure continued access to digital materials for as long as necessary, help withthe analytic exploitation of the data, but also with the responsible protection of historic municipal government registers and safeguarding the economic and legal rights of the municipal government and the city's residents.

• Privacy "by design". Protecting privacy is of maximum importance. The City Council has to consider and protect individual and collective privacy during the data life cycle, systematically and verifiably, as specified in the general regulation for data protection (Regulation 2016/679 of the European Parliament and of the Council) with particular emphasis on informed consent, minimisation of information and limiting to purpose, in an explainable, safe way and in accordance with the law.

• Security. Municipal information is a strategic asset subject to risks, and it has to be managed in such a way as to minimise those risks. This includes privacy, data protection, algorithmic discrimination and cybersecurity risks that must be specifically established, promoting ethical and responsible data architecture, techniques for improving privacy and evaluating the social effects. Although security and privacy are two separate, independent fields, they are closely related, and it is essential for the units to take a coordinated approach in order to identify and manage cybersecurity and risks to privacy with applicable requirements and standards.

• Technological sovereignty. When new equipment, IT resources or support infrastructures and services are planned, budgeted or purchased, the subsequent contracting process and specifications must be in line with the priorities of the "Barcelona Digital City" plan. In order to comply with the technological sovereignty objective set out in the Agile Digital Transformation Strategy and the digital service standards, especially for preventing dependency on suppliers (vendor lock-in), the following guidelines, which expand on the technology and innovation principles governing the Municipal Institute of Information Technology (IMI) are as follows: interoperability, agility, ethics and the

opening up of knowledge and technologies (for both software and data).

• **Open standards.** It is obligatory for the City Council's digital services to use open standards, and in particular the content of the catalogue of standards from the Technical Interoperability Standard (as implemented under Royal Decree 4/2010) or the internationally accepted open standards that update, replace or complement these standards. Where no approved open standard exists in the required format, a proposed format shall be submitted pursuant to the applicable regulations and the requirements of the IMI's open standards.

• **Agile methodology**. The technological projects that are implemented for the management, analysis and dissemination of council data must preferably be carried out in accordance with the methodology defined in the Code of Technological Practices, published in the corresponding Barcelona City Council government measure in October 2017.

4.2. Data sovereignty

"Data sovereignty" is a concept linked to German constitutional law, people's right to their own information (where digital information concerning an individual is not subject to the control of a third party, and in particular, of people or systems that treat data in a third country, with regulations that are alien to the location of that individual)

Most of the current concerns about data sovereignty refer to compliance with privacy regulations and preventing data stored in a foreign country from being intercepted by the government of the host country or of that government having access to it. But the concept of data sovereignty is broader than this international dimension and it involves the need for an individual to have control, at all times and in all relevant systems, over the collection, storage, use, transfer and publication of their data, whether it be of a technical, scientific, economic, social or personal nature.

Organisations increasingly adopt services based in foreign IT systems and, in particular, the cloud, in order to enjoy the benefits of not having to buy, manage, update and replace systems and applications. As one of the main objectives of using the cloud is to enable access to information and systems any time and anywhere, many organisations do not much care where their data is stored, or that it could escape from their control and be accessed by unauthorised persons or even made publicly available.

Data sovereignty presents technical and legal challenges when local systems and stores of third-party information are moved, particularly to the cloud.

In this context, the City Council's information systems have to be determined and configured at all times, in order to guarantee the City Council's sovereignty over its data, and in particular, over the (personal) data of the city's residents, which is administered by the City Council for providing its services. The City Council has to have the ability, at all times, to access its data, process it and make "local" security copies. Furthermore the City Council's organisations and bodies must always respect the applicable data protection regulations regarding the access to and treatment of data by third parties, as well as international data transfers.

4.3. The ethical use of data

Barcelona City Council is committed to the ethical use of data. This principle is structured in accordance with the following main values:

- Transparency: at all times, both the City Council and the city's residents know why and for whom the data is being collected, and the applicable measures for guaranteeing its ethical use.

- Tracing: at all times the City Council knows the origin of the data, its permitted uses and the applicable restrictions.

- Diligence: collaborators and the providers of data-related services comply with the same principles and obligations as the City Council, and the City Council oversees this compliance.

- Privacy: any use of personal data must comply with data-protection regulations, and in particular with the principles applicable to its treatment, including fairness, integrity and accuracy, purpose limitation and data minimisation.

- Trust: data must always be used in accordance with the general public's expectations, and the City Council must implement control and feedback systems to gauge this compliance.

- Responsibility: The City Council assumes responsibility for all data uses that are undertaken.

- Benefit: the data must always be used for the benefit of city residents and society.

All projects that involve the processing of city data must comply with these principles.

Furthermore, many of today's operations and decisions, which used to be carried out by human beings, are increasingly being delegated to algorithms, which can advise, if not decide, how the collected data should be interpreted and processed by information systems and what actions should be taken as a result. More and more often, these algorithms affect social processes, business transactions and governmental decisions, as well as the way we perceive, understand and interact with each other and our surroundings. The differences between the design and operation of these algorithms and our understanding of what they involve can have serious ethical consequences that affect individual people and groups of citizens. It is essential for the decisions made by the City Council using algorithms based on our data to be accountable (applying the concept of algorithmic accountability) and that they ensure the ethical principles of respecting rights, justice, the concept of fairness, well-being and virtue.

As part of this measure, a DMO working group will be set up to identify the subjects raised by algorithmic determinism relating to automated decisions taken by the City Council, and to identify the necessary measures for ensuring the following ethical principles, in order to determine if instruction on the subject will be needed in the future, with the aim of establishing applicable regulations for the ethical use of data and algorithms in Barcelona City Council.

- Transparency: the right of city residents (including the staff of the City Council and related organisations) to be informed about automated decisions and their underlying algorithms.

- Due process: the right of city residents to take action and initiate appeals relating to data processing and the automated decisions that affect them.

- Accountability and proportionality: ensuring that automated decisions are fair and proportional, and that they do not prejudice city residents (in particular, that they are not discriminatory in any way).

Within this context, algorithmic accountability is supported by the transparency of the City Council's open source code IT systems involved in decision-making (or for supporting decision-making). Wherever possible, projects based on data (data driven) will be able to check the algorithms using simulations based on city

data. Likewise, using open source code or other means, third-party technology suppliers must reveal the underlying logic behind any IT process for automated decisions (or for supporting decision-making) pertaining to any of their systems used by the City Council.

Ethical values and principles must be considered as intrinsic features of the City Council's data model and data governance, and the working group will help to build this data model and appropriate controls for its governance, and to establish a process for providing an ethical evaluation of any development project.

5

Scope of application

This measure is applicable to the following organisations and data.

5.1. Organisations and systems

The municipal executive structure and its dependent bodies are responsible for putting the actions and requirements arising from this measure into practice.

They are applicable to management activities that use any IT resources of any kind (unless expressly excluded) that collect, store, use or publish data, including information in paper and electronic mediums. When an organisation carries out an order or acts as a service provider, the ultimate responsibility for the application of this strategy's requirements rests with the receiving management or organisation.

In regard to security and protection systems, the directives and executive orders defined in municipal guidelines and regulations must be applied.

5.2. Data

The data referred to by this measure includes all municipal data, understood as both the municipal data and metadata and the data-management systems that make continual access, use, reuse and preservation possible. In regard to municipal data, it is possible to make a conceptual distinction between various large information deposits / information groups:

 • **Management, administrative and technical data.** These are the data groups that municipal manager's offices and organisations use to carry out their missions. This data comes from, for example, files, sensors or city residents themselves. This group includes the concept of big data.

 • **Open data and sets of raw data and open metadata.** These are the datasets that the municipal council makes available to the public. Furthermore, the website platform that serves them has a system for searching, visualising and downloading. It also has an API that provides access.

• **Official statistics.** The set of statistics obtained by the City Council concerning various datasets and which are listed as official statistics by IDESCAT, the official Catalan statistics organisation.

• **Open Content (BCNROC):** This is data produced by the municipality, published in municipal documents. The content is of all kinds, text-based, number-based, visual, etc. which are found or configured in public documents produced or financed by Barcelona City Council. This means that the City Council is the author and makes them available digitally and permanently to city residents, using standard metadata schemes in order to guarantee interoperability, Creative Commons licences to allow the documents to be reused, uniform resource identifiers (URI) that ensure a permanent link to digital networks and open formats to facilitate the semantic web.

• **External data (CBAB).** These are information resources from sources external to the City Council, produced by third party authors, which the organisation compiles because they are needed for internal work. It is organised and accessible from the SEDAC corporate catalogue.

5.3. Environment and ecosystem

When we talk about data today, we have to speak about technology. The Digital Transformation Plan (**DTP**) aims to change the way the City Council purchases and manages technology and interacts with the general public. At present, Barcelona is very attractive for technological companies of various sizes, and it is also generating new practices in the market in terms of business models that pivot on open code and open-service practices.[4] The DTP's objective is to establish a playing field where SMEs and other economic players that are not large corporations can enter the "game" with a chance of winning tenders related to technology and data. This has the advantage of diversifying the City Council's suppliers, avoiding the closure of suppliers and also promotes a circular economy, where the benefits of public money are reinvested in city stakeholders, while the public money invested in developing services is kept open in a predetermined way for the community. Therefore, the link between the purchasing of data and technology is important because of the programme's scope, although this is obviously not the main concern.

In this sense, this measure's provisions must be applied to all acquisition and technology and service management contracts that work with data. City Council organisations will have to detail in the application specifications the responsibilities of suppliers regarding data and, where appropriate, their function as the people responsible for data processing.

Furthermore, these provisions are extended to all City Council interactions with the "community" involved, i.e. all the possible reusers or proactive consumers (prosumers) of the data that the City Council makes public as open data: activists, data journalists, NGOs, foundations and associations in a non-economic environment, as well as business people, emerging companies, companies related to information sciences and major companies in the business world, and finally, academic research institutes.

[4] *See the government measure of October 2017.*

6 Governance of municipal data: the Municipal Data Office

This **Strategy for the responsible and ethical use of data** entails an organisational change that should enable the proper application of the provisions that include it.

6.1. Organisation: the Municipal Data Office

The **Municipal Data Office** (MDO) has been created. This is a directorate made up of various other directorates and departments that, until now, have had missions concerning council data The Municipal Data Office is located in the Municipal Manager's Office and answers to the Commission for Technology and Digital Information (CTID).

The MDO is responsible for the management, quality, governance and exploitation of data relating to Barcelona City Council and all its associated bodies (public and private) that provide services to the general public. The director of the DMO. the Chief Data Officer, (**CDO**) carries out this task by means of:

• The promotion, execution and supervision of data exploitation projects needed by City Council departments. Relevant city players from the data sector are also involved. In order to carry out this task, there is an office for multi-disciplinary support.

• The establishment of standardised protocols throughout the organisation and a precise mapping of all the existing wealth of data under the umbrella of the City Council, creating a classification for all the data and the promotion of appropriate processing, care and preservation policies for each one.

• Furthermore, their office will oversee responsible data management, in accordance with current legislation concerning privacy, through coordination with the data protection officer (DPO) and will supervise the integration of the data generated by new contracts and services into the municipal structure.

• Management and monitoring of council-data governance.

The Municipal Data Office is an opportunity to stand out in the field of data, at municipal, community, national and European levels, and this is happening at a good time. This is obviously a venture for the future and the present, as data is inundating each and every area of our lives, and in the near future, every municipal service will be likely to generate data. This means that, as an organisation, we have to be prepared and have a solid strategy for how to manage this data and, where necessary, exploit it in order to improve the services provided for the general public.

Due to the nature of its activities, the Office must have an inter-disciplinary, coherent team. Normally, the required profiles (from the Office or through contact with other City Council units) would be administrative (data governance, specifications), legal (privacy and licence aspects) technical in various disciplines (knowledge of existing data architecture and the actions needed during their life cycle in order to turn them into an asset, as well as technical procedures for ensuring the FAIR use of the data), analytic (one of the Office's latest objectives is to carry out data science), graphic (there will be a constant need for communicating knowledge extracted from the data through visual means) and finally, a business perspective (the Office will have to provide services to various City Council units).

Furthermore, another Office objective will be promoting the management of change, with the aim of transforming the organisation's culture, promoting the standardisation of data-management protocols and encouraging the various municipal players to share data and receive training in this area. This requires decisive political support, which will provide the new office with resources and the authority to carry out the ambitious tasks it is charged with.

Beyond political support, in order to achieve this end, the Office or the CDO must be considered as a service provider by the other City Council units. This means that the Office must provide useful information and work side by side with the other units, in order to educate them in data culture and encourage them to continue on their own once the collaboration comes to an end. For this reason, it has to be situated in an appropriate location and with suitable offices.

The MDO's main functions and responsibilities are established in the directive that accompanies this measure.

6.2. Supervision: Commission for Technology and Digital Innovation (CTID)

The CTID must be part of the governance committees which provide information about decisions that include IT resources and data, in order to facilitate advanced information from resources for programme objectives. After consultation with other manager's offices, the CTID can delegate its functions to other technical personnel.

The CTID requires data security and privacy to be completely integrated into the system of data use and evaluation measures at a municipal level, and it can recommend that an organisation's manager's office modify, stop or finalise any purchase, investment or activity that includes significant IT components, based on the CTID's evaluations of the terms of the contracts and current legislation.

A process will be established whereby the CTID will regularly coordinate with project managers in order to evaluate the IT resources and the data-management processes that support the aims and mission of each municipal body. The CTID and the people responsible for the programme must share the responsibility for ensuring that the IT resources and present and future municipal datasets adequately provide the value they apply to the manager's offices and municipal bodies.

The manager's offices and bodies will have to comply with the regulations and instructions for the management of data, information and municipal documents from executive bodies, which will be developed under the Responsible Data-Management Strategy led by the Commission for Technology and Digital Innovation.

la OMD con respecto a la gestión de datos, de la información y de los documentos municipales que se deriven desde los órganos ejecutivos, y que se desarrollarán a partir de esta estrategia de gestión responsable de datos liderada por la Comisionada de Tecnología e Innovación Digital.

7 Strategic areas

In order to deploy **the strategy for the responsible and ethical use of data**, the following areas of action have been established, which we will detail below, together with the actions and emblematic projects associated with them.

In general, the strategy pivots on the following general principals, which form the basis for the strategic areas described in this section.

• Data sovereignty

• Open data and transparency

• The exchange and reuse of data

• Political decision-making informed by data

• The life cycle of data and continual or permanent access

7.1. The deployment of the new data governance

GOVERNANCE POLICIES AND PROCESSES

As a support for the purpose and functions of municipal manager's offices and bodies, and in coordination with the people in charge of data, the municipal processes, standards and policies applicable to all the organisation's data resources will have to be defined, put into practice and maintained.

Subsidiary municipal bodies must obtain this from the CTID, in coordination with the governance committees, where processes and policies will be defined in sufficient detail in order to manage data resources appropriately. As a minimum, these processes and policies will require any investments and projects under development to be evaluated, in order to determine the applicability of the agile methodology, data standards and open content, privacy and the ethical and social impact 1. as well as the indicators for measuring the cost, use and general evaluation of the data resources as a whole.

It must be ensured that:

• There is a single review policy for each organisation for evaluating the investments, the analysis of operations and the other evaluation systems for IT resources, including the projects under development and ongoing activities.

• Information and data needs will be managed in accordance with the organisation's governance policies, where the functions, responsibilities and processes that the organisation's personnel use for treating data as an asset are clearly established, along with the relationship between technology, data, the organisation's programmes, strategies, legal requirements, mission and operational objectives.

• Obsolete information systems will be replaced as quickly as possible and budgetary planning will include items corresponding to depreciation.

LEADERSHIP AND HUMAN RESOURCES

Subsidiary municipal bodies must develop a set of requirements and skills for the teams responsible for or working with data, which will include aspects concerning access, analysis, privacy and security, among others. More specifically, it must be ensured that the teams responsible for data are able to foresee innovation and adapt to it, in a context of constant change. The department of Human Resources must ensure that the executive/management personnel dealing with data have sufficient knowledge to carry out their task appropriately. The people in charge of the organisation must supervise how their data personnel carry out their functions, as well as coordinating with the CTID and the CDO in order to select the staff.

PRIVACY

In compliance with Regulation (EU) 2106/679, the City Council will appoint a council Data Protection Officer (DPO) to assume the functions assigned to that officer under this regulation.

Subsidiary municipal bodies must establish and maintain a data-protection programme, in accordance with the municipal policy on privacy, which ensures compliance with privacy requirements and develops, evaluates and manages the risks associated with privacy. When evaluating risks to privacy, privacy systems must take into account risks concerning the people associated with the creation, collection, use, treatment, storage, maintenance, dissemination and destruction of personal data.

In accordance with municipal policy and the law, municipal organisations and bodies may only create, collect, use, store or disclose personal data if they have the appropriate authorisation. This authority must be clearly identified in their data management software (DMS) and in the architecture document (AD).
The bodies have to designate an RDAD and a data-protection officer who is responsible for their data and who are answerable for developing, putting into practice and maintaining privacy programmes in order to ensure compliance with all regulations, norms and directives that affect the life cycle of personal data,

by means of a privacy policy that applies legal measures to privacy risks. The CTID and the corporate personnel responsible for data, the CDO and the DPO, will have authority over the sub-DPOs in each organisation and will coordinate them.

The principles for personal data protection must be respected, and the details of those principles must be established under the responsibility of the DPO. Specifically, these will include:

• Impact assessments. Municipal units will carry out impact assessments for data protection to preventively ensure that, where processing operations may involve especially serious risks, the necessary measures are taken to reduce, as far as possible, the risk of injuring or harming people or negatively affecting their rights and freedoms by obstructing or limiting the exercising of those rights or their content.

• Privacy by design / PET The necessary measures must be taken to incorporate privacy by design strategies and/or privacy enhancing technologies (PETs), through which the privacy of those concerned is taken into account during all design, development and management processes for the City Council's data systems. Wherever applicable, encryption, anonymisation and pseudo-anonymisation algorithms must be used.

DATA SECURITY

In order to guarantee appropriate data security levels and to ensure confidentiality and correct use, the CTID must designate a person in charge of data security, a Data Security Officer (DSO), who will be responsible for developing and maintaining a security programme for the unit's data, in accordance with pertinent legislation and in collaboration with the Technical Commission for Data Protection Security.

The data will be protected in accordance with the risk arising from unauthorised access to, the use, disclosure, interruption, modification or destruction of this information. The units must produce a recovery plan that includes continuity strategies, in order to ensure that services and access can be restored in time to satisfy the mission's needs. Furthermore, any information project or system must guarantee the possibility of tracing access to the

data and the analysis of decision-making algorithms (or those supporting decision-making) and prepare and facilitate any audits that may be undertaken. Any third party involved in the processing of municipal data must offer sufficient guarantees concerning the implementation and maintenance of the required security measures, and the other directives defined in the Code of Technological Practices and the Technical Commission for Security.

All projects and systems must comply with current laws and regulations, including the General Data Protection Regulation, the Spanish data protection law, Decree 3/2010, of 8 January, which regulates the National Security Scheme for Electronic Administration, and international security regulations, in particular regulation ISO/IEC 27002:2005, which establishes guidelines and general principles for initiating, putting into practice, maintaining and improving the information security management in an organisation.

The physical or logical security of data will be determined by the IMI-defined standards.

COLLABORATION, COORDINATION AND SUPERVISION

General data governance is described in the directive that accompanies this measure, in Appendix 10.1. This is comprised of the Inter-departmental Coordination of Data. Its main aim is to coordinate cross-departmental projects and to act as a means of disseminating the projects.

For proper coordination between the various areas of municipal management, data officers will be defined for each sector, who will be responsible for the data in their own manager's office and for coordination with the council as a whole. Cross-departmental data coordination makes it possible to establish directives for and monitor the work carried out in the MDO and in the various sectoral centres for storing, analysing and disseminating municipal data; establishing operational and treatment criteria for guaranteeing all aspects of the data's life cycle and added value; the monitoring of inter-departmental and council projects, as well as the management of data protection and the regulations concerning intellectual property and authorship protection for the data.

This coordination must lead to the proper management and review of resources and programmes, and ensure coordinated and unified budget management. The CDO will also take part, for the review and authorisation, with the aim of providing effective, specific and visible corporate management of IT resources and data.

Each unit's manager's office, in consultation with municipal data officers, must describe the processes used to define the inventory of IT resources for efficiently achieving management objectives, considering new investments in IT and their potential and appropriateness for the council inventory. It will also be necessary to identify the differences between the programmed and executed budget, the schedules and the evaluation of IT objectives, and ensure that the necessary corrective measures are carried out.

7.2. Ethical and responsible data management

This tool establishes principles and directives for correct data management, in accordance with the principles indicated in this measure. The more technical aspects of this management are included in the Code of Technological Practices, published under the Government Measure for open digitalisation: free software and the agile development of services, of October 2017.

Subsidiary municipal bodies must manage data responsibly, inventory and register the authorised treatment processes, identify the data's sources and its basic metadata, guarantee the data's life cycle and take users into account when determining the format and frequency of updates, as well as other data management considerations. They must collaborate with other organisations on the promotion of efficient public services in order to comply with all the transparency policies and those related to privacy, security and accessibility.

Specifically, municipal bodies must follow all the processes established by the DPO regarding strict compliance with data protection regulations, notify the Catalan Data Protection Authority about the creation of databases where necessary, and appoint the people in charge of data. It is necessary to minimise the collection of personal data, apply anonymisation or pseudo-anonymisation wherever possible, obtain the consent of the people concerned, and take into account the repercussions that every action at each moment of the data's life cycle has on every other moment and the people concerned.

GUIDING PRINCIPLES FOR ETHICAL AND RESPONSIBLE DATA MANAGEMENT

Subsidiary municipal bodies must include the following steps in their planning, budgeting and management, where appropriate:

• Municipal data must be ethically managed during its entire life cycle (creation, collection, storage, use, analysis, dissemination, archiving and destruction).

• Municipal information is managed as a common asset and its access, consultation and use by the public is made possible on the basis of the legal provisions in force.

• Activities carried out on the data in a set of metadata must be registered, following the most appropriate metadata schemes for the operations of each business.

• Privacy and security risks will be identified throughout the data's life cycle, and risk analyses and security solutions will be developed.

• Management will involve a clear allocation of roles and responsibilities in order to promote the efficient design and operation of all management processes.

The municipal bodies must provide the general public with the information in a way that is coherent with its objectives and mission, based on current legislation. Anonymised data must be provided, so that access, analysis and reuse of the data can be promoted for a wide range of purposes. The information must be publicly accessible and automated, and it must be correctly described, complete and up to date. This also includes data being available in formats that are accessible to people with functional diversity. It is necessary to consider the cost of this public service for the organisation, as the imposition of charges or public prices should be avoided.

Municipal bodies must store information in such a way as to allow interoperability between information systems and, wherever appropriate, its public disclosure by means of open formats, data and metadata standards. The organisations must also make mechanisms for obtaining feedback on the data available to the general public. Municipal finance systems must be able to reward the units that include systems for the long-term preservation of data and its access in their service contracts.

The City Council and all municipal group units must observe a set of procedures aimed at improving the acquisition of data and which make effective, economical, safe, ethical and open data management possible, as well as guaranteeing privacy. Planning has to focus on the data that supports each unit's mission, and they have to implement management processes that are integrated into budgetary programming and execution.

PLANNING AND BUDGET

Budgetary planning is an essential part of producing and maintaining a data management strategy, and it must ensure effective collaboration between the various manager's offices and directorates in this area of management.

Strategic planning: data management plans (DMP). As a support for Barcelona City Council's management needs and its mission, and as part of the general strategy and planning to improve the municipal group's processes, each unit must produce and maintain its own data management plan (DMP) that describes the objectives of IT resources, including, among others, the processes described in this strategy. The DMP must show how the map of the IT resource objectives relates to the unit's mission and priorities. The objectives must be specific, measurable and verifiable, so that their progress can be monitored.

One example of an emblematic project in the budgetary area is Open Budget, a tool that facilitates the general public's analysis and understanding of Barcelona City Council's budgets. Open Budget allows users to download data in open formats, to browse items ranging from the most aggregated to the most detailed budgetary data, for both the current fiscal year and previous years. (*http://ajuntament.barcelona.cat/estrategiaifinances/pressupostobert/ca/*).

INVENTORY

Business units will have to keep an inventory[5] of their main information systems, containers and dissemination tools, with a determined level of detail for their supervision and management. This inventory must identify the datasets containing personal information and procedures will be determined to enable regular checks that ensure this data is of the necessary quality, that it is possible to respond to the rights of the people concerned and that it is the minimum required to develop the unit's powers and functions. Each unit will also have to keep a record of all the actions taken regarding both management and analytical databases. The Municipal Data Office must determine the metadata for these systems.

MANAGEMENT OF DATA PROCESSING SYSTEMS

The units and subsidiary bodies must be able to continually facilitate the adoption of new technologies and to evaluate the entire life cycle of each information system, with an inventory of the software tools and machines associated with the system, the management and sustainability of the resources and the infrastructures supporting the system; they must actively determine the updates, revisions, substitutions and provisions needed to properly carry out the unit's functions and protect its assets, and it must ensure the terms and conditions of the contracts and other service agreements involved in the collection, processing, storage, access, exchange and availability of municipal information, which are confirmed and in line with the data-protection policy and cover the units' legal and ethical requirements.

RISK MANAGEMENT

Units must evaluate the security measures for information and data, records management, transparency, impact assessment and supply chains, and they must do so during the entire data cycle, so that the risks are assessed and managed. Furthermore, in coordination with[5]

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[5] *Each unit's inventory will be integrated into one of the municipal group's general inventories.l.*

the DPO, the CDO and the CTID, they must produce a plan so that the information systems are duly protected and ensured, while updating, revision, substitution and withdrawal are given the highest level of priority.[6] It is also necessary to periodically review and report on the risks concerning processes, people and technologies.

RESILIENCE PLAN

Municipal units and subsidiary bodies must produce a resilience plan that takes into account the management of their data. This resilience plan is crucial for ensuring services are able to continue carrying out their tasks during disruptions. It is therefore necessary for organisations to develop continuity strategies in order to ensure that services can be re-established in time to meet their objectives. "Manual shortcuts" must be part of this, so that critical operations can have continuity while normal services have not been resumed.
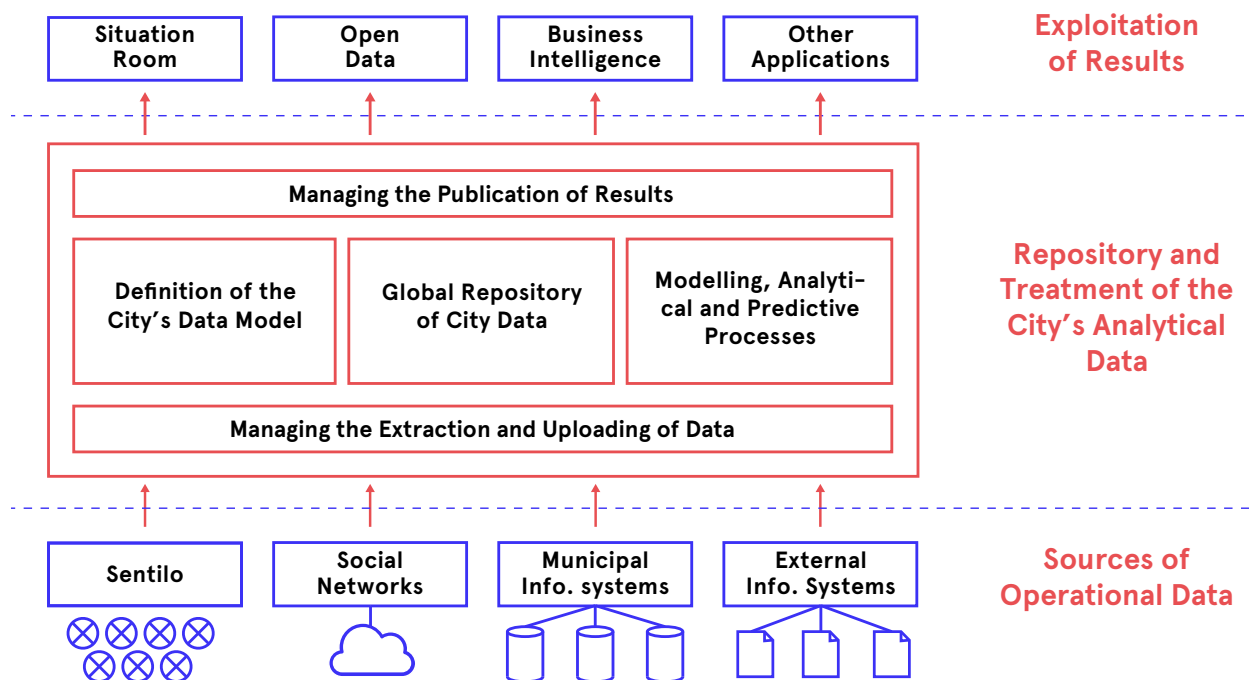
7.3. City Data Infrastructure

This line of action aims to define the conditions at the architectural level in order to make the City Council's internal management more agile, improve the services that the City Council offers city residents and facilitate the joint exchange of interesting data with society, both inside and outside the municipal government, and to ensure its preservation and continual access. The CDO and their office will be responsible for understanding the City Council's data and having a unified, documented concept of it, as well as maintaining, planning and developing its architecture by using a unified management model.

The City Council therefore has to work towards a model of grouped data from different sources in order to create common repositories for management, analysis and secure preservation.

These repositories are:

• **Data lake.** A single analytic repository is created, a data lake, where the data input and consumption or access points are centralised. These single input and access points make it possible to improve security and have better traceability. Furthermore, the data lake, which must be based on a type of big-data infrastructure, must include the availability of a precise map of the City Council's data. This means that the CDO must prioritise the possible development or definition of datasets, and the rights of data access and exploitation that are included in or excluded from the data lake. The CDO will also be responsible for ensuring data quality. This data lake is the current emblematic City OS project.

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[6] *This includes machinery, software, firmware components not maintained by their developers, salespersons or manufacturers, through the availability of pieces of software, firmware updates, spare parts and maintenance contracts.*

| Situation Room | Open Data | Business Intelligence | Other Applications | **Exploitation of Results** |

Repository and Treatment of the City's Analytical Data

Managing the Publication of Results

| Definition of the City's Data Model | Global Repository of City Data | Modelling, Analytical and Predictive Processes |

Managing the Extraction and Uploading of Data

Sources of Operational Data

| Sentilo | Social Networks | Municipal Info. systems | External Info. Systems |

City OS is a cross-departmental deposit and architecture project for the centralised, uniform storage and access of the city's data. It is the sole analytic repository for municipal data. Municipal data as a whole is stored in various systems according to the needs of use and the technology that is applied. City OS provides an analytical layer for all the data. It has been developed in such a way as to allow autonomous management of the knowledge of the variety of municipal data by the operational data-management systems. In other words, it makes data analysis and operational management independent. The data is organised according to a system of ontologies geared to creating analytical knowledge.

• **A secure, verified municipal repository:**
This repository for archive preservation must guarantee continual access to all municipal data, registers and information resources that, after undergoing archive-evaluation processes, have been selected for permanent preservation. The secure repository must guarantee the authenticity of the data it stores and avoid the obsolescence of digital materials,

while permitting the long-term sustainability of this tool.

It will be necessary to write an information policy that includes all the data and obligatory processes needed to complete the data life cycle and deposit it in the city lake or in the secure preservation repository, according to preference. In order to do this, close collaboration from the IMI (technology provider and responsible for the development and maintenance of the City Council's technological infrastructure) and from the various units and services that have their own infrastructures.

Units must develop an architectural description (AD) that details the available architecture, the target architecture and the plan to achieve the latter. Each unit's AD must be in line with the **data model** defined by the MDO. The AD must include the unit's plans for significant changes in up-dating, revisions, substitution or availability of information when the systems no longer effectively support the required needs and functions. The AD must align operational resources and technologies in order to attain

strategic objectives. The descriptive process for the present and future state of the unit helps to eliminate duplications and irrelevant data, increases shared services, maximises performance and promotes interrelation between areas. The AD must identify the functions that need access to certain systems and which profiles have access to what information and under what circumstances. Requirements must be defined, based on attributes for accessing sensitive information and they must be recorded in the logging systems.

In regard to the emblematic City OS project, various sub-projects will be carried out, such as:

• **Improvements to the ODI's API.** Improvement to Barcelona's Open Data BCN (ODI) portal, in order to focus on reuse and developers, adding APP register capacities, access control, news bulletin and improving API documents so that it is easy for developers to use.

• **IGLU.** Convergence of various datasets in a unified storage solution (data lake) using the City OS project's standardisation and API transformation, making use of new offers of key infrastructures, adapting them to a new unified operability standard.

• **API standardisation.** Defining and putting into practice standards in order to provide a guide for purchasing technology, in order to ensure the interoperability of City Council data providers.

• **Protocols for opening open data.** Defining the protocol to be followed in order to proactively include data in the open-data catalogue, in particular for municipal civil servants who are willing to do so.

• **Connection with the DECODE infrastructure:** Connecting City OS, IRIS, ASIA, SENTILO and BCNOpenData to the experimental DECODE platform (*https://decodeproject.eu/*)

7.4. Internal innovation based on data: analysis and data-based projects

Data is becoming increasingly important in the Administration. It is necessary to design a long-lasting strategy for carrying out City Council projects, based on innovative data exploitation, carrying out better analysis and using big-data methodologies so as not to fall behind society and the private sector. In this sense, it is a good idea to learn from advanced experiences in this field, and the United States is a good example.[7]

Modern organisations are characterised by the need for managing their services and processes, fundamentally with a set of databases which have multiplied in recent years and which will continue to grow in the near future. In an organisation like Barcelona City Council, efficient, coordinated and structured data management contributes to various objectives. Beyond specific, instrumental purposes for each database,

global governance must include two essential objectives in a modern public organisation:

• **Management with knowledge:** se trata de diseñar e implementar proyectos y servicios basados en datos (*data driven*) haciendo un uso intensivo de los datos, de metodologías de analítica de datos y de la data science o ciencia de datos, para adaptar los servicios a las necesidades reales de la ciudadanía, responder a problemas reales, identificar y gestionar riesgos reales y reducir errores.

• **Citizen empowerment:** returning control of their data to city residents, by means of municipal tools and processes, giving them the possibility of deciding how their data is used and for what purposes, and offering services and projects that empower city residents and give them more say on how the city is run.

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[7] *For example, see the document https://ash.harvard.edu/links/lessons-leading-cdos-framework-better-civic-analytics, May 2017.*

Barcelona City Council's need to create knowledge and intelligence has always been and continues to be of strategic importance. In recent years, the volume of information has increased exponentially (big data). However, municipal analytical tools cannot handle this volume of information properly. The available information is disperse (mostly in spreadsheets), unconnected and subject to unplanned maintenance. To counter this "hole", various initiatives have been set in motion to create a culture of accessible, centralised data and the corresponding culture to feed and, in the near future, use the platform's data. This includes City OS, the project for a centralised municipal information deposit that will facilitate the capture, preparation, organisation and analysis of data from municipal services and the general public, in order to foster these data-based projects through the City Council and outside it (see the next section on open data).

The new data culture makes it possible for information and knowledge to flow through the organisation much more efficiently. However, in today's world, it is not enough to obtain and analyse data in post-mortem processes. It is necessary to have the capacity for analysing data in real time and to be able to produce projections and scenarios using complex algorithms, in order to foresee and predict possible future situations and reduce undesired repercussions. This capacity cannot be substituted; it must be internalised by the organisation, as it is a major part of its grey matter. Until now, digital service projects have been led by sectors unrelated to data analysis or data science (IT, transactional application managers, etc.). In order to ensure that the data-analysis management model works smoothly, it is necessary to move between the old model of business intelligence, based on data selection and visualisation, and a new data-science model that leads to predictive analysis, prescriptive analysis and artificial intelligence. From this perspective, the MDO must play a relevant role in the key areas of defining and managing data, as well as those of modelling, access, metadata, quality and life cycles.

Analysis must answer the maximum number of questions relating to various areas:

• City residents: improving the general public's satisfaction with municipal management, the rationalisation of processes, increased efficiency, adaptation to new needs.

• Internal management: integrating analysis into applications and indicators.

• Risk management: enriching services with advanced analysis.

• Dissemination: providing higher value and quality to analytical products in service to the community, such as open data and statistics.

Along these lines, the **MDO** has the mission of changing the organisation's internal culture regarding data management in its projects. Given that the data and technology associated with this discipline are very new, the DMO must provide data-based analytical consultancy and solution services to the other units. These services must be accompanied by appropriate courses, ensuring that every City Council unit is progressively trained, so that they understand the methodology of a data-based qualitative focus on city problems. It must also lead an internal transformation, in order to "evangelise" the organisation in data culture, by means of internal workshops and seminars. Within the DMO, a**n analysis area** must be created that offers internal services to various City Council areas, in the form of "internal consultancy", with one part dedicated to solving problems and also training personnel from each department on how to use the developed tools.

As integral analytical elements, the DMO and the analysis area must also collaborate in order to establish the vision and strategy for all initiatives geared towards council data, the exchange of knowledge about data-administration policies, standards and good practices, as well as aligning technological tools to needs of use.

The emblematic projects in this area are:

• **Comprehensive Information System for Barcelona Economic Areas and Activities (EIAE):** the creation of a corporate reference database for strategic analysis in the area of local economic development.

• **Monitoring gentrification:** providing information and data in order to define responses addressed at stopping the expulsion of local residents and retailers from city neighbourhoods.

• **Municipal Management Dashboard:** a data-visualisation tool that explains the state of the city in real time.

• **The Barcelona Metropolitan Housing Observatory:** Barcelona City Council, the Barcelona Metropolitan Area, Barcelona Provincial Council and the Regional Government of Catalonia have jointly created a supra-municipal instrument for analysing and consulting housing data. It is presented as a major tool for city residents and administrations in questions relating to housing. It is an instrument for evaluating and designing housing policies and designing and consulting available housing data.

7.5. Barcelona Data Exchange: external data enhancing

Barcelona City Council collects and regularly publishes an important set of data, statistics, indicators and sectoral studies concerning the city and its surrounding area, so that urban leaders, people in the field of research, consultancies and the entrepreneur community and the general public can get precise knowledge about the city, socio-demographic dynamics, the economy, the urban area, the general public's opinion on various subjects, etc.

The objective of this work is to create the BCN Data Exchange, an essential part of data commons, and to organise, centralise and improve the formats, the reusability (through interoperability) and access to the data published by the City Council, from a technical perspective (based on City OS) and a relational perspective, and establish contact with groups of Barcelona data users and reusers and attempt to show our concept of data as a public asset that must be shared under clear and transparent regulations.

The BCN Data Exchange project aims to connect the city to data stakeholders, understand their perception of data and try to build a framework that encourages the responsible use of data and for data to be seen as a provider for creating solutions and services rather than as an owned asset that offers an advantage. Furthermore the city will listen to their contributions on matters relating to public tenders and data-exchange practices.

This line of action includes tasks dedicated to processing and publishing city data, with the infrastructure needed to do so, and to involving a community of professional data users and proactive data consumers (prosumers) in a constructive dialogue, covering the data as a whole and the opening of infrastructures.

A major part of this information, which includes data of various kinds and formats (raw data, indicators, statistical tables, opinion studies, surveys, maps, sectoral analyses, etc.), is collected and published manually or semi-automatically through various municipal departments and websites.

• **BCN Statistics**, which includes access to nearly 36,000 of the city's statistical tables, information by district and neighbourhood, the historical archive of statistics year books in PDF, as well as an application for consulting and the dynamic generation of displays. Barcelona City Council's Statistics Department specialises in the theory and practice of collecting data and the analyses and presentations needed to turn them into useful information.

• **Open Data BCN** began in 2010. The portal was presented in 2011, in order to make certain datasets available to the general public, including open data, or opening up public sector information and allowing access and reuse for the common good and for the bene-

fit of interested individuals and organisations. The Open Data BCN project, which covers various pillars of the city's strategy, is based on the main international standards and recommendations and adopts some characteristics that sum up the principles of this movement.

• **BCNROC** is Barcelona City Council's open-access institutional repository, through which the Council provides free access to its public digital documents. BCNROC is an advanced search engine, using modern search technology, that includes extensive descriptive metadata in order to ensure that individual users have a good experience in searching for and reusing information. BCNROC eliminates economic, technological and legal barriers for accessing municipal digital documents and it aims to guarantee permanent access to those digital files. This tool makes it possible to collect, store, manage, share, transform and disseminate municipal information resources and the associated metadata, as well as facilitating searches and being able to access and reuse them at a later date.

• **CBAB** is the catalogue of Barcelona City Council libraries that contains descriptive metadata on the internal and external information resources that Barcelona City Council needs for its everyday work, and offers a direct link to online resources, which are available to the council and all city residents, who can consult them directly or ask to borrow them through SEDAC.

• **Barcelona Economía** is the Barcelona City Council website that monitors the city's economy, based on collection and evaluation of how the main situation indicators for Barcelona and its Metropolitan Area are behaving. Barcelona Economia includes a large number of mainly economic tables and graphs, grouped by sub-themes, which are usually accompanied by a brief analysis, as well as PDF documents on the economic situation, historical publications, etc.

· The **Survey and opinion-poll registry** includes opinion polls commissioned by the City Council on the evaluation of services, use of time, mobility, cultural consumption, etc. Some of the results are already included in the

statistics portal, in table format, while others are in document format.

• The **Geoportal** and web services for Barcelona City Council's Spatial Data Infrastructure make municipal territorial information available through the website using Open Geospatial Consortium (OGC) standards. The need for creating a geoservice infrastructure stems from a demand for both internal and external management concerning the interoperability of territorial information.

• **CartoBCN:** is a website for downloading Barcelona City Council cartography, aimed at end users. It is a Department of Basic Information and Cartography project which aims to become Barcelona City Council's centre of cartographic production.

With the aim of facilitating and promoting the use of all this accumulated information and knowledge, Barcelona City Council plans to design and set in motion **a new portal for consulting and exploring information**, based on City OS, which centralises all the currently managed and published information and documents in a single website, i.e. to create the **Barcelona Data Exchange**, with various objectives:

• To centralise all the currently managed and published information and documents in a single website environment.

• To offer a new consultation experience that is more dynamic, interactive and graphic, where users can quickly explore the wide range of information available.

• To add new functions for consuming, sharing and disseminating information related to Barcelona, addressed to various user profiles: city residents, students, technical and research personnel, etc.

• To open up a new environment for exploring and consulting information that is freer, more direct and more user-friendly.

• To offer a new way of presenting more graphic and more interactive information, with greater capacity for sharing.

• To have a new data architecture connected to the City Council's City OS, which makes it possible to explore and show a diverse range of content (data in various formats for later exploration, PDF documents, pages and posts in HTML, etc.) and where it is easier to administer and manage content.

This new Barcelona data portal will be aimed at users with different profiles and needs, from municipal political and technical personnel, who need to have access to vital, complete information on the dynamics which affect their decision-making, to normal city residents who are looking for specific information or who are curious about some urban information or indicators. This involves controlling security, by applying various profiles and functions. Between these extremes there are researchers, journalists and students, who have different needs, in terms of the type, quantity and amount of detail given in city information.

With regard to the city's current data repository and website projects, the Barcelona Data Exchange will improve access to information and compliance with FAIR principles for open scientific data with interoperable data and standard formats.

• Improving the access and interoperability of municipal statistical data on the city as a system and its socio-economic, demographic and urban planning reality, with reliable statistical data that is efficient and up-to-date, and now interoperable and standardised.

• As a central feature of the "Barcelona Digital City" data strategy, improving the functions of Open Data BCN will foster a plural digital economy with a new model of urban innovation based on the digital transformation and innovation of the public sector and collaboration between companies, administrations, the academic world, organisations, communities and people, with clear public and citizen leadership.

• BCNROC's current stock of municipal documents already acts as a sole repository, used by the other municipal websites that disseminate municipal documents, and it will now be incorporated into the Barcelona Data Exchange. It's

information is interoperable with other national and international open-access repositories, as it supports the OAI-PMH (Open Access Initiative Protocol for Metadata Harvesting) standards and protocols and enables the reuse of documents using the most open Creative Commons licenses possible. It also complies with the Dublin Core metadata standards to help facilitate the Semantic Web. These principles will be extended to the other datasets, whose managers will be able to make good use of the experience and competence of those in charge of BCNROC.

• Similarly, the Barcelona Economia data will be more usable, and the ongoing register of indicators will be made available to the public in an organised series of data, as well as the information and evaluation of methodological changes carried out to obtain them, which are relevant for interpreting their evolution over time.

In this sense, initiatives for the "external" publication and evaluation of data include actions such as:

• Using and correlating existing data-science initiatives under the name of the City Council, in order to generate a space in the Open Data BCN portal where selected scientists can contribute and maintain data.

• Using the "NUMA DataCity" programme to set challenges for resolving city problems and promote the conscious positioning of the common-data programme's objectives for entrepreneurs and emerging companies.

• *Opening WiFi data:* an API service providing access to Barcelona WiFi data while also complying with privacy obligations.

• *Opening Sentilo data:* will be made accessible to a wider public, with a protocol and API for official access to Sentilo, in order to consult information, and the appropriate documentation of all the datasets present on the platform.

The emblematic projects in this area are:

• **BCN Data Store:** this will be the public library for services, easy to use and scalable as the services offered by the Municipal Data Office are developed.

• **BCNOpenData:** the improvements to BCNOpenData's functionality make it possible to access and reuse the data generated or kept by public bodies, for the common good of interested people and organisations.

• **Data City Challenges:** ensuring the utmost efficiency in the services offered by the City Council, we will use datasets and the city as an experimental model for seeking solutions to major urban problems.

Emblematic projects

The programme relating to the application of a new strategy that uses data in decision-making. It is described in previous sections and will be deployed throughout the organisation, in a cross-departmental, multi-disciplinary way, by setting in motion a set of projects.

These projects are structured around the creation of the Municipal Data Office and the development of a new architecture, where the launching of the new design of repository for data-lake information will be used to support the entire data strategy, implemented through the projects described below, as well as all other future projects.

In this section, we present and provide a brief description of the most relevant projects to be undertaken in relation to this data programme, some of which are at an advanced stage, and which are known as "emblematic projects" because of their content and relevance.

1. The Municipal Data Office	**2. City OS**
3. Open Data BCN	**4. DECODE**
5. Data City Challenge	**6. Data Exchange**
7. Control Panel for the Municipal Manager's Office	**8. Monitoring gentrification**
9. Economic Activities Census	**10. Housing Observatory**

8.1. The Municipal Data Office

The Municipal Data Office is a directorate that includes various areas and departments that are responsible for council data, and it is charged with overseeing the application of this measure. It is located in the Municipal Manager's Office and it answers to the Commission for Technology and Digital Information. It is responsible for the management, quality, governance and exploitation of data relating to Barcelona City Council and all its associated bodies (public and private) that provide services to the general public.

In particular the department of Data Analytics will be created in the DMO. This is an office for analysing multi-disciplinary data and it will oversee the proper management of and respect for the general public's digital rights. It will use public data to provide information that helps to resolve the challenges facing the city, as well as providing services for the various municipal units. It will also have a role in the internal training and encouragement of City Council personnel.

8.2. City OS

City OS is an advanced data analysis platform with a unified concept of the city's information, based on free and open-code products that will be offered to the community. It will help to detect problems in the city, shorten response times and improve public services by applying descriptive, predictive, simulation and modelling analysis, as well as pattern recognition. The City Council's manager's offices and service departments will be able to use this data platform to make a more accurate analysis of information and therefore implement better public policies for the general public.

8.3. Open Data BCN

The Open Public Data movement is promoted by public administrations, and its main objective is to make the best possible use of available public resources, publish the information generated or kept by public bodies and to allow access to it for its reuse for the common good and for the benefit of interested individuals and organisations.

The Open Data BCN project began in 2010 and has since been evolving to foster a plural digital economy while developing a new model for urban innovation based on the digital transformation and innovation of the public sector and the involvement of companies, administrations, the academic world, organisations, communities and people, under clear public and citizen leadership. The Open Data BCN project, which covers various pillars of the city's strategy, is based on the main international standards and recommendations and adopts some characteristics that sum up the principles of this movement.

· Open data by default

· Quality and quantity of information

· Data for everyone

· Data for improving governance

· Fostering innovation

8.4. DECODE

DECODE is a European pilot project being developed in Barcelona and Amsterdam to manage data sovereignty in a shared economy. The technical solutions being developed in this project will be used to improve services for citizens, making them more secure while further safeguarding data ownership and control. DECODE will explore how to build a digital economy focused on data, where the data generated and compiled by the general public, the internet of things and the network of sensors will be available for the common good (data commons), safeguarded by appropriate privacy protection.

As a result, innovators, emerging companies, NGOs, cooperatives and local communities can make use of this information to create applications and services that respond to their needs and those of the community in general.

8.5. Data City Challenge

Continuing with the approach of maximising the use of resources (data) in order to improve the efficiency of City Council services, Data City Challenges will use datasets and the city as an experimentation model for seeking solutions to major urban challenges (housing, unemployment, exclusion, health, energy and mobility) and they will develop prototypes with the most skilled stakeholders in the innovative ecosystem. These projects (challenges) will make it possible to test and subsequently adopt clearly defined and delimited solutions, while fostering collaboration between emerging companies, other companies and the public sector. It will encourage the use of data for the common good (data commons), improve public services, foster the economy and social return on public spending.

8.6. BCN Data Exchange

The BCN Data Store, to be developed by Barcelona City Council, is one step further along the path initiated with the BCNOpenData project. It aims to facilitate access to the data kept by the city, people and organisations for the common good (data commons).

It will also develop a philosophy that emphasises the exploitation of the city's data in all areas of the city's political activity and will help to promote a clear "city data market" culture of exchange for both the public and private sectors.

BCN Data Store will be a public library for services, easy to use and scalable as the services offered by the Municipal Data Office are developed. In order to bring this about, the "platform as a service" (PaaS) concept will be used.

It will include communities and social groups in all services and will try to establish a network of people, member bodies, members, reviewers, friends and followers. This strategy must allow day to day improvement and maintain direct contact with the general public, as well as with data-science professionals (from research or companies) and students.

8.7. Municipal Management Dashboard

In addition to developing a dashboard for the government team, there will also be a free application for city residents that shows a summary of strategic indicators and provides data on City Council services, along with management indicators for their projects, progress made on accomplishing government commitments, the general public's evaluations, etc. This service is an important step towards greater transparency in municipal management and public scrutiny.

8.8. Monitoring gentrification

Monitoring gentrification is a cross-departmental City Council project that aims to define ways of stopping the expulsion of local residents and retailers from city neighbourhoods. Furthermore, the idea is to also design and implement a coordinated strategy of measures and actions that neutralises and reverses gentrification processes in the city, by defending city residents' rights in their neighbourhoods.

This is one of the city's most urgent, key projects, and it requires a complex analysis in various areas, including population, housing, economic activities and tourism. For this project, our mission is to identify the key variables involved in this process, define the gaps in information and provide an analysis and diagnosis that can be used as a basis for establishing new policies that can tackle this problem.

8.9. Comprehensive Information System for Barcelona's Economic Areas and Activities, EIAE (Economic Activities Census)

Barcelona City Council's Department of Commerce is promoting the development of the Comprehensive Information System for Barcelona's Economic Areas and Activities, (EIAE), with the aim of responding to the lack of comprehensive information on economic activities, as well as areas that are liable to contain them, through the creation of an information system that integrates and normalises date on economic activities.

This database will be the municipal reference for the strategic analysis of local development.

Furthermore, it will form the basis for building up products and services addressed to the city's commerce and local economic structure, both internally and for external developers, who are service providers in this area.

Conceptually, it will be an open node within the information-systems network. IT applications, and especially the integration system (internal and external interoperability) will be built with the new agile development methodology using free and open-source software.

8.10. Housing Observatory

Barcelona's Housing Observatory is a supra-municipal instrument founded with the aim of providing a holistic perspective on housing, in order to tackle housing problems in the Barcelona Metropolitan Area. It is promoted by various administrations: Barcelona City Council, the Barcelona Metropolitan Area, Barcelona Provincial Council, the Generalitat of Catalonia and the Association of Social Housing Managers (GHS).

Knowledge concerning the housing sector and the residential situation of the population from various angles is a primary need and an essential condition for designing sensible, rigorous and effective strategies and public policies. The Observatory is therefore an instrument that is able to provide all the necessary information and tools for evaluating and designing policies that must be undertaken in this area. Additionally, as society has advanced in terms of knowledge and the democratic demand for information, it must also be a body that provides city residents with information.

The aim is to fill in the information "black holes" while also providing detailed information about the territory, which is often not available in large, wide-ranging statistical operations.

Budget and schedule

The schedule for carrying out the emblematic projects relating to the new municipal-data strategy is as follows.

Project	Budget	2018				2019	
		Q1	Q2	Q3	Q4	Q1	Q2
The Municipal Data Office	680 K	███	███	███			
City OS Services	1.132 K	███	███	███	███	███	███
BCN Open Data	56 K	███	███	███	███	███	███
DECODE	545 K	███	███	███			
Data City Challenge	180 K	███	███	███	███		
BCN Data Exchange	130 K	███					
Municipal Management Dashboard	235 K	███	███				
Monitoring gentrification	Recursos propios	███	███	███	███		
Census/EIAE	500 K	███	███	███			
Housing Observatory	349 K	███	███	███			

Appendices

09.1 DIRECTIVE CONCERNING MUNICIPAL DATA GOVERNANCE AND THE MUNICIPAL DATA OFFICES