Deliverable due date: M60 – November 2021 (Final version)

D2.12 – Cross-modal Mobility Observatory

WP2, Task 2.5 (Subtask 2.5.5)

Transition of EU cities towards a new concept of Smart Life and Economy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Project Acronym	mySMARTLife
Project Title	**Transition of EU cities towards a new concept of Smart Life and Economy**
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Work Package	WP2
Lead beneficiary	Cerema (CER)
Contributing beneficiary(ies)	Nantes Métropole (NAN)
Task description	Subtask 2.5.5: Cross-modal observatory on mobility. In this subtask led by NAN, a succession of thematic observatories in silos will be integrated to set up an intelligent tool for feeding automatic track of data, monitoring change in the mobility policy, by crossing data with demographics, socio-eco data and compile key data on mobility and making available to partners and / or the general public a wide range of certified and explained data. To do this, in this subtask it will be developed the observatory data base, connection of the observatory data base to the urban platform and open data developments to be used by third-parties to develop mobile applications that will simplify travel and multi-modality.

Date	Version	Author	Comment
29/11/2019	1.0	P. NOUAILLE (CER), G. CHANSON, C. CUVELIER (NAN)	Interim version
15/09/21	1.1	P. NOUAILLE, L. DECROS, W. LECOINTRE (CER), G. CHANSON, M.JANICKI (NAN)	Version to be reviewed
16/11/21	1.2	P. NOUAILLE, L. DECROS, W. LECOINTRE (CER), G. CHANSON, M.JANICKI (NAN)	Final version

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Abbreviations and acronyms

Acronym	Description
AADT	Average Annual Daily Traffic
API	Application Programming Interface
CNIL	Commission Nationale de l'Informatique et des Libertés
GIS	Geographic Information System
INSEE	Institut national de la statistique et des études économiques
mySMARTLife	Transition of EU cities towards a new concept of Smart Life and Economy
LiDAR	Light Detection And Ranging
LOM	Law on the Orientation of Mobility
SNCF	Société nationale des chemins de fer français
TER	Train Express Regional – Regional Train
Traffic PC	Poste de Contrôle de la Circulation – traffic control room

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1. Executive summary

As part of the definition and evaluation of its travel policy, Nantes Métropole wanted to structure and perpetuate its mobility observatory through the MySmartLife project. The objectives of the observatory are to facilitate the collection and use of mobility data, to produce knowledge that is accessible to all on the changes observed in terms of travel and to facilitate the evaluation of policies in this area.

The starting point for the observatory is an annual publication produced in 2017, covering 9 themes within the remit of Nantes Métropole: public transport, cycling infrastructure, parking, pedestrian areas, traffic accidents, traffic fluidity, mobility services, school mobility services, interurban buses and regional trains. In this first version of the observatory, the data sets scattered among the services have to be collected every year, the source data are not shared and the process of calculating the indicators is not automated.

Although the publication provides a set of reliable indicators, its production is not optimized and its form does not meet all the needs identified (access to source data for the city's internal services, a communication document for the general public, historical data for policy evaluation, feeding the open-data platform, etc.).

At the same time, a single metropolitan GIS is being set up: all of the metropolis' data sets are gradually being brought together, replacing several tools that coexist in the various services. This common portal is an opportunity for the overhaul of the mobility observatory, which can rely on this common tool that centralizes and makes the data sets more reliable.

In this context, the time required to deploy the GIS has enabled Nantes Métropole to gradually consolidate the objectives of the mobility observatory, to adapt the content and form of the observatory, and to arrive at a tool that best meets its needs. Thus, the work of redesigning the observatory took place in several stages, defined progressively according to the subjects to be studied in depth:

- **1st stage**: an exploratory work enabled the transfer of the observatory to a digital version based on Opendatasoft technology, which calculates indicators and creates dashboards and graphs from data layers published in open data by Nantes Métropole. This test solution, implemented while awaiting the migration of the metropolitan GIS, made it possible to qualify the available data sets and to question the functionalities expected for the observatory. This first stage revealed the weakness of the available data on road and cycle facilities. In addition, this first attempt at a digital version of the observatory led to questions about the technical characteristics of the mobility observatories set up by other cities, and more broadly to identify their objectives and operating methods.

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- **2nd stage**: following the exploratory work, two initiatives were launched in parallel: a benchmark of mobility observatories in France and a field inventory to consolidate the data relating to road and cycle facilities in Nantes Métropole:
    - **benchmark of mobility observatories in France**: seven observatories deployed in the cities of Bordeaux, Grenoble, Marseille, Rouen, Rennes, Strasbourg and Toulouse were analyzed. Through a summary of the main characteristics of the observatories studied, the benchmark presents a range of possible options on governance, geographical scope, objectives, indicators and communication tools. It emerges that, in general, beyond the function of collecting and centralizing certified historical data sets on mobility, the observatory is also most often a partnership structure, which brings together the territory's stakeholders to share data and produce collective knowledge on mobility issues.
    - **Field inventory of road and cycle facilities**: an inventory of traffic rules, parking and cycle facilities was carried out on the whole of Nantes Métropole's road network using high-performance systems (car and bicycle equipped with cameras and GPS). The analysis of the videos made it possible to build up detailed geographical data layers, considerably enriching the knowledge of the facilities.
- **3rd stage**: work on the choice of indicators and communication methods was carried out in thematic workshops, by combining the lessons learned from the benchmark, the needs of services and the availability/reliability of data. At the same time, the governance and geographical scope of the observatory were defined, initially limited to Nantes Métropole and its service providers. In the end, the observatory offers 4 means of consulting mobility data within the Nantes Metropolitan area:
    - summary dashboards by theme, for internal use by departments via the metropolitan GIS, allowing consultation of indicators in the current situation and source data maps, as well as historical data since 2007 on a selection of indicators;
    - the source data layers in open-data (deployment in progress);
    - a detailed technical publication for professional use, whose indicators have been enriched compared to the 2017 publication, calculated from the synthetic dashboards which make it possible to freeze the situation at the end of the year in order to retain the representative value for the past year;
    - a one-page summary publication for the general public, in the form of an infographic, presenting some fifteen key mobility figures.

At the end of the project, Nantes Métropole has a mobility observatory, based on existing data portals, used daily and maintained: the metropolitan GIS for data sources, and the Nantes Métropole Open Data site. The decision not to develop an additional portal dedicated solely to the mobility observatory was clearly

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motivated by the need to ensure the sustainability of the approach, which requires significant human and financial resources to regularly update the data and make it reliable. In the medium term, the Observatory's development prospects are in line with this approach, by directly collecting computerized data flows from external partners to lighten the data collection process, and by using the open-data channel to disseminate the historical series of Observatory indicators in addition to the detailed publication.

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2. Introduction

2.1. Why a cross-modal mobility observatory in Nantes Métropole?

Nantes Métropole, a public structure for inter-municipal cooperation, brings together 24 municipalities in the Nantes urban area. It covers an area of more than 520 km² and has more than 656,000 inhabitants.

Transport and mobility management is one of the main fields of responsibility of Nantes Métropole, which concerns all residents and companies. Indeed, mobility is one of the essential factors in the quality of daily life and in the attractiveness and economic competitiveness of the Nantes urban area. Mobility is also an essential sector in the fight against climate change and for the reduction of greenhouse gases emissions. Finally, with more than 138 million euros of investment expenditure in the 2021 budget, it is the main budget item for the metropolis.

These elements partly explain the need for Nantes Métropole to have tools at its disposal to accurately track changes in residents' mobility practices, to monitor progress in the implementation of transport projects, to detect any malfunctions and to evaluate the effectiveness of the policies and resources deployed in the mobility field.

However, the management of transport and mobility requires to act in many and varied areas: public transport (network development, definition of service levels, pricing policy, etc.), parking, urban logistics, new mobility services, promotion and development of soft modes of transport (walking, cycling), development of the road network, signage and road maintenance, etc. Over time, this diversity of fields of intervention has led to the development of many management, knowledge and monitoring tools. These "thematic oriented" tools are specific and adapted to each of the fields of intervention for which they have been designed. As a result, they have led to the fragmentation of data and information into thematic knowledge silos. In addition, the delegation of the operation and management of certain mobility services to external operators (public transport network, bicycle services, car parks, etc.) may partly restrict access to certain data for Nantes Métropole Mobility Department. This organization of data and information thus makes it more difficult to carry out cross-analyses in order to obtain an overall view of the mobility issues at the Nantes urban area level and, in the long-term, to propose elements to assist decision-making.

This is why, as part of mySMARTLife project, Nantes Métropole wanted to develop and implement a new tool: the cross-modal mobility observatory. This project is also in line with the adoption in December 2018 of the new Urban Mobility Plan. This plan defines the main objectives and the strategy of Nantes Métropole for the period 2018-2027 in terms of transport. It sets out the main principles for the organization of passengers and freight transport, traffic and parking. It aims to reconcile accessibility for all, daily mobility

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and ecological requirements, while serving the quality of life of the inhabitants of the 24 municipalities of the metropolitan area.

The first objective of the cross-modal mobility observatory is therefore to constitute a tool for the Urban Mobility Plan and more generally for Nantes Métropole's public transport policy. However, it must also be a transversal knowledge tool on mobility issues, enabling the Mobility Department of Nantes Métropole to respond to internal (elected officials, General Management, other thematic Departments) or external (partners, journalists, even residents) requests.

Built on a new digital information system, the mobility observatory must therefore contribute to:

- Access by all Nantes Métropole Departments to the technical information required for the study of a district of the agglomeration or for the implementation of a project. The interface that will be developed will be an “entry point” for accessing all the available data in the field of mobility. It will also allow cross-analyses, cartographic representations and their distribution.
- Dissemination of Open Data to encourage experimentation, the development of new knowledge and even the development of new services in the field of mobility (or in other sectors).
- Publication of communication documents, annual reports (communication of indicators, monitoring and assistance in the evaluation of public policy, etc.)

The purpose of this deliverable is to describe the content of this new cross-modal observatory, its operation and technical characteristics, but also to review the various stages of its construction:

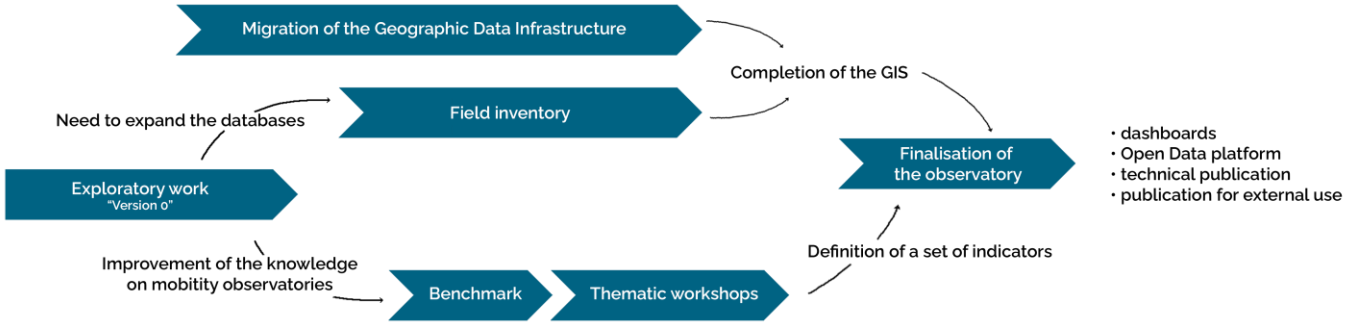

Figure 1: Stages in the construction of the multimodal mobility observatory

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2.2. Contributions of partners

The following table depicts the main contributions from participant partners in the development of this deliverable.

Table 1: Contribution of partners

Participant short name	Contributions
CER	Leader of the deliverable, drafting of the deliverable, carrying out the benchmark of observatories
NAN	Leader of the action; Contribution to the deliverable: providing of technical information and data

2.3. Relation to other activities in the project

The following table depicts the main relationships of this deliverable to other activities (or deliverables) developed within mySMARTLife project and that should be considered along with this document for further understanding of its contents.

Table 2: Relation to other activities in the project

Deliverable Number	Contributions
D2.1	Nantes city audit and baseline assessment of the Nantes demonstration area
D5.1	Integrated evaluation procedure
D5.2	Definition of the data sets and requirements
D5.3	Monitoring programs and deployment in the three lighthouse cities
D2.8	Development of improved services in Nantes Urban Platform

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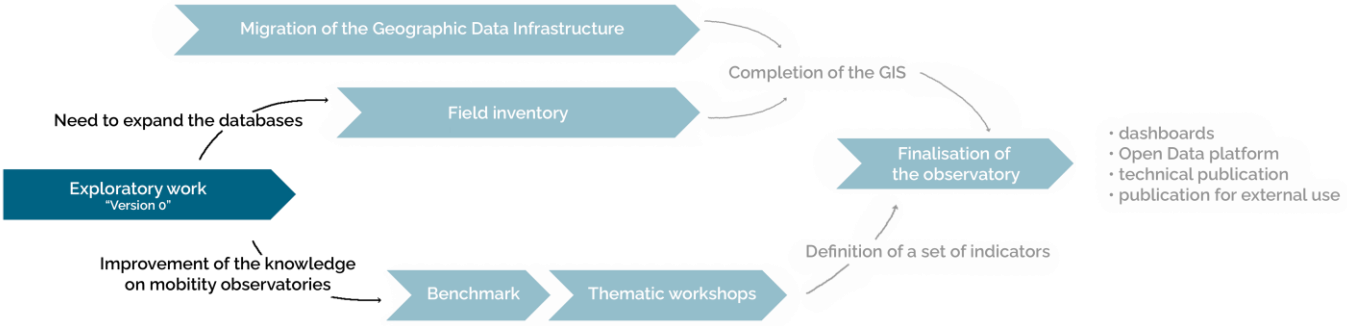
3. Exploratory work

This section describes the exploratory work carried out at the beginning of the process. This section describes the exploratory work carried out at the beginning of the process. This stage enabled a better definition of Nantes Métropole's needs; it also enabled an initial inventory of the existing data assets to be carried out.



3.1. Reminder of the objectives and the approach adopted

The purpose of the mobility observatory is to be a tool for monitoring public travel policy. It must collect and synthesize information in order to assist in decision-making. To do this, it is necessary to be able to access reliable information, i.e. up-to-date and certified data that are available in a centralized space. This makes it possible to gain in consistency and to carry out the analyses necessary for knowledge of mobility and monitoring the impact of public policy. Figure 2 shows the ambition of Nantes Métropole concerning the functioning of the mobility observatory.

The work first focused on identifying the available data and looking for possible responses to the need to produce and centralise a set of mobility indicators for reference. At this stage of exploratory work, two prototypes of the observatory were drawn up and made it possible to specify the characteristics expected from the final version.

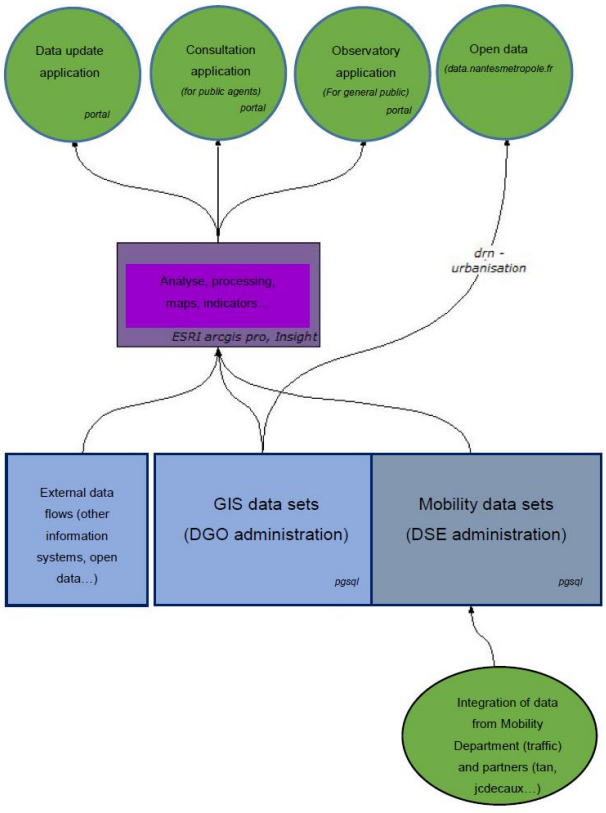


Figure 2: Projected operating principle of the observatory (source: Nantes Métropole)

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3.2. Inventory of mobility data assets among Nantes Métropole services

On the basis of these objectives, the first step consisted in carrying out a complete inventory of the data assets relating to mobility issues available within the Mobility Department of Nantes Métropole. The inventory also covered any data sets related to mobility issues but hosted by other Nantes Métropole units (for example, within Nantes Métropole's local centres1). Each identified dataset was described according to the following analysis grid (extract in Figure 3):

- general description: name, description, access path, data type, volume;
- life cycle: owner, producer, manager, update frequency/modes/dates;
- technical elements: production application, updating, format, storage, typology;
- possible access restrictions;
- conservation: CNIL (Commission Nationale de l'Informatique et des Libertés) declaration, conservation period, archiving;
- uses of the data: referential data, internal/external sharing, consuming applications;
- utilization rate: internal, external;
- data quality and metadata.

Général						Cycle de vie				
Nom de la donnée	Chemin et Nom de la table	Description de la donnée	Mots-clés	Nature de la donnée	Volumétrie horodatée	Propriétaire	Producteur	Nom gestionnaire	Email gestionnaire	Nom gestionnaire NM si producteur externe
Accidents corporels	R:\SIG\MAPINFO\Donnees\Commune\Nantes\Metier\Voirie\Accident\ACCIDENT_5ANS_P	Localisation des accidents sur les voiries métropolitaines	Accidents, Blessés, Date	géographique	2 Mo - 15605 accidents corporels de 1996 à 2016	NANTES METROPOLE	Police Nationale, Gendarmerie, DDTM 44	Brigade Accident et Délits Routiers(Police Nationale), Escadron Départemental de Sécurité Routière(Gendarmerie)		N Sucheyre
Aires	R:\SIG\MAPINFO\Donnees\Commune\Nantes\Metier\VOIRIE\CIRCULAT\VO_PIET\Aires	Visualisation des aires piétonnes sur Nantes	Voie, Piétonne, semi-Piétonne, Accès Controlé, Lieu, Rues	géographique	18 Kms au 10/2017	Nantes		DET		N Sucheyre / P Patourel
	R:\SIG\PrivateMapinfo\									

[1] In addition to the thematic services of the head office, Nantes Métropole also has services located in 7 local centres, responsible for the development and maintenance of public spaces, economic development and sanitation, within their perimeter (which generally covers several communes - see: https://www.nantesmetropole.fr/institution-metropolitaine/poles-de-proximite/les-poles-de-proximite-22944.kjsp).

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				Technique					
Email gestionnaire NM si producteur externe	Fréquence de mise à jour	Modalités de mise à jour	Date de mise à jour	Application de production	Application de mise à jour	Format	Localisation stockage	API publique disponible	API privée
noel.sucheyre@n	Mensuelle	Automatique	Saisie	Logiciel de BAAC (import de données texte)	Concerto	Excel, MapInfo	Collectivité	N	N
noel.sucheyre@n patrick.patourel@	Au fil de l'eau	Saisie	Saisie		MapInfo	Excel, MapInfo			

1	Général		Technique						
2	Nom de la donnée	Chemin et Nom de la table	Application de production	Application de mise à jour	Format	Localisation stockage	API publique disponible	API privée disponible	Typologie
6	Accidents corporels	R:\SIG\MAPINFO\Donnees\ CommUrbNmetier\Voirie\ Accident\ACCIDENT_5ANS_P	Logiciel de BAAC (import de données texte)	Concerto	Excel, MapInfo	Collectivité	N	N	structurée
7	Aires	R:\SIG\MAPINFO\Donnees\ Commune\Nantes\Metier\ VOIRIE\CIRCULAT\VO_PIET\ Aires		MapInfo	Excel, MapInfo				

Restrictions d'accès éventuelles		Conservation					Usages de la donnée		
Données sensibles ou personnelles ?	Restrictions d'accès	Déclaration CNIL ?	Durée de conservation définie ?	Valeur durée de conservation	Archivage	Précisions éventuelles sur l'archivage	Référentiel	Référentiel à créer	Partage interne
N	S/O	N	N	?	O	?	O	N	Oui, avec l'ensemble de l collectivité

Figure 3: Analysis grid of the dataset (extract)

The inventory identified nearly 350 mobility datasets, covering the following themes:

- road safety (number of victims, causes of accidents, etc.)
- school transport
- cycling policy (bicycle infrastructure, bicycle parking spaces, etc.)
- pedestrian areas (area, location...)

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- urban public transport (use, equipment and vehicles, fare system, etc.)
- intercity buses and regional trains (use, user profile, level of service, etc.)
- road traffic (inventory and characterization of streets and roads, traffic levels, etc.)
- urban logistics (number of deliveries, etc.)
- parking (number and location of parking spaces, uses, etc.)
- mobility services (car sharing, car pooling, route planner, etc.)
- transport-related noise

However, these data are scattered in several directions and their use systematically requires checking with the thematic referents to ensure that they are kept up to date. The formats also vary widely (spreadsheets, GIS data, maps, reports, etc.). The inventory therefore clearly confirms the need to pool and certify data as a prerequisite for the production of recurring mobility indicators that should be used as a reference. From these observations, we also understand that the cross-referencing of data seems complex, and yet one of the challenges of the observatory is to allow for better transversality between services.

Yet, this inventory made it possible to identify missing data, which was nevertheless deemed essential for the observatory. An additional field inventory (see part 6) was then necessary in parallel with the work of constructing mobility indicators.

3.3. First publication of a collection of mobility indicators

The first prototype observatory, named "Version 0", is a publication presenting an overview of key mobility indicators at the scale of the Nantes Métropole and is based on the infrastructure and data already in place. This 19-page document (Figure 4) was published in 2017 (which serves as the reference year) and covers nine areas:

- public transport
- cycling infrastructure
- parking
- pedestrian zones
- traffic accidents
- traffic fluidity
- mobility services
- school mobility services
- intercity buses and regional trains

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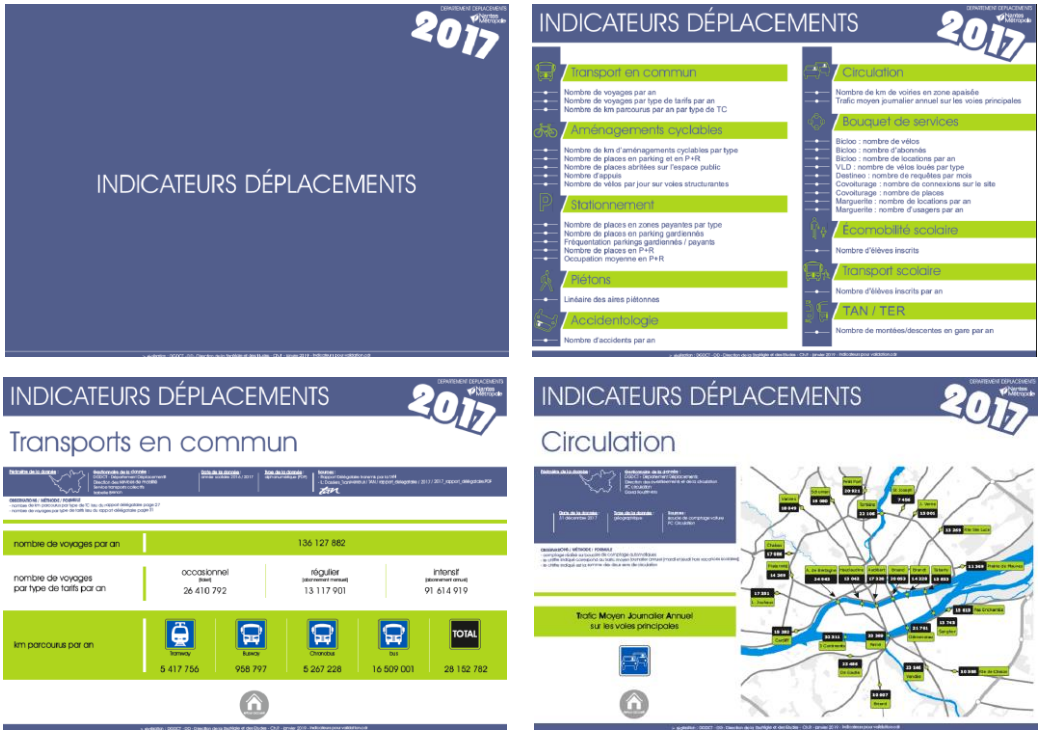

Figure 4: Extract from the 2017 publication (source: Nantes Métropole)

This publication is the first step in the centralisation of a set of certified mobility indicators, available and shared between the various departments of Nantes Métropole. The aim was to cover all the areas of transport for which Nantes Métropole is responsible and to offer a limited number of indicators for easy access.

Nevertheless, at this stage, the indicators are generally calculated or collected by the various thematic referents in the departments, and are then compiled in the publication. The source data are not necessarily pooled, and the processes for calculating the indicators are not automated. Yet, his first publication constituted an initial approach and allowed for an initial exchange of views on the definitions of the indicators (for instance what is a bicycle facility).

For example, the data on public transport come from the annual report of the operator (SEMITAN), a document provided in pdf format in which the figures used to obtain the indicators must be found. Another example, road traffic data (average annual daily traffic - AADT) are produced by Nantes Métropole from the automatic counting loops installed on the road (Figure 5). The service in charge of these counts, the Traffic PC in the Department of Mobility, must provide geographical data compatible with the GIS, and this element had to be developed during this work.

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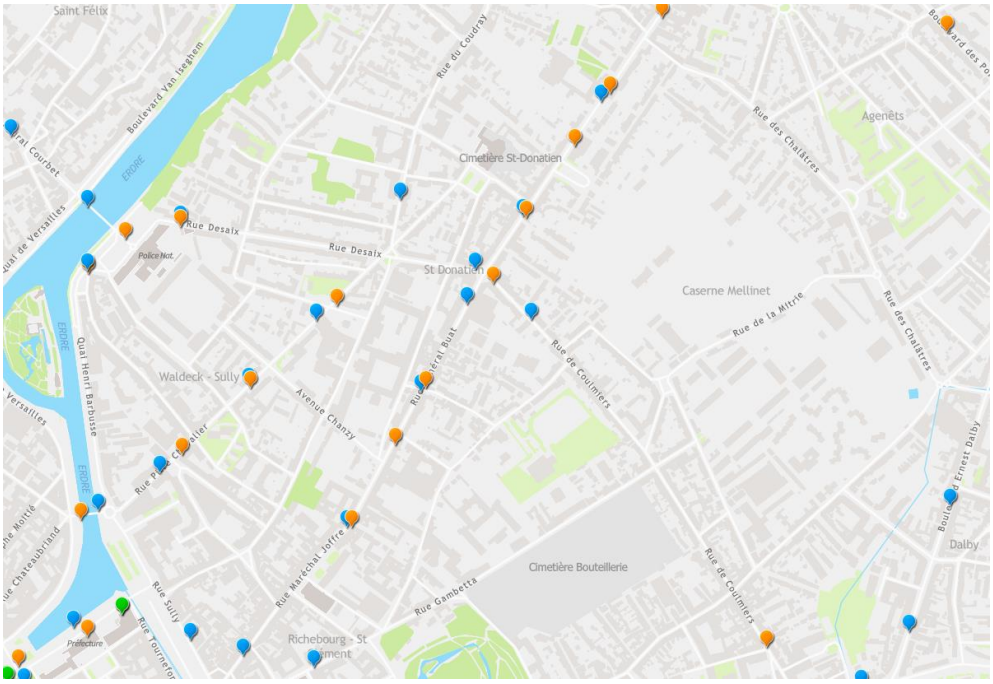

Figure 5: Localisation of the counting loops available on the GIS

The processing of raw data (hourly traffic) is carried out by the thematic referent at the traffic PC to calculate the expected indicator. This mode of operation requires periodic collection of all the data by the observatory manager and does not contribute to the establishment of a shared data warehouse.

Some of the data are already managed in the local authority's Geographic Information System, but it is in the process of being renewed (BRIDGE approach presented in part 5). The necessary data administration work must therefore be conceived in this context.

3.4. Prototype of an observatory in digital version

3.4.1 The choice to rely on Open Data technology

The first prototype in the form of a collection of indicators is based on the available data, with the limits explained in terms of their dispersion, their heterogeneous formats and their non-systematic updating. Moreover, the indicators produced are gathered in a pdf publication, which does not really contribute to the implementation of a database allowing to follow their evolution on the long term.

The development of the second prototype version of the observatory's indicators therefore took advantage of the Open Data portal of Nantes Métropole. This portal hosts the portals of the Pays-de-la-Loire region and the Loire-Atlantique department on the same instance.

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Pending the migration of data to the new metropolitan GIS, the development of this second version of the observatory's indicators is intended to be agile, with a first iteration in digital form based on the Nantes Métropole Open Data portal.

The interests are multiple:

- having the first experience in developing the observatory to "get the hang of it";
- establishing an initial assessment of the availability of mobility data in Open Data, their quality and their scope;
- testing the hypothesis of a development of the observatory in Open Data;
- learning from this experience for the full development of the global mobility observatory;
- making the most of the time available before the redesign of the Geographic Information System - on which the observatory will be based - is completed (see part 5).

Another element of context weighed in the balance. The massive rise of data and the regulatory, political and democratic context around data and its place in the city is in full swing. The Law for a Digital Republic democratizes the use of Open Data, leading to the massive opening of public data. Beyond making data available, the question of its use arises. Open Data platforms open the way to advanced possibilities for making data available. In particular, there are the following functionalities: data editorialization, the possibility of adding visualizations, infographic design, and even interactivity to a data table, which offers multiple possibilities for the form of the observatory.

This second prototype of the Open Data portal has thus allowed a double learning process: to carry out a first iteration of the multi-modal mobility observatory in order to draw lessons from it, and to take advantage of the economic interest to experiment with the capacities of valorisation of public data on the Open Data portal.

3.4.2 Indicators selected for the prototype from data available in Open Data

The technological choice of the prototype limits the scope of the indicators to the data available in Open Data. However, this constraint is not really one because the prototype aims precisely to experiment with the possibilities that already exist, based on mobility data that have been exposed in Open Data, a fortiori, to provide feedback on the level of Open Data availability of the Department of Mobility data.

Out of the corpus of approximately 300 indicators on which the multimodal mobility observatory can be based, an initial selection of 30 indicators has been chosen to produce a first prototype. Indeed, some indicators are more complex to present from Open Data, whereas others are more immediate ("quick win", typically a direct visualization aggregated to the month of the affluence in station). Also, data such as the geographical lines corresponding to cycle facilities may be available without the tool being able to calculate the length of the lines.

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The requirements for choosing the indicator were therefore to have data (i) in Open Data (ii) within the perimeter of the observatory (iii) with a sufficient level of quality (iv) and adapted processing capacities (v). They further narrowed down the selection of indicators during the implementation of the prototype; from a selection of thirty (30) indicators, the constraints of the prototype's development environment made it possible to carry out thirteen (13):

1. Cycling facilities: km/year and location
2. Places in public spaces - support: number
3. Places in car parks: number
4. Places in park-and-ride facilities: number
5. Pedestrian areas: length of routes
6. Up and down (TER) / day (all stations in the metropolis combined): number
7. Road network: km of roads and status (major, main, secondary)
8. Paid on-street parking: Red Zone - number of spaces
9. Paid on-street parking: Yellow zone - number of spaces
10. Paid on-street parking: Blue zone - number of spaces
11. Parking garage: number of spaces
12. Enclosed car park: number of spaces
13. Carpooling spaces: number of spaces

3.4.3 Test of a digital visualisation tool based on an OpenDataSoft solution

This first digital version was developed in collaboration with Nantes Métropole's data management service, in the Digital Resources Department. This collaboration was rich, it was both the support of an experience for the mobility teams and offered an evaluation, an analytical overview, on the level of availability of mobility data in Open Data. It is therefore a double experience that this first iteration brought.

Among the options available to realize a first version of the Open Data portal, two main solutions have been studied:

- Power BI: software recognized for its data processing and visualization capabilities, the tool is more oriented towards a "business" use - i.e. data practitioner - and report production. This tool was first used in the field of energy with the production of reports.
- OpenDataSoft: platform widely used in France and in the world for the exposure of data in Open Data. It allows you to develop your own web pages around the data.

The choice was made to use the OpenDataSoft platform for the Nantes Métropole Open Data portal. It allows to calculate and generate indicators and data visualizations on the fly. In concrete terms, when the observatory page is loaded (i.e. when someone visits it), the portal makes requests to the necessary data sets to retrieve the information and calculate the indicators.

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This way of doing things therefore displays a permanently updated observatory. Nantes Métropole used this method to experiment with the first version of the observatory directly linked to Open Data.

This approach is fundamental for the first iteration: it is a question of killing two birds with one stone. Indeed, since the observatory is a direct visualization of the datasets exposed on the portal, it is necessarily up to date and therefore reflects the level of availability and quality of the associated datasets at any time. Similarly, it is "sufficient" to maintain the datasets to ensure an up-to-date observatory (which is not the case in certain evaluation approaches where indicators are set, for example). The interest is strong in the prototyping phase because it allows to test the availability and quality of the observatory data in Open Data.

As presented in the previous section, the data sources available in Open Data reduced the scope of the selection of indicators from thirty to thirteen. A first version was developed on this basis (Figure 6).

To calculate the daily TER boarding and alighting times for all stations in the city, for example, the observatory makes a query on the daily boarding and alighting data set for each station in the region, published and maintained in Open Data by the Pays-de-la-Loire region. From the raw data, it is sufficient to filter on the stations of the metropolis, and to make an aggregation of the daily traffic of each. This can be visualised in columns and curves, as is the case in the bottom right-hand corner of the illustration below (Figure 6).

Figure 6: Screenshots of the test version developed (reference: Nantes Métropole)

On the evolution of cycling facilities in Nantes Métropole, this prototype revealed that the data published in Open Data is updated, but without history. It is therefore not possible to dynamically display the indicators for previous years. In this case, the visualisation deliberately highlights this aspect by displaying "..." each time the indicator is not possible to obtain.

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3.4.4 Assessment and lessons learned

Table 3: Assessment and lessons learned

Advantages	Inconveniences
- solution allowing an automation of the data flows (updating of the calculation of indicators each time the page is updated) - many possibilities for graphic representations of the indicators	- the portal requires advanced digital skills to be managed, which the Mobility Department does not have (it cannot be “independent” in the daily management of the tool) - few cartographic representations - need to transfer all mobility data on the Open Data platform (while some of them have not be designed for such a use case), technical problem to archive historical datasets

Experience has shown the value of an "on-the-fly" observatory, i.e. one that can generate indicators as needed (for a study, for a report, for a publication, etc.), based on data that is already shared. This is also an asset in terms of efficiency, since it means capitalizing on data that must be exposed in Open Data anyway. While this aspect is attractive, this first digital version does not correspond to the need for an observatory of public travel policies, which relies instead on annual indicators, and requires data management and processing functionalities. The first prototype revealed therefore certain limitations of the Open Data Soft portal.

First of all, the geographical data raises an analysis problem. For example, the portal did not allow for the calculation of the cumulative distance of bicycle lanes on the territory of the metropolis from the source data which represents the bicycle lines in polylines. It would be necessary to evolve the data modelling in order to add a length attribute from the polylines, and to integrate it in the open-data portal alongside the reference data. Yet, OpenDataSoft is not strictly speaking a GIS tool and the Department of Mobility is a major consumer of geographic data.

Similarly, the iteration revealed that the majority of datasets exposed in Open Data are not historicized. Annual data are archived at the metropolis, but only the latest version of the dataset is made available in Open Data. This practice renders the tool irrelevant for designing an observatory whose main challenge is to monitor the evolution of mobility indicators with regard to public policies.

Nevertheless, this iteration has allowed us to review the quality of the data and the ways in which they are made available in Open Data.

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3.5. How to go further? - The need of a benchmark

At this stage of the project, a first version of publication and a first test of a digital tool have been designed, but in order to go further, two main difficulties arise.

First, given that the preselected digital tool does not seem to be the most convenient way to combine data management and data visualization, are there other solutions that could be more suitable? Is the observatory necessarily digital and interactive? Is it common and what is the added-value compared to a standard publication? Secondly, multiple indicators can be produced with all available mobility data, and the choice depends on the needs of the targeted users. Yet several kinds of users have been identified in the objectives of the observatory: internal (technicians of the Mobility Department or of other thematic Departments, elected officials, General Management) or external (partners, journalists, residents). How can the observatory appropriately cover all these needs? Should indicators be specific for each category? Therefore, should the observatory take a different form depending on the user?

To answer these questions, it was decided to carry out a benchmark of existing mobility observatories in France. The task was assigned to CEREMA and based on these questions:

- what objectives are pursued in other observatories?
- who are the targeted users and beneficiaries?
- what kind of governance is organized around the observatories?
- what topics are usually covered?
- which indicators are most appropriate for the intended users?
- what types of data and communication solutions are typically used in mobility observatories?

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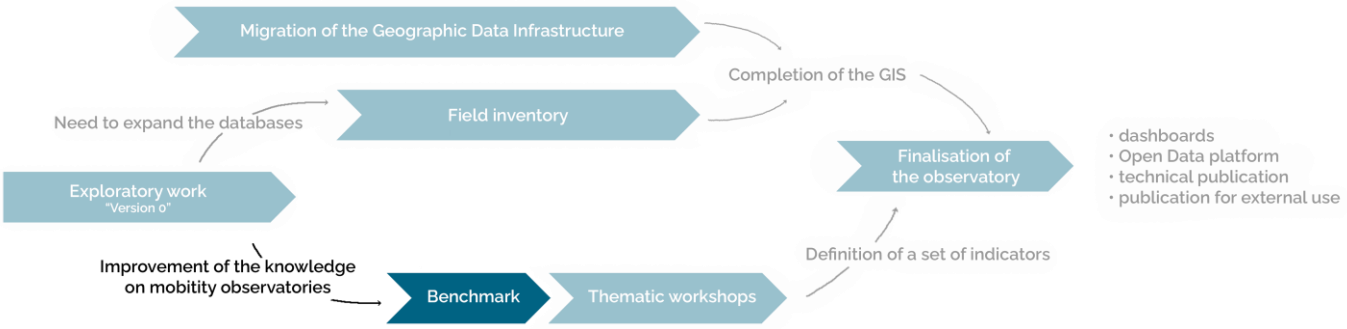
4. Benchmark of mobility observatories



4.1. The scope of the benchmark

In 2020, CEREMA carried out a benchmark of mobility observatories in France. This work was based on seven observatories rightly selected from the following cities: Rouen, Grenoble, Rennes, Bordeaux, Marseille, Strasbourg and Toulouse. They were chosen because they are multi-modal and not only focused on public transport. In addition, the monitoring of indicators and the publications made on the observatories are regular.

The objective of the benchmark was to compare and cross these observatories in order to extract the general principles and the best concepts that could be implemented.

4.2. What is a mobility observatory?

4.2.1 Definition and goals

A mobility observatory does not have a clear definition, but several aspects are common to most observatories.

First, the data is pooled to provide a unique system where all the data on mobility is shared. This system facilitates the use of the data. An observatory is then characterised by the ability to monitor these data over time and to analyse their evolution. The objective is to share the analysis among partners and to contribute to the evaluation of public policies and their impacts. In some cases, the observatory has been used to optimise the infrastructure or to evaluate more specific elements such as an Urban Mobility Plan or a tramway line.

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4.2.2 Management and governance

As one of the objectives is to share data, the observatories are often managed by a group of partners (Metropolis, State, Regions, Departments, SNCF, associations, highway operator, transport union, ….). The annual works are also planned in partnership. It is also important to notice that urban planning agencies often play an important role in the animation and production of the observatory. The networks studied in the observatory are from varied Organizing Authority for Mobility and managers. One of the main differences between the seven observatories analysed is their geographical scope. From one to another, it is the metropolitan area, the department area or the area of the household survey, often carried out at the urban area level.

4.2.3 Communication and publications

One of the key elements of an observatory is the communication of its work and publications. For each of the seven observatories, a publication has been produced every year or two. The monitoring indicators and analysis are communicated through this document. From one observatory to another, the publication is between 10 and 80 pages long and includes from 20 to more than 100 indicators. Communication can also take place during quarterly/annually meetings or during a thematic event/day. Only one observatory (in Rouen) offers an interactive map-portal for the general public. Open Data solutions are not yet well developed.

In most cases, the publication is structured by mode of transport with an additional section on road safety and other issues. Factual indicators are displayed with their evolution over time. Sometimes the publication includes contextual sections, demographic aspects, upcoming projects or the household-travel survey. Comparison with multi-annual objectives (from the Urban Mobility Plan, the Outline Plan of Cycling, the climate plan, etc..) is rarely made, as well as with national indicators. Interpreted indicators such as the number of inhabitants served, the number of kilometres per inhabitants are also very rarely published.

4.2.4 The information system

Having an observatory implies having a platform for sharing data. This platform can be opened to the partners or linked to the metropolitan Geographic Information System. Publications opened to the general public and the websites have not provided any further indications on the information system on which the observatories are based. Yet, some questions can be raised concerning the collection and processing of data: is the collection automatic? Is there a standardisation of data? Are the indicators automatically computed? Is the system linked to other observatories?

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4.3. Questions raised in the case of Nantes Métropole's observatory first publication

4.3.1 Which new topics or indicators could be included?

The 2017 publication of Nantes Métropole can be analysed in the light of the lessons learned from the benchmark. More specifically, the indicators used were compared to those found in the seven observatories studied.

Here is the reading grid of the following table:

Topic	In Nantes publica-tion	Recurrence of the topic in the studied observatories	Recurring indicators	"Good ideas"
Topic **not in** the 2017 publication	✗	**3/7** 3 observatories on 7 have this topic	Most frequently used indicators in the observatories from the benchmark	Indicator more rarely used but providing an interesting insight
Topic **in** the 2017 publication	✓	**6/7**	Most frequently used indicators in the observatories from the benchmark and found in the 2017 publication from Nantes Métropole	

4.3.1.1. Territorial context and travel demand indicators

Topic	In Nantes publica-tion	Recurrence of the topic in the studied observatories	Recurring indicators	"Good ideas"
Household travel survey results	✗	**3/7**	Main results of the survey, in particular the modal share of the different modes Evolution of the modal share through the surveys	Distribution of travels by distance class Distribution of travel flows between territories
Commuting data from INSEE	✗	**3/7**	Modal share for commuting between home and workplace	Modal shares by distance class

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				Distribution of flows to the heart of the agglomeration by sector of origin
Distribution of the population and jobs	X	2/7	Total population (INSEE data) Annual or multi-year demographic evolution Total volume of jobs and employed persons by territory	% of daytime population

The table above shows that the territorial context and the travel demands indicators are not treated in the same way from one observatory to another. The most highlighted indicators focus on the modal share and its evolution over time. These indicators reveal the effect of the policy on the mobility. They are not indicators of means but of results. The use of these indicators is yet limited by the frequency of data updating. The implementation of household travel survey is complex and therefore only takes place every 5 to 10 years. As the publications are released every one or two years, the analysis of the evolution of these indicators is often not possible. This explains why some observatories have chosen not to communicate on this subject.

Concerning the INSEE data, the difficulty lies in the motives for travel. Only two types of travels are monitored: home – workplace and home – study-place. The analysis is therefore partial. Moreover, as with the household survey, these data are not fully updated every year.

Finally, the distribution of the population and jobs can be easily updated but it is more of a long-term indicator. Therefore, its evaluation is not very significant since the publications are annual. Yet it sheds light on population flows in the territory and relates mobility to demography (e.g. it can highlight the peri-urbanization) and the economic context (e.g. the evolution of mobility and motorization after a crisis).

4.3.1.2. Individual mobility indicators

Topic	In Nantes publica-tion	Recurrence of the topic in the studied observatories	Recurring indicators	"Good ideas"
Cycle - Public cycle, long-term cycle rental	✓	7/7	Total number of location Total number of annual subscribers Number of cycle stations and public cycles	Most frequented stations Flows between stations

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Topic	In Nantes publica-tion	Recurrence of the topic in the studied observatories	Recurring indicators	"Good ideas"
Car – road traffic	✓	**7/7**	Detailed map of counts Analysis by sector or average traffic indicator	Map of congested areas
Cycle – infrastructure and traffic	✓	**5/7**	Aggregate or point-counted cycle traffic Lengths of cycle facilities Number of bicycle racks in public space	% of connections made in relation to the Outline Plan for Cycling Lineage offered per inhabitant
Car – parking	✓	**5/7**	Number of regulated on-street parking spaces Number of parking spaces in car parks Average use of car parks Subscriptions	Number of free on-street parking spaces Map of regulated parking areas Turnover rate on places
Car – motorization and fleet	✗	**4/7**	Household motorisation Spatial disaggregation of car ownership Vehicle fleet Number of new vehicles registered in the department	Multi-year sales history of vehicles

Individual mobility is a recurring theme in all observatories. With the exception of household motorization, the recurring indicators are present in the observatory of Nantes Métropole. One way of improving their observatory would be to aggregate the data from the counting points in order to have an overall evolution over the entire geographical scope.

It is also interesting to notice that both indicators of offer and use are present in most observatories.

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4.3.1.3. Collective urban mobility indicators

Topic	In Nantes publica-tion	Recurrence of the topic in the studied observatories	Recurring indicators	"Good ideas"
Urban Public Transport (UPT) use	✔	**7/7**	Number of annual trips on the network Disaggregation by type of public transport (tramway, bus...) Number of journeys per inhabitant	Getting on/off at stops Most frequented stops Map of lines and their frequency
UPT offering	✔	**7/7**	Number of kilometres offered on the network Disaggregation by type of public transport (tramway, bus, etc.)	Kilometres offered per inhabitants % of population and jobs served % of exclusive lanes on the network Commercial speed Motorization of the rolling fleet % of accessible lanes for persons with reduced mobility
Car sharing	✔	**5/7**	Number of car-sharing stations Number of car-sharing vehicles Number of subscribers Number of journeys made	Annual kilometres travelled Motorization of the rolling fleet
Company Mobility Plan / Walking bus	✔	**1/7**	Number of companies with a Mobility Plan Number of employees concerned Number of schools with a walking bus Numbers of pupils enrolled	-

In terms of collective urban mobility, two reference indicators stand out: the number of travels per inhabitants or the number of kilometres offered on the network. These indicators are currently used by the public mobility managers to compare transport networks with each other. They reflect the efficiency of the network, yet they were not included in the observatory of Nantes Métropole.

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4.3.1.4. Collective interurban mobility indicators

Topic	In Nantes publica-tion	Recurrence of the topic in the studied observatories	Recurring indicators	"Good ideas"
Regional train use	✓	**6/7**	Number of passengers per train station Number of passengers per line	-
Regional train offering	✗	**6/7**	Number of services offered per line Number of kilometres offered on the network	-
Bus use	✗	**7/7**	Annual number of passengers on the network Disaggregation by line	-
Bus offering	✗	**7/7**	Number of kilometres offered on the network Disaggregation by line	-
Multimodality	✓	**5/7**	Number of intermodal tickets sold Number of park-and-ride facilities Number of places in park-and-ride facilities	Secure cycle places at train stations Passenger car parking places at stations Occupancy rate of places
Carpool	✓	**4/7**	Number of carpooling areas Number of parking places Number of registrations on the web platform	-

This theme is not very much addressed in choice of indicators in the observatory of Nantes Métropole. The collective interurban mobility is not within the competence of Nantes Métropole but as it provides alternatives solutions to the car it is part of the overall mobility policy. These indicators would therefore benefit from being more detailed in the observatory of Nantes Métropole.

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4.3.1.5. Long distance collective mobility indicators

Topic	In Nantes publica-tion	Recurrence of the topic in the studied observatories	Recurring indicators	"Good ideas"
Air transport	✗	**5/7**	Number of annual passengers Number of destinations offered Public transport service to the airport	-
Rail transport	✗	**4/7**	Total number of passengers per year Number of trains per day Annual number of passengers on main lines	-
Freight transport	✗	**2/7**	Air freight in tonnes Sea freight	-

This theme is unevenly addressed among the observatories and is not addressed at all in the one of Nantes Métropole.

4.3.1.6. Externalities indicators

Topic	In Nantes publica-tion	Recurrence of the topic in the studied observatories	Recurring indicators	"Good ideas"
Road security	✓	**7/7**	Number of accidents Number of deceased persons Disaggregation by user categories Disaggregation city centre/suburb	Location of accident accumulation areas
Air polllution	✗	**6/7**	NO2 concentration PM10 particles concentration	Number of days with an ATMO index ≥ 6, ≥ 8, = 10 (max) Number of days with information or alert procedure
GES emissions	✗	**3/7**	CO2 emission for road transport	-

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Topic	In Nantes publica-tion	Recurrence of the topic in the studied observatories	Recurring indicators	"Good ideas"
Noise	X	2/7	Number of inhabitants per exposure class Lden (daily average) : - to road noise - to railway noise	-

The Nantes Métropole observatory contains only the theme of road safety, a theme covered by all the observatories studied. The other themes are not covered.

4.3.2 What geographical and institutional perimeter for Version 0 of Nantes Métropole observatory?

"Version 0" of the observatory of Nantes Métropole, represented by the 2017 publication is, for a few indicators, centered on the city of Nantes and does not cover the whole metropolis. So far, Nantes Métropole made the choice to use the data within its competence. Thus, the road of the non-metropolitan network is not included in the monitoring and analysis of the observatory, since these roads are within the competences of the Department or the State.

This first version was only initiated by Nantes Métropole, and partners were not associated in a steering committee. With the lessons learned from the benchmark, the question of a partnership with other mobility managers could be raised to conceive the final observatory and the geographical and thematic scope is likely to be extended.

4.3.3 Raw data or calculated information: what is the appropriate level of analysis and communication?

As previously stated, the purpose of the mobility observatory is to be a tool for monitoring public transport policy. It must enable information to be collected and summarised in order to help in the decision-making process. To do this, several levels of analysis are necessary and this is done using different types of indicators. There are both raw indicators and value-added indicators resulting from processing.

The raw indicators are chosen to study mobility trends and have a time series analysis with data that can be compared from year to year.

The observatories also include aggregated indicators, i.e. constructed and calculated, in order to have a higher level of interpretation for shared knowledge. These processes make it possible to move from simple information to more detailed knowledge about supply, use or impacts. For example, here are some aggregated indicators on the subject of cycling:

- on supply: percentage of roadway equipped, percentage of inhabitants or jobs near a bike-share station;

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- on usage: evolution of usage in relation to the evolution of the length of the road network (base 100), maps of the modal share of cycling by territory;
- on the impact: bicycle/car or bicycle/pedestrian accidents

An efficient way to display these indicators is to use maps, such as the example from Grenoble (Figure 7). The daily road traffic on the main roads has been summed up. Thus, this map clearly shows the direction of the main flows on the territory. The evolution (in percentage) since 2013 is also shown. The way the data are constructed add value to the raw data and directly provides an explanation and analysis of the travels, which makes this map very effective.

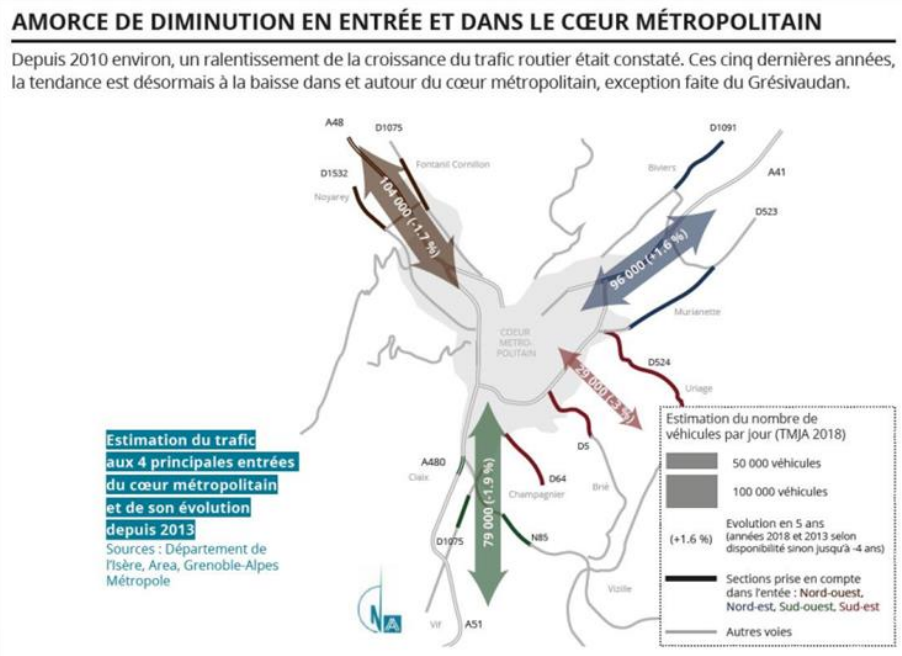

Figure 7: Map extracted from the observatory of Grenoble

4.4. General learnings of the benchmark

The benchmark has highlighted several parameters that must be determined in order to conceive and implement an observatory. One important thing to keep in mind is that the observatory has three dimensions:

- a technical dimension: this is a digital tool that gathers mobility data for the entire geographical area.
- a partnership dimension: the observatory is embodied by a group of partners who collaborate to collect data and who can take part in the decision-making process. a communication-dissemination dimension: publication and, more broadly, communication are an essential part of the observatory.

Several parameters must be chosen to design the observatory, starting with the geographical scope. This has an impact on the mobility stakeholders to be involved in the process the, in order to have all the data.

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The involvement of these actors is generally achieved through the formalisation of a partnership whose objective will be to manage the observatory.

The main part of the conception process is to determine the indicators that will be monitored and analysed. On the one hand, the more indicators there are, the more resources (human, material, time) are needed to collect and format the data. On the other hand, a sufficient number of indicators must be selected to have a valid observatory. This is a compromise that has to be made. A non-exhaustive list of indicators is provided in the previous section. Environmental indicators (air quality, noise level, greenhouse gases emissions, …), demographic indicators and also socio-economic indicators can be included in the scope of the observatory.

The next step is to design the sharing platform. There are several possibilities: is it public? Interactive? Are they maps or Open Data? And finally, it is important to decide on the communication tools. There are many parameters to define: the frequency of publication, the beneficiaries, the added value on indicators, the structure, etc… The publications issued by the observatory constitute a reference; their consistency over time is therefore important to become a decision-making tool.

The following figure shows some examples of of graphical representation, which are common in the observatories studied. It highlights their diversity and their added value. In the observatory of Grenoble, different types of maps are used with aggregated data. Using tables and graphs is also a possibility such as in the observatory of Rennes. The graphs show the evolution or indicators over the years. The indicator displayed can also be compared to a base year as in the observatory of Bordeaux. Bordeaux has added value to its data by aggregating it and commenting on it with a column.

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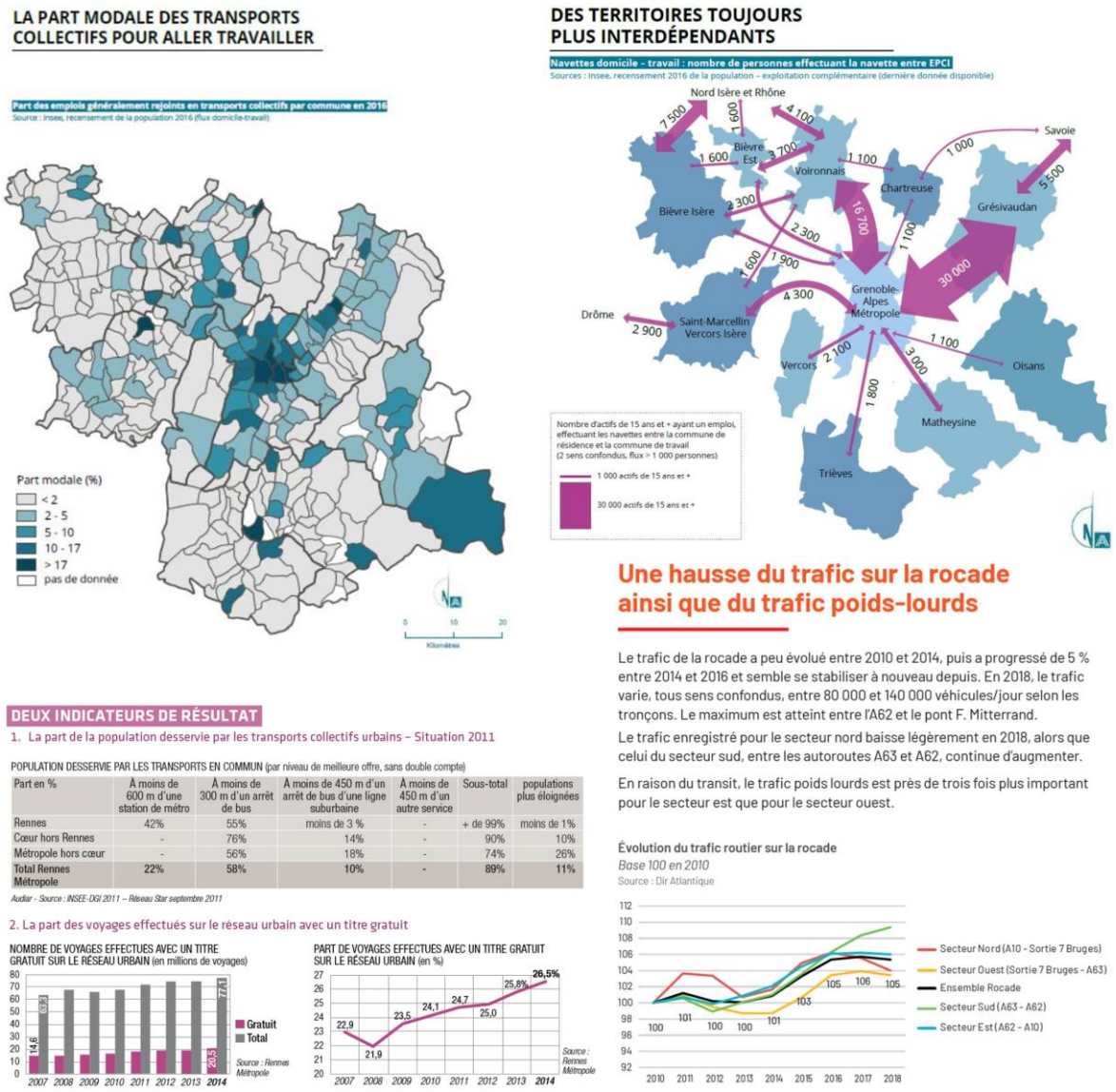

Figure 8: Images extracted from the observatories of Grenoble (top), Rennes (left) and Bordeaux (right)

The benchmark has thus identified the main key parameters to be defined by the project leader in order to set up an observatory that meets its objectives.

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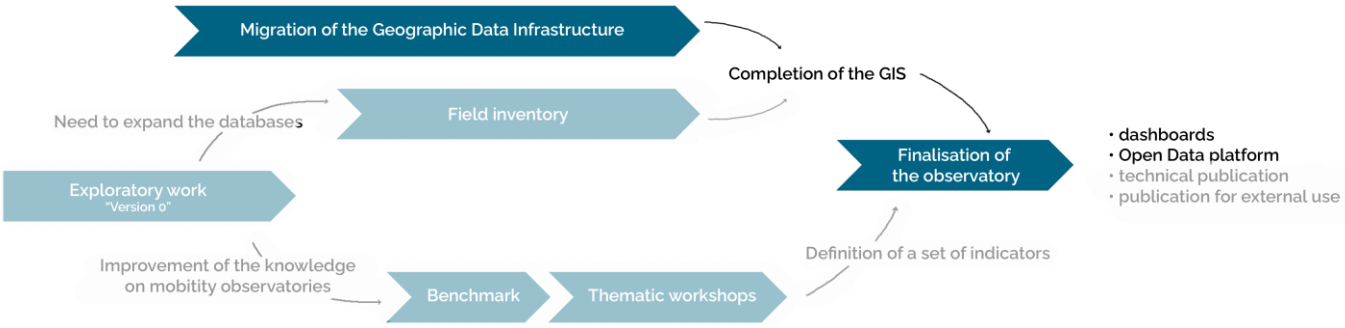
5. The new GIS of Nantes Métropole: main database of the observatory



It was decided to base the mobility observatory on the foundations of the local authority's Geographic Information System (GIS). This metropolitan GIS, which is shared by all Nantes Métropole's departments and which was in the process of evolving when the multimodal observatory was designed, was an opportunity that was all the more interesting in that the planned changes to the infrastructure would make it possible to move towards a more interactive tool, greater user autonomy and more effective tools adapted to observation.

5.1. Evolution of the information system of Nantes Métropole: a technical opportunity to gather mobility data

The need to use Nantes Métropole's geographic information system to build the mobility observatory came at a time when the evolution of Nantes Métropole's geographic data infrastructure had become necessary. Indeed, Nantes Métropole was using (Appendix 1):

- an infrastructure that was too complex, not agile enough and generated over-quality
- an ageing infrastructure that was less and less adapted to users' needs (collaborative work, data sharing, web, roaming…)

Thus, before setting up the observatory, the information system had to be overhauled. This section describes the migration from the old infrastructure to the new one in order to understand the new functionalities brought and their interest with regard to the multi-modal observatory.

The migration of the Nantes Métropole Geographic Information System is called BRIDGE. The challenges were to offer an interoperable infrastructure, to give autonomy to users and to rationalize the range of tools because three tools were used (STAR-APIC, Mapinfo and ESRI) with fragmented skills, costs to be rationalized and uses that were sometimes complementary but also redundant.

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- STAR-APIC was a tool mainly used for geographic data management (few possibilities of formatting, sharing).
- Mapinfo was the tool most used. In addition to data management, it allowed cartographic production and was relatively accessible to a public of technicians. The limits of this software were, for example, rather on the sharing of productions via the Internet and on collaborative work.
- ESRI was used within the community for the deployment of an internal GIS tool, easily accessible to all agents (even non-geomatics specialists) via a web browser. This internal GIS tool, called Géonantes, has come to a point where an evolution is necessary in order to remain in line with technological developments and to allow for the functions now expected in terms of user autonomy and collaborative work.

All these 3 tools were connected, more or less directly, to a central database called SSF (Server Spatial Federator) under Oracle.

Figure 9 shows that there is a desire to streamline the life cycle between data and users. Before, the system was based on the following concept: data managers updated data that were then processed and stored in a warehouse (SSF) that was refreshed every week. Only then was this data made available to different types of users (through new processing). There was therefore no immediacy between data updates and availability. Now, the management (update for example) and the exploitation of the data is done by the same interface in direct link with the new database (called Bridge as the name of the project) under PostGreSQL. Thus, an update made on a data set is directly visible by all users. Collaborative work, or nomadic work, is now easier.

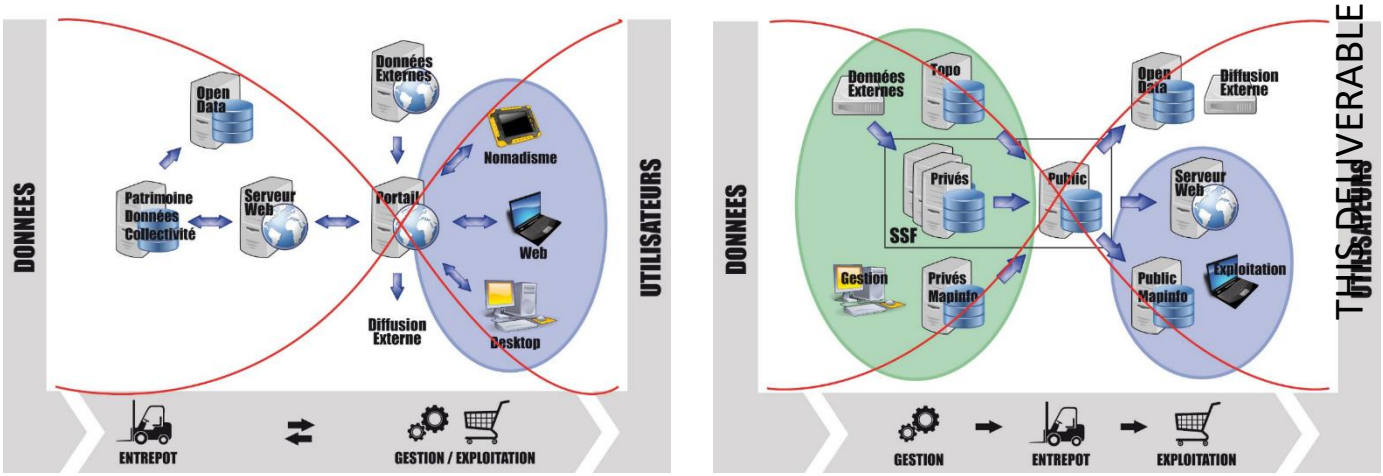

Figure 9: Vision of the GIS infrastructure after the project BRIDGE (left) and of the Initial GIS infrastructure (right)

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The choice was made to keep only an ESRI solution after the migration of the geographic data infrastructure. This new solution includes the functionalities previously managed in Mapinfo and STAR-APIC and allows to answer the new needs identified, in particular those carried by the observatories of the community and which are detailed below.

Several key points in the initial vision of the BRIDGE approach to GIS infrastructure migration meet the needs of the various users and bring real improvements in the operation of the mobility observatory.

The new GIS infrastructure allows for the provision of appropriate GIS tools and harmonized data. Ideally, the entry point to the data and tools is single. The new infrastructure also provides a centralized repository for data models, geospatial data semiotics and reliable, high-quality, easily accessible data - including topographic data.

Thanks to the migration of the infrastructure, it is also possible to easily publish maps on the web. A framework with rules on operation, data sharing and sensitive data was developed during the project, with a strong focus on maps intended for the general public, for which an editorial circuit will be set up with the external communication agents.

The new GIS is now available in mobile mode, which makes it possible to access and work remotely with the GIS data. This can be useful for citizen workshops, for example, in the context of data co-construction. It is above all an essential and primordial need for the metropolis' fieldwork.

The GIS infrastructure also provides easy access to geographic and static data. All map data represented on the web comes from the BRIDGE platform, including maps on the Open Data site. And the metadata of the geographic data is captured centrally and uniquely, but disseminated in any application using geographic information.

The Mobility Department was one of the departments that quickly benefited from the migration of tools and the geographic data infrastructure, in particular thanks to the development of the Mobility Observatory, which had as a pre-requisite the availability of the technical base offered by the new infrastructure.

5.2. Process of integrating mobility datasets into the GIS

As previously mentioned, the idea is to base the mobility observatory on the technical foundation provided by the new infrastructure of the Nantes Métropole Geographic Information System. Thus, the mobility datasets likely to be used in the framework of the mobility observatory are gradually integrated into the database connected to the GIS. This database is not only accessible to all the departments of Nantes Métropole via the GIS, but it can also be used by other tools and solutions for data processing or visualisation.

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For the calculation of indicators from this database, there are several cases. Some indicators are calculated from geographical data managed by Nantes Métropole, others are calculated from data provided by an external service provider, and others are only provided annually when an activity report is submitted. These different management methods coexist and must be organised in order to feed the observatory's indicators.

Here is how the data is managed (integration into the database or regular update) depending on the partner in charge of the data:

- for the geographic data that Nantes Métropole manages, updating is managed internally by referents (data managers). The massive updating of patrimonial data by a service provider who works by direct observation of the territory will be developed in part 6 devoted to the collection of data in the field.
- the counting data (bicycle and vehicle) come from the Nantes Métropole traffic control centre (Mobility Department) which has its own information system and sensors in the field. These sensors are counting loops and allow to know in real time the traffic conditions. The traffic PC exposes its data in Open Data and also provides aggregated indicators (road traffic expressed in AADT) that the Mobility Observatory communicates. These data are intended to be integrated into the database associated with the GIS to record the indicators and communicate them in the form of maps.
- for data coming from an external service provider, different processes have been set up. The section concerning data flows is generally included in the contract between Nantes Métropole and the service provider. To illustrate with a concrete example, JCDecaux is currently the service provider for the self-service bicycles. JCDecaux exposes its data via an API, so by processing, their data is recovered and then integrated into the geographic database. From there, an upload is made to the Open Data and reuses via GIS tools are made possible.
- finally, some data are provided annually when an activity report is submitted. This is the case for SEMITAN, for example. Nantes Métropole receives a monthly report, but the report with all the final and official data in the form of indicators is only sent annually and allows the indicators that have been selected to be entered into the database.

Some data management processes can move towards greater automation and this is the continuation of the work planned. In particular, it is possible that the changes currently being made to the way data is shared between Nantes Métropole and SEMITAN could lead to greater autonomy in the collection of data through the integration of more and more computerised flows.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

5.3. First interfaces of the observatory and calculation of indicators

Applications, based on GIS tools, have been developed by the Department of Mobility to automate the calculation of certain indicators. A dashboard-type tool is used, for example, to obtain the indicators related to the cycle theme. On the dashboard presented in Figure 10 the various boxes show the distribution of types of cycle facilities, key figures corresponding to the number of geographical objects identified and a map showing the location of these geographical objects. The indicator calculations and map displays are updated according to the geographical filters chosen (municipality(ies) or local area(s)).

This interactive dashboard interrogates the database in real time. If the person(s) in charge of administering the data updates the data, it is reflected in the calculations and the figures change. This type of "dashboard" tool is built around geographical data and there is always a cartographic display with basic navigation tools and layer overlays (cycle facilities and cycle stands, for example).

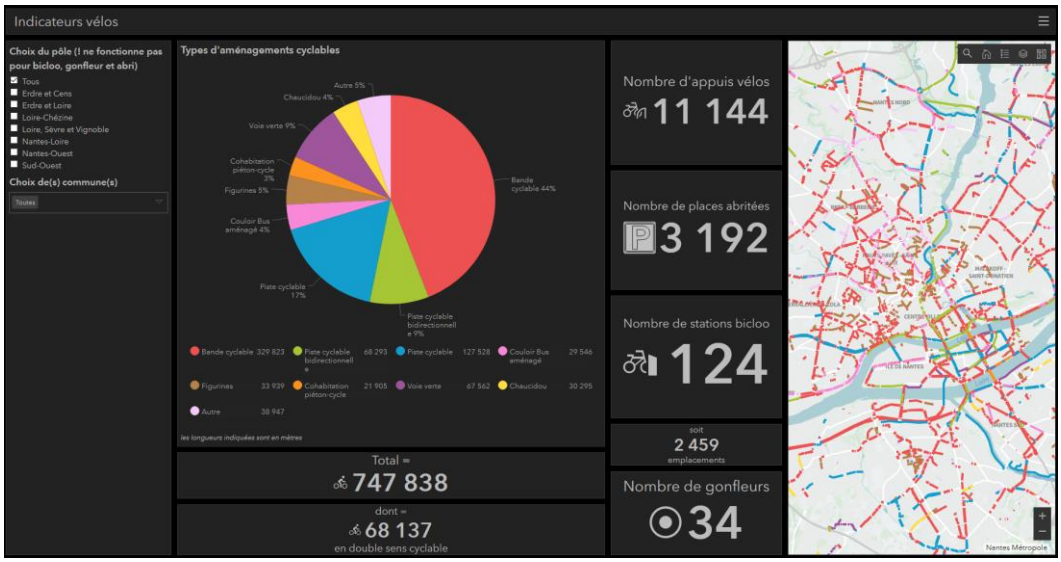

Figure 10: Dashboard of the topic "cycling"

In order to go further in map production, other applications for consulting, analysing and updating data are also deployed. These applications are administered directly within the Mobility Department. Figure 11 shows an overview of the mobility data consultation tool. This tool is accessible to all Nantes Métropole employees.

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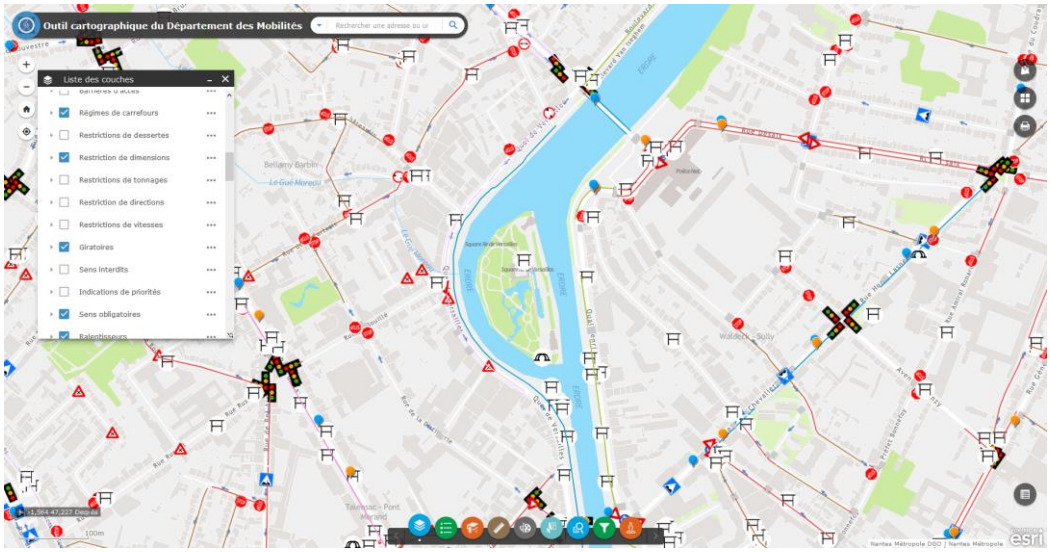

Figure 11: Screenshot of the data visualisation application

5.4. Data historicization

The historicization of data, i.e. the fact of keeping annualised data to provide a history, is one of the key points of the mobility observatory in order to monitor the evolution of indicators, to observe trends over time and to evaluate public policy in terms of mobility.

The data is saved from the interactive dashboards. The data queried on the dashboards are those present directly in the database and the figures are calculated on the fly when the application is opened. It is then possible to "freeze" these data at the end of each year in order to set a value that will serve as a reference indicator for the year.

Thus, archival data since 2007 have been recovered and integrated into the database of the Department of Mobility. Each year in December, the new data of the past year is added to the observatory's warehouse.

An application (an extract of which can be seen in Figure 12 has also been developed to display the details of the data (cycling facilities in the following example) by year. A cursor (top left) allows to select the desired year, between 2007 and 2020, and a list of checkboxes allows to choose the types of facilities studied. In addition to the "archive" aspect of the data and public action, this tool simplifies access to data that can be used to determine tailor-made developments, i.e. without having to call on a GIS researcher who has to go and do this work of archiving and making the data sets consistent in order to calculate this development.

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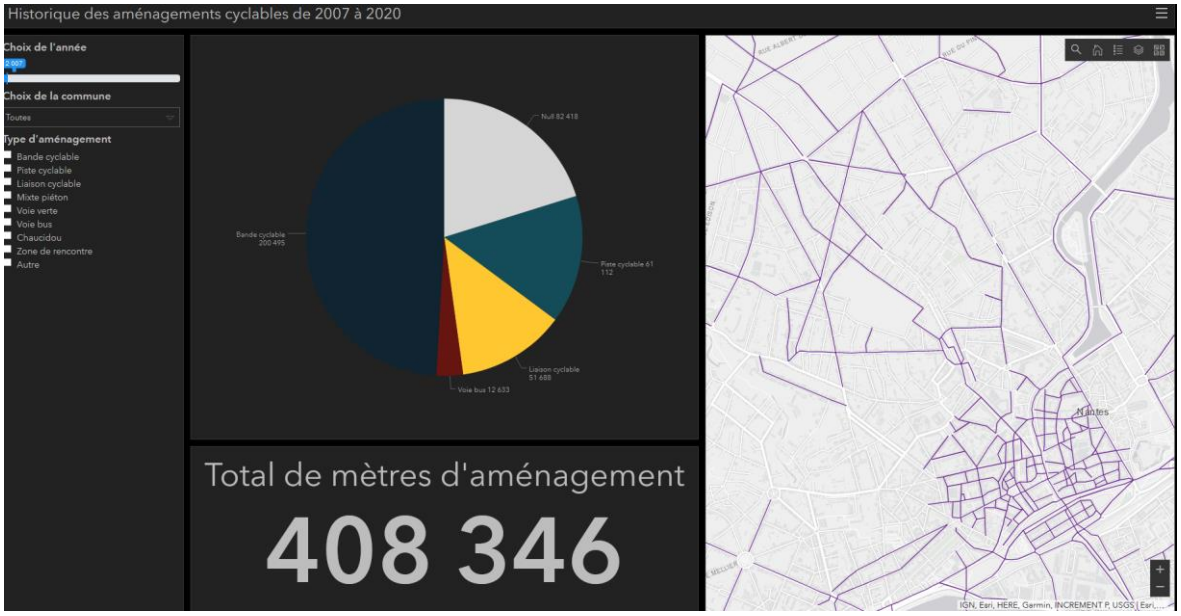

Figure 12: Screenshot of the application displaying the history of cycling data

The indicators and dashboards presented here are based on data that must be as close as possible to the reality on the ground. This is why it was decided, as part of the construction of the mobility observatory, to carry out a field inventory of mobility assets in order to complete, make reliable and update the data sets already available.

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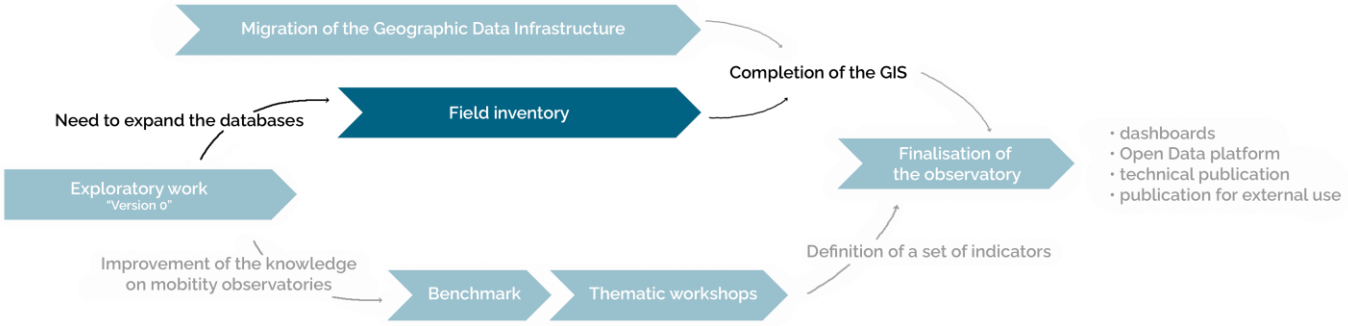
6. A transversal and periodic field inventory to feed the mobility database



6.1. A complete update on bicycle and road facilities

Nantes Métropole wished to improve its knowledge of traffic rules, parking and cycling facilities. Indeed, it was found that this knowledge was too partial and heterogeneous on the metropolitan territory and did not allow for the analysis and use of data necessary for the most efficient exercise of the authority's powers.

This approach also aimed to improve the monitoring of the travel policy, to continue the efforts of resource management and to make better use of other data produced or managed by the collectivity, which until now have been little used. It was also necessary to guarantee the reliability of the data needed to calculate the annual indicators and to ensure the quality of the data disseminated in Open Data on the assets in question. This step is therefore necessary in the context of the implementation of the mobility observatory.

The local authority made a contract with a service provider for the initial acquisition and updating of geolocated data on Nantes Métropole's assets concerning traffic rules, parking and cycle facilities in order to feed its Geographic Information System.

The acquisition and updating of the data were carried out by means of a field survey. This inventory was carried out on the roads, their surroundings, and the public spaces of the metropolitan area, the municipalities as well as the private spaces open to traffic and travel in the 24 municipalities of Nantes Métropole.

The inventory covered approximately 3170 km of roadways and lasted 1.5 years (including a test and a lock-down periods).

The services to be provided were as follows:

- a census of the different elements of vertical and horizontal traffic signs and certain street furniture that regulate the use of the road;

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- a transcription of the information from the census of elements in the form of geographical data files in accordance with Nantes Métropole specifications;
- the transmission of the geographical data files as well as any raw data files on digital media.

The service provider thus had to update an ESRI File Geodatabase provided by Nantes Métropole containing the classes of entities relating to traffic restrictions, road markings, parking lots and bicycle facilities.

Table 4: Entities updating during the field inventory

Traffic rules	Parking	Cycling facilities
- Panels: - prohibited direction - one way - stop - yield - speed limit - tonnage - height - width - length - obligation or prohibition to turn - entry/exit of built-up areas and restricted zones - right priority - priority direction - Fire - Roundabout - Retarder - Floor markings - Pedestrian crossing	- Blue zone - Regulated place (taxi, motorized 2-wheelers, delivery) - PMR (person with reduce mobility) places (which were not identified in the accessibility master plan) - Free parking - Paid parking in Rezé	- Development (track, strip, greenway...) - Bicycle support

The service provider had to return the data filled in or corrected, depending on whether they were provided empty or pre-filled, without altering the structures. The restitution took place in the same format Geodatabase ESRI File. Figure 13 shows the overlay of the main data sets collected during the field inventory.

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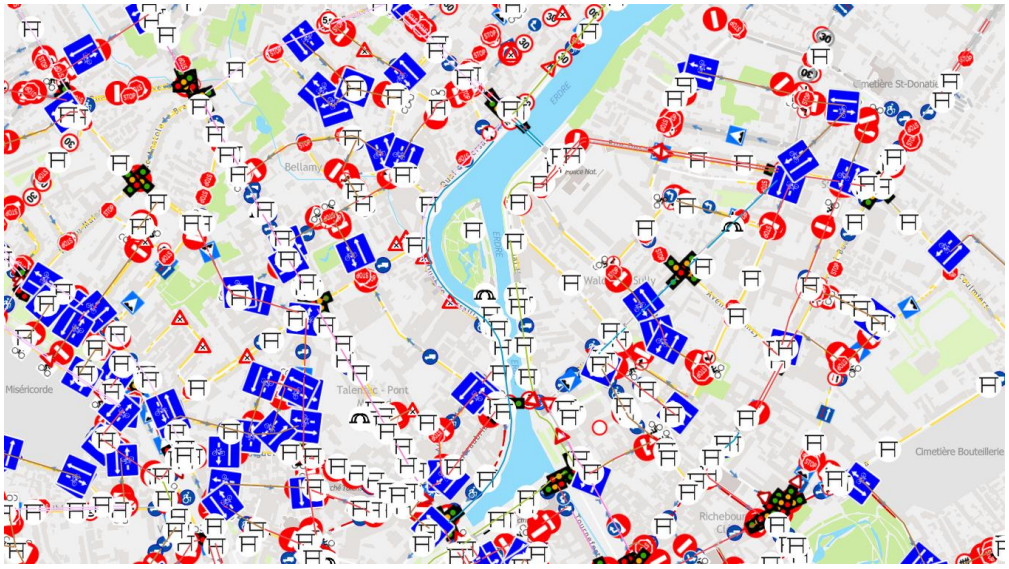

Figure 13: Display of datasets collected during the field inventory

The specifications expected were particularly tightly defined by both the Department of Transportation and the Digital Department.

For example, the framework on data modelling and description of field elements for cycling facilities is in Appendix 2.

6.2. A periodic field inventory shared with several departments of Nantes Métropole

Once the data sets were identified and characterized, they were updated to a "baseline".

This inventory for a baseline situation was completed in June 2021 but the updating of all these datasets has been thought out in advance. This initial situation must be updated periodically to ensure the sustainability of the data quality.

In future updates, the idea is to pool this "mobility" inventory with other community themes. Themes such as public spaces, green spaces and accessibility have been identified. The next inventories will therefore be common to several patrimonial data sets. The objective of this approach is to optimize the collection of information in the field so that it can be used by a maximum number of the community's professions. Consequently, it is planned to launch a consultation that will lead to the conclusion of a single-award framework agreement that will be managed in part with purchase orders and in part with subsequent contracts for inventory and management services for heritage data in public spaces.

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6.3. High performance investigation techniques

In order to reach its objective of a wider collection of data, Nantes Métropole wishes to promote, in the future, innovative operating methods for processing existing or future data, particularly geographical data. Artificial Intelligence and more particularly neural network techniques are some of the techniques that can be implement.

Prior to the field inventory, an experiment was conducted by the Department of Mobility in conjunction with the Department of Digital Resources in 2018. The aim was to determine the appropriateness of using a data survey using LiDAR technology to carry out the heritage inventory. A test was done on a LiDAR dataset already in possession of Nantes Métropole. LiDAR (Light Detection And Ranging) is a remote sensing and telemetry method that emits pulses of infrared light and then measures the return time after they are reflected off nearby objects. Knowing the speed of light, the LiDAR sensor can accurately calculate the distance to each object from the time between the emission of the laser pulse and the return pulse. The result is a highly accurate 3D point cloud. The idea was to superimpose this point cloud with a calibrated photo (Figure 14, left) in order to proceed to an automatic extraction of the objects to be inventoried (Figure 14, right).

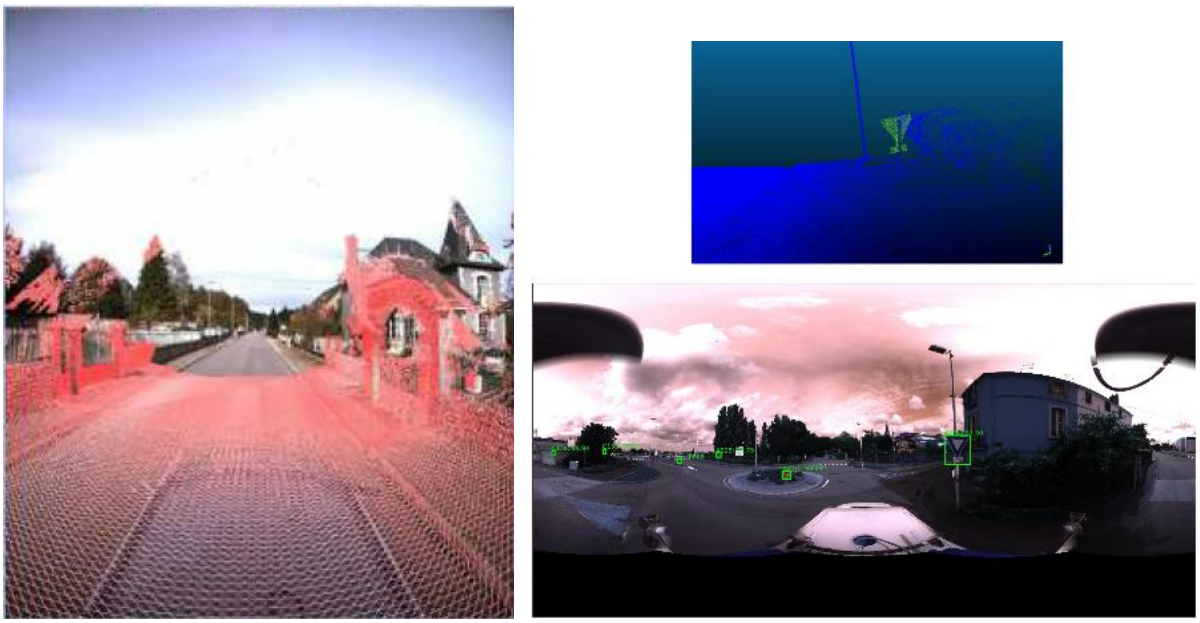

Figure 14: Superposition of the point cloud and the photo (left) and automation of objects tracking (right)

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The results of this experiment are that the method offers an estimated 85% to 90% restitution rate for traffic signs. However, the costs of this method and the very large volumes of data generated mean that this method is not favoured over another. This is why, when the technical part of the field inventory contract was drawn up, no survey method was put forward.

Thus, for the first inventory of travel assets, a different method from LiDAR was implemented by Immergis, the service provider selected. The data collection was done by a mobile mapping system for the acquisition of georeferenced images for the purpose of collecting geographic data at high output. The device was installed on a car or bicycle acquisition vector (Figure 15).

Figure 15: Installation on car (left) and bicycle (right) to collect data

The high-performance vehicle, equipped with 2 or 3 units, was used to collect data on all the roads accessible to cars.

The high-performance bicycle, equipped with 2 units, was used to collect data on areas inaccessible to cars or not visible from the road or on areas subject to congestion problems (parking, works, etc.)

- One unit was facing the rear of the vehicle and the second was facing the front.
- Once the data collection was done, the data processing and analysis was carried out via software:
- Import of all field data (image sequences)
- Setting up data entry forms respecting the data structure
- Entering and qualifying objects (see Figure 16)

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- Geometric measurement
- Projection of GIS layers
- GIS data export
- Export of images in JPG format

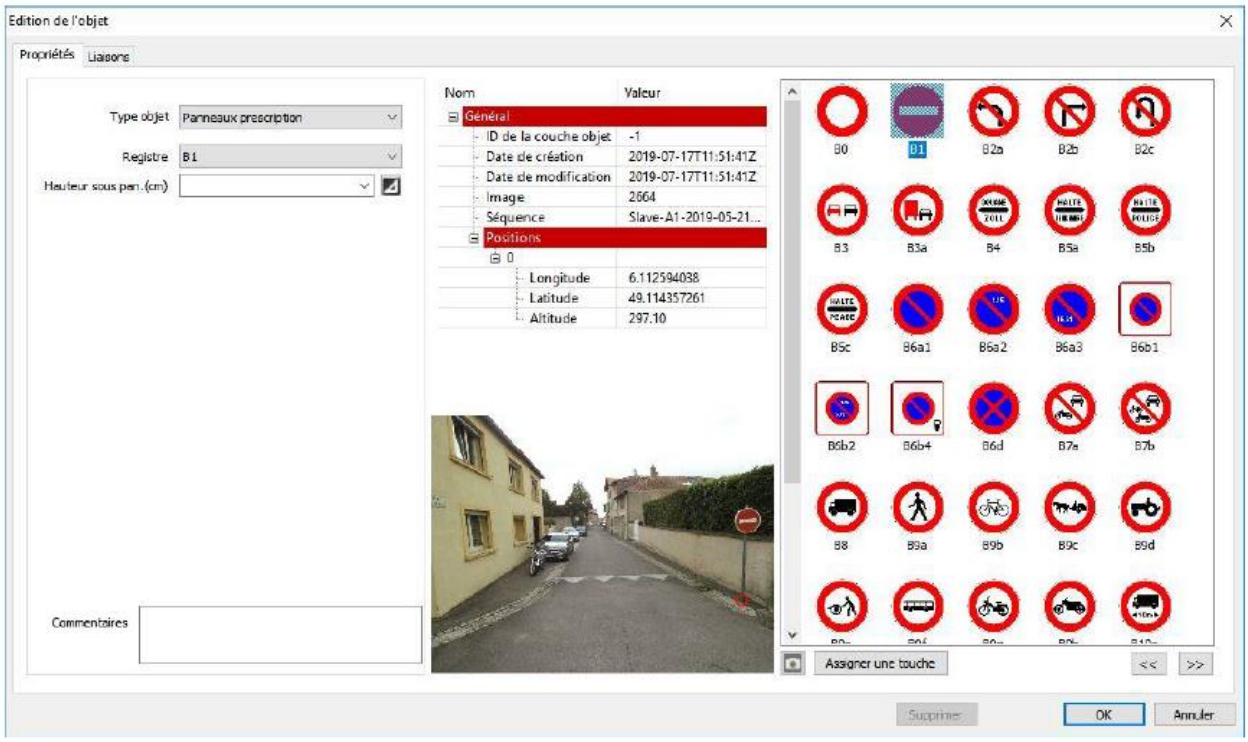

Figure 16: Example of an entry form for a traffic sign

The deliverables were a GIS database (ESRI GDB) and georeferenced object images.

In order to quantify the contribution of this inventory, the database has been expanded from 31,094 geographic objects to 149,025. Figure 17 details the number of objects before and after the inventory by type and by territory. It can be seen that Nantes Métropole's knowledge of its heritage has made a significant qualitative leap in each of the fields of study.

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		barrière	carrefour	contre-sens	desserte	dimension	direction	giratoire	interdit	ligne	priorite
Nantes-Loire	base initiale		628		7	42	89	93		1	8
	base livrée	65	1253	113	8	69	328	106	567	2481	23
Erdre et Loire	base initiale		1100		36	34	57	286		1	37
	base livrée	38	3664	54	50	65	371	331	596	7172	201
Nantes-Ouest	base initiale		1117		73	9	142	97		1	44
	base livrée	53	1747	199	37	23	404	114	615	3435	125
Edre et Cens	base initiale		627		2	34	33	202		1	22
	base livrée	61	2179	20	28	43	209	281	300	4233	122
Loire-Chézine	base initiale		601			3	13	230			14
	base livrée	86	2276	36	28	42	238	244	394	3842	148
Sud-Ouest	base initiale		485			1	1	163			36
	base livrée	65	1909	76	45	25	193	351	368	5067	389
Loire, Sèvre et Vignoble	base initiale		1208		1	25	30	296			61
	base livrée	154	3472	120	22	77	349	345	584	7381	338
	total avant	0	5839	0	119	152	370	1384	0	5	224
	total après	530	16643	629	220	355	2168	1792	3463	34055	1356

		ralentisseurs	rétrecissement	sens	tonnage	traversée piéton	vitesse	zone reglementée
Nantes-Loire	base initiale			410	24	1490	32	156
	base livrée	140	4	608	32	1592	114	462
Erdre et Loire	base initiale			209	67	1252	241	257
	base livrée	358	125	372	100	2815	1116	736
Nantes-Ouest	base initiale			443	53	1592	122	208
	base livrée	179	33	868	56	2354	307	577
Edre et Cens	base initiale			84	21	973	125	214
	base livrée	360	106	190	90	1920	708	690
Loire-Chézine	base initiale			95	28	837	221	281
	base livrée	196	64	290	97	2043	642	494
Sud-Ouest	base initiale	148		118	37	695	145	381
	base livrée	230	271	312	133	1795	954	923
Loire, Sèvre et Vignoble	base initiale	275		363	92	1712	86	461
	base livrée	346	288	590	168	3303	623	1048
	total avant	423	0	1752	330	8673	979	1965
	total après	1829	898	3258	685	16022	4508	4987

		STATIONNEMENT					Aménagement cyclable	
		aire livraison	emplacement	gratuit	pmr	reserve	aménagement	appui
Nantes-Loire	base initiale	299	2129		309	136		950
	base livrée	311	2310	1000	322	169	1326	1027
Erdre et Loire	base initiale	20	34		256	5		145
	base livrée	45	34	5694	449	57	1874	353
Nantes-Ouest	base initiale	187	1411		327	34		455
	base livrée	203	1411	6323	389	146	1474	764
Edre et Cens	base initiale	5	11		273	1		86
	base livrée	27	11	4674	398	23	1213	348
Loire-Chézine	base initiale				230			63
	base livrée	20	115	4722	344	14	1130	242
Sud-Ouest	base initiale				402			53
	base livrée	6	85	3589	464	18	780	183
Loire, Sèvre et Vignoble	base initiale	7	42		391	1		281
	base livrée	23	549	7191	633	98	1948	546
	total avant	551	3808	0	2209	194	0	2117
	total après	668	4696	33321	3027	542	9818	3555

Figure 17: Number of geographical objects identified before and after the field inventory

As an illustration, a case of use of the data from the field inventory quickly arose. The implementation of the LOM (Law on the Orientation of Mobility) requires the removal of parking 5 metres upstream of pedestrian crossings. A study was therefore carried out using the GIS, on which the mobility observatory relies, in order to obtain an estimate of the number of parking spaces in order to help with the decision and to forecast the budget necessary for this operation. The cross-referencing of data from the field inventory quickly made it possible to determine the pedestrian crossings and parking spaces concerned by the application of this regulation.

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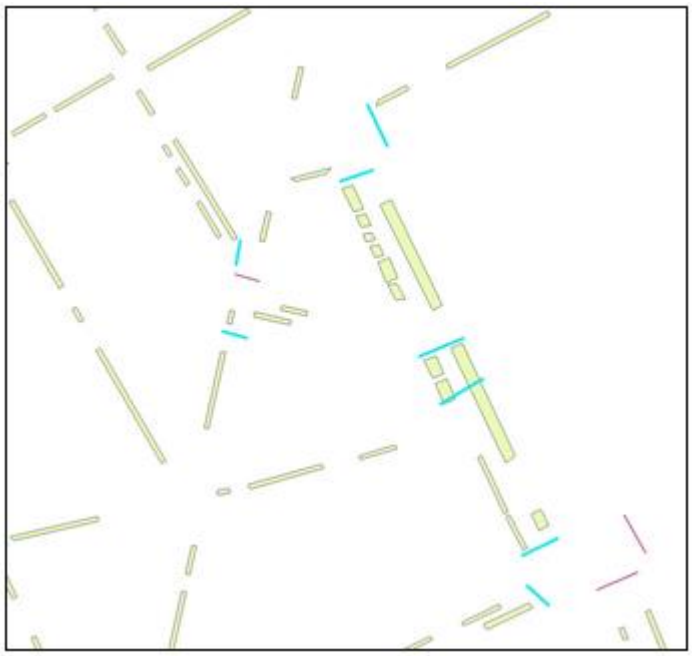

Figure 18: pedestrian crossings that intersect or are within 5 metres of a parking space in blue / pedestrian crossings not concerned in purple.

In parallel to these field inventories, the integration of exogenous data sources into the GIS is an interesting way to improve data quality and to be part of an open context for the construction of data sets (e.g. OpenStreetMap).

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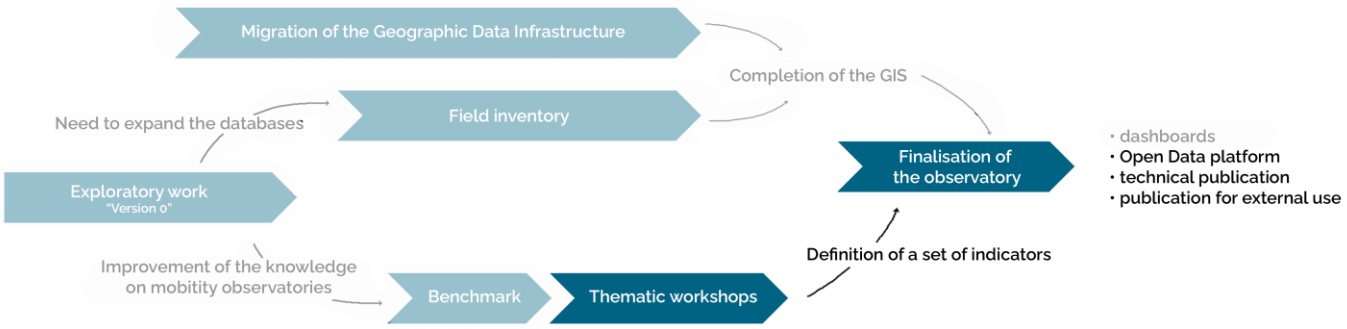
7. The mobility observatory: scope, indicators and communication methods selected



7.1. Short-term choices on the geographical and institutional scope of the observatory

7.1.1 Local partners and governance

At this stage, the construction of the observatory has focused on the implementation and reliability of the technical infrastructure, which supports the observatory, and on the selection of mobility indicators. The partnerships developed have therefore focused on data collection and concern only certain mobility stakeholders in the territory:

Table 5: List of partners of Nantes Métropole for the mobility observatory

Partner	Presentation
SEMITAN	Mixed economy company of public transport in Nantes Métropole in charge of operating the network on behalf of Nantes Métropole
JCDecaux	Multinational company specializing in urban advertising on street furniture such as bus shelters, and known for its self-service bicycle rental systems
AURAN	Nantes Region Urban Planning Agency
ONISR	National Interministerial Road Safety Observatory
Destineo	Web platform offering a multimodal information service, such as a route planner, on public transport in the Pays de la Loire
Geobike	Website and mobile application to organize your bike trips (map, itineraries, ...)
OuestGo	Carpooling platform in Brittany and Pays de la Loire
Marguerite	Private company offering a self-service car rental service in the Nantes metropolitan area
Several departments and services of the community that intervene at one time or another in the life cycle of the data that allow for these indicators.	

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The constraints of completing the migration of data to the GIS did not allow the project to be extended to other institutional players: other mobility organising authorities, other network managers, etc., nor to engage in more collaborative communication and exchange work on indicators and changes in mobility practices. It seemed preferable to stabilise an initial set of observatory functions and to build up a certain amount of observation experience before opening up to other mobility stakeholders.

This approach has the advantage of mobilizing partners at the right time, with an operational tool, more refined objectives and more proven data exchange protocols.

Today, the observatory's partners are essentially data providers. In the future, it could be interesting to study closer partnerships with these partners, for example on the co-construction of indicators, on the provision of visualization interfaces, etc.

7.1.2 Geographical scope

Although the observation of mobility cannot be restricted to the territory of Nantes Métropole alone, as this territory is included in a wider living area, the choice of geographical perimeter stems from the observatory's partnership structure. Thus, data collection and indicator calculation are carried out on the metropolitan territory alone (Figure 19). It is within this territory that the local authority has the authority to manage the data. Apart from survey data (Enquête Déplacement Grand Territoire provided by AURAN, Baromètre des mobilités or data from INSEE), most of Nantes Métropole's data sets are limited to the boundaries of the territory. This is the case, for example, for geographical data on cycling facilities, which are only managed and updated at the metropolitan level.

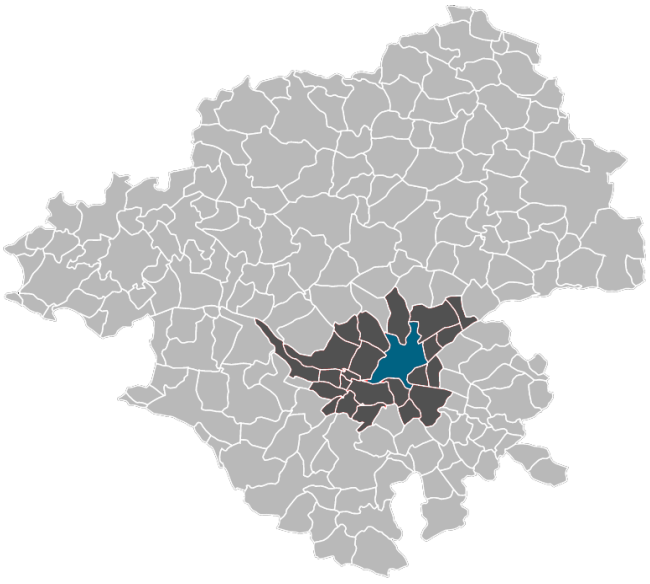

Figure 19: Spatial footprint of Nantes (blue) and Nantes Métropole (dark grey) in the Loire-Atlantique department (light gray)

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7.2. Working method used to develop the observatory's indicators

The indicators for monitoring public policy on mobility are intended to provide a broad view of the actions undertaken over the long term by the Department of Mobility. This is why the panel selected shows the themes addressed by all the departments while providing information that characterises the territory and its evolution.

When updating the indicators in 2020 (on 2019 data), several difficulties were encountered. This led to the choice of some indicators being called into question. At the same time, the first deliveries of data from the field inventory of the patrimony carried out in 2020 and 2021 were received (see Part 6). These new data suggested new opportunities for analysis. It is therefore relevant to draw on this work to see how to develop the first panel of indicators selected in 2017 (in the short/medium/long term).

In order to finalise the choice of indicators, the aim was to cross-reference the weaknesses of some of the indicators in the first panel and to compare them with those from the benchmark carried out by CEREMA, while maintaining the objective of using already existing and automatically structured data.

Following the benchmark, a series of workshops was organised with the relevant thematic referents within the Mobility Department. The aim was to consider once again, on the basis of these new elements, the choice of indicators to be included in the observatory with regard to the following parameters

- the calculation method,
- transmission formats,
- the periodicity of transmission.

Each thematic workshop was organized in several stages:

- reminder of current indicators
- assessment and possible developments
- proposals brought by the benchmark
- new indicators possibly proposed by the referents
- methods of communicating indicators (at what time of year, in what form, what additional analysis, etc.)

The thematic groups that met were:

- public transport
- cycles (facilities and counting)
- road traffic

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- accidentology
- pedestrian areas
- the peaceful city
- parking
- carpooling
- self-service bicycles
- the route planner
- car sharing
- school ecomobility

During these workshops, discussions took place on the relevance of disseminating some indicators, such as, in the case of public transport, the "number of trips per kilometre travelled" indicator. Indeed, this is a very "technical" performance indicator that needs to be understood by the reader. Nevertheless, it is a reference indicator for comparing the performance of the network with other local authorities or between the different modes of public transport (bus, high service level bus, tramway), which is why it has been retained in the new set of indicators.

During the workshop on active modes, it was also requested to add the number of two-way bicycle lanes in order to have a more detailed knowledge of the bicycle topic. Thanks to the field inventory, the data required to calculate this new indicator is available and it has therefore been added to the observatory.

At the workshop for parking referents, there were also discussions on whether the number of transactions per parking meter was a relevant indicator to include. The discussions finally set aside this indicator, which can be found in the assessments carried out by the department concerned by the subject in the City of Nantes, but which does not necessarily have its place in the panel of indicators of the mobility observatory.

Generally speaking, the discussions were rich and made it possible to stabilize a new set of indicators to be implemented from 2021 onwards on the 2020 data.

This was approved in June 2021. The particular context of the year 2020 (health situation related to COVID-19) has had direct impacts on the figures related to mobility: less travel, less use of shared modes, development of teleworking. The data will necessarily have to be placed in this context and comparisons with the data for year n-1 will not be relevant.

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7.3. Reflections on the communication objectives of the observatory

In addition to the choice of indicators, work was carried out on the methods of disseminating these indicators, sharing knowledge and communicating on the monitoring of public action, which are among the aims of the observatory. The following concept was decided upon: two documents will be published for different uses.

A comprehensive technical document in PDF format including all indicators by theme will be kept, in the spirit of the first publication of the indicators in 2017.

At the same time, a more communicative document for external use will be published and will only cover a selection of indicators. The choice was made to publish the indicators rather than a web portal (cartographic or not, interactive or not, linked or not to Open Data) in order not to multiply the data platforms to be maintained. Indeed, the metropolitan GIS portal and the Open Data portal, enriched with mobility data and indicators, already meet several of the observatory's objectives: cross-sectoral accessibility of data within Nantes Métropole's departments, provision of improved Open Data to the general public thanks to the field survey and better knowledge of the available data. Thus, the chosen strategy is to propose a complementary tool (publication), better adapted to easy consultation of the indicators and allowing easy addition of comments and explanatory analyses, rather than building a multi-purpose observatory portal that duplicates the other two data portals.

7.4. A comprehensive reference publication for professional use

7.4.1 Terms of publication

The objective for the technical publication is that the complete document with all the annual indicators can be published before the summer of year n+1 in relation to the reference data. The campaign to update, verify and contextualise the indicators, if necessary, takes place in the spring for the stabilised figures of the previous year. This complete document includes all the indicators discussed with the referents during the thematic workshops. Of course, this list is a living document and will evolve as public policy or current issues change.

Developments will only be analysed in relation to the previous year in order not to burden the publication. However, it will always be possible to show a more substantial history for certain relevant indicators. On request, the history can be traced in a thematic study or publication. For example, at the end of the mandate, it would be interesting to compare the indicators at the beginning and end of the mandate in order to trace the evolution of certain themes.

7.4.2 Selected indicators

Nantes Métropole has chosen to include the following indicators:

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Caption:

	new indicator		indicator updated because of changes in supply
	change of scale (Nantes → Nantes Métropole)		evolution of the maps for bicycle and light vehicle harmonisation in the scale
	data in strong evolution following the field inventory		

Table 6: Indicators selected for the professional publication

Themes	Indicators	
Accidentology	number of accidents	
	number of accidents per 100,000 inhabitants	
Change Activator Mobility	number of mobility packs: 3 levels (info/price/study, support)	
	number of eco events	
	number of participants in eco event training	
Carsharing	number of users / year	
	number of rentals / year	
	number of stations	
	number of vehicles	
Traffic	km of roadways in traffic-calmed zones	
Carpooling	Carpooling NM: number of places	
	West Go: number of registrants	
	CovoiTAN: number of registrants	
	CovoiTAN: number of trips	
School Ecomobility	number of students involved	

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	number of schools in the scheme	
Itinerary	Destinéo : number of requests	
	Geobike: number of requests	
Pedestrians	linear pedestrian areas	
Parking	number of places: red paying zone	
	number of places: yellow paying zone	
	number of places: blue zone	
	total number of seats: red yellow blue zone	
	number of places: delivery	
	number of seats: motorcycle	
	number of seats: taxi	
	number of seats: PMR	
	number of spaces: access control car park (enclosure + structure)	
	number of spaces: enclosed parking	
	number of spaces: multi-storey car park	
	P+R number of places: enclosed car park	
	P+R number of spaces: multi-storey car park	
	P+R number of places: open parking	
	P+R number of places: barrier parking	
	annual attendance at controlled access car parks (paying)	

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	annual attendance at P+R with access control	
	electric vehicle charging stations in public car parks and P+R	
Public transport	number of kilometres travelled: Tram	
	number of kilometres travelled: Busway (+e)	
	number of kilometres travelled: Chronobus	
	number of kilometres travelled: Bus	
	number of kilometres travelled: Total	
	number of trips: occasional (per ticket)	
	number of trips: regular (monthly subscription)	
	number of trips: intensive (annual subscription)	
	number of journeys / year by public transport	
	accessibility of stops	
	V/K network	
	V/K Tram	
	V/K Chronobus	
	V/K Bus	
School transport	number of children registered (2018 / 2019)	
Bike	length of cycling facilities: cycle lane	
	length of cycling facilities: cycle track	
	length of cycling facilities: two-way cycle tracks	

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	length of cycling facilities: pedestrian-cycle cohabitation	
	length of cycling facilities: greenway	
	length of cycling facilities: bus lane built	
	length of cycling facilities: chaucidou	
	length of cycling facilities: other or figurines	
	of which two-way cycling facilities	
	length of cycling facilities Total	
	BiclooPlus: number of bikes	
	BiclooPlus: number of stations	
	BiclooPlus: number of subscribers / year	
	BiclooPlus: number of rentals / year	
	of which unlimited, tailor-made and short term tickets	
	Bicloo: number of mechanical bicycles on medium and long-term rental	
	Bicloo: number of VAE bicycles on medium and long-term rental	
	number of sheltered spaces (parking and public space)	
	number of supports on the public space	
Bicycle and light vehicle counts	figures of the counting loops	

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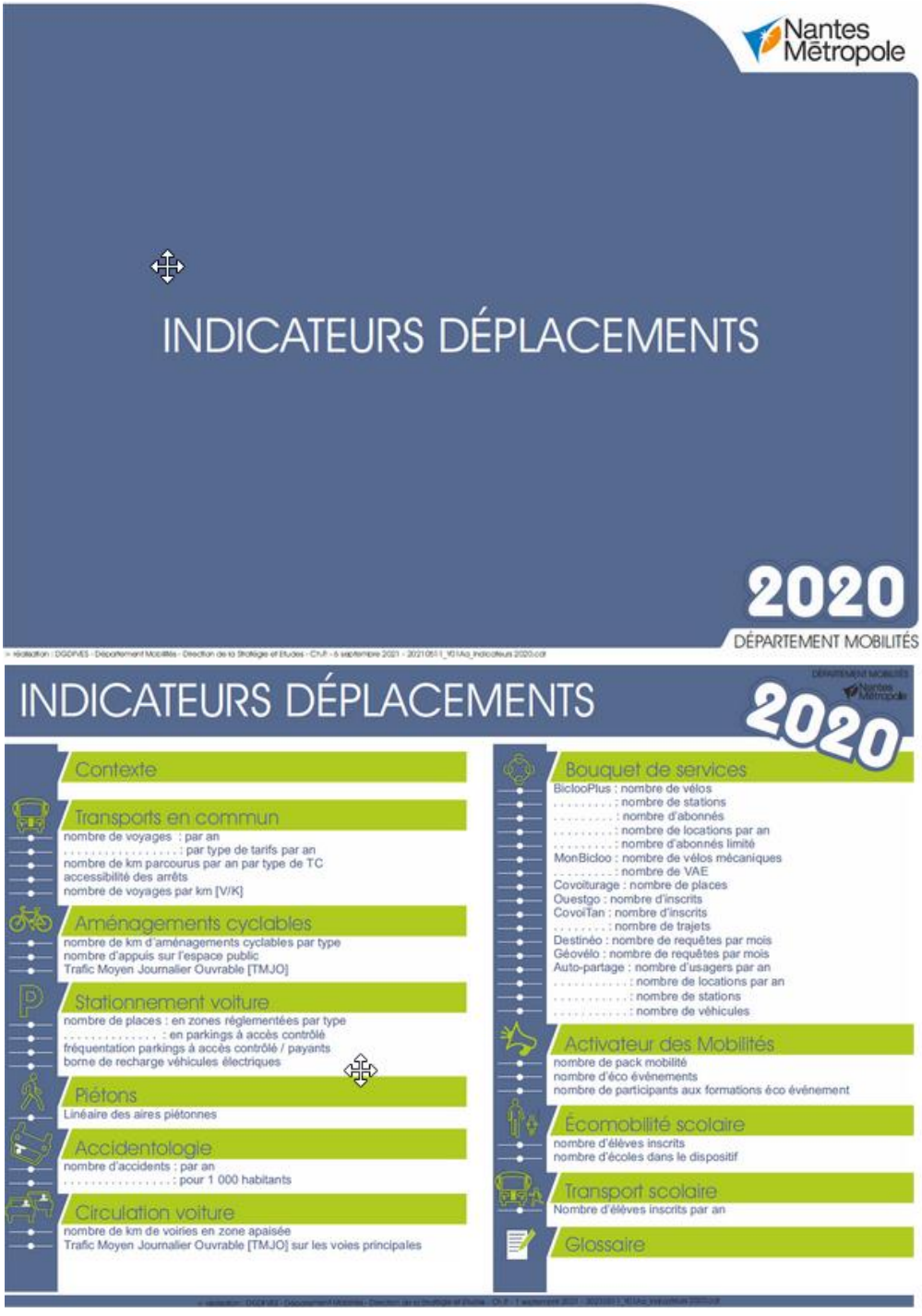

Figure 20: Extract of the publication for professional use

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7.5. A synthetic publication for external use

7.5.1 Terms of publication

The publication for external use will include only a part of the indicators calculated and analysed in the mobility observatory. For reasons of communication readability, a maximum of twenty figures will be published. The selection of indicators was made in coordination with the Communication Department and the person in charge of mobility issues. Her outside view and knowledge of the issues facing the Mobility Department helped determine the key figures to be included in this publication called “Infogram”. However, it is planned that those who are interested will be able to access the more complete PDF document.

The document was produced by Nantes Métropole's External Communication Department and is in digital format because it is intended to be viewed on any type of medium.

7.5.2 Selected indicators

The external publication mainly addresses issues related to the evolution of supply. It should be noted that the first edition of this document will take place in 2021 on 2020 data. As previously mentioned, the 2020 figures are always to be placed in the context of the health crisis, which makes them very difficult to compare with the previous year. It therefore seems complex to include changes in this summary communication document.

Nantes Métropole has chosen to include the indicators displayed on the Figure 21.

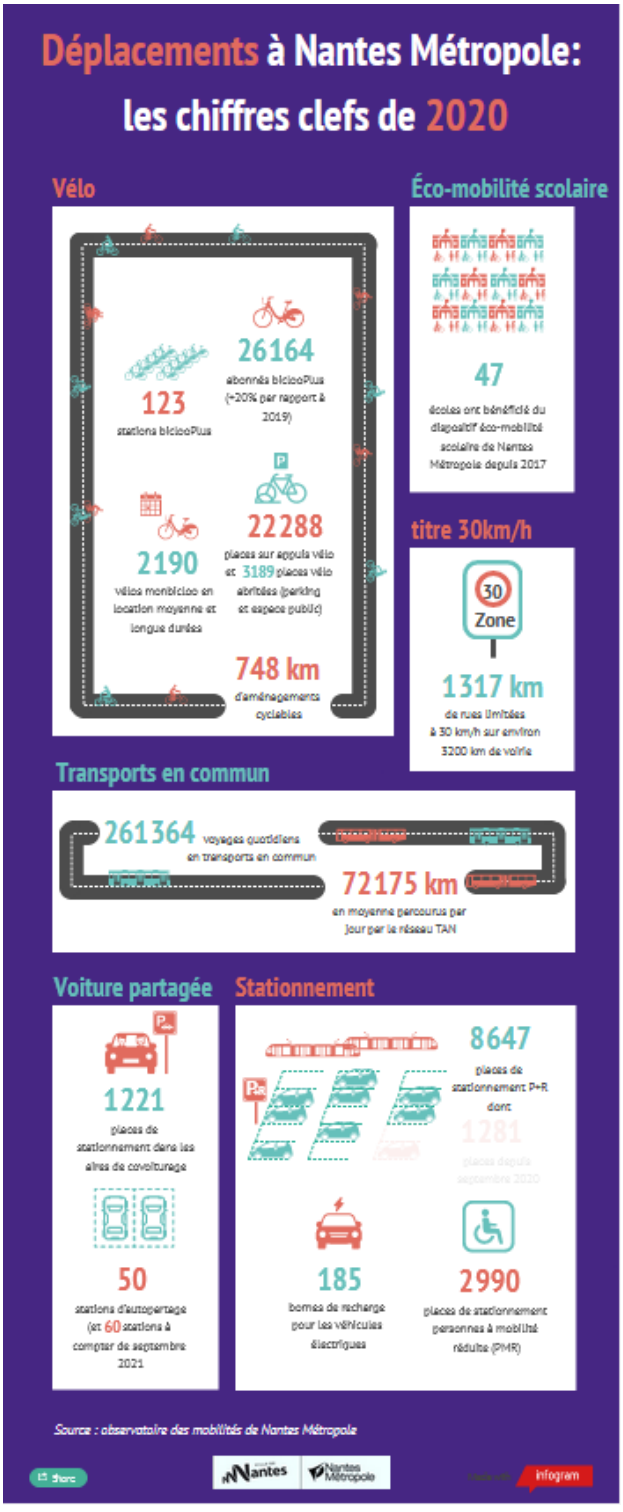

Figure 21: “Infogram” used to communicate about the mobility observatory

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7.6. The sharing platform focused on Open Data

The data collected during the field inventory are being uploaded to the Open Data. This work is started in the summer of 2021 and will be the occasion to propose visualizations of certain data. The roadmap for the availability of all the data is spread over the second half of 2021.

In the long term, it may be possible to make the annual indicators available in Open Data in the form of a summary table. This will only be possible once the indicators have been stabilised.

The platform2 developed from an OpenDataSoft solution is accessible to the public and allows a large-scale sharing of knowledge of the territory's mobility and of high value-added visualization tools.

The first datasets used in the framework of the mobility observatory are available on the Open Data portal:

- Nantes Métropole's bicycle facilities (link)
- parking zones (determining pricing policies): (link)

2 https://data.nantesmetropole.fr/

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8. Conclusions

The construction of the multimodal mobility observatory has led to the implementation of a permanent data storage and management tool for monitoring the mobility policy, thanks to the structuring of databases and the implementation of automated calculation processes for monitoring indicators. The work of collecting and calculating the observatory's indicators has been rationalised by centralising and structuring Nantes Métropole's mobility data sets in the metropolitan GIS database, guaranteeing their reliability and availability. The incorporation of data sets from external partners may have been more restrictive in terms of the nature of the data flows available, particularly in terms of format, frequency of transmission and level of aggregation, and may have necessitated a re-specification of the details of the data expected at the time of the next renewal of contracts or agreements. The set of indicators monitored has nevertheless been significantly enriched. The databases were also consolidated by a major field survey of road and cycle infrastructures. Better knowledge of the mobility offer has already made it possible to respond to operational study needs such as the inventory of parking spaces located near pedestrian crossings, with a view to their development in favour of pedestrian safety within the framework of the Law on the Orientation of Mobility.

While the preliminary step in setting up an observatory is indeed the consolidation of data sets, its main purpose is to enable the evolution of mobility supply and demand to be monitored over time. Consequently, the question of data historicization has proved to be central. The data in Open Data or in the metropolitan GIS are generally the most recent. A work of archiving vintage data sets was carried out to allow at any time the calculation of indicators on the years prior to the establishment of the observatory. Subsequently, the observatory will be able to generate directly at the end of each year a set of indicators established according to the latest data in force so as to constitute historical series on the indicators monitored. The annual publication of the collection of indicators is the concrete result of the data validation work that has been put in place and makes it possible to constitute a reference source for the observation of mobility.

The observatory has also made progress in communicating with the general public, by proposing an annual summary publication, making it possible to report on public action. While the exploratory work to build an observatory based exclusively on Open-Data layers was not entirely conclusive, particularly as it did not easily manage data historicization, it also revealed the unavailability of datasets that had not been published in Open-Data. The collection of field data and the consolidation of mobility data in the metropolitan GIS make it possible to envisage the provision of new layers, as well as, in the longer term, the annual publication of the observatory's set of indicators.

Within Nantes Métropole, the setting up of the mobility observatory has made it possible to create a collective dynamic around this tool, in particular via the work on the choice of indicators involving the thematic referents and via the new consultation interfaces accessible to all departments. For its creation, the observatory required several complementary fields of expertise. A multidisciplinary project team was therefore mobilised,

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including the mobility department, the digital resources department, the communication department, etc., in order to organise data collection and processing and to select the relevant indicators. In addition, the data consultation and display interfaces developed for the construction of the observatory's indicators are also a means of giving everyone user-friendly access to the data, in a cross-cutting approach to mobility issues.

The challenge now is to keep the observatory going over time. It is a project that requires significant human and financial resources, particularly for the regular updating of data in order to have reliable and complete data without which the annual production of indicators is no longer possible. The integration of computerized data flows with external partners is one of the observatory's work perspectives to lighten the data collection process. By choosing a solution for the observatory that is backed up by existing data portals (the metropolitan GIS for data sources, and the Nantes Métropole Open Data site for any publications), tools that are used daily and maintained, the issue of sustainability was clearly taken into account and led to the decision not to create an additional portal for the observatory.

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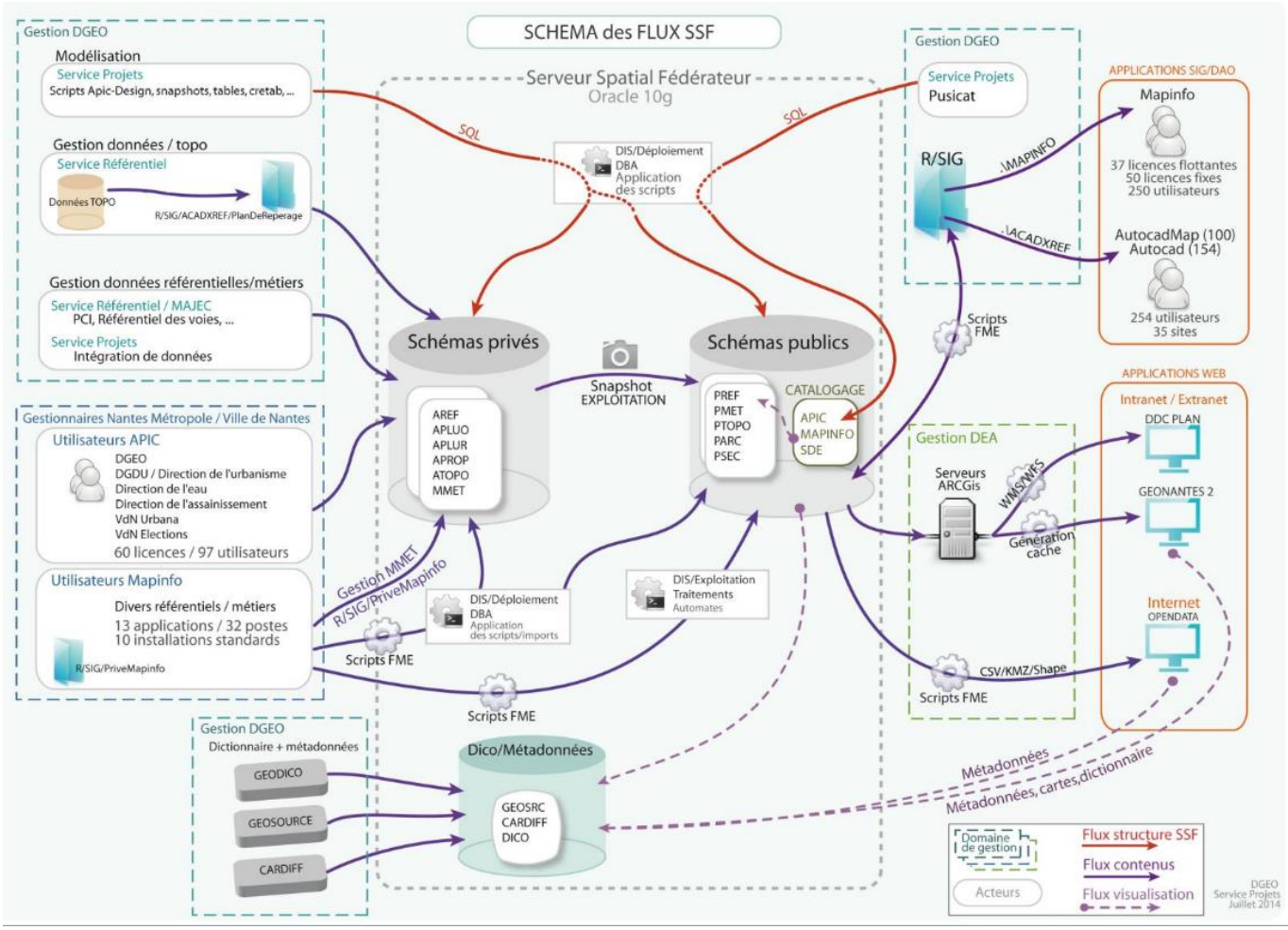
10. Appendix

10.1. Appendix 1: Data flow diagram around the former GIS infrastructure



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10.2. Appendix 2: Framework for data modelling and description of field features for cycling facilities

Nom de la classe d'entité: cycle_amenagement_l

Méthodologie de relevé

Représentation géométrique sur l'axe individuel de chaque aménagement cyclable.
Règles de segmentation : début et fin de l'aménagement, rupture de continuité cyclable, limite de commune, de pôle. D'autres règles contextuelles sont indiquées dans les paragraphes suivants.

Structure de la classe d'entité [cycle_amenagement_l]

Attribut	Description	Observation
type_amenagement	Qualification de l'aménagement	Liste de valeurs décrite ci-dessous (1)
double_sens	Présence d'un double sens cyclable (2)	0=Non 1=Oui
pole_gestion	Pôle de gestion	Calculé
annee_reference	Année de référence (création de l'aménagement)	Saisi
id_prestataire	Identifiant prestataire	Identifiant unique attribué par le prestataire

(1) type_amenagement, valeurs possibles :

Code	Description
0	Bande cyclable
1	Piste cyclable bidirectionnelle
2	Piste cyclable
3	Couloir Bus aménagé
4	Figurines
5	Cohabitation piéton-cycle
6	Voie verte
7	Chaucidou
99	Autre

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domaine dom_cycle_amenage
valeur par défaut : 0

Les types, avec des exemples, sont précisés au paragraphe suivant.

La présence d'un double sens cyclable exprime l'existence d'un contre-sens autorisé aux cycles dans un tronçon à sens unique pour les véhicules à moteur.

Éléments à relever

Piste cyclable : chaussée exclusivement réservée aux cycles à deux ou trois roues. Elle peut être unidirectionnelle ou bidirectionnelle.
Sur le terrain, une piste cyclable se repère par le fait qu'elle est située hors de la partie circulée par l'ensemble des autres usagers (en particulier voitures) et est séparée de cette voie par un de ces types de séparateurs :

- d'une zone neutralisée par deux lignes continues
- d'un site propre séparé physiquement de la voie principale
- d'éléments en élévations (bordures, haies…)
- d'éléments en dénivellations (lorsque la piste cyclable est à hauteur du trottoir ou décalé)
- de stationnements
- d'espaces verts.

Il n'est pas demandé de relever le type de séparateurs.

EXEMPLES D'AMENAGEMENTS DE PISTES CYCLABLES

Photo 1 – piste séparé par une bordure

Photo 2 – piste séparée par de l'espace vert

Photo 3 – piste à hauteur de trottoir

Photo 4 - Insertion d'une piste en bande cyclable dans un carrefour.

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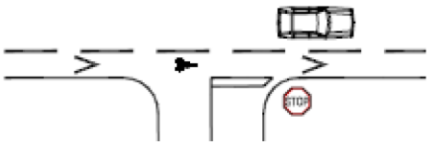
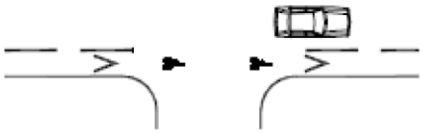
Le relevé est un linéaire entre le début et la fin de la piste cyclable ; ils sont caractérisés par un changement d'aménagement.

Bande cyclable : espace réservé exclusivement aux cyclistes sur la chaussée, séparé de la circulation motorisée par un simple marquage (et non par un séparateur référencé comme caractéristique d'une piste cyclable). L'espace est généralement délimité par une bande de peinture. Le marquage de la bande cyclable est identifiable sur le terrain par une figurine cycliste et/ou des chevrons.

Aux carrefours, la bande cyclable n'est pas à relever comme interrompue si la configuration présente est relevée:



Par contre, elle est considéré comme interrompue dans le cas suivant :



ainsi que dans le cas où il y a une interruption de l'aménagement cyclable au niveau d'un passage piéton.

Le relevé est un linéaire entre le début et la fin de la bande cyclable.

Aménagement de cohabitation piétons cycles

Présence d'un panneau à chaque extrémité de la zone concernée.

Le relevé est un linéaire entre le début et la fin de l'espace de cohabitation.

Voie verte : voie exclusivement réservée à la circulation des véhicules non motorisés, des piétons et des cavaliers. Elle se caractérise par la présence, à chaque extrémité des panneaux suivants (panneau C115 en entrée et panneau C116 en fin de voie verte) :

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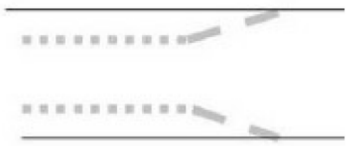
Sur le terrain, c'est la présence de ces panneaux qui permet de qualifier une voie verte.
Le relevé est un linéaire entre le début et la fin de la voie verte.

Chaucidou : Un chaucidou consiste à offrir un espace aux cyclistes, via un partage de la chaussée.
Il se caractérise par la présence du panneau suivant :

et /ou la présence d'une ligne de rive (T2 3u) sur des voies centrales entre 3,2m et 4m en double sens.
Sur le terrain, c'est la présence d'un panneau et/ou un marquage d'accès/sortie qui permet de caractériser un chaucidou.



Marquage de fin/ de début de chaucidou

Le relevé est un linéaire entre le début et la fin du chaucidou.

Aménagement dans un couloir bus : dans les couloirs bus, il peut être matérialisé un aménagement qui combine des figurines cyclistes et un marquage de guidage type bande cyclable largement espacé.

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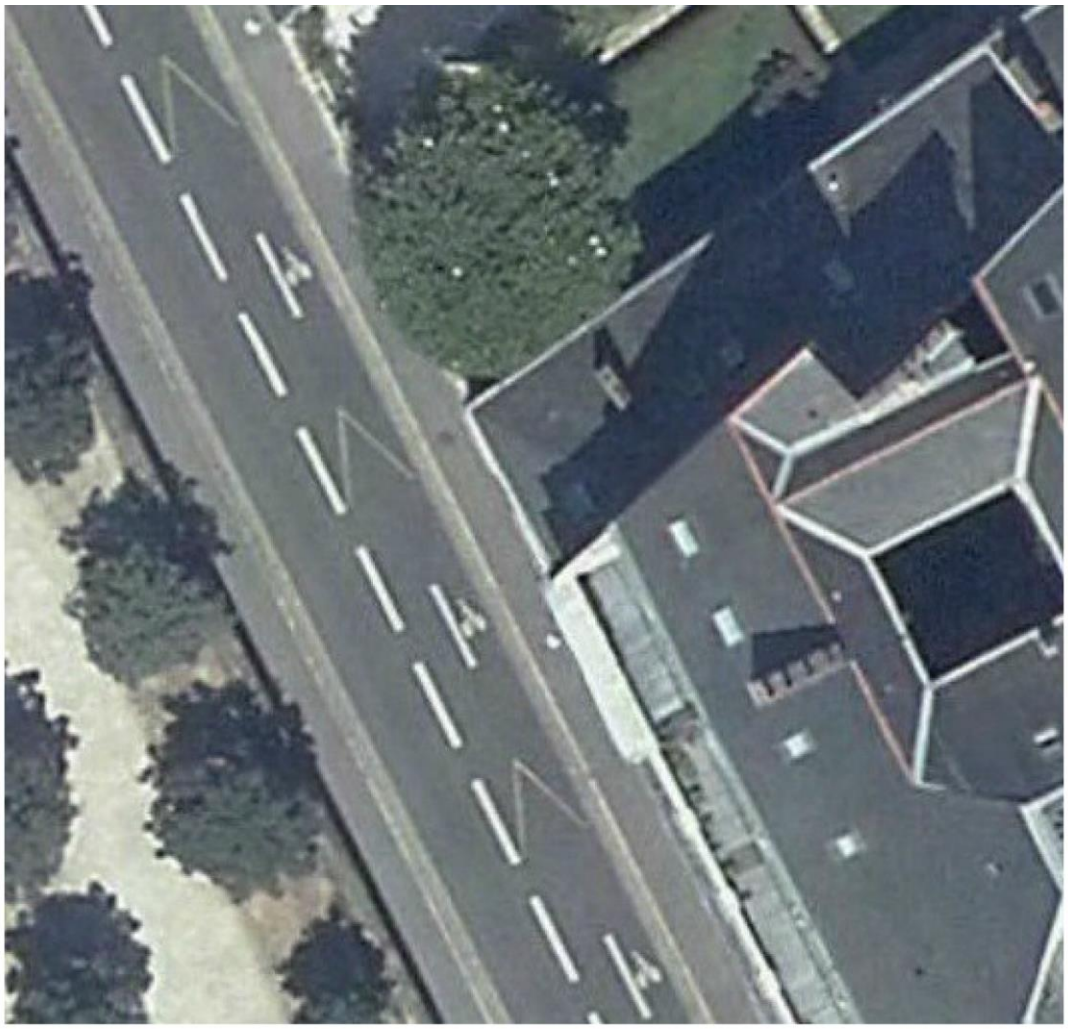

Le relevé est un linéaire entre le début et la fin de l'aménagement dans un couloir bus.

Qualification de l'aménagement en double sens cyclable : voie à double sens dont un sens est réservé aux cyclistes.
Une information liée à cette qualification sera relevée dans le cadre des restrictions de circulation (cf. annexe 1) via le panneau de sens interdit et le panonceau qui lui est associé pour autoriser les cycles.
Un linéaire sera relevé selon son type_amenagement (bande cyclable le plus souvent) auquel viendra s'ajouter la saisie de l'attribut 'dsc' qui sera à qualifier en 'oui' si on est en présence d'un double sens.

Figurine : On ne considère pas que les figurines cyclistes soit un aménagement cyclable en tant que tel sauf si elles servent à marquer la présence d'un double sens cyclable. Les figurines seront donc à relever uniquement lorsqu'elles se situent sur un double sens cyclable (cf. illustration ci dessous)
Le relevé est un linéaire entre le début et la fin de la présence des figurines dans le double sens cyclable.

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Marquage sur les giratoires : indiquer si le giratoire possède un marquage cycliste.
Cette information a été intégrée à la classe d'entités circul_giratoire_p Ponctuels des giratoires (ANNEXE 1, page 19) par la présence d'un attribut 'marquage cycle' o/n

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