# D6.5 S2CP Dashboard

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|---|---|
| Abstract | This deliverable (D6.5, M30) describes the work carried out in Task 6.5, aiming to develop a frontend (web and mobile) gathering all the available information from different sources and tasks. It will focus on user experience design (UX), developing an adaptive dashboard capable of integrating different web and mobile interfaces to serve as decision support systems in CITIES2030. The dashboards will allow users to query project data, apply data analytics operations and visualize the outcome, while customizing the dashboard based on their own needs. The living and policy labs can use this environment to compare the results of applying different processes or techniques to their data, and to monitor the performance of their solutions. |
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## Disclaimer



## Copyright notice



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## Legislation

Legislation H2020 Framework Programme – Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 – The Framework Programme for Research and Innovation (2014-2020) (OJ 347, 20.12.2013, p. 104).

Euratom Research and Training Programme (2014-2018) – Council Regulation (Euratom) No 1314/2013 of 16 December 2013 on the Research and Training Programme of the European Atomic Energy Community (2014-2018) complementing the Horizon 2020 – The Framework Programme for Research and Innovation (OJ L 347, 20.12.2013, p. 948).

H2020 Specific Programme – Council Decision 2013/743/EU of 3 December 2013 establishing the Specific Programme Implementing Horizon 2020 – The Framework Programme for Research and Innovation (2014-2020) (OJ L 347, 20.12.2013, p. 965).

Rules for Participation (RfP) – Regulation (EU) No 1290/2013 of the European Parliament and of the Council of 11 of December 2013 laying down the rules for the participation and dissemination in Horizon 2020 – the Framework Programme for Research and Innovation (2014-2020) (OJ L 347, 20.12.2013, p.81).

Financial Regulation (FR) – Regulation (EC, Euratom) No 966/2012 of the European Parliament and of the Council of 25 October 2012 on the financial rules applicable to the general budget of the European Union (OJ L 298, 26.10.2012, p.1).

Rules of Application (RAP) – Commission Regulation (EC, Euratom) No 1268/2012 of 29 October 2012 on the rules of application of l Regulation (EC, Euratom) No 966/2012 of the European Parliament and of the Council on the financial rules applicable to the general budget of the Union (OJ L 298, 26.10.2012, p.1).

## Document history

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## Glossary and abbreviations

| | |
|---|---|
| CRFS | City Region Food Systems |
| AI | Artificial Intelligence |
| ICT | Information and Communication Technologies |
| KPI | Key Performance Indicators |
| UFSE | Urban Food Systems and Ecosystems |
| WP6 | Work Package 6 |
| D6.5 | Deliverable 6.5 |
| FAO | Food and Agriculture Organization |
| IoT | Internet of Things |
| MAA | Multi-Actor Approach |
| SOCS | Service-based Open Collaboration Space |
| JSON | JavaScript Object Notation |
| REST | Representational State Transfer |
| API | Application Programming Interface |
| GIS | Geographic Information System |
| WMS | Web Map Service |
| WFS | Web Feature Service |
| OGC | Open Geospatial Consortium |
| XML | eXtensible Markup Language |

# 1. Introduction

In this first Section, the context and global overview of Task 6.5 is described, with a special focus on document D6.5, which is the outcome from this task and collects the development and integration efforts of the S2CP dashboard and data visualization in the context of the Cities2030 project, into the proper subsystem of the S2CP platform developed in WP6 (see document D6.1).

## 1.1 Short description of the CITIES 2030 project

The main goal of Cities2030 is to create a future proof and effective UFSE via a connected structure centered in the citizen, built on trust, with partners encompassing the entire UFSE. Cities2030 committed to work towards the transformation and restructuring of the way systems produce, transport and supply, recycle and reuse food in the 21st century. Cities2030 vision is to connect short food supply chains, gathering cities and regions, consumers, strategic and complement industry partners, the civil society, promising start-ups and enterprises, innovators and visionary thinkers, leading universities and research across the vast diversity of disciplines addressing UFSE, including food science, social science and big data.

## 1.2 Short description of the WP6 Package

This work package will gather, design, and develop the main components and technological tools to establish a data-driven CRFS management platform for data collection, analysis and representation in multiple interfaces. An initial requirement acquisition will lead to the proposal of a common technical architecture for Cities2030, for which supporting datasets will be incorporated to be considered for data analysis and representation. Particularly, a service-based open collaboration space will be incorporated, to be used by Cities2030 participants to improve their multi-stakeholder dialogue processes. In this space, blockchain technology will be employed to provide some proof of concepts of token-based monetization processes and reflect multi-stakeholder interaction in a reliable and transparent way. Documentation and software repositories will be available for policy labs and living labs to develop their own solutions with assistance from WP6.

## 1.3 Purpose of D6.5 report

The objective of document 6.5 describes the **work carried out in Task 6.5**, aiming to **develop a frontend** (web and mobile) gathering all the available information from **different sources and tasks**. It will focus on **user experience design** (UX), developing an **adaptive dashboard** capable of integrating **different web and mobile interfaces** to serve as decision support systems in CITIES2030. The dashboards will allow users to **query project data, apply data analytics operations and visualize the outcome**, while customizing the dashboard based on their own needs. The living and policy labs can use this environment to compare the results of applying different processes or techniques to their data, and to monitor the performance of their solutions.

## 1.4 Relation of the D6.5 Report with other WPs and deliverables

This deliverable has a direct relationship with WP6 and in particular with task T6.1 “Requirements and reference architecture” which will provide the Cities2030 technical architecture, based on the experiences of participants from previous project platforms and compatible with other already established ecosystems.
This task also has a direct relation to task T6.2 “Data management and integration”, as in this task the information and data sources to be displayed and represented are identified, acquired and processes. Finally, mechanism in task 6.5 are employed to represent the results.
The link between tasks T3.7 “Data-driven CRFS management system ideation” and T6.5 is the establishment of the initial final user requirements and development guidelines that will become technical requirements to be taken into account in the development of the S2CP dashboard.
Regarding WP4, elements developed within task 6.5 are essential to enable the analysis of the political, social, cultural, etc. situation of policy labs (to be included in document D4.3) and allow labs to define scientific and quantitative objectives to be achieved by future policies.
Similarly, in WP5, and according to Design Thinks methodology, elements developed in task 6.5 allow living labs to design and develop the actions within the stage “Analyze the challenge” (see D5.2). Additionally, quantitative objectives defined using the S2CP dashboard would be integrated into the WP5 exploitation plans (D5.4).

## 1.5 D6.5 structure

The structure of this deliverable is as follows:
Section 2 describes the work methodology considered for T6.5 (from WP6). Although this methodology refers only to the part of the S2CP platform architecture that has been developed in the context of T6.5, it is an approach that is fully compatible with the general working methodology of WP6 and with the CDM development methodology of the S2CP platform.
Section 3 introduces the design and architecture of the S2CP dashboard. The main modules making it up are described, as well as the interfaces relating some modules and data sources with each other. It is presented a general requirement analysis too. It includes requirements from task T3.7 and other User Experience (UX) requirements to be considered. Finally, a general overview of all developments technologies to the employed is provided.
Section 4 is focused on content. In this section the different labs for which information has been acquired and displayed within T6.5 are presented. First, a general description for every lab is provided. Later, data sources are present with details. Contrary to D6.2, where those same data sources were analyzed from the data management perspective, in this document we are focusing on visualization aspects (so data formats can be different). Finally, a general web map relating the labs and the data sources is provided.
The software development methodology is described in Section 5. The methodology employed to implement the data visualization modules and components (mainly the S2CP dashboard), so the results fulfill the initial requirements and the UX requirements is presented. The objective is the data visualization components to be useful for WP5 and WP4 labs.
Section 6 is focused on the interconnection of task 6.5 components and other components previously developed in the context of other WP6 tasks. Specifically, components in task 6.5 will display data from the geospatial information components (task 6.3). The S2CP dashboard will also share the same authentication services with the communities platform (task 6.3) using the Sigle Sign On solution. The objective is all

Cities2030 users to have a unique identifier and password to access and work with all components in the S2CP platform. In the future, the S2CP dashboard will be integrated with other components such as data fusion.
Finally, Section 7 describes the UX experimental analyses. These results are very important to understand the current state of data visualization components and how the next steps should be. Statistics and surveys are designed, carried out and discussed.
The last section (Section 8) concludes the document presenting the possible future functionalities for the S2CP dashboard and components developed within task 6.5. Some conclusions about the current state of the platform are provided too.
In Annex I, a user manual describing the use of the S2CP dashboard is provided. This material will facilitate users to work and interact with S2CP platform and dashboard after the initial training workshop.

## 1.6 Roles and responsibilities

Lead partner role: PRIM (P37) coordinates the activities, provide guidance, steer implementation and secure alignment, implement activities to deliver planned outcomes.

The rest of task participants: UPM (P20) and Uni.lu (P35) develop the task simultaneously at EU level and beyond.

# 2. Methodology for data visualization

The objective of S2CP data visualization components is the provision of technological solutions to improve the decision and analysis process of living and policy labs in the Cities2030 project. For this, a main technological component (S2CP dashboard) capable of displaying relevant information (in a custom manner) is designed and implemented.
In order to fulfill this task is needed to collect a catalogue of data sources, which were already described and analyzed in the context of task 6.2. In order to connect the data sources and other components producing relevant information, and the S2CP dashboard, it is required to define for each source a data format and protocol so the dashboard can capture and represent properly and precisely all the information. In order to improve the efficiency of all this process, all data sources were processed and formatted by different partners in parallel. Each one of these partners are responsible of developing the different visualization mechanisms. The following table shows those data sources together with the responsible partner.

*Table 1. Data sources and visualization and responsible partners*

| Component | Geospatial information | Sentiment analysis | Surveys | Statistical data | Data management and visualization |
|---|---|---|---|---|---|
| Responsible | UPM | UNIL | UNIL | PRIM | PRIM |

The data sources were integrated, adapted and visualized in parallel together with the S2CP dashboard software development, with several development cycles in accordance with the CDM methodology and the schedule planned for WP6 (described in D6.1). In any case, in order to achieve the planned Development

Objectives within the established times, a work methodology will be followed that we briefly describe in the following subsections.

## 2.1 First phase

In the first phase, requirements from T3.7 are analyzed, as well as general UX requirements any end user platform should meet. Specifically for those platforms dealing with data visualization. The state of the art regarding the technologies for the implementation of data visualization components are reviewed too, selecting those with the best characteristic to fulfill the previously identified requirements. Considering all this information, the general architecture and design for the S2CP dashboard can be provided (Section 3 present the resulting proposal).

In this phase the data sources to be integrated into the S2CP dashboard, as well as the labs to act as final users, are identified and characterized. These data sources, besides, will be continuously updated, so the platform and the S2CP dashboard get adapted to the WP4 and WP5 needs as the evolve. Section 4 introduces the data sources and labs to be initially integrated in the S2CP dashboard.

## 2.2 Second phase

In the second phase, development work will begin in accordance with the general CDM methodology. To this end, an agile development scheme will be followed, in which Labs will be interacted with on a regular basis, either through specific workshops for the general public or through individualized and personalized bilateral training meetings for each of the Labs. The software development methodology, with all the particular characteristics associated to T6.5, is presented in Section 5.

In this phase it is also specifically relevant the interconnections of the S2CP dashboard with other components, specially those developed in the context of T6.2 and T6.3. Solutions such as Single Sign On, of geospatial data sources must be integrated into the dashboard following the CDM methodology. Section 6 described those developments with details.

## 2.3 Third phase

In the third and last phase, a step of continuous improvement and customization is triggered. Using UX techniques and methodologies, the S2CP dashboard and other similar components (as well as data visualizations) will get adapted to the dynamic need of users (policy and living labs). This process will be supported by the periodical WP6 workshops (described in document D6.1).

In this document (Section 7) the first results coming from this continuous improvement process are presented and discussed.

This continuous improvement process will cause new technological developments to be executed. All of them will the handled through the WP6 CDM methodology.

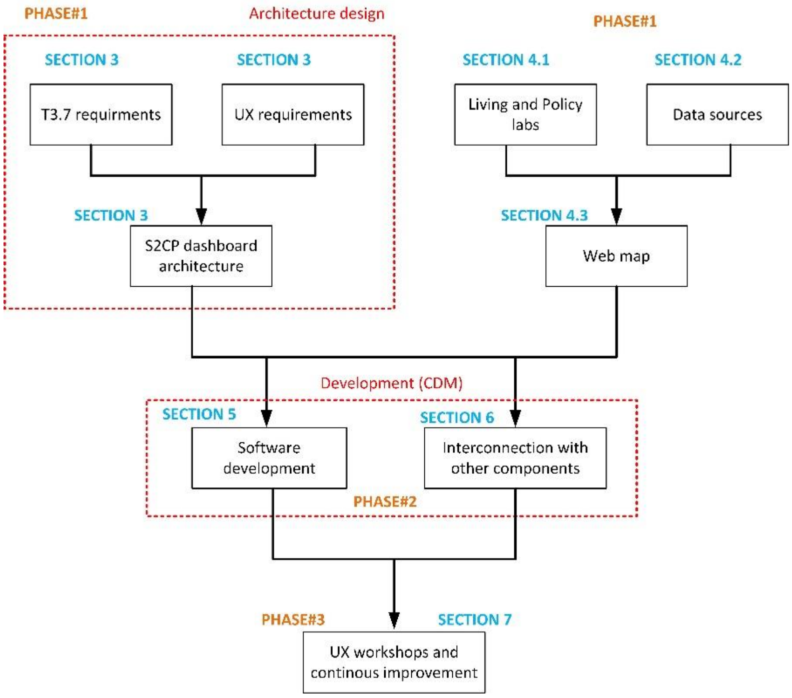


*Figure 1. Methodology for the development of the data visualization subsystem*

# 3. Design, architecture, and modules

Data visualization is the graphical representation of data and information. It is an essential tool for decision-making in various fields, including business, science, and academia. The primary objective of data visualization is to communicate complex data insights in a clear, concise, and understandable manner. Data visualization plays a critical role in decision-making processes by allowing individuals to interpret and analyze large sets of data quickly. With the explosion of data in recent years, it has become increasingly challenging to make sense of complex data without visualization. Data visualization provides several benefits: (i) identify patterns and trends enabling users to identify patterns and trends that are not easily discernible from raw data; (ii) allows decision-makers to discover correlations and relationships between different data points, leading to new insights; (iii) easier to communicate complex insights to stakeholders who may not have expertise in the data; (iv) stakeholders can quickly grasp the implications of the data and make informed decisions by presenting data in an easy-to-understand format; (v) be more engaging and memorable for users, since users are more likely to remember information presented in a visual format compared to plain text.

Data visualization is an essential part of modern data analysis, allowing us to explore and understand complex data sets in a more intuitive and visual way. These platforms typically consist of several components that work together to provide a complete data visualization solution:

1. Data Sources: refers to the different types of data that the platform can connect to and retrieve for visualization purposes. The platform should be able to connect to a wide range of data sources,

including databases, spreadsheets, CSV files, and APIs, among others. The ability to connect to multiple data sources allows users to easily import, merge, and analyze data from different sources in a single visualization.

2. Data Preparation: refers to the process of transforming, cleaning, and formatting the data to make it suitable for visualization. The platform should provide tools for performing these tasks, such as data cleaning, filtering, aggregation, and normalization. These tools ensure that the data is accurate, consistent, and relevant for visualization.
3. Visualization Components: the most critical component of a data visualization platform is, of course, the visualization components themselves. These components are the visual representations of the data, such as charts, graphs, maps, and tables. The platform should provide a wide range of visualization components, each designed to display different types of data in the most effective way possible. The components should be customizable, allowing users to adjust colors, labels, and other visual elements to suit their needs.
4. Interactivity: An essential feature of modern data visualization platforms is interactivity. Interactivity allows users to interact with the data in real-time, enabling them to explore the data and gain insights quickly. Interactivity can take many forms, such as filtering, sorting, zooming, and panning. The platform should provide tools for creating interactive dashboards and reports that allow users to explore and analyze data in a more intuitive and engaging way.
5. Sharing and Collaboration: the platform should allow users to share and collaborate on visualizations easily. This can be achieved through features such as data sharing, commenting, and version control. The platform should allow users to share visualizations with colleagues, customers, or stakeholders easily. Collaboration tools can help to streamline the decision-making process by enabling multiple users to work together on the same visualization.

In relation to the general architecture of the S2CP platform, which is described in detail in D6.1, we make a particularization here to reflect the main elements that interact with the *Adaptive visualization dashboard.* The visualization subsystem and the main interactions can be seen in the following figure.

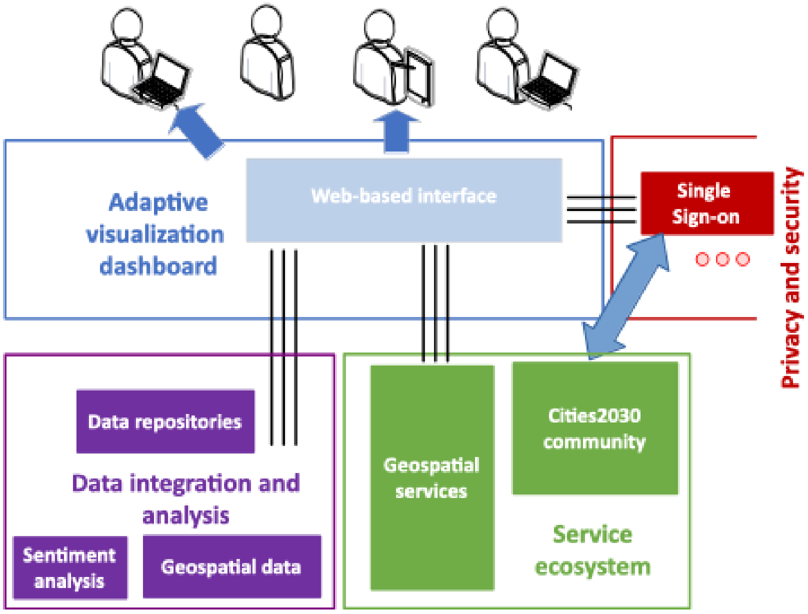


*Figure 2. S2CP data visualization subsystem architecture*

As can be seen, the concept of platform as a composition of interconnected services is demonstrated by the relationship between components from the different subsystems: (i) Data integration and analysis, (ii) Service Ecosystem and (iii) Privacy and Security. The relationship between the components will be described in detail in the section in Section 6 of this deliverable.

A major issue that is underlying the S2CP platform is the User Experience (UX). For the development of S2CP, a responsive design has been foreseen in the platform to adapt to different screen sizes and devices. This is particularly important for mobile users who need to access the platform on the go, as expected by the S2CP mobile application providing a seamless user experience. Data visualization needs also to tell a compelling story, creating visualizations that are easy to understand and that convey a clear message. Data storytelling can help to engage users and communicate complex data sets in a more intuitive and engaging way. For the user, interactivity with the S2CP platform and animation is also involved in the front-end development since it will simplify complex data sets and make them more accessible to users. Finally, customization and personalization are techniques that must be used to tailor the user experience. For example, creating personalized dashboards provides users with the information they need most.

The development of the S2CP visualization platform relied on the best practices of UX, namely:

- User research to understand users' needs, goals, and pain points, and identify user requirements ensuring that the product meets their needs. This has been done by previous platform development by PRIMELAYER, surveys, user interviews and workshops, and usability testing.
- Accessibility is critical in ensuring that the product is usable by everyone, including people with disabilities, by including design for screen readers, ensuring color contrast, and using alt tags for images.
- Simplicity, since the product should be easy to use and understand, with clear and concise language. The interface should be intuitive and straightforward, with a clear hierarchy of information.
- The product should have a consistent design across all pages and should use the same visual language throughout. Consistent design helps users to understand how the product works and makes it easier to navigate.
- User testing helps to identify issues and pain points, allowing for improvements to be made. Iteration allows for continuous improvement of the product, ensuring that it meets user needs.
- The platform should provide users with feedback on their actions, such as confirmation messages, error messages, and progress indicators. Feedback helps users to understand how the product works and ensures that they are aware of any issues.
- Design also for mobile, since they are becoming increasingly popular, and should be responsive, with a focus on simplicity and ease of use.

The frontend of S2CP connects the components in a systemic approach, as it may be seen in Figure 3.

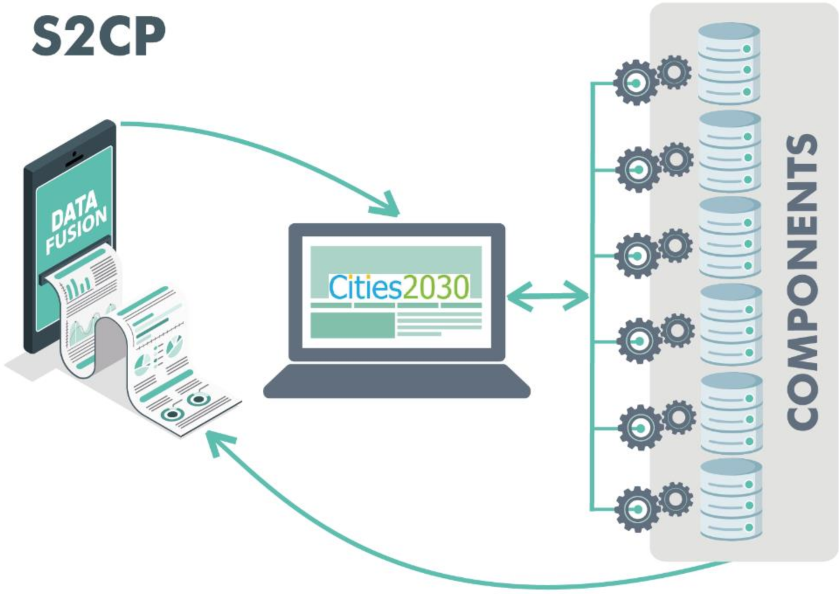


*Figure 3. Schematic integration of components and databases into S2CP platform*

The architecture of the platform has been conceived using the background of previous civil protection and decision-making platforms, and built to provide a modular, scalable, and maintainable structure. The main interaction with the user comes from the presentation layer that can render the user interface requirements by displaying the information. In the case of S2CP, this layer is based on HTML and CSS libraries.

The second layer deals with the application's logic, data processing, and data storage. The application layer includes JavaScript files that interact with backend APIs and databases to fetch or manipulate data. The front connects directly to the databases of each component using API interfaces gathering the data that will be visualized. The collected data populates a temporary local database in such a way that the data is curated, validated, and processed according to the needs of the user. The S2CP will also connect to the fusion database, again through an API connector.

The component library is a collection of pre-built UI components that can be used across an application, to standardize the visual appearance and behavior of UI components across an application and improve the development speed by providing pre-built components. For S2CP it has been employed in house developed and open-source plugins:

- Bootstrap framework that gathers modular and customizable components for CSS that are needed for visual representation of gradients and shadows, linked with variables, maps, functions, and mixings defined by the developer.
- CodeIgniter framework gathers the PHP web application, for building web applications more quickly and easily by providing a set of libraries and tools that handle common tasks like database interaction, input validation, and session management.
- Leaflet is an open-source JavaScript library for interactive maps that are rendered with low memory cost and clean aspect.

- jQuery and jQuery components are JavaScript libraries that aim to simplify the process of interaction between the Document Object Model (DOM) in web pages, to add interactivity and dynamic behavior to web pages, like hiding, slide images (as in the frontpage of S2CP), or add textures.
- iCharts is the front-end module for chart rendering, based on a cloud-based platform for creating interactive charts, maps, and dashboards. It is connected to a json parser plugin developed by PRIMELAYER that interprets the information gathered from the local database to be transposed to the front-end visualization routines.

Since it is expected to have dynamical data to be included in S2CP, state management has been included in the design of the platform, in such a way that managing the application's state and data flow can be more easily achieved. For that the CodeIgniter has been employed, a feature that allows data to be passed down to the component tree without having to pass props down manually through every level of the tree. It is used to share data that can be considered "global" for a tree of components and allow for the centralized management of data and state across the application. Finally routing which deals with the handling of the navigation between different pages and views in the application.

Underlying spatial tools of S2CP, it may be found a GIS engine, which provides tools for the creation, analysis, and visualization of geographic data. GIS engine visualization platforms typically include a map interface that displays data in a geospatial context, such as on a satellite image or topographic map. Users can interact with the data by zooming in or out, panning across the map, and selecting features of interest. The platform may also include tools for measuring distances, creating buffers, and performing other spatial analysis tasks.

In addition to the map interface, GIS engine visualization platforms often provide a variety of data visualization options. Users can create charts, graphs, and other visual representations of the data to gain insights and communicate findings. The platform may also allow users to customize the display of the data by choosing different colors, symbols, and labels.

For the S2CP platform it has been used QGIS, also known as Quantum GIS, a free and open-source server software. It provides tools for creating, editing, visualizing, and analyzing geospatial data on various platforms including Windows, Linux, and Mac OS. QGIS supports a wide range of file formats, including shapefiles, GeoJSON, GeoTIFF, PostGIS, and many more. Users can load, edit and save various vector and raster datasets, as well as connect to databases to manage their geospatial data. The software also provides a powerful set of spatial analysis tools, such as buffering, intersecting, and overlaying, to perform complex geoprocessing tasks.

# 4. Living and Policy labs, data sources and analytics

In this section the content in the S2CP dashboard is described. The different policy and living labs acting as end users, as well as their main needs and objectives are identified. Besides, the data sources to be integrated in the dashboard are also discussed and presented. Finally, a cross-analysis indicating which labs are consuming which data sources is provided too.

## 4.1 Living and policy labs in the S2CP dashboard

Currently, fifteen (15) Living and Policy Labs are included in the platform with available data:

- **Quart De Poblet, Spain:** Quart de Poblet Living Lab aims to identify and involve the owners of unproductive land, farmers in the municipality and unemployed students of an agricultural workshop offered by the employment center of the municipality in order to co-create innovative solutions to make use of abandoned land, cultivate and exploit it, generating a short local supply chain, through which farmers can sell their products directly in the municipality. The second priority of Quart de Poblet Living Lab will be developing a sustainable food culture and skills in order to change consumption patterns and habits by promoting healthy and sustainable diets and reducing food waste.

- **Vicenza, Italy:** The Lab intends to design and implement a "food-for-all" approach to guarantee better nutrition, greater health, wider social inclusion and economic development through food policies. In this respect, one of the most important challenges Vicenza will have to confront will be to maintain a good equilibrium between the local traditions on the one hand, and the will and capacity to innovate on the other.
- **Bremerhaven, Germany:** The lab is interested in monitoring the promotion and users' opinion of the local products, but also, they need generic statistical data to decide the most suitable promotion policies to be implemented. The objectives are: (i) support socially disadvantaged neighborhoods and districts; (ii) Networking to improve community catering; (ii) increasing the supply of nutrients, vitamins, and minerals, for example through the targeted cultivation of plants/herbs in urban gardening; (iv) Improving the nutrition education of people; (v) combating the nutritional poverty of children, the elderly and everyone who suffer from nutritional poverty; (vi) expand regional supply chains.
- **Troodos, Cyprus:** The objectives of this lab are still under discussion. General information will be displayed until more specific description are available.
- **Murska Sobota, Slovenia:** City of Murska Sobota cooperates closely with Green Point (Zelena točka) Short Food Supply Chain (SFSC) incorporating more than 70 local farmers, food producers and cooperatives, covering the production process in greenhouse and open-air fields, with logistics from own distribution center and different means of sales such as public bodies (schooling sphere, retirement homes), private (restaurants, health resorts), own retail stores and online shops. **Haarlem, Holland:** The municipality of Haarlem has initiated an extensive sustainability program that focuses on climate adaptation, energy transition and circular economy. As part of the implementation strategy for this program, several living labs have been created to test new concepts in a practical urban setting. Close cooperation between the municipal government, local business and business organizations, educational institutions and NGOs has created an easily accessible network of expertise. Actual living labs, active over a period of two years now, include projects focusing on zero emission city logistics and combating food waste. **Lasi, Turkey:** The Living Lab is designed as an innovative collaborative hub whose main purpose is to connect actors and agents in the urban food system of Iași in order to identify the most important problems of the system and find innovative solutions to solve these problems and to develop sustainable local development. One of the main reasons is the desire to improve the quality of life, based on the idea of healthy diet and the support and promotion of local mechanisms for sustainable production and food consumption.
- **Agrotopia, Belgium:** Works on innovation pathways, from ideas to co-creative validation in a practice-oriented research environment. Use co-creation processes to develop, test and further improve new greenhouse horticultural technologies and demonstrate installations. The associated technical and practical knowledge helps to implement systems in practice. The living lab can also explore the possibilities of professional urban farming thanks to Agrotopia's unique location on the

roof of the warehouse of REO Veiling (agricultural auction market) and on the edge of the city of Roeselare (Belgium). This allows it to synergize with its surroundings by investigating how the functions of agriculture, industry (e.g., residual heat) and the city are intertwined.

- **Arganda, Spain:** Only 4% of what they eat comes from Arganda. At present, the production capacity of the region can only respond to 5% of the demand for fruits and vegetables; to 20% for dairy products, honey and eggs and almost 50% of meat consumption. To comply with the nutritional recommendations, the Arganda population should multiply by two the fruit consumption, triple the intake of vegetables, and increase by 400% the consumption of legume. Especially worrying is the quality of the population's diet child: 40% are above the recommended weight, a percentage 5 times higher in homes with lower income. Although Arganda has a fabric commercial of diverse proximity and accessible (municipal markets, small shops, markets, most grocery shopping is done in supermarkets. Investing in this trend would help to promote the regional economy: for each euro invested in short channels of marketing contributes to the local economy twice as much as if that euro was spent on large surfaces.
- **Bruges, Belgium:** Connected to the rural context existing food lab with proven track record focusing on Catering facility for local elderly population as well as for tourism. In terms of living lab activities 4 partners (City of Bruges, Ruddersstove, Mintus and Vives) will be working closely together with many partners of the foodservice and care network in and around Bruges. The main goals are: (i) enhance circularity and local food belts; (ii) protect & preserve natural resources; (iii) secure healthy and sustainable food; (iv) stop food poverty and insecurity; (v) develop food culture and skills topics included in the lab.
- **Mugla, Turkey:** The Labs develops especially in the fisheries and more globally seafood value chains. Muğla CRFS Labs connects with organic aquaculture, microalgaes, microalgae-assisted integrated multi-trophic aquaculture to deliver healthy, sustainable, nutritious and culturally appropriate food, especially to the schooling sphere.
- **Pollica, Italy:** A rural village in the south of Italy, is the epicenter of Mediterranean lifestyle and the crossover point of history, culture and anthropology of this ancient heritage. The "Paideia Campus" in Pollica, is an experimental center where one can learn a new kind of sociality and live the concept of integral ecology, of which the Mediterranean diet is a concrete example. Everything is connected – environmental protection and human health, regeneration of the territory and citizens' well-being, social justice, and climate change.
- **Vejle, Denmark:** Using the existing platform the Labs wants to connect innovators and stakeholders in Food and Gastronomy.
- **Velika Gorica, Croatia:** Development of an efficient nutrition system of the city based on connecting consumers, strategic partners, civil society participants (existing and start-up companies), innovators and leading universities. Rural development through the creation adaptation of innovative digital and social solutions at the local / regional level. Establishing innovative and tailored methodologies for thinking about the food system in order to jointly address challenges. Digital platform for connecting all stakeholders in the food system (CRFS) for local and regional connectivity.
- **Vidzeme, Latvia:** The Lab will work in existing challenges in the REGIONAL FOOD SUPPLY SYSTEM in the territory of the Vidzeme Planning Region. It will identify the best ways to establish and maintain a sustainable and resilient regional food system and to strengthen ties among all food chain stakeholders (producers, processors, traders, logistic enterprises, catering services providers etc.). Especially between producers, processors and consumers – to develop, implement and strengthen sustainable and resilient short food supply chains.

## 4.2 Data sources

In general, when submitting this document, four different data sources were considered and integrated into the S2CP dashboard.

### 4.2.1 Geospatial data from S2CP data repository

At the time of writing this deliverable, the Cities2030 repository component has a total of 58 datasets, grouped by Labs (13 groups of Labs) and in the following formats:

- Geojson (29 items)
- CLS (13 items)
- CSV (12 items)
- XLSX (2 items)
- JSON (1 item)
- Zip (1 item)

Among these data sets, we highlight the 29 that directly contain Geospatial Data and that have been directly integrated into the dashboard.
Thanks to the use of Open Data licenses (mostly Open Data Commons Open Database License, ODbL[4]), they allow us to use them to show visualizations on the dashboard.
We recall the information collected in Section 6.2 of D6.2, where the workflow of geospatial information and service components is described. This workflow is used to obtain spatial information, which ranges from the collection of information in public repositories to user engagement in the use and update of information. Below is a diagram of this process:

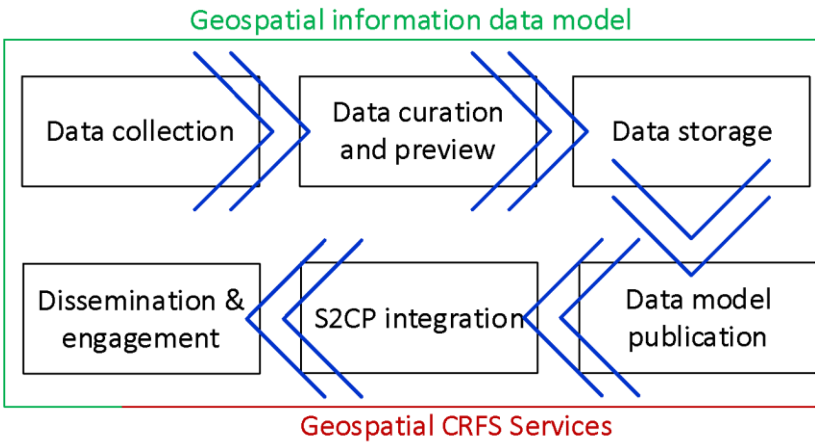


*Figure 4. Geospatial information and services component workflow*

While the deliverable D6.2 focused on the first phases of this workshop, in this section we will focus on the last phases of the methodology up to the date of preparation of this deliverable, that are: (4) Data model

[4] https://opendatacommons.org/licenses/odbl/

publication, (5) S2CP integration, and (6) Dissemination & engagement. In the final S2CP report of M48, the information will be completed with the evolution of this component during the last period of the project.

### 4.2.1.1 Data model publication

The last step described the database used for the storage of information, allowing a quick consultation without losing versatility (relational database with spatial extension, PostgreSQL v14 with PostGIS extension). In order to publish this information to the Internet, so that it is accessible by other components, we have needed to use a geospatial information server.

To meet the KPI for the use of standard formats and protocols for the publication and access to information in the project (please refer to KPI "Open-source standards supported by S2CP components" in D3.8), we wanted to use OGC standards for the definition from an API for querying information about the cities of the project from external sources, such as a web page.

For this we use the Open Source Geoserver[5] software, and the standard Web Feature Service (WFS)[6], to obtain geographic features according to the information stored in the database. The designed connection model can be seen in the following figure:

```
owsrootUrl := <DOMAIN>:<PORT>/geoserver/cities2030/ows?<defaultParameters>

<defaultParameters> := {
        service: 'WFS'
        version: '1.0.0'
        request: 'GetFeature'
        typeName: <typeNameNodes> | <typeNameWays> | <typeNameLimits>
        outputFormat: 'text/javascript'
        SrsName: 'EPSG:4326'
}
                                  <typeNameNodes> :='cities2030:<City>_nodes'
                                  <typeNameWays> :='cities2030:<City>_ways'
                                  <typeNameLimits> :='cities2030:<City>_limit'

<City>:= Quart de Poblet | Bremerhaven | Brugge | Velica Gorica
| Troodos | Seinäjoki | Vidzeme | Iasi | Murska Sobota | Vicenza | Haarlem
...
```

*Figure 5. Data model syntax for Geospatial queries*

As can be seen, a set of addresses are encoded in an API type space, with different variability parameters, indicated in the figure with a text highlight color. We highlight the three types of information that can be obtained:

<typeNameNodes>: *Point-type* set (OSM nodes), which represents the point-based elements of the establishments according to the categories present in D6.2. Section 7.3.2 Geospatial information.

<typeNameWays>: *Linestring type* set (OSM Ways), which are presented in open or closed polygons, generally demarcating an area of an establishment, such as a supermarket.

[5] https://geoserver.org/

[6] OGC Web Feature Service (WFS) Implementation Specification: https://www.ogc.org/standards/wfs

<typeNameLimits>: *Polygon type* set, which represents the administrative limits of the municipality involved in the Cities2030 Lab. This is being used alto to filter other *TypeNames* to ensure they belong to the experimentation area.

The following figure shows a representation of the three types of spatial elements in the S2CP dashboard.

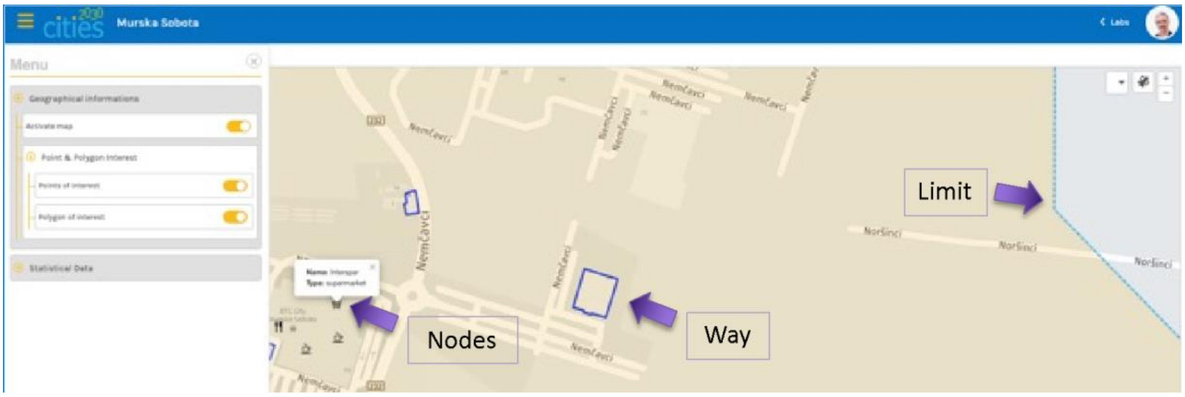


*Figure 6. Geospatial information data types for Murska Sobota Lab in S2CP dashboard*

#### 4.2.1.2 S2CP integration

The S2CP integration phase, in the Geospatial information and services component workflow, allows the integration of the information in the dashboard. The details of this integration are developed in Section 7 "Interconnection to other S2CP components: Data repository".

#### 4.2.1.3 Dissemination & engagement

The operation of this component is disseminated through a set of events where we make this tool available to the labs, through the S2CP dashboard. A workshop was established according to CDM methodology (see Section 2 in this Deliverable), with code R-211 "First Workshop with pilots" of the M30, where a preliminary version has been presented, already integrated in the S2CP dashboard. For more information on these Workshops, please see Gantt chart of D6.1 Section 2.3. Most of the labs or at least of the labs that showed interest in this component confirmed participation. User feedback regarding the workshop is presented in Section 6 "UX on S2CP platform".

### 4.2.2 Sentiment data

Sentiment data are generated from social networks such as Twitter, using the appropriate artificial intelligence technology. All this process, the data formats and results are described with details in D6.2. However, in order to integrate those results (typically displayed in a Jupiter notebook) in the web based S2CP dashboard a CSV format was employed.
Results were exported using common Jupiter's libraries and the resulting CSV datasets were finally imported in the S2CP dashboard.

| ID,day,NEG,NEU,POS |
|---|
| 0,2021-12-20,5.0,36.0,0.0 |
| 1,2021-12-21,8.0,35.0,0.0 |
| 2,2021-12-22,1.0,39.0,3.0 |
| 3,2021-12-23,1.0,10.0,0.0 |
| 4,2021-12-24,0.0,18.0,0.0 |
| 5,2021-12-25,0.0,2.0,0.0 |
| 6,2021-12-26,2.0,6.0,0.0 |
| 7,2021-12-27,1.0,20.0,0.0 |
| 8,2021-12-28,1.0,17.0,0.0 |
| 9,2021-12-29,0.0,8.0,0.0 |
| 10,2021-12-30,3.0,17.0,0.0 |
| 11,2021-12-31,3.0,15.0,0.0 |
| 12,2022-01-01,1.0,7.0,0.0 |
| 13,2022-01-02,0.0,9.0,0.0 |
| 14,2022-01-03,3.0,14.0,0.0 |
| 15,2022-01-04,1.0,39.0,1.0 |
| 16,2022-01-05,1.0,14.0,0.0 |
| 17,2022-01-06,0.0,11.0,0.0 |
| 18,2022-01-07,6.0,5.0,1.0 |
| 19,2022-01-08,1.0,2.0,0.0 |
| 20,2022-01-09,2.0,8.0,0.0 |
| 21,2022-01-10,2.0,19.0,0.0 |
| 22,2022-01-11,1.0,22.0,2.0 |
| 23,2022-01-12,0.0,13.0,0.0 |
| 24,2022-01-13,0.0,7.0,0.0 |
| 25,2022-01-14,3.0,7.0,0.0 |
| 26,2022-01-15,0.0,4.0,0.0 |
| 27,2022-01-16,0.0,6.0,0.0 |

| ID,hour,# tweets |
|---|
| 0,0,6 |
| 1,1,4 |
| 2,2,1 |
| 3,3,2 |
| 4,4,4 |
| 5,5,12 |
| 6,6,11 |
| 7,7,36 |
| 8,8,34 |
| 9,9,29 |
| 10,10,33 |
| 11,11,34 |
| 12,12,48 |
| 13,13,31 |
| 14,14,23 |
| 15,15,43 |
| 16,16,30 |
| 17,17,37 |
| 18,18,17 |
| 19,19,40 |
| 20,20,30 |
| 21,21,18 |
| 22,22,18 |
| 23,23,12 |

*Figure 7. Sentiment data as CSV datasets*

### 4.2.3 Statistical data

Statistical data can be used to improve city region food systems. For example, it can be used to evaluate the effectiveness of food policies and map the food system in a city region, including the locations of farms, food processing facilities, and retail outlets. This information can help identify gaps in the food system and opportunities to strengthen local food production and distribution.
The initial iterations with the Living and Policy Labs regarding the data to be included in the S2CP platform, the focus was to include statistical data that may be relevant for the decision-making process. The procedure that has been implemented has been to search open data at country level and municipality/regional level in case it is available. In the following Tables is described the full set of statistical data per country that have been proposed to populate the database and to be used in data fusion.

*Table 2. Statistical data per country*

| Germany | Cyprus | Slovenia | Spain |
|---|---|---|---|
| Average age at death | Average Monthly Earnings | At-risk-of-poverty rate by age and gender | Active population by professional situation |
| Average life expectancy at birth | Deaths by Cause of Death and Sex | Average monthly earnings by activities | Active population by age group |
| Average population | Demographic Indicators | Basic data on deaths | Aggregates by industry |

| | | | |
|---|---|---|---|
| Deaths | Enterprises with Innovation Activities by Sector | Basic data on live births | Demographic phenomena |
| Employees subject to social insurance contributions at their place of work | Gross Domestic Product and Gross National Income | Number of buildings, their size and dwellings in them by type of building and municipalities | Employed by professional situation |
| Habilitations | Index of Industrial Production | Employed persons by activity and sex | Employed persons by level of education attained |
| Live births | Life Expectancy at Birth | Financial situation of households | Employed population by age group |
| Person's employment and unemployed persons | Number of Enterprises and Employment by Economic Activity NACE Rev2 and Size | Life expectancy at birth by sex | Unemployed persons by age group |
| Total fertility rate | Population by age and sex | Participants in formal education | Unemployed population by sector of the level of education attained |
| Stillborn children | Registered Unemployed by District | Persons in employment | |
| Pupils in German schools | Vital statistics -1974/2019 | Population by age and sex | |
| Population density | | Number of students by school year | |
| Population by administrative districts | | | |
| Population by age and sex | | | |

*Table 3. Statistical data per country*

| **Netherlands** | **Italy** | **Romania** | **Belgium** |
|---|---|---|---|
| Average age of the mother and the father | Average hourly earnings for employee jobs in the private sector by level of education | Early school leaving rate of young people | Births |
| Confinements | Deaths | Wage differences by gender | Educational level of the population |

| | | | |
|---|---|---|---|
| Health expectancy | Gross Domestic Product and main components | Innovator Startups | Employees |
| Infant mortality | Gross domestic product supply side | Life expectancy per gender | Evolution of the crude mortality rate |
| Life expectancy at birth and Average age at death | Import and export by country and commodity Nace 2007 | Public funds spend on education | Migration |
| Live born children | Live births | Ration between economic independence of families per age groups | Persons employed |
| Population dynamics | Population by age group (%) | Population with low level of education | |
| Stillborn children | | PIB | |
| Total deaths | | Fertility | |
| Welfare of persons - 1 000 euro | | Mortality | |
| Welfare of persons - perc | | Employment | |
| Welfare of persons - x1 000 | | Resident population by age group | |

*Table 4. Statistical data per country*

| **Croatia** | **Denmark** | **Finland** | **Latvia** |
|---|---|---|---|
| Education-institutions | Employment rates | Deaths | Activity rate |
| Education-students | Deaths | Employed | Deaths |
| Employment | Educational attainment | Live births | Employment rate |
| Gross domestic product | Employees by industry | Migration | Gross domestic product per capita |
| Migration | Income | Population by level of education | International long-term migration of population |
| Nature change in population | Life expectancy for newborn babies | Students in basic education and additional education | Population aged 15 – 74 years by highest educational level attained |
| Population by age | Live births | | Population at the beginning of the year, population change and key vital statistics |

| | | | |
|---|---|---|---|
| Population by counties and age group | Population at the first day of the quarter | | Unemployment rate |
| Population by region | Total external trade | | |
| Quarterly gross value added and gross domestic product | | | |

*Table 5. Statistical data per country*

| **Turkey** |
|---|
| Adult Mortality by External Causes |
| Adult Mortality by Certain İnfectious and Parasitic Diseases |
| Adult Mortality by Diseases of the Circulatory System |
| Adult Mortality by Diseases of the Respiratory System |
| Births by Province and Sex |
| Child employment rate |
| Deaths |
| Employment |
| Formal Education Completed |
| Gender pay gap |
| Gross Annual Earnings |
| Immigrants and emigrants |
| Population by Sex and Age Group |
| Unemployment Rate |

The data has been curated, to check date interval availability, missing values in the time-series, and capabilities to generate reliable outcomes for the CFRS (as requested by the Living and Policy Labs). In the following Table the number of datasets per lab and the number of records associated may be seen. The dataset is the number of distinct information gathered from the national statistical records. Thus, the total number of datasets of statistical data is 163 with 35592 individual records.

*Table 6. Datasets per policy and living labs*

| **Laboratory** | **#sets** | **#records** |
|---|---|---|
| Quart De Poblet | 24 | 1359 |
| Vicenza | 8 | 545 |
| Bremerhaven | 14 | 13575 |
| Troodos | 12 | 1380 |
| Murska Sobota | 12 | 1368 |
| Haarlem | 12 | 510 |
| Lasi | 13 | 888 |
| Agrotopia | 5 | 1921 |
| Arganda | 9 | 1242 |
| Bruges | 5 | 1921 |
| Mugla | 14 | 3333 |
| Pollica | 8 | 545 |
| Vejle | 9 | 1700 |
| Velika Gorica | 10 | 3721 |
| Vidzeme | 8 | 1584 |

### 4.2.4 Other data sources

Other data sources, such as individual surveys, are also integrated into de S2CP dashboard. However, this data sources are not general, but specific from each living and policy lab (as described in D6.2). In general, these data sources are surveys, whose processing and presentation is delegated into de S2CP dashboard (see D6.2, Annex I).
Data formats in this case are typically CSV datasets exported from the analysis software (see Section 4.2.2).

## 4.3 S2CP map

Currently The S2CP gathers information from 15 Labs. Each Lab has its own container of data in the local database and web site. This is clearer from the sitemap presented in Figure 8, representing the structure and hierarchy of a S2CP and its content, in such a way an optimized UX front end may be achieved, and bugs may be detected. The tree of the S2CP is currently very simple and straightforward, depending on API connections to additional components (not shown, since they are simple connectors).

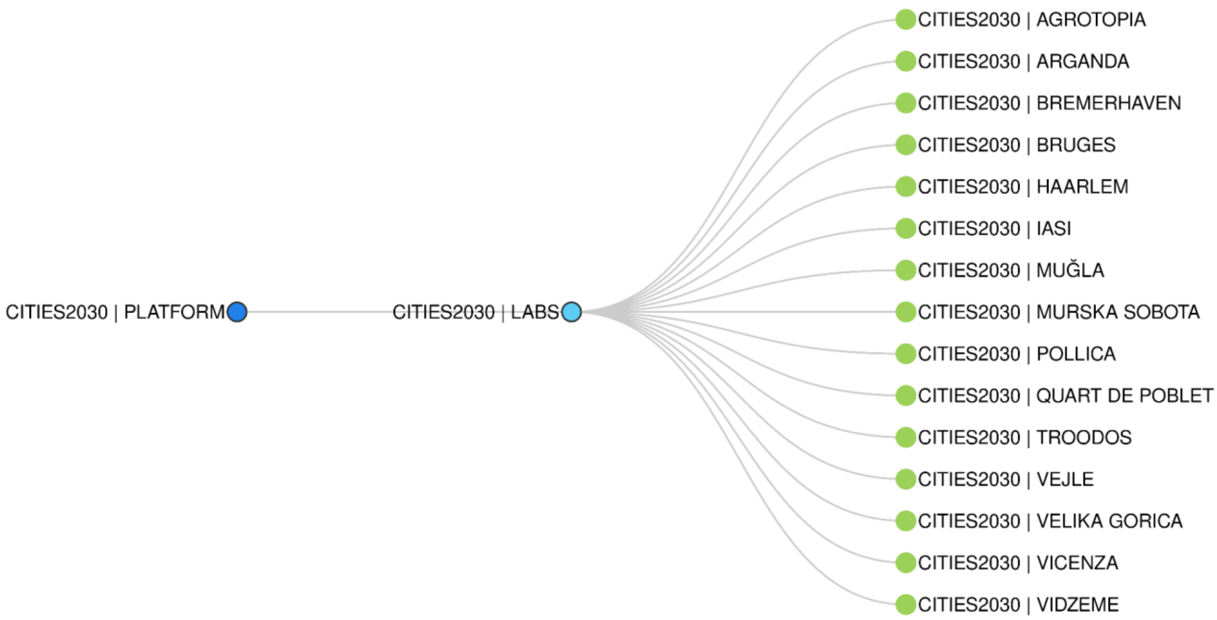


*Figure 8. S2CP dashboard web map*

*Table 7. Relation between data sources and policy and living labs*

| **Laboratory on S2CP** | **Statistical data** | **Points of interest** | **Regions of interest** | **Sentiment Analysis** |
|---|---|---|---|---|
| Quart De Poblet | ✓ | ✓ | ✓ | ✓ |
| Vicenza | ✓ | ✓ | ✓ | |
| Bremerhaven | ✓ | ✓ | ✓ | |
| Troodos | ✓ | ✓ | ✓ | |
| Murska Sobota | ✓ | ✓ | ✓ | |
| Haarlem | ✓ | ✓ | ✓ | |
| Lasi | ✓ | ✓ | ✓ | |
| Agrotopia | ✓ | ✓ | ✓ | |

| | | | | |
|---|---|---|---|---|
| Arganda | ✓ | ✓ | ✓ | |
| Bruges | ✓ | ✓ | ✓ | |
| Mugla | ✓ | ✓ | ✓ | |
| Pollica | ✓ | ✓ | ✓ | |
| Vejle | ✓ | ✓ | ✓ | |
| Velika Gorica | ✓ | ✓ | ✓ | |
| Vidzeme | ✓ | ✓ | ✓ | |

# 5. Software development methodology

The methodologic of the S2CP front-end has been based on Scrum. The approach is commonly used in PRIMELAYER software development projects, and the framework emphasizes collaboration, iterative development, and continuous feedback, and it is designed to deliver high-quality products quickly and efficiently. Based on sprints between iterations of software implementation, PRIMELAYER team implemented the following approach:

- Sprint Planning. At the beginning of each sprint, the team starts the planning of activities. Meetings with Labs allowed the analysis of software and data requirements that needed to be completed in the sprint. The project manager focused on part of activities based on capacity and velocity, breaking into tasks and estimates the time required for each task. For the S2CP case, this initial approach showed difficulties in the Labs telling the needs, and bilateral discussions carried out by questionnaires prompted directions to the data requirements. Each partner in WP6 built the component independently, to be gathered as shown in Figure 1 in a unified frontend. Each sprint plan took nearly 2 months of planning and data research.
- Weekly Scrum. Several meetings were held internally during the sprint in the planning activities and task preparation. Most of the meetings have been used to identify obstacles and bottlenecks, and to the development team sharing progress updates planning for the week ahead. From the front-end activities, the sprints have been sufficiently stable to have an alpha version immediately. Major difficulties for the development team have been the lack of data beyond the national statistics.
- Sprint Review. At the end of each sprint, the development team holds a sprint review meeting to demonstrate the work that was completed during the sprint. The Labs and other partners provided feedback on the work that has been completed, and the product backlog is updated accordingly. These events have been held in Labs workshops and Harlem UX events.
- Sprint Retrospective. The Sprint Retrospective is a meeting held after the Sprint Review to review the development process and identify areas for improvement. PRIMELAYER development team analyzed the scrum sprint providing feedback to improve for the next sprint. In this step, new approaches for lack of Lab data have been considered by proposed bilateral meetings.

Overall, the Scrum methodology applied to the S2CP front-end platform has currently made 3 major cycles based on two workshops, bilateral meetings with Labs and one major UX activity (see next section).

# 6. Interconnection with other S2CP components

For any visualization platform, such as the S2CP dashboard, it is critical to get connected to any other WP6 components generating information or providing security services. In this section we discuss the main current and future interconnections.

## 6.1 Geospatial CRFS services and Data repository

This section explains how the Geospatial CRFS Service, and the data repository component offer an integration API that can be used by the dashboard.
In relation to the Geospatial CRFS Service CRFS services we use a *Geoserver* as a means of interconnection between the database that contains the geographic information. In the following figure you can see the list of layers it contains, which can be downloaded in various formats, such as GML, KML or GeoJSON.

| Type | Title | Name | Common Formats |
|---|---|---|---|
| | Haarlem_limit | cities2030:Haarlem_limit | OpenLayers GML KML |
| | Haarlem_nodes | cities2030:Haarlem_nodes | OpenLayers GML KML |
| | Haarlem_ways | cities2030:Haarlem_ways | OpenLayers GML KML |
| | Iasi_limit | cities2030:Iasi_limit | OpenLayers GML KML |
| | Iasi_nodes | cities2030:Iasi_nodes | OpenLayers GML KML |
| | Iasi_ways | cities2030:Iasi_ways | OpenLayers GML KML |
| | Murska_Sobota_limit | cities2030:Murska_Sobota_limit | OpenLayers GML KML |

*Figure 9. Layer preview of Geospatial data in deployed Geoserver*

Once the request is made to the server, certain styles are applied, on the client or frontend side, to categorize the types of establishments in the field of food systems.
Below are the icons of open licenses (MIT and Creative Commons) that have been selected for the representation of markers in the geographical areas where living labs and policy labs carry out activities.

*Figure 10. Icon set of CRFS establishments for Geospatial representation*

Regarding the data repository, we take advantage of the use of the CKAN Datastore and Data API, available in CKAN Open-Source repository since v1.7. The DataStore provides a database for structured storage of data - together with a powerful Web-accessible, JSON-based, Data API. Data can be automatically inserted into the DataStore from spreadsheet files in .csv or .xls (MS Excel) format that are uploaded or linked to in the Repository.

When datastore is enabled, datasets the Data repository gives an interactive preview onto the file, and by accessing to the "Data API" it is possible to consume the information from other S2PC components. This displays useful information about using the API for this resource, including the endpoints, some examples, and links to further information.


*Figure 11. Preview of Agriculture numbers in Valencia region with Data API activated in Cities2030 Data Repository.*

Data preview enables the user to do filtering, searching, graphing, and sorting on the resource page. On the screenshot above, the user can sort magnitudes in Millions of euros for different food typology in the Valencia community.

Finally, it should be noted that the integration of some data from the Data repository, such as surveys or social network analysis, has currently occurred indirectly. That is, these data from the repository have been first downloaded and integrated into the S2CP dashboard. Direct integration of these types of data is planned for months M30 to M36.

## 6.2 Single Sign On

The Single Sign On (SSO) functionality has been provided in the scope of T6.4, as a way to integrate security and management of permissions and credentials following a single configuration for the S2CP platform.

SSO is a technique where-by one (or more) applications can automatically recognize a user as logged in when that user has logged in elsewhere. The Cities2030 Community platform has been selected as an authentication server, which can let a remote application recognize a user who has already logged in to the Community platform. A Single sign-on schema for the S2CP platform is described in the following figure:


*Figure 12. SSO schema for the S2CP platform*

Cities2030 Communities is chosen because it currently (at the writing date of this deliverable) has more than 100 registered members, both beneficiaries and alliance partners and other external stakeholders.
An SSO functionalities integration guide is established for S2CP component developers, which will be attached as an annex to the final S2CP M48 deliverable. Following this guide, the dashboard has integrated SSO functionalities. Below is a description of how this integration has been done and what it will allow in the future according to the integration with users.
The Custom Confidential OAuth Client option has been chosen, which is the preferred option. This client is intended for web pages with back-end, or server support. The implementation follows the following scheme: (1) URL authentication visit (2) Obtaining the OAuth Token (3) API visit to obtain user profile information (4) Return to the main page of the Dashboard.
The following figure provides a graphic scheme of the authentication process following SSO functionality.


*Figure 13. Single sign-on schema for the S2CP platform*

In the future, this integration will allow individualized access to resources in the dashboard, so that user profiles have access only to the features appropriate to their profile and prevent that the future incorporation of information of a more restricted nature could be accessible to unauthorized parties.

## 6.3 Other (future) interconnections

In the future, other components will be integrated with the S2CP dashboard, when they are ready. One of the most important is the data fusion component (see D6.2).

# 7. UX and usability of S2CP platform

Designing an experience goes beyond simply making the software user-friendly. It involves designing all aspects of the product experience, including marketing campaigns, packaging, and after-sales support. The core focus of UX design is to deliver solutions that effectively address pain points and fulfill user needs, as ultimately, a product that serves no purpose will not be used.
To test the UX and UI of the S2CP platform, a study has been carried out in Harlem in a dedicated workshop. The methodology that has been employed has been the following:

1. The users (Lab's representatives) have been briefing regarding data collection by forms and non-detected layers at the platform to record anonymously the activities.
2. It has been given to the users the link to the S2CP platform, without any manual or discussion about how the platform works (blind test).
3. The users have navigated into the platform, recording the steps. This has been done for a limited time (15 min.)
4. The users have filled up a form regarding the UX feedback:
    a. Usability.
    b. Number of clicks.
    c. Easy access to the required information.
    d. Number of different types of charts and maps.
    e. Easy to find the data of the Lab.
    f. What have we missed?
    g. Suggestions to improve the S2CP platform.
2. Discussion and new features proposal.

The study had 23 participants, while 10 filled the forms and questionnaires. The main results are gathered in Figures 14 to 17. Overall, the experience carried out by the Labs has shown that S2CP is currently an easy to navigate platform, with an acceptable number of clicks prior to reaching the information, having relevant information for the Labs in charts and maps.
The metrics of the access dashboards have shown a total of 954 single clicks navigation for a 10 min activity. Some users explored the platform thoroughly, with typical 60 pages accessed, and not only one living/policy

lab, but tried to correlate with different labs. This is also clear in the comments and suggestions presented in Tables 8 and 9. It is also seen that the UX multiplatform approach and libraries used resulted in good access independently of the operating system and browser.

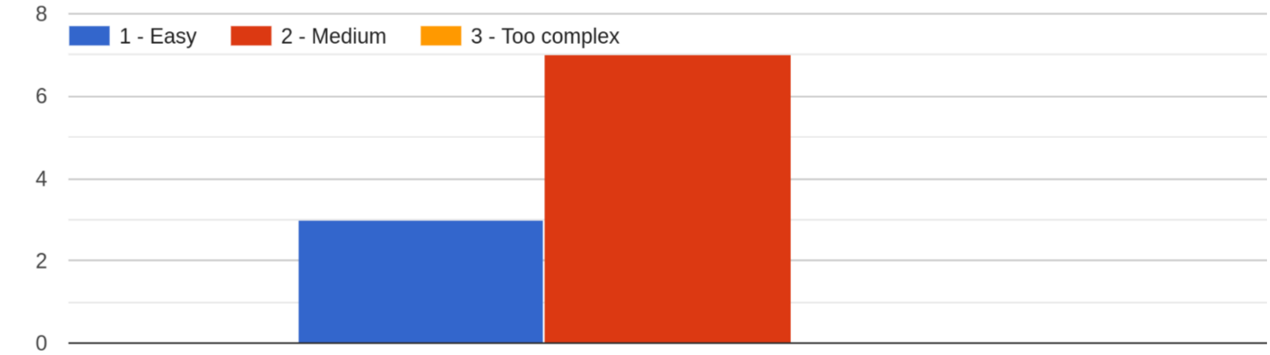


*Figure 14. Usability*

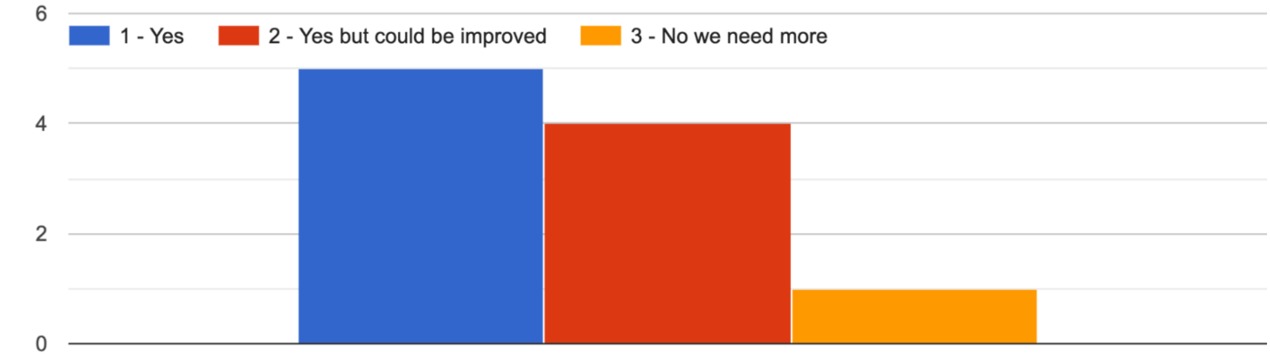


*Figure 15. The number of different charts is enough?*

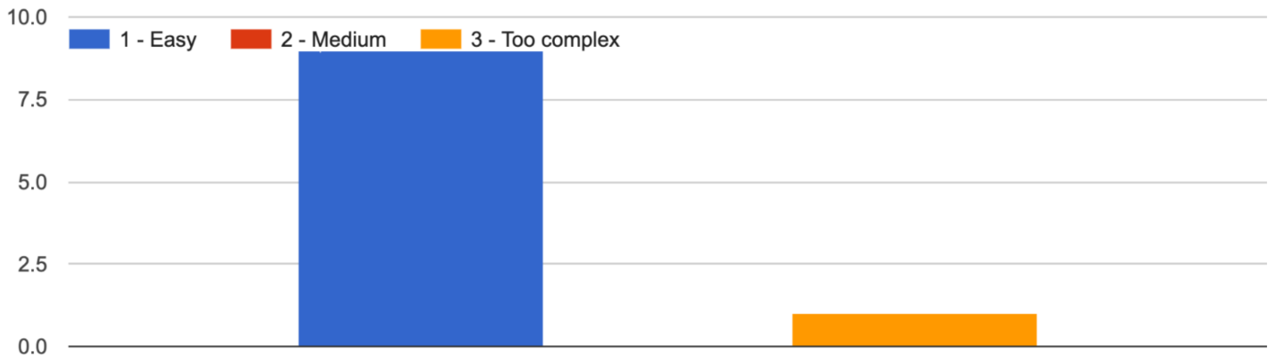


*Figure 16. Front-end easy to access?*

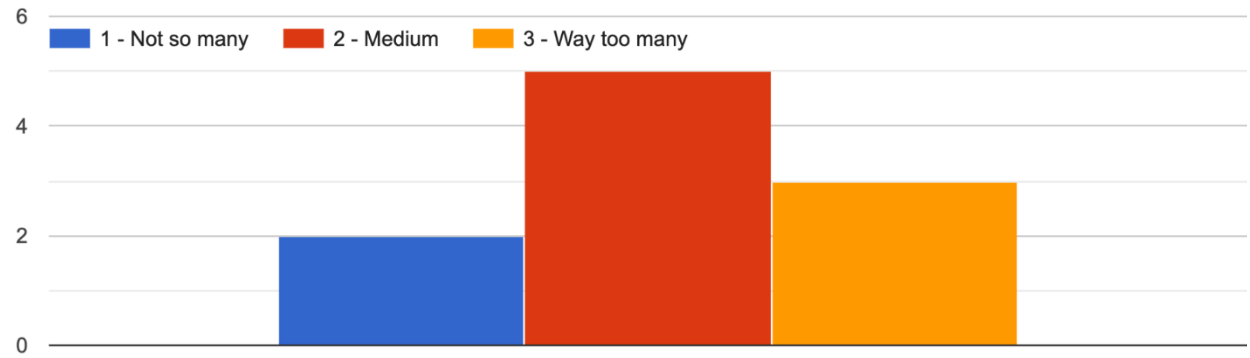


*Figure 17. Number of clicks*

*Table 8. What have we missed?*

| |
|---|
| • Nothing<br>• When visualizing statistical information. Some tables are behind the left-hand menu. So we need to minimize the menu to see all the graphics. It would have been nicer if tables and graphics adapt to available space in the mainframe.<br>• Venice Lagoon Case Study<br>• Information aggregated across labs<br>• well, not much, it would be good if all partners have all the same data so it can be compared. So if you have a partner who has most of the data, you can ask a partner if he can provide this set of data. if it has it. if not, that could be a great input for them to start the process of collecting new data (or to consider it)<br>• After accessing a city, it was difficult to navigate inside<br>• I don't see the origin of the data, from which database comes the data in the platform.<br>• More about food systems stakeholders, the amount of processors in the territory, contacts, open databases, workforce movement, schools in the territory.<br>• Adding more data about labs<br>• In the tables the sorting arrows are grayed out. That may lead users to think the option is disabled. As a final note, data regarding Vicenza, Italy is reporting data for the whole of Italy. |

*Table 9. Suggestions for improvement*

| |
|---|
| ● I don't have it<br>● The lab's card should be a whole clickable component. It is better that the button "See data"<br>● Put the origin of data sources in scientific manner<br>● Map navigation, contextual help, graphics improved with zoom in/out sata, remember charts, menú overlaps graphics, sentimental analysis does not show information, what does legend colores mean in the map<br>● when i click on a polygon (location: Lab Velika Gorica->Geographical informations->Point & Polygon Interest->Polygon of interest), the system zooms out and i cannot see information of selected polygon<br>● Navigation - breadcrumbs, back button, visible menu, behaviors<br>● More visibility for the order filter. The values of the resident population of Vicenza are wrong.<br>● Menu doesn't allow you to see all the pictures. Some charts could be integrated on the map to see the flows of migration, identify schools, processors etc. |

Regarding the comments of the users, it should be emphasized the need of data, either produced by the Labs or by national/communities/municipalities level. After the UX experience, it is hoped that the Labs have been stimulated to produce data that may be used by others, so that correlations between similar perspectives, activities and problems can be considered. All the comments will be considered in the next scrum sprint.

# 8. Conclusions and future functionalities

The S2CP iterations and new functionalities will be carried out based on the needs of the living and policy labs. From the visualization component, it is expected that the platform may display real-time data together with the interactive charts, graphs, and tables that are or will be available.

One of the requests of the Labs that came from the in-situ activities is the use of Earth Observation analytics that arise from Copernicus services and imagery. Satellite imagery can provide valuable insights into CRFS and help support more sustainable and resilient food systems. They can be used to measure crop density, plant health, and other parameters that are important for estimating crop yields. This information can be used to optimize crop management practices, such as irrigation and fertilization, and to forecast crop yields. Satellite imagery can also be used to monitor land use changes and track deforestation and other forms of land degradation that may be employed for land use policies to support sustainable agriculture. However, it is important to note that satellite imagery is just one tool in a larger toolkit for managing CRFS and must be used in conjunction with other data sources and management strategies to be most effective.

The availability of large data sets produced by the project will lead to the development of predictive analytics to forecast future trends and outcomes. The focus will then be the data integration that may come from multiple sources. From the platform perspective the major iteration step will be the mobile

optimization/dedicated service. This is due to the large number of users that access the platform from mobile devices.
In terms of the next scrum sprint, the availability of new data and the need for the mobile platform, will lead to a redefinition of the base framework. This will be carried out using Laravel, a more secure open-source PHP web application framework that builds robust and scalable web applications. Laravel follows the Model-View-Controller (MVC) architectural pattern, which helps to separate the application logic from the presentation layer and is currently being implemented in many projects of PRIMELAYER.
From the data management activities and driven policies, the multilayer privileges of access based on single-click login will also be implemented. This will create a hierarchy of data access according to the user credentials, since not all fields of the database are open data repositories.

# Annex I – User manual

This chapter describes the user manual or steps that are taken in order to navigate on the S2CP platform. After login, the user can select the Lab to analyze the data, select the dataset and the chart type or map, obtaining the information in the visualizer. The following steps are similar in the current version of S2CP prior to the definition of layers of access:

- Step 1: The problem is formulated, and the user will look for information related to the CFRS.
- Step 2: User login into the platform to access the layer of information.
- Step 2: The user selects the Lab.
- Step 3: The user selects the map or chart for visualization.
- Step 4: At the chart, the user will select as many datasets as possible, and each dataset may have different visualizations tools.

### *1. Login*

In order to access the platform, the user must log in with the credentials previously defined at the time of registration. After the implementation of the Single Sign On, the next page will display only authorized datasets to the users.

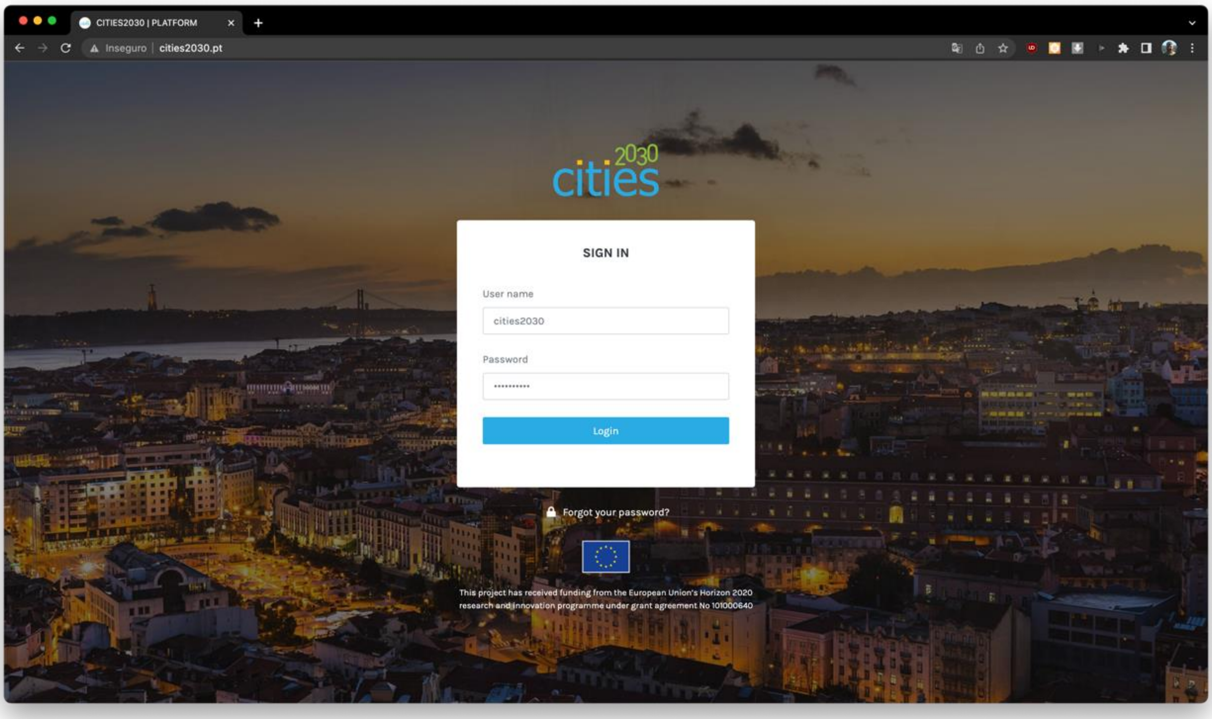


*Figure 18. S2CP dashboard login page*

## 2. *Main Dashboard*

After entering the platform, the user has access to the main dashboard, where he can find the available labs.

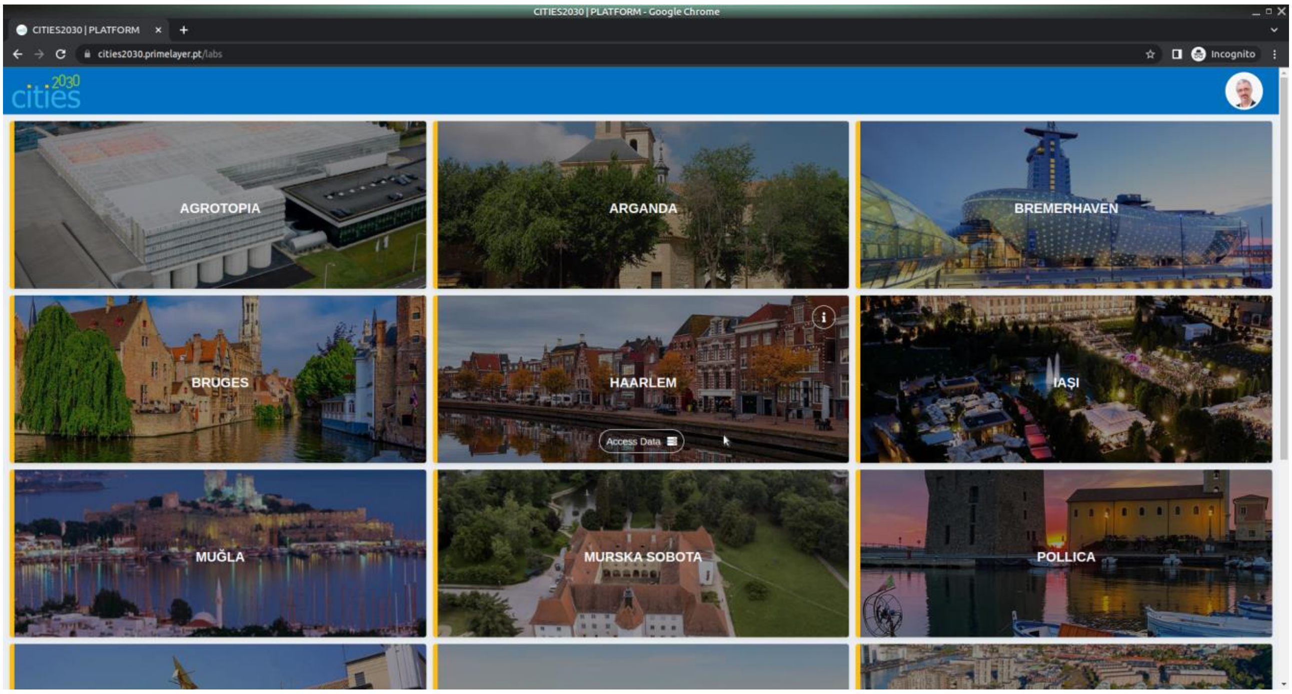


*Figure 19. S2CP dashboard main page*

## 3. *Data visualization: Maps*

On the page corresponding to the selected laboratory, the user has at his disposal, in the left side menu, two menus related to available statistical data, georeferenced maps, and other data. The map section is straightforward and activates the GIS module.

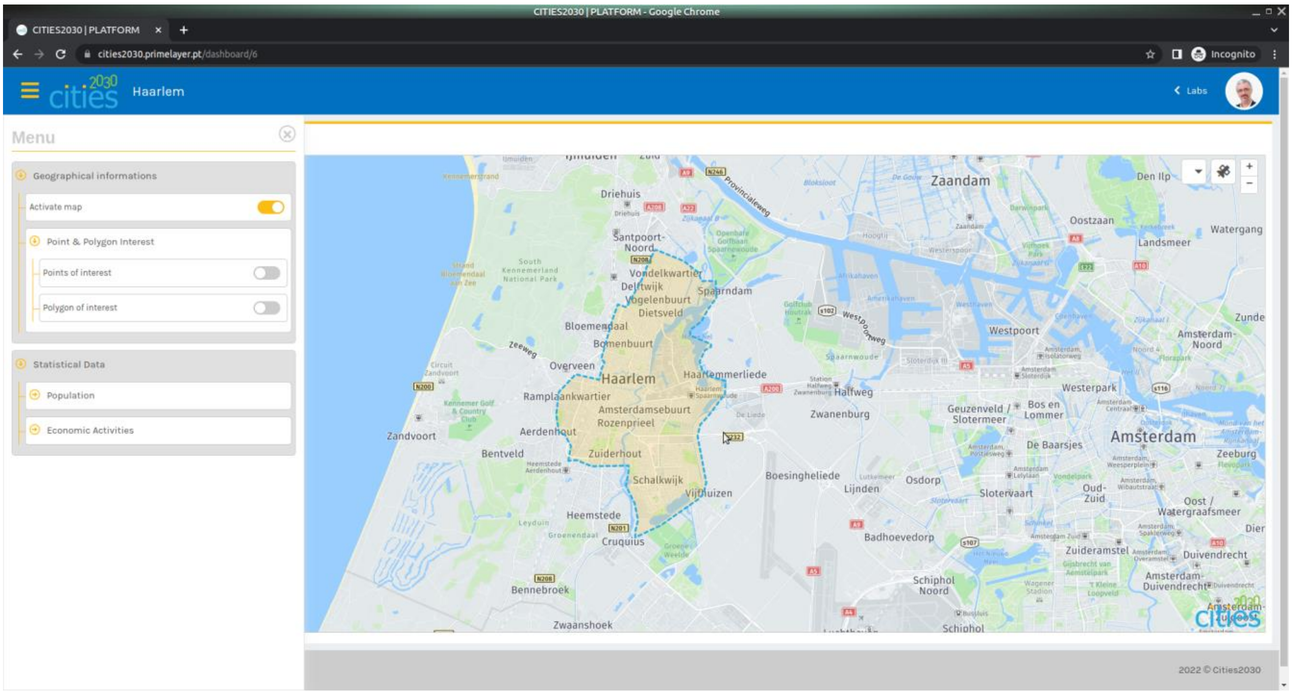


*Figure 20. Administrative limits in a map*

In the particular case of Harleem, the selection of points of interest, returns some of the CRFS end to user: restaurants, supermarkets, convenience stores, pubs, coffee shops, bakeries, bars,…

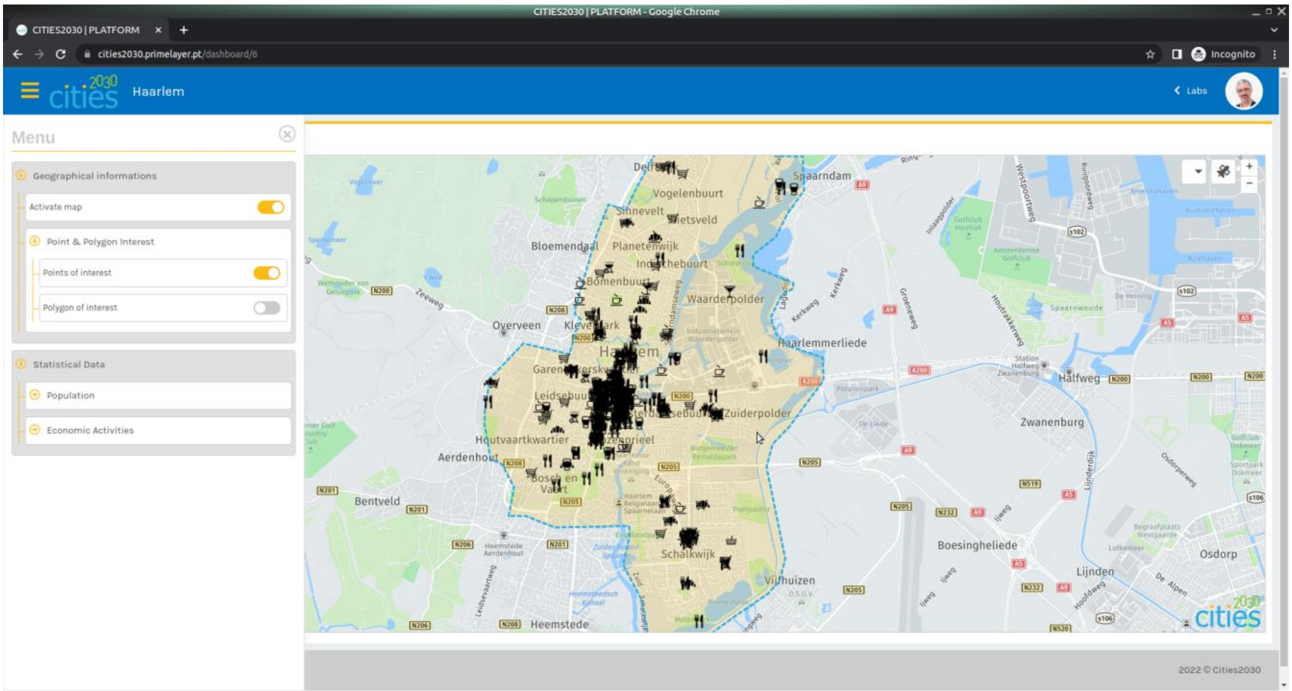


*Figure 21. Points of interest in a map*

The selection of polygons of interest provides areas of relevance for the CRFS.

### 4. *Data visualization: statistics*

The layer of statistics is divided into classes according to the Lab and available data. Selecting, for example, "Population" in Harlem, all the data is shown and may be selected.
By activating one of the previously processed statistical data, the user can visualize them through a table and the respective graph that is generated based on the data.

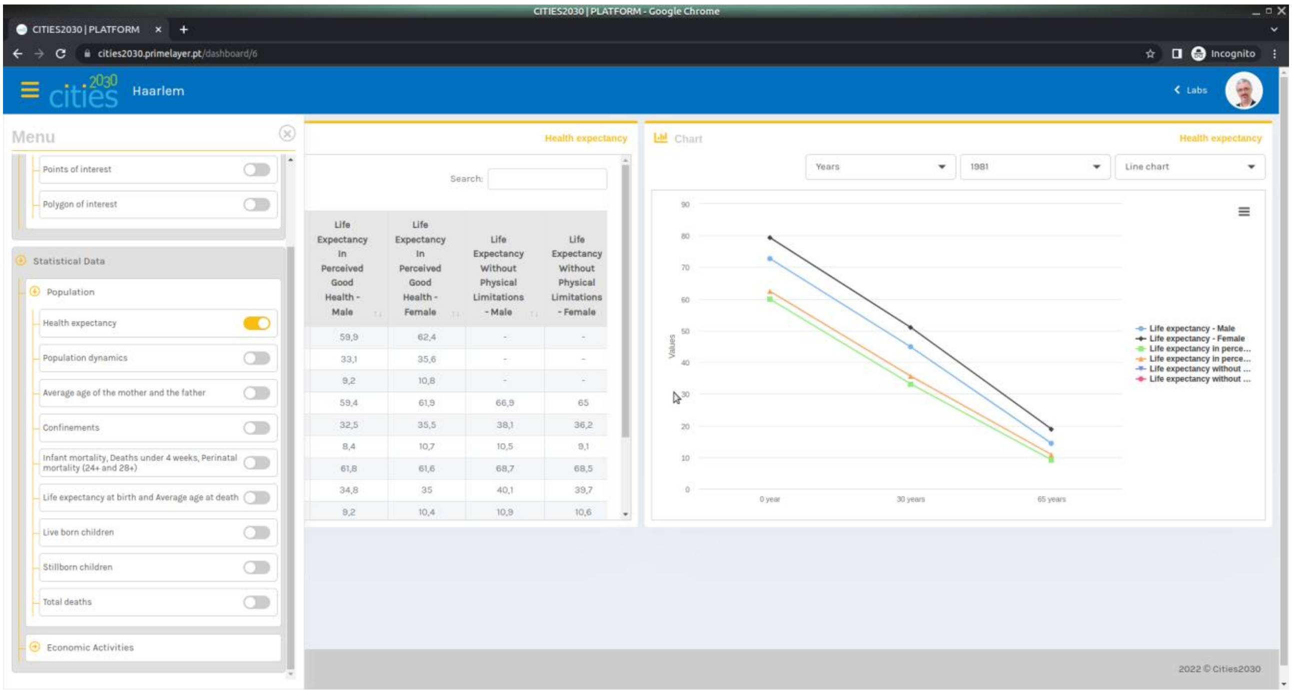


*Figure 22. Statistical data in the S2CP dashboard*

After selection of the class, a table and a chart is shown. Selecting the data type on the top from Years to Age, the cumulative plot is generated.

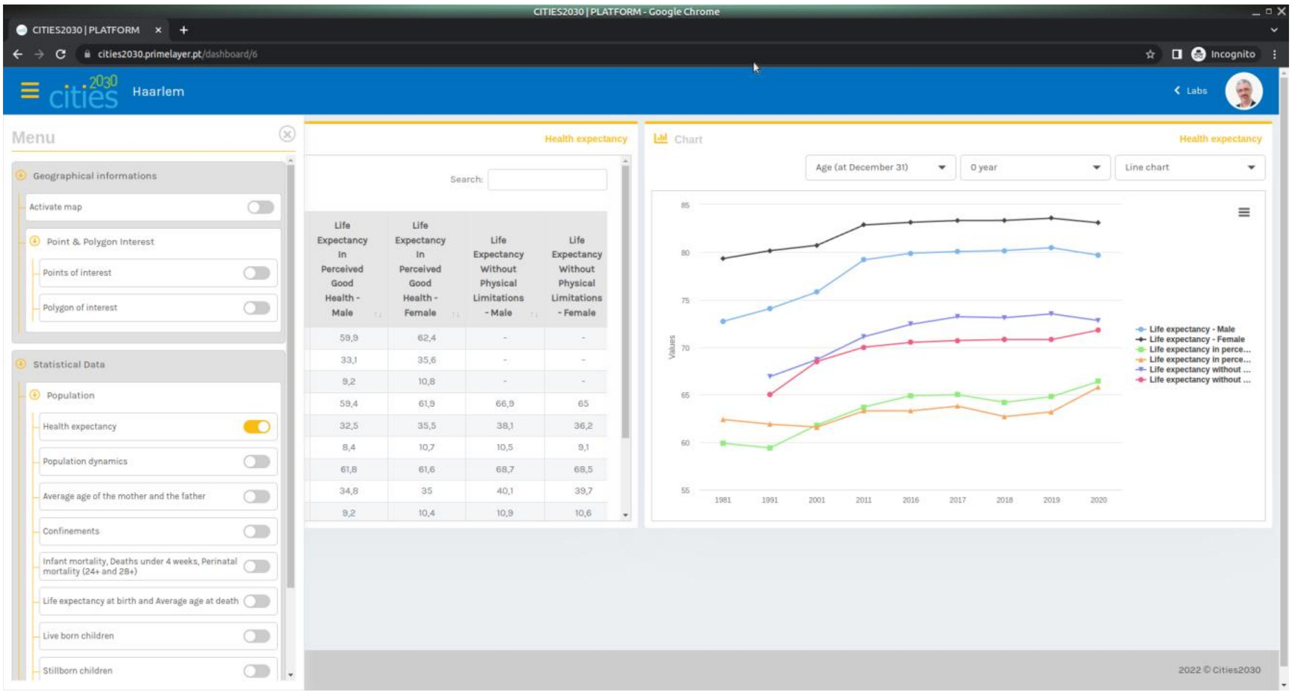


*Figure 23. Cumulative plots in the S2CP dashboard*

The representation is also selected by the user.

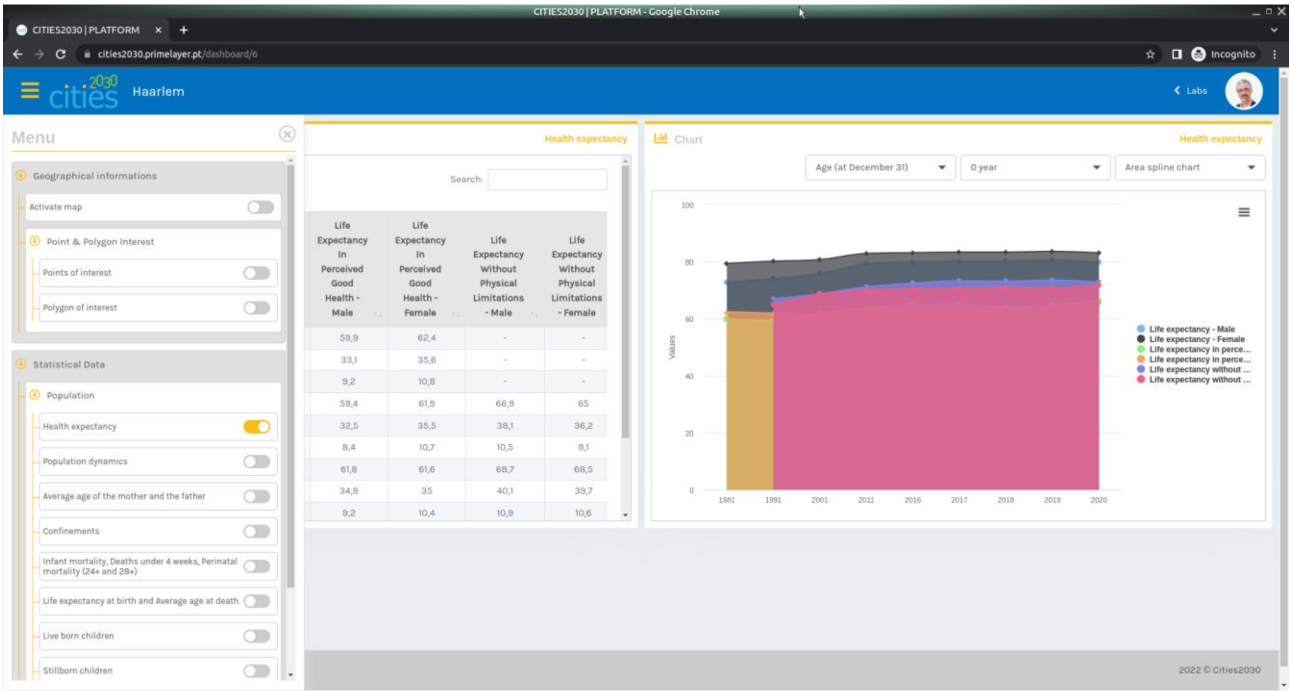


*Figure 24. Different visualizations for statistical data*

Multiple selections are also possible by the modularity of the platform.

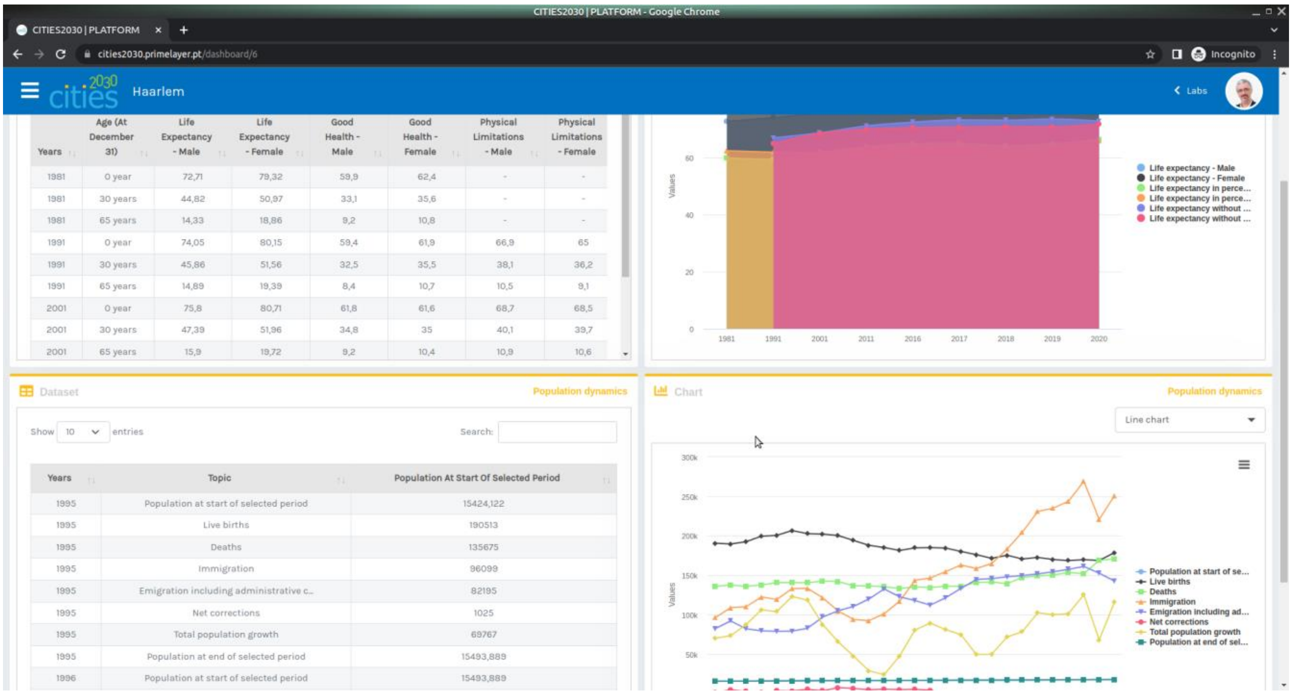


*Figure 25. Multiple sections in the S2CP dashboard*

## 5. *Additional data*

The availability of additional data is easily included in the S2CP platform. Selecting Quart De Poblet, the field "Sentiment Analysis" both in the Map and Statistical Data menus. In the Map menu, it can be seen the origin of the tweets.

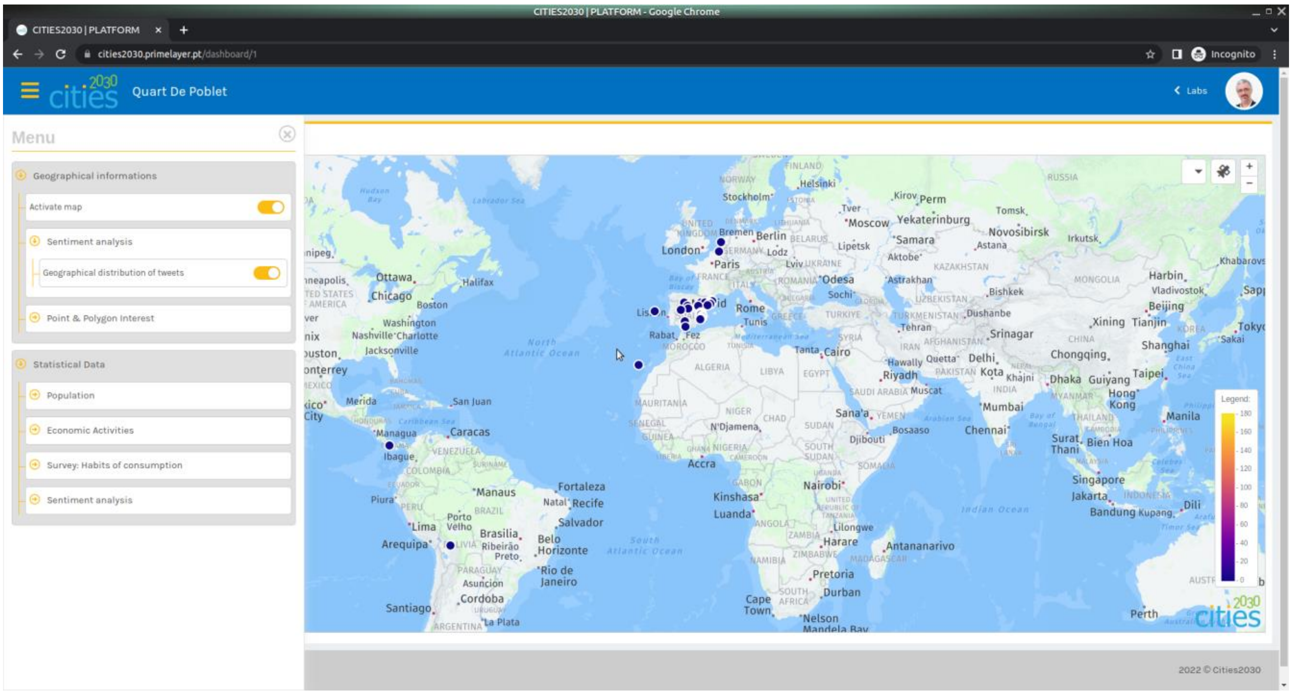


*Figure 26. Sentiment analysis: geographical representation*

A user has the capability of zooming in and out.

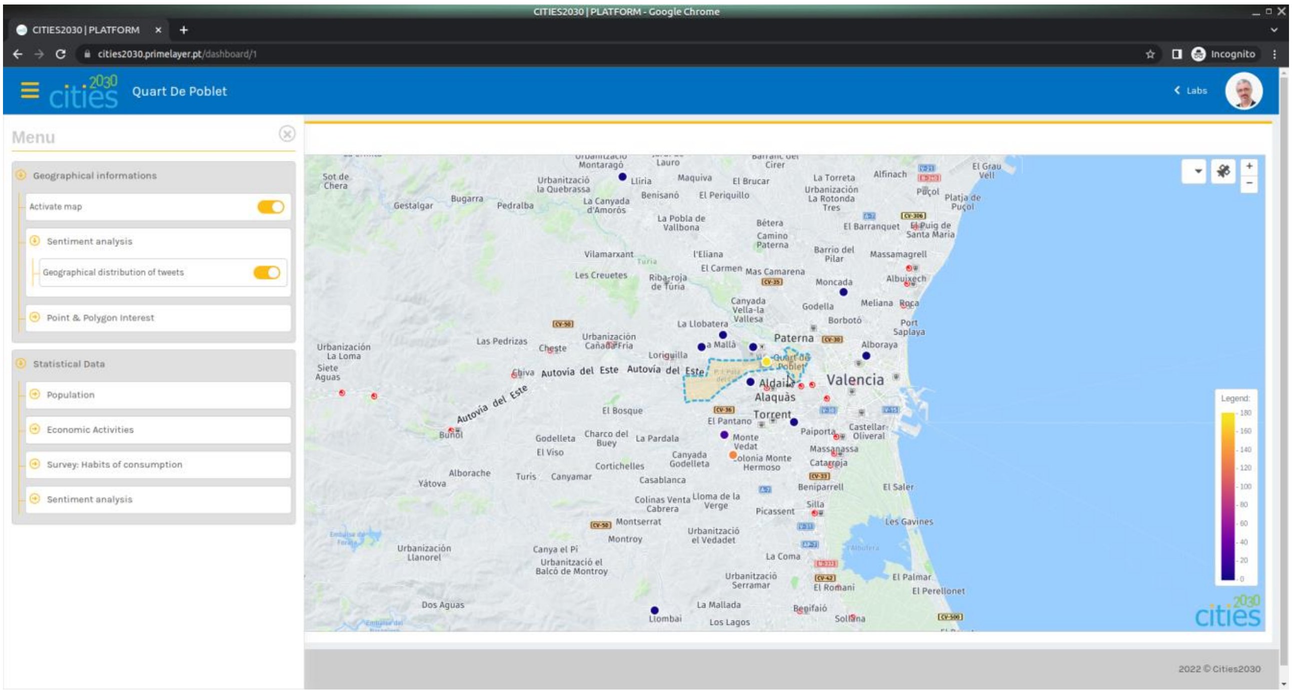


*Figure 27. Zoom functionality in maps*

In this case the number of tweets is from the Valencia region with the maximum inside the area Quart-de-Poblet. Both panels may be seen simultaneously by scrolling down.

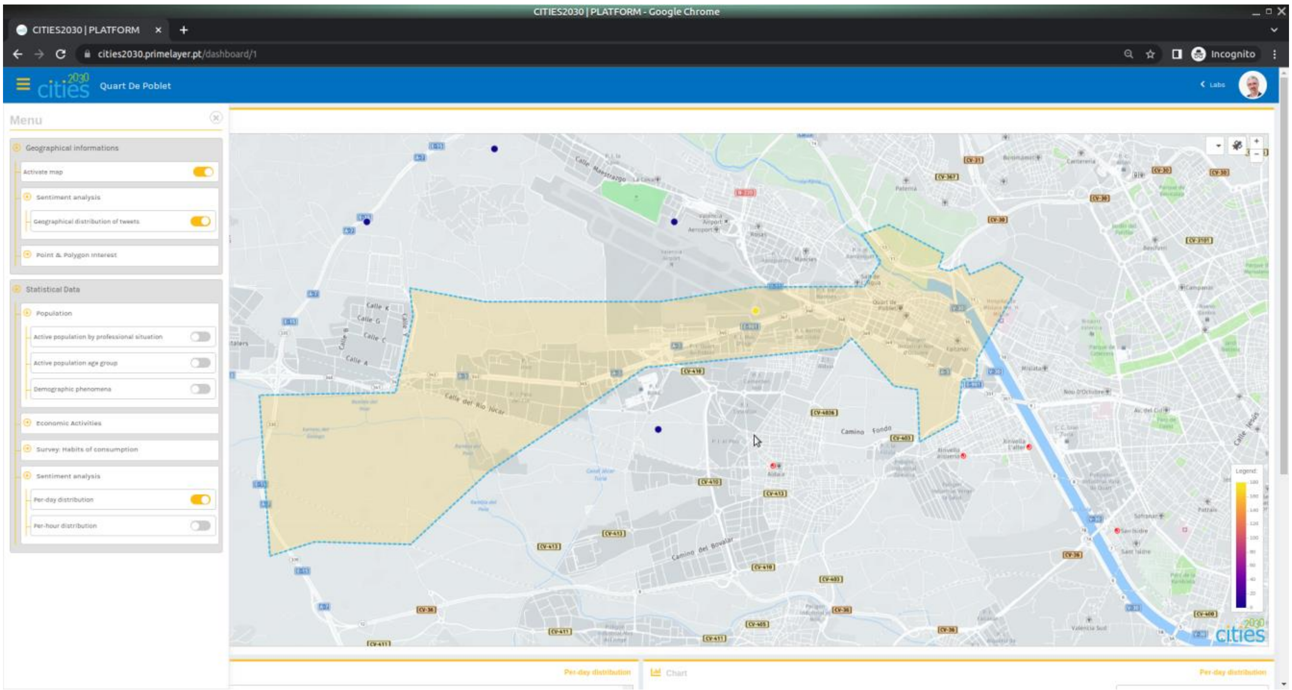


*Figure 28. Sentiment analysis as a heat map*

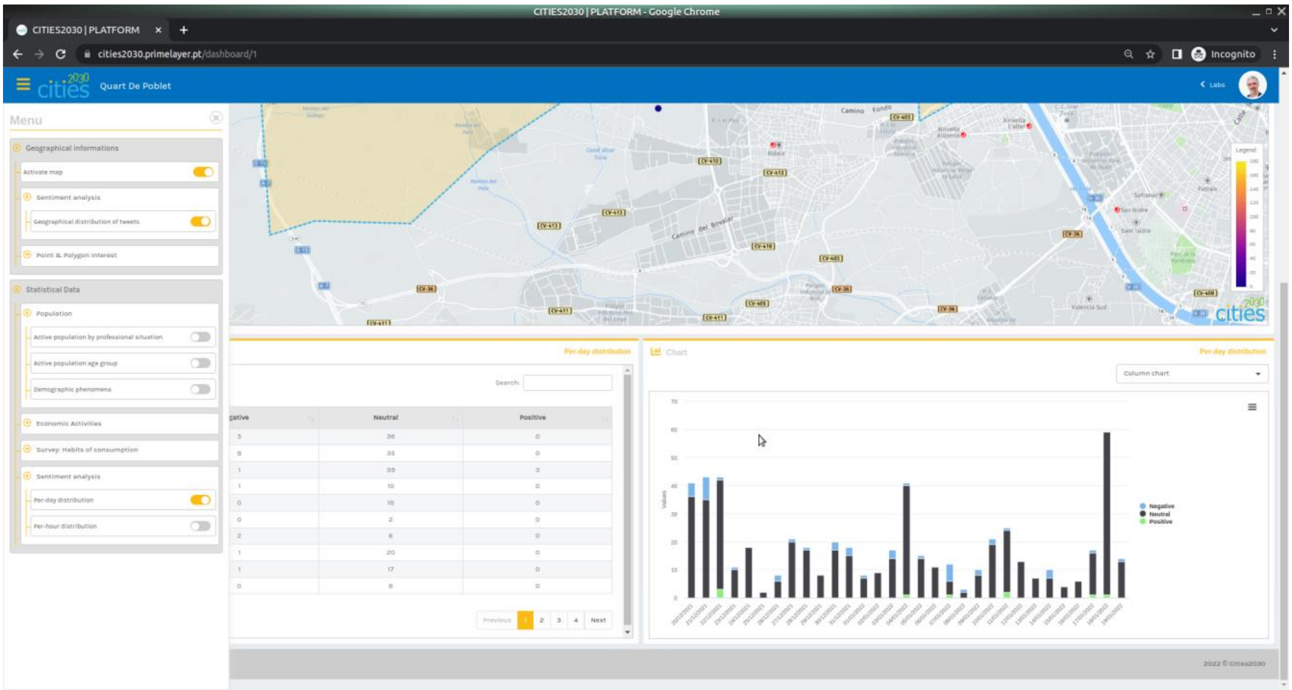


*Figure 29. Sentiment analysis as a bar chart*