URBiNAT Observatory
Ongoing monitoring and evaluation platform

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Purpose of Deliverable

The Observatory Platform aims to support all URBiNAT partners, and especially cities, in combining and sharing all available information connected to the intervention areas. This includes spatial and non-spatial, as well as quantitative and qualitative data. By combining these datasets, multi-dimensional analysis is encouraged, which is necessary to unveil the expected complex effects deriving from the implementation of Healthy Corridors (a cluster of Nature-based Solutions) in the URBiNATs Partner Cities. Further, the objective is to underpin various kinds of analysis by applying different features of the platform. Part of the purpose is for the platform to prepare and showcase datasets to fulfil continuous monitoring of the intervention areas (socio-culture layer and physical-territorial layer), and also how they relate to the broader city context. In a subsequent step, the monitored data will be evaluated to assess the overall impact of the newly implemented healthy corridor (including various NBS).

It is the aim to ensure long-term sustainability and independence of proprietary vendors and software, to the extent possible. Therefore, the Observatory platform employs some of the highest-ranked open-source software repositories. Further, it is taking stock of existing information and available tools of data collection in all intervention cities (frontrunner, follower, and observer cities). Various tools are applied to facilitate combining data and improve the interface between data sets for more user-friendly processing. Moreover, the Observatory serves as a Community of Practice by providing a space for cities and project partners to share and exchange knowledge and assessment strategies.

Roles and objectives in relation to other work packages

The report takes into account the scientific foundation of the project as outlined in WP1 (T1.2), the local diagnostics 1 and 2 (WP2), citizen engagement in support of NBS (WP3), and the nature of the NBS to be implemented and specified within the NBS catalogue (WP4). All this data will provide essential information in order to evaluate the implementation process and to support the replication of the co-creation process for follower cities (MS5). This report is furthermore part of WP5 and therefore building on previous reports (D5.1 and 2.1). The outcomes and observations of this report can be used in upcoming deliverables, such as the deliverables of tasks 5.3, 5.4, 5.5 and 5.6.

Executive Summary

URBiNAT's Observatory Platform sets out the project's assessment of the effectiveness of any solution that holds its validation under various environments and conditions. Cities are complex ecosystems and as such are prone to face diverse challenges that need to be addressed simultaneously, such as the well-being of residents, economic and social improvements as well as the quality and effectiveness of governance. All of these factors are intended to be addressed through the implementation of NBSs, but in order to prove the accuracy of URBiNAT's Healthy Corridor (as a flexible combination of NBSs), all methods being used for the creation and implementation of those solutions need to be carefully monitored and evaluated. The Observatory will be the facilitator for this monitoring and evaluation process. In particular, within task 5.2 the digital Observatory Platform is being designed to digitally display the process of co-monitoring and co-evaluation.

The Observatory Platform is being defined as the digital equivalent to the physical project execution and implementation of the healthy corridors by virtualizing ongoing processes and results. Therefore, the document is structured by presenting the objective of WP5 and the overall concept of the Observatory Platform (T5.2). As such task 5.2 refers to a responsive and participatory approach to enable monitoring and evaluation of NBS activities and implementation progress. The effectiveness of the Platform depends on the adequate utilization of its digital features and tools. To enable project partners and in particular the cities to make use of these applications, the functionalities of the Observatory Platform are being presented and exemplified. Afterwards, the multidisciplinary approach is used to collect quantitative and qualitative data, and how these are providing valuable information for monitoring and evaluation. The task 5.2 is leading to the fulfilment of milestone 5 for which it is relevant to monitor the healthy corridor and evaluate its impacts on the regeneration of the urban areas, in particular on health, economy and local governance. In particular, we focus on research conducted and content collected within T5.3 (health and wellbeing), T5.4 (economy and society), and T5.5 (local governance) T5.6. (action-research and scientific analysis). These tasks are providing data analyses to WP 2, 3, and 4 in order to evaluate the implementation process and to support the replication of the co-creation process for follower cities (MS5).

1. General Framework of the Observatory Platform

URBiNAT focuses on inclusive urban regeneration applying innovative Nature-Based Solutions (NBS), further combined in Healthy Corridors in support of sustainability and mobilising driving forces for social cohesion. Interventions and co-creation activities, underway in the three lead cities of URBiNAT (Porto, Nantes and Sofia), while also under consideration by the four followers (Siena, Nova Gorica, Brussels and Hoje-Taastrup) and two observer cities, will be focused on the urban public space to co-create with citizens within and between selected neighbourhoods. The Observatory platform operates as a technological tool which combines relevant and diverse sets of data, potentially connecting with IoT and Ambient Intelligence technologies, making it possible to live-stream the performance and effects of NBS in the Healthy Corridors. The collected data is of high relevance for the European Commission for sharing and dissemination purposes, e.g. in order to compare results and find synergies with other Horizon 2020 EU projects, such as Eklipse. The aggregated data will furthermore be used to contribute to the establishment of an EU-wide reference framework for NBS (T5.6). In this regard, Task Force 2 has been put into place to assess the impact of the EU-wide reference framework on NBS as well as the Eklipse Report (2017). Moreover, the platform provides crucial information for the Scientific Community through open access research permissions, allowing any related research institution or private researcher to use the URBiNAT data for comparison or other purposes. Especially locals from the intervention areas will benefit from the data collection in order to share findings among each other, and also to generate a generic understanding of conducted work and implemented NBS. The report summarizes a comprehensive list of possible indicators for an impact evaluation framework for assessing the performance of NBS in dealing with 10 different challenges. Currently, Task Force 2 is in the process of publishing a subsequent report on evaluating the impact of NBS (Dumitru and Wendling 2019).

Figure 1 is explaining the goals of the Observatory Platform for Urban Inclusive and Innovative Nature. Our main goal is to employ some of the highest-ranked open-source software repositories to achieve a long-term sustainable and maintainable data platform for supporting monitoring and evaluation. Substeps to achieve this vision are 1) to take stock of all existing information and available tools of data collection in the frontrunner, follower, and observer cities, 2) to combine data and tools to introduce more user-friendly features, opening up the possibility for citizens to make use of city data and 3) to contribute to the establishment of a Community of Practice for knowledge exchange between citizens, city administrators, and project partners.

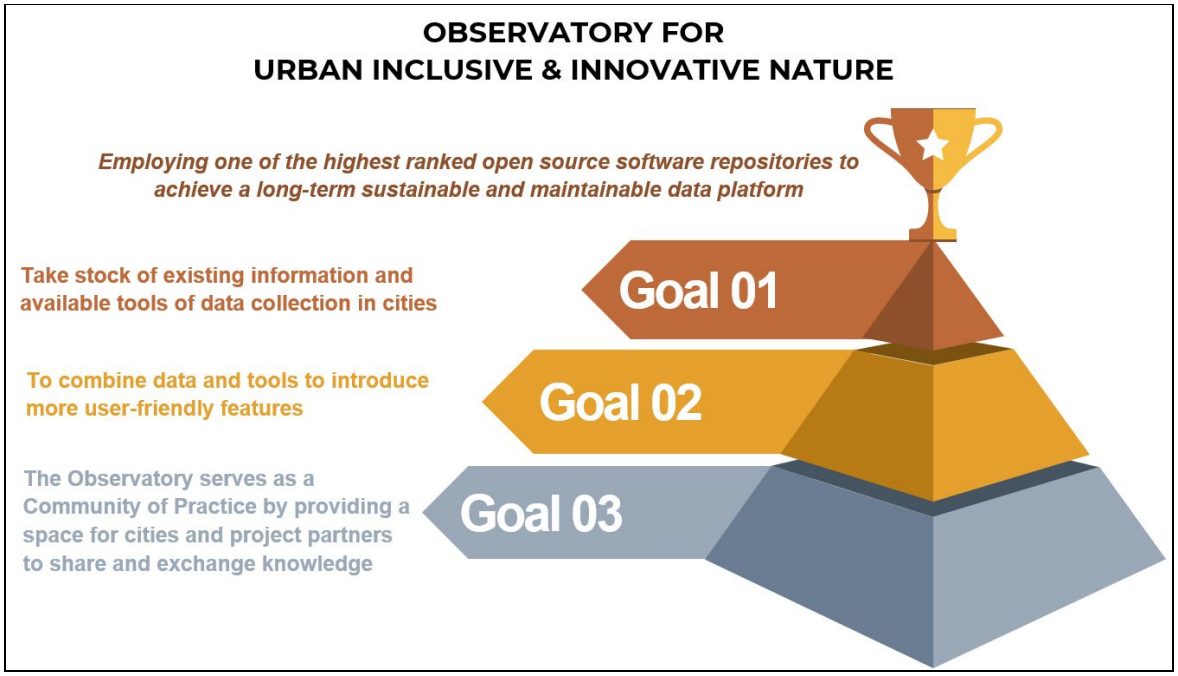

Figure 1: Goals of the Observatory Platform

2. The Study Areas

2.1 Approaching areas under urban regeneration

Within the context of innovative approaches to urban regeneration furthered by the EU, URBiNAT's focus is on inclusive urban regeneration of areas through community involvement and citizen participation as key elements in the innovative development of NBS and Healthy corridors. In the areas classified as "areas under urban regeneration", residents are left behind in a number of respects, including access to essentials, such as economic resources, healthy food, housing or good living conditions. They also tend to suffer from downsides such as lack of access to the quality public service, higher crimes rates, more pollution, noise, and so forth. Adding to social and physical-territorial aspects, part of the issues at hand are psychological, reflecting a sense of exclusion, lack of belonging, low self-confidence, etc. These various elements naturally play out differently for different groups and individuals. URBiNAT considers the importance of recognition of specificities such as gender, elderly, race and ethnicity, functional diversity, childhood, citizenship status (migrant, refugee, asylum seeker condition), religious diversity, age, education, and so forth, observing the important role of less privileged groups, as well as areas under urban regeneration. Additionally, as a user of the platform, it will be possible to upload data privately in order to ensure a non-bias treatment of uploaded data and potentially evolving issues regarding a user's background. The platform will equally accessible for all genders, inducing non-binary groups. The cities are being

asked to have a balanced representation of users with a diverse background, representing the multinational nature of the URBiNAT project.

In order to improve living conditions in areas under urban regeneration and for less privileged groups, URBiNAT undertakes an in-depth analysis of the intervention areas, co-creating NBS in Community of Practice (CoP) workshops, evaluating and assessing suitable NBS, and co-implementing promising NBS in the neighbourhoods of areas under urban regeneration. The selected cities and neighbourhoods were chosen based on simultaneously distinct and complementary geographical features. They represent the diversity found in the different countries of Europe, which allows testing the Healthy Corridor in diverse socioeconomic and cultural contexts. The adequate and committed relationship established with the local public government was another criterion taken into account as well as the willingness of the local authorities. Additionally, the chosen cities needed to demonstrate the ability to promote and implement NBS and to function as living labs. This was analysed through preliminary diagnoses, periodic meetings, and data mapping. In this way, the chosen cities promoted public spaces that are references and demonstrate consistent capacity in nature-based-solutions. The key measure to evaluate the intervention cities was the existence of neighbourhoods of areas under urban regeneration within the peripheral scope of the city. Therefore, selected cities were asked to pre-assess social housing neighbourhoods and evaluate their potential for green improvement. Three of those cities were considered front-runner cities due to their advanced efforts and initiatives within the implementation of green solutions into the city. Four cities were categorized as follower cities due to less developed sustainable efforts in the study area and their high potential as adapters of best-practice NBS within the healthy corridors.

2.2 Healthy corridors

Throughout the social housing intervention areas, a so-called Healthy Corridor (HC) will be co-created together by URBiNAT partner cities, local citizens and stakeholders (e.g. urban planners, architects, sociologists, social workers, and private service providers). The purpose of the corridor is to connect the less privileged neighbourhood with the rest of the city in order to foster inclusivity, to increase attractivity and to create a green path for health improvement and ecosystem regeneration.

The Healthy Corridor is, therefore, a physical and social construction, which aims to lift stereotypes, misconceptions, and geographical barriers through the connectivity between diverse neighbourhoods, both in terms of economic dimensions and variables, as well as in terms of social, cultural, ethical backgrounds and gender aspects. HC is an innovative and flexible cluster of NBS of the URBiNAT project, which itself integrates a large number of micro NBS emerging from community-driven design processes, which will be established in each of the frontrunner and follower cities (GA of the URBINAT project, page. 3). It can take the form of a pathway, including other NBS collected in the URBiNAT catalogue, e.g. ceramic bio-receptive tiles made of moss, luminescent pathways for cycling and pedestrian paths, or clay floor tiles for water collection purposes. Prior to the construction of the HC, at the co-diagnostic phase, biophysical and social components of the territories will be taken into consideration with the ultimate goal of recovering ecosystems and circulatory features of healthy corridors. These corridors offer sustainable support to host

technological equipment, territorial infrastructures and social and solidarity economy initiatives as solutions within public space, including and intertwining several layers of natural, urban and social life.

3. The Ecosystem of the Study Areas

The assessment of the effectiveness of any solution holds its validation under various environments and conditions. Cities are complex ecosystems and as such are prone to face diverse challenges that need to be addressed simultaneously, such as the preservation of biodiversity, well-being of residents, and economic wealth. To prove the accuracy of URBiNAT's Healthy Corridor solution the assessment of the results of the project is required to be monitored and evaluated and hence the Observatory platform is being developed to tackle this challenge with supporting monitoring and evaluation process.

The review of the EU funded Horizon 2020 projects, 5.6 and Task Force 2 of the European Commission indicated that the structure indicators of the URBiNAT cities are aligned with the general challenges and framework. However, addressing the challenge of quantifying qualitative research results challenges and their evaluation is still open. The Observatory platform is an attempt to bring some lights to this issue by creating a digital ecosystem. We are using the ecosystem model that has been applied in different academic disciplines as well as, in the business world in order to define a conceptual framework aimed to better identify the characteristics of a specific system, its main components, interactions and its results to determine final benefits (Llewellyn and Erikko, 2012). The 'ecosystem model' is a practical tool describing how an ecosystem creates, delivers and captures value (Ibid, 2012). In recent years, the ecosystem concept has gained increasing significance in the field of information, technology management and innovation (Tsujimottoa et al, 2018).

In our perspective for the URBINAT platform (figure 2), the term ecosystem turns out to be a well-fitted definition of the technological instrument implemented to support, monitor and evaluate the outcomes of the URBINAT project. The technological platform aims to be the virtual environment in which all data and results provided by different methods, seen as components of a specific ecosystem that work together, can be stored, visualized and matched, creating, as a result, an evolving virtual space for knowledge-sharing. This process is further explained in the figure below. It is being illustrated how the digital platform serves as a virtual environment where the URBiNAT data is visualised in a collaborative ecosystem due to the inherent nature of the different kinds of NBSs implemented in the healthy corridors. Intrinsically, the digital ecosystem is representing the human habitat/environment in a digital format through the depiction of a virtual environment, powered by a software that is creating interactive tools to ease cross-culture and cross-border collaborations.

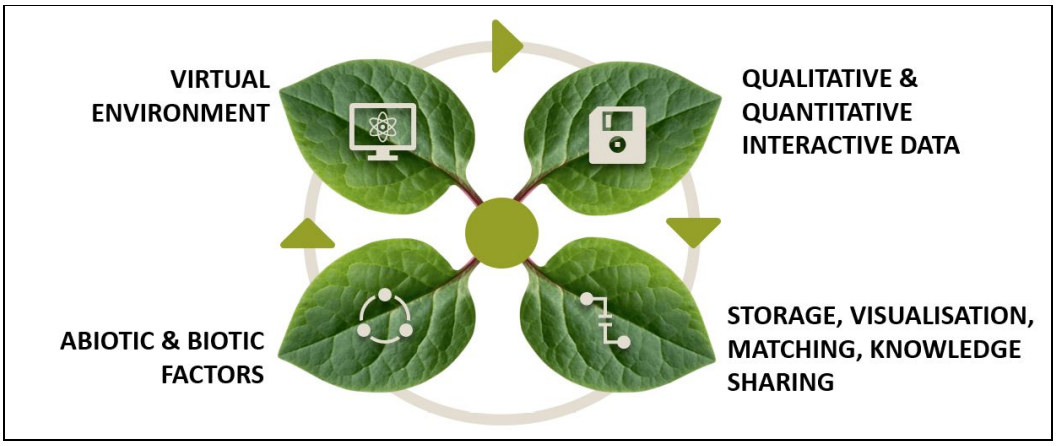

Figure 2: Digital Ecosystem

In particular, the ecosystem components of the URBINAT platform, have been defined as the combination of abiotic factors (city area, study area, small scale areas and their specific components), biotic factors (projects performed by cities before and after the implementation of healthy corridors and results of the methods application), and the interactions among actors (interactive learning and co-creation of activities). Both abiotic as well as biotic factors of the intervention areas are being taken into consideration when comparing changes and improvements before, during and after the implementation of NBSs in the healthy corridors. As for natural ecosystems, the stability of the platform is affected by the interactions between biotic and abiotic factors, thus the procedures for defining interactions need to be approached with carefulness. Therefore, not only qualitative and quantitative data is being monitored, but also interactive data, which includes interactions among workshop participants and other actors to capture interactive learning processes, such as co-creation and co-design. **The digital ecosystem serves as a place for storage, visualisation and matching of data as well as knowledge sharing among cities and other URBiNAT partners.** Interactions consist of several activities, such as uploading of documents referred to method results, spazialitation and visualization of quantitative and qualitative data stored in the platform, sharing information and data according to each specific level of permission.

The URBINAT Observatory Platform can be defined as an ecosystem that builds an environment for all its users to enable, on the one hand, the storage of different datasets derived from the results of the application of different methods, and on the other hand, the possibility to share and compare data by matching area specific information.

3.1 Purpose of Data Collection

The collection of data serves to provide answers to emerging research questions concerning wellbeing and health (T5.3), social and economic effects of NBS (T5.4, 4.7 and 7.1, 7.2), political and governance strategies for NBS implementation (T5.5), environmental issues (T2.1) and inclusive urban space (T4.6). The task 5.6 on scientific correlation between concepts, methods, results and

impacts will provide an Analytical Framework to systematize and analyse the data collection for monitoring and evaluation process with a focus on its substantive dimension.

The purpose of information gathering by conducting the Local Diagnostic analysis stage 1 and 2 (D2.1 of the LD of the Front runner cities), is to serve as a baseline measurement and to support decisions on urban renewal in the districts in the first phase of the project. Ongoing monitoring and a complementary measurement after implementation complete the impact assessment strategy. This is being done by applying an interdisciplinary approach, which includes applying different kinds of research methodologies and tasks (URBiNAT methods) and the combined effort of people with different backgrounds leading towards the same goal - capturing inefficiencies and discrepancies in our intervention areas. Researchers and project partners from architecture, economics, sociology, engineering, cultural studies, humanities, communication, and many more are combining their expertise and skill sets to apply the most fitting and efficient ways of capturing the necessary data to give important insights into the study area during the project and to finally answer the research questions at the end of the project. All of the collected information and knowledge will be disseminated in designated platforms (URBiNAT website, Observatory Platform, OPPLA etc.) to inform the different stakeholders about the findings of the project at any stage. The Platform for dissemination is being operated to facilitate and mirror the multidisciplinary nature of URBiNAT by offering interactive maps and tools to illustrate in a clear and easily understandable manner, the impact NBSs have on the local population and their daily living environment. Figure 3 is summarizing the interdisciplinary approach of data collection by generating an understanding of the local situation in the intervention areas through the collection of primary and secondary data, including the UBRINAT methods. This information is then being used to inform the outside world on the ecological, economic, social, and cultural progress achieved as a result of the implementation of the healthy corridors.

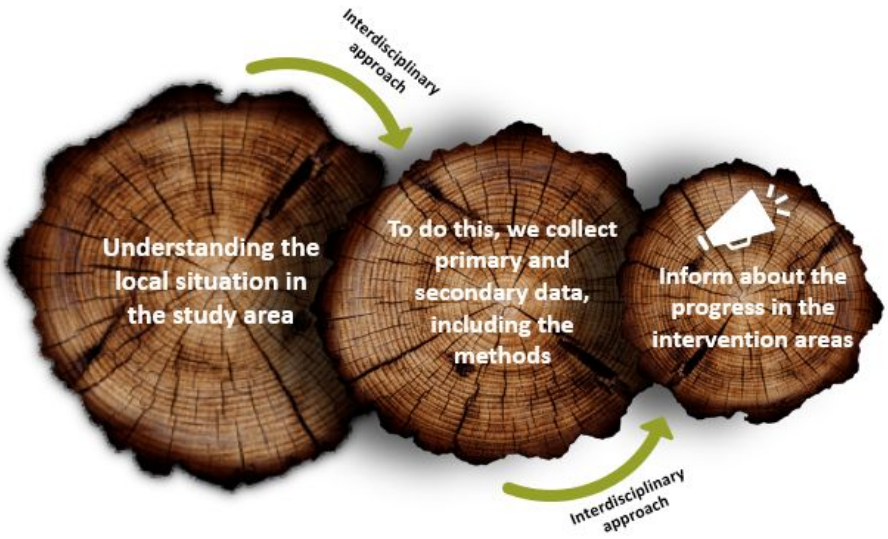

Figure 3: Interdisciplinary approach of data collection

4. The Functionality of the Observatory

Figure 4 illustrates the process of data management and the core concept behind the Observatory Platform. In the first step, data provided by the city is being preprocessed before it is being uploaded onto the platform. Files are being transferred into popular formats (such as CSV, shapefile, GeoJSON). Once all maps, docs, video files, etc. have been transformed into the correct format, cities can use the features provided to store and collect their data. The IULM team will then convert the provided files into interactive maps and tools to better showcase the activities and progresses undergoing in the healthy corridors. Through the keywords and categories table (see figure 7), all account owners of the Observatory Platform can search for required information, e.g. on existing NBS in the intervention area. In a fifth step, the interactive maps and tools help to compare and analyse the progress between cities, but also visualise the development within one neighbourhood throughout the lifespan of the project. This comparison helps in assessing the impact of healthy corridors. Additionally, there will be some platform features for direct messaging, personalisation, and game-learning purposes.

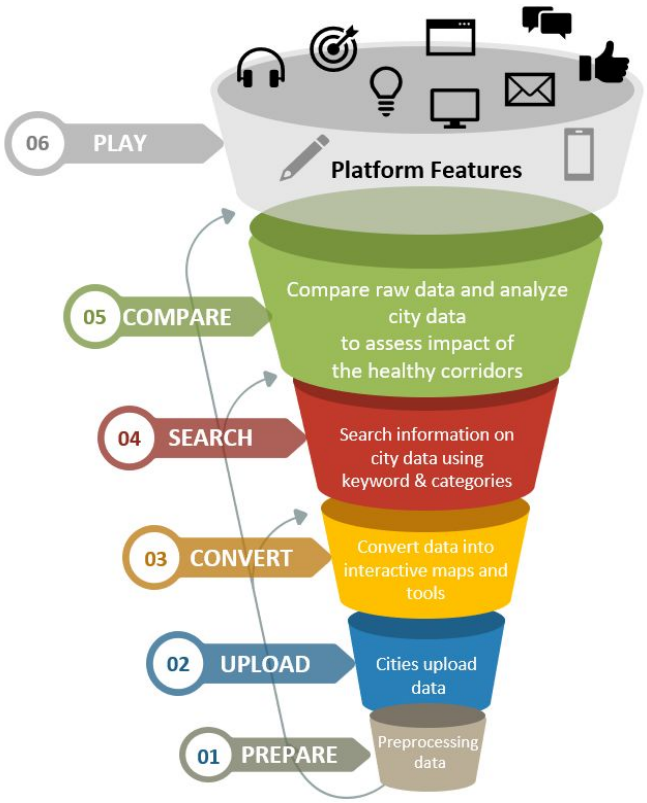

Figure 4: Overall Concept of Observatory Platform

Of high importance to the functionality of the Observatory is the sharing of content with citizens and local stakeholders in the study area. One means in this respect is the feeding, by the Observatory, of material and innovative approaches for two-way communication to URBiNAT's website, while also making selective use of social networks to help create active feedback-loops. The toolbox in this

respect includes aspects of Artificial Intelligence Analysis, Statistical Analysis, Qualitative Analysis, Social Network Analysis and Data Visualisation. These tools are served by H20 as complementary tools. Serving as a fast and scalable data processor, the Observatory will be applicable to both search and dissemination. Security and authorization can be managed using a preferred choice of access rights along with conditions for sharing, based on a menu offering seven different levels of permission. Other services include geographical representation, timelines with structuring according to the calendar, content combined with web-site arrangements and structured interface with the outside world. Last but not least, the Observatory receives various types of data with different formats and creates convergence using metadata and converts data to standard formats and coordinate reference systems which is being used by most analysis and visualization software. This means the Observatory platform is open to accept value-added services by standardizing data and sharing through its API.

The Observatory is meant to service all partners and actors directly engaged in URBiNAT, using open systems where experts and practitioners can work together while respectful of privacy and security. Where possible, open-source is applied in order to avoid lock-in with individual software and vendors. For scientific analysis, specialised commercial software is likely to be required, depending on the purpose, but not on terms that promote or enforce its use more broadly. In order to align with GDPR regulations, to protect owner, user, and producer rights, there will be 7 different levels of permission when uploading data (see Figure 5). The first level is called the “Uploader”. The uploaded data is only visible and accessible to the person/designated city who has uploaded the data. The “Producers” describe the permission level where only cities of the URBiNAT project (front-runner, follower and observer cities) who produce content and/or need to use and exchange data between municipalities can access data. The “Resolver” level allows only partners who produce data and/or need the data for treating and creating results to access data. “Associates” permits users who are not directly involved in URBiNAt activities, but produce relevant content and non-URBiNAT users that are invited to join the platform and need to access some data for project activities to view data. The “Inquiries” permission level is providing access of data for non URBiNAT partners (i.e. sister projects) and experts (i.e. members of the scientific committee) to ask questions, share ideas, and for evaluation purposes. The 6th level is called “Publisher” which enables URBiNAT partners to use the URBiNAT website to publish specific content for the public. The owners of files are permitted to provide temporary access to specific residents. The 7th and last permission level is the “Public Eye”. Here, data is open for the public through open-access permission, e.g. on OPPLA and other sister project platforms.

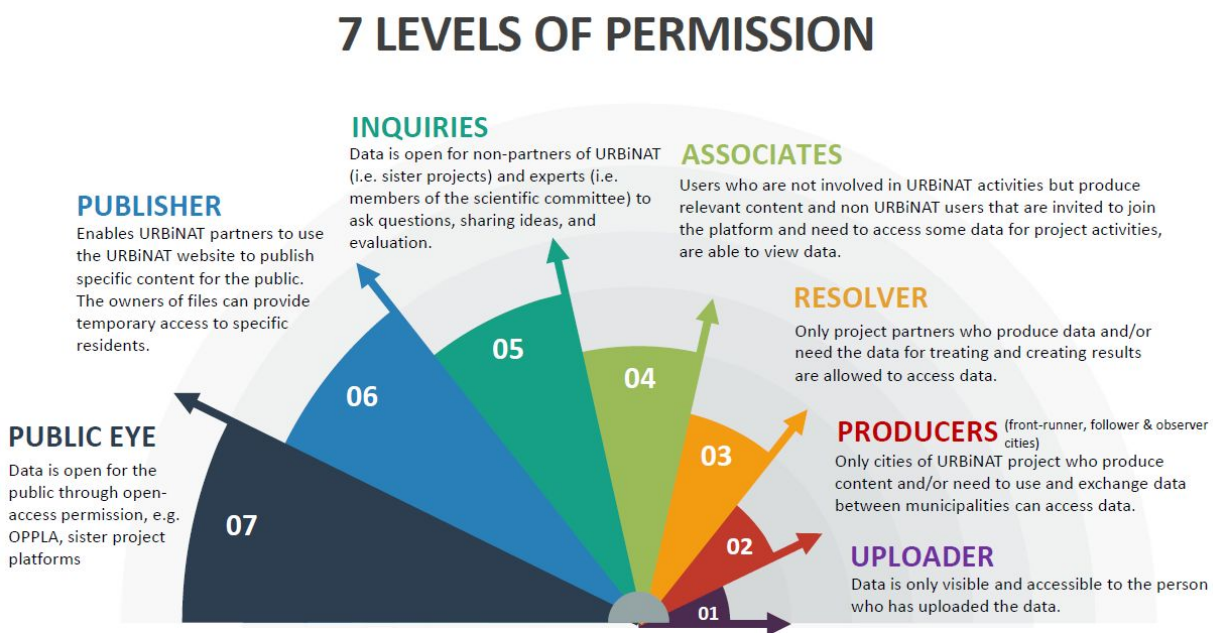

Figure 5: 7 Levels of Permission

4.1 Transition from Physical to Digital Ecosystem

Several features in the Observatory Platform support transferring the physical (analogue) world of our intervention areas into digital space. The idea is to replicate challenges and solutions of the "real" world in a computerized space, which enables experimentation and exploration of ways to manage them in a controlled environment. On this basis, the real-life struggles of physical eco-systems (lack of inclusivity, environmental damage, economic decline) can be given various kinds of representation in a modifiable arena. Within the digital ecosystem, testbeds can be tried out to simulate the effects of possible interventions into the study areas. Programmed features, such as interactive maps, can project and animate how nature-based solutions from our catalogue and how the execution of our methods are potentially influencing the physical neighbourhoods. Figure 6 is giving an example of how the NBSs will be represented within an interactive map on the Observatory Platform, capturing both the method being used for choosing the suitable NBS, while also showcasing and providing information on the specific NBS. Additional features will add information on people being involved in the implementation process, a how-to guide explaining the practical aspect of implementation, as well as a feedback and comments section, making it possible for users and residents to evaluate the benefits and shortcomings of the new solutions.

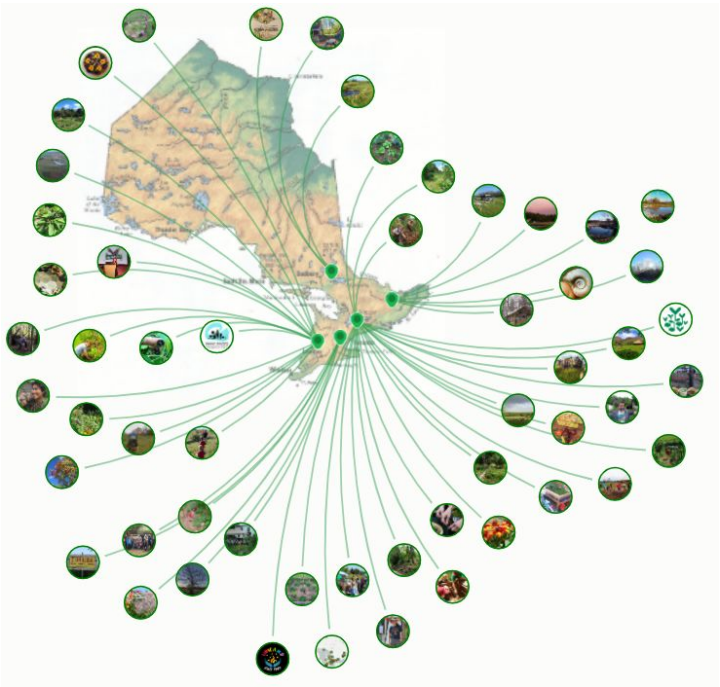

Figure 6: Representation of different NBS projects in intervention cities (Garden Jane)

In order to rationalize producing data in the URBiNAT project and create a digital ecosystem which could be monitored and observed, with cooperation and collaboration of the involved partners, the matrix of keywords and categories (Figure 7) presented by the Observatory Platform. The matrix of keywords and categories, filled by the responsible for each method in the URBiNAT project in a participatory approach. This matrix has been revised several times after having feedback of the frontrunner cities that had implemented some of the methods and then it was enriched by the feedback of the follower cities. The Observatory chose the participatory approach to form this matrix and as it evolved since the first version it could be updated and evolved as the project goes on and enhanced based on the new experiences.

(Cultural mapping A) PARTICIPATORY ACTIVITIES of MAPPING	Walkthrough A	Photovoice A	Focus group	Face-to-face Interviews	Behavioural mapping	Neighbourhood Survey	On-site and Laboratory Analysis	Territorial Mapping	LD1 data Territorial	LD1 data Social	LD1 data Economic	NBS Catalogue	Other
mixed methods	qualitative data	qualitative data	pain	mixed methods	quantitative data	quantitative data	quantitative data	quantitative data	quantitative data	quantitative data	quantitative data	Territorial	report
results	results	results	process	results	results	results	results	results	results	results	results	Social and Solidarity Economy	deliverable
satisfaction	Perceptions	Perceptions	collaboration	best-practice business model	family activities	Satisfaction with the neighbourhood	microclimate quality	Study area	climate/urban environment	Public services	Income and poverty	Technological	notes
dislike	Spaces	Spaces	drawing	champions	liveliness	Reputation of the neighborhood	microclimate/climate conditions	Landscape evolution	biophysical characterization	Health Spots	Employment	Participatory	publication
like	People	People	imagining	green start-ups	physical activity	Appearance of buildings	microclimate/evapotranspiration	Proximity analysis	Land use/Land cover	Cultural spots	Innovation	healthy corridor	book
perceptions	cleanness	cleanliness	inspiration	list of sustainable businesses	playgrounds	Upkeep of buildings and housing	microclimate/thermal confort	Fragmentation analysis	Transportation network	Sport spots	Activity sectors	new	paper
feelings	community space	community space	Participation	innovation hubs	social activity	Level of safety in the neighbourhood	soil quality	Green structure	Built infrastructures	Security spots	Facilities	existing	presentation
value	belief	belief	trust	interview transcripts	sports-friendly	Density	soil/Physical characterisation	Green spaces and circulation axes	Green structure and Biodiversity	Public administration spots	Average family income		media
activities	belonging	belonging	commitment	interview recordings	male	Neighbourhood relations	soil/Biological characterisation	Green spaces and equipment	Permeability	Education spots	Current expenditures		results
challenges / problems	coexistence	coexistence	Atmosphere	surveys	female	shops	soil/Chemical properties	Green spaces and streets	Green spaces	Participation	tourism/leisure/culture/sport expenditure		
discomfort	imagining	imagining	Motivation	semi-structured questionnaire	children	Leisure facilities	water characterization	Green spaces and habitational units	Water management	Attendance to Political events	Poverty		
relations	living	living	Interaction	Sustainable SWOT Business Model Canvas	elderly people	Public transport service to the district	water/Chemical properties	Agricultural spaces	Local Masterplans	Number of NGO's	Demographic data and age pyramid		
close to nature	reflectation	reflectation	Participation	Enablers for sustainable business growth	movement	Upkeep of the streets	water/Physical properties	Vacant lots	Future Projects	Society in social public media	Employment rate		
people	dislike	dislike	Openess	SWOT analysis	walking	sidewalks	drone measurements	Private green spaces with heritage value	Overall city description	attendance to public events	Unemployment rate		
co-creation	like	like	Skills	not-for-profit companies	running	Green areas and parks		Woodlands	Location, area, administative bundaries	Safety and health	Activity sectors		
inclusion	improvements	improvements	Awareness	for profit companies	supported	Degree of naturality		Parks and gardens of public access		Crimes (murders, stealing, etc.)	Number of patents, Research and development expenditure		
prospective	safety	safety		eco-social benefit	carried			Pedestrian network		Accidents (car, work, etc.)	current expenditure		
changes	nature	nature		eco-social cost	rolling	Air pollution		Crosswalks		Perception of safety	tourism/leisure/culture/sport expenditure		
contributions	shelter	shelter		unique value proposition	cycling	Household garbage and other waste		Pedestrian paths		Perception of Good Health	Ownership of durable assets		
priorities	culture & leisure	culture & leisure		non-for profit organisations	age	Wastewater and rainwater disposal		Shared roads		Social Life intensity			
visions	affection	affection		for profit companies	posture	traffic noise		Sidewalks		Intense in sport or physical activity			
dreams	mobility	mobility			standing	Noise due to the neighbors		Informal paths		Diseases and their intensity			
cultural assets	built up	built up			waiting	Thermal discomfort outside		Synthesis map		Police surveillance rate			
Tangible urban capital	mobility	mobility			leaning	Odors		Social housing		Social activities			
Intengible cultural dimensions of urban capital	playfulness	playfulness			sitting	physical activity in the neighbourhood		Facilities and services		Demography			
cultural vitality and community well-being	neighbourhood	neighbourhood			lying	Physical activities vigorous		Parks and gardens		Education/Literacy			
How does understanding the local cultural ecosystem inform and influence the community's cohesion, vitality and well-being?	park	park			passive	Physical activities moderate		Future projects		Cultural rate			
How are cultural components produced and reproduced in the context of the territory's urban regeneration?	services	services			drinking	Walking		Protected heritage		Families description			

Figure 7: Screenshot of the matrix of keywords and categories

4.2 Community of Practice and Living Labs

A central instrument for the successful collaboration between platform users and cities is the Community of Practice (CoP). The coP can be defined as an active network for collaboration that serves to promote constructive sharing of experiences and joint learning (Anderson, Anderson, Björner 2020). Conceived of in a broad sense, a CoP is not a new phenomenon: this type of learning framework has existed for as long as people have been sharing experience through storytelling and the build-up of various mechanisms to support bonding and aligned interests through mutual learning (Harari, 2014).

A central feature of CoP is to capture joint learning processes, in part through the collection and use of comparable data across cities, and by analysing shared experiences made by the whole URBiNAT consortia, including regular technical visits as well as yearly city visits. To capture and structurally visualise the outcomes and observations of these joint learning processes, digital enablers will be experimented with and operationalised in parallel activities on the ground, linking URBiNAT cities and their citizens in joint learning in-real-time. WP 3 is responsible for the successful design and implementation of digital enablers. To facilitate this process, the platform will provide the space for residents, non-URBiNAT partners (external experts etc.) and city authorities to privately as well as openly exchange ideas, give feedback, and share suggestions around the topics of improving inclusivity and sustainability within their communities. This process of knowledge and idea exchange will be supplemented and operationalised by different kinds of tools, such as the function

of online living labs and webinars. By bringing both methods into the digital ecosystem, cross-border as well as multi-disciplinary participation will be guaranteed by the operational system. The purpose being to facilitate a workshop addressing diverse and multi-layered challenges faced by as many groups as possible, specifically targeting the most vulnerable people. The difference between living labs and webinars is the participation level. Living labs are laboratories that are activated in each city with and by the community to develop the co-creation process from diagnostic to monitoring, designed to achieve tangible outcomes (immaterial and material) through coaching and sharing (MS2), whereas webinars focus on knowledge transfer through showcasing presentations and giving lectures. Both methods are resourceful, value-creating approaches to build up a Community of Practice in times of Covid-19. The inherent nature of CoP is the trial-and-error practice through which participants, as well as facilitators, evaluate - in a collaborative setting - which solutions are leading to a successful outcome and which solutions need to be adjusted and altered further. While the set-up for the Observatory and the URBiNAT CoP is partly framed to support sharing practices between the participating cities by connecting lead cities with follower cities, the dissemination and diffusion of results reach further by including a range of diverse audiences outside of the URBiNAT project.

Furthermore, the CoP will be advanced from tweets and retweets of residents of the intervention areas, dating back to 2018 until the end of the project in order to capture impressions and sentiments regarding the implemented changes throughout the healthy corridors. With Twitter being the most popular microblogging platform, analysis of the traffic and content, opens for examining attitudes, behaviours and responses, how these correspond to user attributes (age, income, gender, employment status, etc.), and also to map special interests that can be built upon to link and engage specific local communities. The continuous collection of public tweets and retweets can further support monitoring as well as evaluation during project implementation, allowing for innovative comparisons with the state of traffic ex ante, within as well as across the various cities, the frontrunners as well as followers. It can also distinguish the specific position and changes over time occurring in the study area and with a view to the structure of the city related to the Healthy corridor concept.

The CoP prepared for URBiNAT has been specially devised and structured to promote knowledge-sharing and learning processes between highly diverse actors, reflecting the broad-based nature of the consortium, including its reach beyond Europe (Andersson et al., 2020). Digital enablers provide important support, with the introduction of the URBINAT Observatory as a focal point in terms of data processing, with the capability to upload all kinds of files and operating on the basis of open systems. The purpose is to help fulfil the tasks of the project, creating the support environment by way of collecting, processing and making data available for all. Shunning unnecessary lock-in caused by proprietary technologies and/or specific vendors, the Observatory operates well-known open-source software repositories. The latter implies active facilitation of collaborative work with programs that are modifiable while also able to create and alter content without being constrained by particular tools and/or proprietary vendors (Ferilli et al., 2020).

The Observatory plays an important role in underpinning URBiNAT's overall concept of the CoP, which similarly aims to enable candid sharing of information and joint learning. The term "Virtual

Community of Practice" (VCoP) denotes a situation in which exchanges occur predominantly online, using, e.g., web forums, Internet-based chats, social media, and electronic sharing of resources. While VCoPs have great potential to help overcome constraints of space and time, issues arise as well, including skills in meeting new requirements to keep the exchange structured and engaging (Dubé et al., 2003; Bourhis et al., 2005). The VCoP is especially applicable during our current times with Covid-19 requiring to develop novel non-analogue ways of participation. The Observatory, therefore, also offers a digital city infrastructure through IoT and Ambient Intelligence technologies in order to live-stream the performance and effects of NBS in the Healthy Corridors. The Observatory Platform will furthermore introduce new tools of collaboration, such as interactive network maps, which show relations between users. Figure 8 is exemplifying the features of such a network and collaboration matrix. Relations between organisations and also individuals will be made visible to ease the process of finding and accessing the most needed content in a fast way. Data from IoT and Ambient Intelligence are feeding into the network and collaboration matrix by showing how NBSs are communicating with each other and offering live data on usage, maintenance, quality, and frequency of implemented solutions within the healthy corridors. The below figure is representing the application of indicating relations between topics by using three different kinds of arrows that show in which way different topics are related to each other. In this case, some topics are addressing the same content, other topics are related to opposites or interlinked in a conceptual manner. Translated to the URBiNAT project, linkages between our 7 intervention neighbourhoods, the healthy corridors, and the implemented NBSs will be showcased. This application will be broadened to also visualise policy similarities as well as addressing social, economic, and cultural implementations and activities. To feature this additional dynamic between sectors, a knowledge-landscape matrix will be created, as illustrated in figure 9.

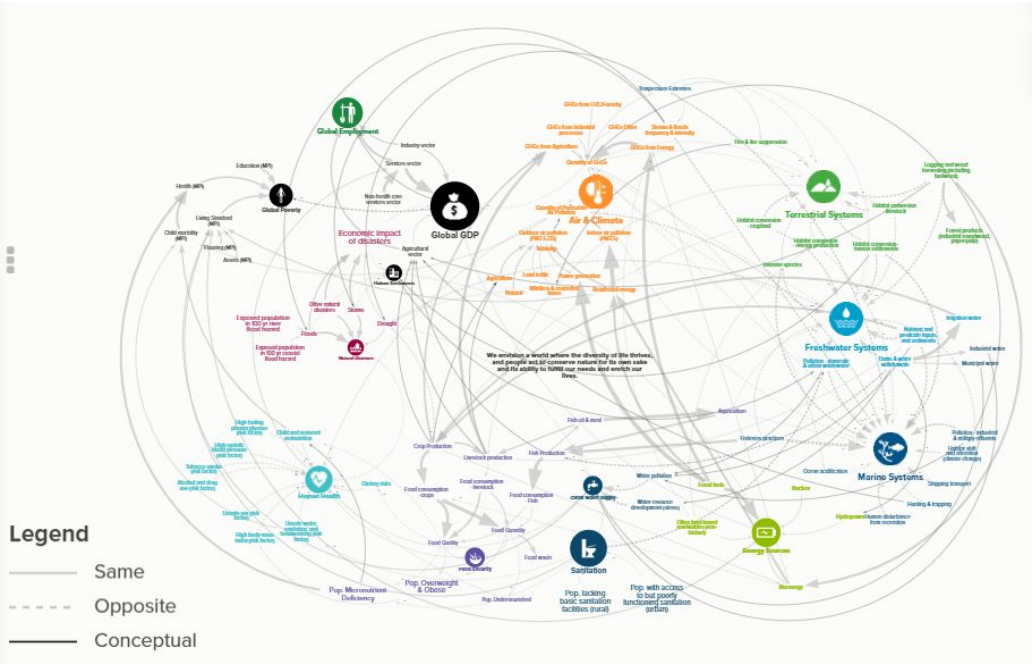

Figure 8: Networks and collaboration matrix - Illustrative case

Additionally, by combining online communication with strategically timed smaller physical meetings and workshops with citizens at the centre, URBiNAT's focus on inclusivity is being addressed as much as possible. A few selected participants from other cities are present to provide outsiders' view and to enable linking between the cities. In this sense, the application of technical tools is not viewed as an objective of its own. By contrast, many critics argue that cities tend to approach technology as a panacea to resolving their problems, while the key to success is about serving the interests of the people who live there (Greenfield, 2013). Lessons-learned from both online and offline workshops will be combined within the Observatory Platform and serve as a source of insights addressing social, environmental, and cultural aspects. These insights and workshop results, among others, can be collected within the Matrix of Knowledge Exchange (see figure 6). In the below figure, the potential clusters and categories for knowledge exchange are exemplified. On the right-hand side, it is visible on how to specify the required information by using different kinds of filters, including the entity type which includes the kind of information the searcher is looking for, e.g. specific activity (the "methods"), a person, a project, or a publication. Once a selection has been made, it is then possible to view the connections available. Additionally, the search can be specified by filling in the open columns "description search", "refine description" and "name search".

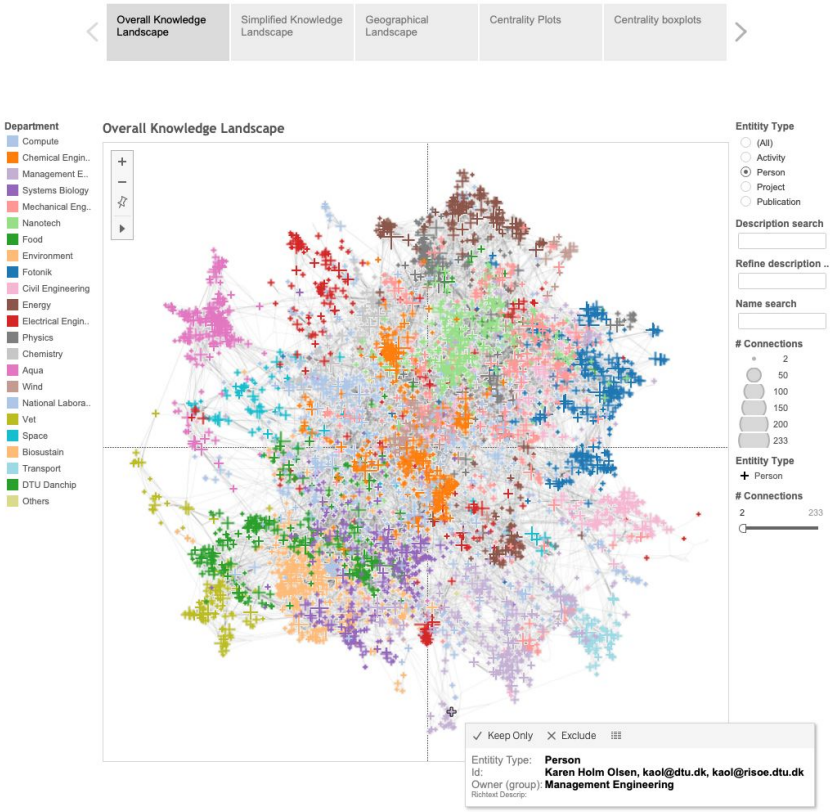

Figure 9: Matrix of Knowledge Landscape - Illustrative case (Thirdroom)

The value of data collection, processing and dissemination of data magnified by digital enablers will, at the end of the day, depend much on the competencies, incentives and governance propelling their use. The scope for feeding a learning process in support of organisational change and a reoriented administrative capacity on the part of the city should be borne in mind. The fulfilment of potential benefits will require technical skills as well as the organisation and systems to enable full-fledged collaboration between operators, professionals (including in social and behavioural sciences) and urban planners (Fenwick and Edwards, 2016). Required infrastructure and administrative capacity need to operate in tandem with the providers of suitable methodology in order to plan, organise, evaluate and act upon citizens' inputs and responses. To improve coordination and mutual learning between the URBiNAT cities, the Observatory will ensure continuous support and knowledge exchange by using visualisations and the application of interactive methods. The aim is to connect knowledge partners as well as to simplify the process of retrieving valuable information. For example, each partner can create their own "live project" and showcase the development of the creation and implementation process of NBSs within the healthy corridor. This visualisation will help to present in detail the different steps necessary for the execution of a successful co-creation process.

Several ideas and digital enablers are being tested to further explore more digital opportunities for conducting participatory processes, embedded into a digital ecosystem. For example at the present time, this naturally includes, in the medium term, jointly assessing and addressing the changing landscape that has arisen due to the arrival of COVID-19, while also preparing for and coping with the anticipated long term effects on urban regeneration and sustainability (for further explanation, D3.3).

In the next section, the methods for monitoring and evaluation of the collected data will be specified and presented with more details.

5. The Multidisciplinary Approach

Social inclusion and the creation of innovative sustainable solutions will be approached through a holistic framework, which takes into consideration environmental issues, as well as mental health and social well-being. In an effort to address all aspects, URBiNAT's expected impacts include an inclusive urban model (HEALTHY URBAN LAB + LIVING LABS + HEALTHY CORRIDOR) which will develop, through the wide benefits of the proposed NBS, a healthier, culturally diverse and ecosystem regeneration of deprived districts in our intervention cities.

The Healthy Urban Labs in frontrunner cities will co-design, co-develop, co-implement and test the combination of NBSs that compose the healthy corridor. These labs are public-private-citizen partnerships, working with collaborative methodologies such as design thinking, ecology knowledge, knowledge heterogeneity, cultural and artistic participatory approaches. They will also develop methodologies for replication and up-scaling of NBS in different contexts, such as evidence-based framework and guidelines for collaborative decision-making and policy development, a school of NBS and local governance, and research on best practices. Special

attention will be paid to the creation, in each HEALTHY URBAN LAB, of social and solidarity economy initiatives on NBS, which will be targeted at individual (social entrepreneurship) and collective (solidarity economy) entrepreneurs' initiatives.

This inclusive urban model (HEALTHY URBAN LAB + LIVING LABS + HEALTHY CORRIDOR) will develop a healthier, culturally diverse and greener regeneration of districts of areas under urban regeneration and neglected or abandoned areas in our seven European cities as well as function as an inspiration for replication in our two observer cities in Iran and China.

5.1 Quantitative Research

Quantitative procedures enable an intersubjectively comprehensible description of complex structures by making social conditions measurable and analyzing them statistically. Its main purpose is to falsify and verify the relationships between of variables and their realisation (cf. Raithel 2008: p. 8). According to Silva and Wright (2008), qualitative interviews can be used as additional or confirming research results to 'check and correct the quantitative data' and support findings discovered throughout the quantitative analysis. Quantitative research is defined as a systematic investigation of phenomena by gathering quantifiable data and performing statistical, mathematical, or computational techniques. Quantitative research collects information from existing and potential customers using sampling methods and sending out online surveys, online polls, questionnaires, etc., the results of which can be depicted in the form of numerical. After careful understanding of these numbers to predict the future of a product or service and make changes accordingly.

5.2 Qualitative Research

In qualitative research, the focus lays on capturing the special properties and characteristics of a social field as precisely, differentiated and objective as possible. It is less about "measuring" something, but rather about understanding issues from the perspective of the object of investigation (cf. Raithel 2008: p. 8). For example, prior to the face-to-face interviews, semi-structured interview guidelines were designed. A semi-structured interview guideline allows to maintain a thread and continuity throughout the conversation, but at the same time, leaves enough openness for evolving questions (DiCicco-Bloom and Crabtree 2006). The "(…) person interviewed is more a participant in the meaning making than a conduit from which information is retrieved" (Ibid, 314).

Michael Meuser and Ulrike Nagel analyze the expert interview in the book "Expert interviews - tried and tested, little thought: a contribution to the qualitative discussion of methods". The context in the expert interview is an organizational or institutional context that represents a "factor" with the life context of the people acting in it. With the help of an openly designed interview, the situation definition of the expert and the structuring of the subject as well as evaluation are to be examined. The characterisation of an expert depends on the research interest. Functionalists who are responsible for the design, implementation or control of a problem solution or who have privileged access to information about groups of people or decision-making processes can be described as

experts. The associated responsibilities, tasks, activities and exclusive experiences and knowledge are central components of the expert interview. The interviews provide information about the contextual conditions of the target group's actions. The interest is pursued to analyze structures and structural connections. The experts are addressed as representatives of an organization (see Meuser / Nagel 1991: pp. 442ff.).

The central requirement lies "(…) in this type of investigation (…) to determine the external effects and standardizations as context conditions from the experts" (Meuser / Nagel 1991: p.446). Empirical research can provide operational knowledge and context knowledge. Information from operational knowledge is used to record internal business processes as well as decision-making processes. For example, the face-to-face interviews conducted with social and green businesses, insights on internal operations provide vital information in order to understand and assess the underlying business model and its advantages in comparison to similar business models. Context knowledge, on the other hand, is about examining so-called status passages. Characteristics and structures of action that are typical for the company under investigation are being recorded (cf. Meuser / Nagel 1991: pp. 446f.). The purpose is to uncover the company's unique value proposition and unfair advantages towards competitors. The reason behind this investigation is to understand why the proposed solution is different from similar ideas and therefore worth paying attention to.

Quantitative and Qualitative Data Collection

Qualitative and quantitative data feed the digital ecosystem (platform) by generating results through the execution of different research methodologies in each of the intervention cities. URBiNAT project employs different methods. Each of the methods is generating qualitative and/or quantitative data. Cultural Mapping (quantitative and qualitative results), Behavioural Mapping (quantitative results), Walkthrough (quantitative and qualitative results), Photovoice (qualitative results), Focus Group and observation (qualitative and quantitative results), Face-to-Face Interview (qualitative results), Neighborhood Survey (quantitative results), Laboratory Analysis (quantitative results), and Territorial Mapping (quantitative results). The co-diagnostic process entails the gathering of secondary data (Local Diagnostic stage 1) and primary data (methods of the Local Diagnostic stage 2). Throughout the co-creation process, other methods and data will be produced, e.g. SROI, governance analysis, social media content, and digital enablers for monitoring and evaluation of Healthy Corridor and NBS.

5.3 Mixed Methods

The use of mixed methods encompasses research with both qualitative and quantitative survey methods. According to Kuckartz, there is another significant step in the analysis of the qualitative and quantitative study strand - mixing. This involves the integration and connection of the two analysis strands and result types with each other. Comparative analysis of the conclusions represents the decisive benefit of mixed methods studies (cf. Kuckartz 2014: p. 101).

Mixed methods have been applied to achieve the best results when collecting information from diverse sets of citizens, in some cases undertaking interviews in others, conducting quantitative surveys reaching large numbers of participants. A semi-structured questionnaire was created to be suitable for cross-city comparisons. The results of this survey help interpret the perspective of various citizens, including how the selection process for NBS has been perceived under varying circumstances. In parallel, face-to-face interviews were conducted with selected stakeholders of high relevance, such as CEOs and founders of sustainable businesses (WP7).

Mixed methods can help to complete research questions by combining both quantitative and qualitative methods. The gaps left by one method can be filled by another. For example, when ethnographers employ structures interviewing or possibly a self-completion questionnaire because participant observation alone is not sufficient (Bryman 2012). In this case, mixed methods were used to complement research conducted on the one hand, through quantitative analysis by using an online survey and on the other hand, through qualitative research by conducting, among others face-to-face interviews with key personnel of social and green businesses.

5.4 The Analytical Framework for monitoring and evaluation

The process of analysing and integrating the research results within the scope of the monitoring and evaluation framework is being undertaken as part of task 5.6, coordinated by CES. The overall objective is to systematize the project's trajectory in light of a critical theoretical-conceptual framework and research methodologies that show the effectiveness and correlation between concepts, methods, results and impacts achieved. In order to ensure efficient and consistent data analysis within the Healthy Urban Lab and Living Labs of the NBS, task 5.6 is developing an Analytical Framework (AF), a transversal instrument that contributes to research analysis in a more integrated way. As mentioned in section 3.1, this instrument aims to address emerging research questions concerning wellbeing and health (T5.3), social and economic effects of NBS (T5.4, 4.7 and 7.1), political and governance strategies for NBS implementation (T5.5), environmental issues (T2.1) and inclusive urban space (T4.6). The purpose of the AF is to highlight the interconnection between different aspects of the project and capture the complexity within an integrated process. It also aims to strengthen the connections between tasks and, thus, to generate more detailed, refined and precise analyses. In practice, the AF provides new opportunities to reflect on and contribute to the process of measuring expected impacts. The AF plans to integrate the participatory dimension by adopting specific methodologies. This dimension seeks to address EC recommendations on the inclusion of priority social groups in a citizen-centric approach. The detailed process of co-design and structure of the Analytical Framework will be presented in the interim report under T5.6 and be referred to in Milestone 5. The research results of the Analytical Framework will be presented in D5.6.

The dissemination of these reports will be supported by WP6, according to the targeted audiences, taking into account the needs of different actors, as recommended by the EC. The objective is to ensure that the results of task 5.6 will target both wide and specialized audiences. The dissemination

will also be integrated in clustering activities with other EU funded projects on NBS, namely through the EU task forces on “NBS for urban regeneration”.

6. The flow of data

The data sets are being collected by using different methods and by distinguishing between monitoring and evaluation of city data. In a first step, the local diagnostic analysis is being conducted by collecting secondary data (Local Diagnostic stage 1) and primary data (methods of the Local Diagnostic stage 2), in the intervention areas in order to generate a deeper understanding of the study area by collecting data on co-diagnostic processes. As depicted in figure 10, city data is being monitored and evaluated for further exploratory purposes. Monitoring is defined as the process entailing continuous observation during the process of co-creation of NBS in the study areas and their combination and extension into Healthy corridors (co-diagnostic, co-design, and co-implementation). Evaluation refers to comparative assessment of the study area before and after the implementation of the healthy corridors.

Throughout the process of monitoring and evaluation, the URBiNAT project is assessing each of the 4 steps of co-creation, starting with the co-diagnostic process. Within T2.1, IULM is delivering data of local diagnostics in frontrunner cities. The co-selection process of NBS is conducted by CES in T2.4, focussed on creating and analysing local plans for all URBiNAT cities. Both T4.2. and T4.4 are producing data on the co-design process of NBS and the healthy corridor. T4.2 in particular, led by IAAC, analyses territorial and technological NBS, whereas T4.4, under CES, is producing a healthy corridor concept and developing an urban co-planning methodology for territorial and technological NBS. All data derived from the three co-creation processes are delivering valuable information for the co-monitoring and co-evaluation process, formulated in D5.2.

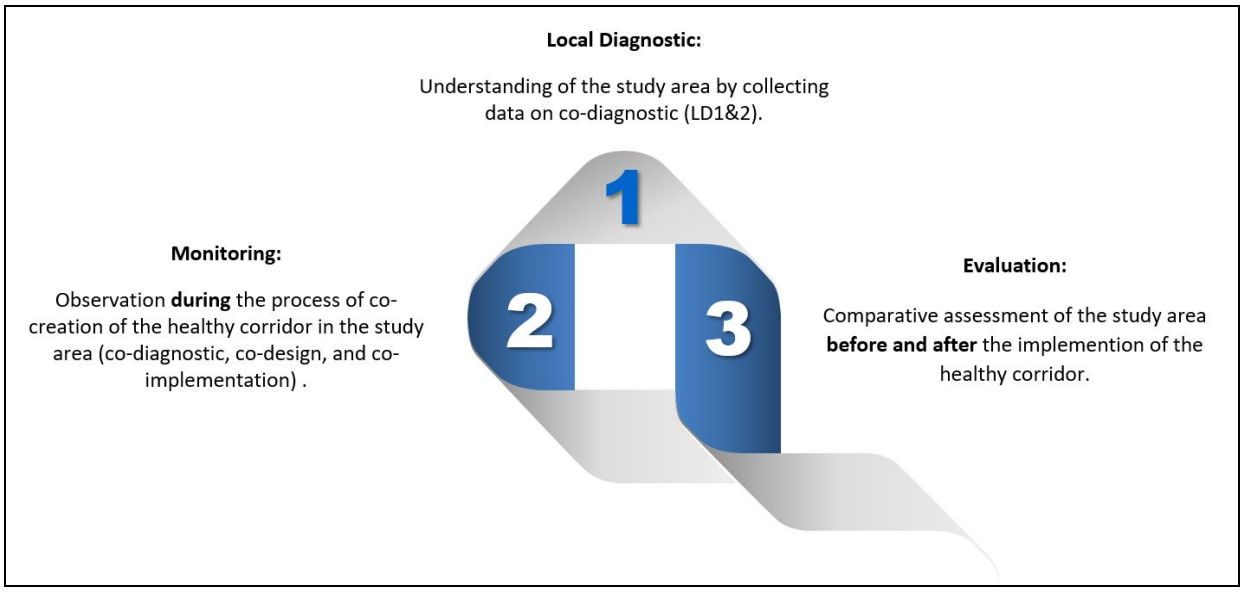

Figure 10: Overview of Monitoring and Evaluation

6.1 Monitoring

During the monitoring process, where possible, quantitative secondary data is collected in support of comparability (between, areas, cities, over time, etc.), and also for representative purposes. Quantitative data offers additional advantages by facilitating identifying and signalling variation at systems levels, and so as to be able to monitor more easily. In some instances, only qualitative data will be available but, yet be possible to translate into quantitative format whenever adequate. When that is not so, qualitative data serves to provide complimentary, additional information to feed specific purposes. In many cases, for instance, qualitative data open for more in-depth and personalised analysis, for instance, attitudes, experiences, feelings, symbols, and certain behaviours, supplementary to quantitative data. This conglomerate of data is the source for monitoring and evaluation used by project partners. In particular, T5.3, T5.4, T5.5 and T5.6 provide data analyses to WP 2, 3, and 4 in order to evaluate and monitor the implementation process and to support the replication of the co-creation process for follower cities (MS5).

Additionally, data from social media analysis, including posts and interactions, are increasingly relevant to gauge social developments. New dimensions in this respect have arisen with the onset of COVID-19 in 2020, as on-line communication has taken over many physical contacts. The Observatory has accessed data on Twitter activities for both the front-runner and follower cities, which can be effectively used to examine selected trends and patterns. The idea is to trace tweets and retweets during the implementation process of NBSs, and Healthy corridors with a view to capturing anticipated as well as non-anticipated reactions and experiences of residents in the study areas.

Other external open-source data related to URBiNAT's activities will be monitored and evaluated as well, in order to enrich and widen the analysis of interventive actions, including in terms of inclusivity, sustainability, and innovation. **In their capacity as an advisory board, the Scientific Committee might be involved in staging the data collection through the co-creation process in order to prepare for realizing adequate assessment of key variables and to verify the accuracy and alignment of content being monitored.** The keywords and categories table assumes a central role in structuring the monitored data in the intervention areas.

Moreover, there is the possibility of intensifying the local monitoring approach by creating local teams with required skills according to the workshop KPIs to make observatory notes that shed light into the ongoing process of the developments taking place on-the-ground. Another feature could include a new interface tool integrated into the Observatory Platform to provide users (primarily residents) to share direct feedback and inputs as well as to enable the local monitoring teams to store changes in their neighbourhood. Additionally, places of non-intervention, meaning areas that have been affected by URBiNAT activities, although those effects were not initially planned, will be monitored, e.g. pathways or districts neighbouring healthy corridors.

6.2 Evaluation

The subject of evaluation is the assessment of the study area before and after the implementation of the healthy corridors in the front-runner and follower cities. Additionally, it concerns the evaluation of the steps of the co-creation process in different phases that are monitored in the study areas. Reflecting the diverse nature of NBS as well as the diverse conditions under which they are introduced, the data collected will be assessed using an interdisciplinary approach. The evaluation must consider, e.g. the ecosystem and human influence on different parameters, taking account of the local economic and social situation (including health and wellbeing) as well as cultural factors and the environment. Local Diagnostic step 1 and 2 contribute relevant content and a significant amount of data being used for evaluation purposes. Additionally, other tasks, e.g. T5.3, T5.4, and T5.6 will provide research results and intermediate observations that are feeding into the evaluation process. The methods being used to compare data prior and after the intervention will be framed in an evaluated research scheme to make it easier and faster to compare data in order to structure and standardize the process and to avoid everyone using their own methods for comparison. All methods used for comparison should be non-linear (neutral networks and similar) to explain the details and feedback loops between variables. Validation takes place by conducting a citizen engagement survey to collect feedback from citizens experiencing the advantages of healthy corridors.

For the improvement of the functionalities and the assessment of the functioning of the digital platform among the members of the scientific committee, and other groups of stakeholders will be employed in the Delphy survey method. The protocol for each group of stakeholders will be designed with the purpose to receive multidisciplinary and multi competences opinions.

The Observatory does not interact directly with citizens on the platform, apart from specific cases when it is required the involvement of some stakeholders for sharing and commenting on specific profiles of the city/study area. However, it disseminates analysis and elaborated information to the website of URBiNAT and other external sources of communication. To support the WP3 and 4 citizens could be engaged with the platform during the participatory process and the co-monitoring phase through designated mediums such as the website of the project with information and knowledge sharing.

Having said this, URBiNAT includes several activities where data will be generated by users themselves, based on a co-production model. For instance, the participation of citizens in focus groups or interviews, direct observation, and cultural mapping. Another example will be the application of digital enablers in WP3, where smart apps will be applied to enable interaction in real-time with users that share certain characteristics, e.g., in a “Community of Interest” (CoI), notably in support of participation and co-creation of NBS and Healthy corridors (D3.3). Analysis of the resulting data, which needs to be thoroughly protected in regard to the privacy and integrity of uses, applying appropriate mechanisms for anonymisation, etc., will generate important insight into the response of user categories marked by attributes of high importance to understanding diversity

and the specifics of deprived areas and disadvantaged groups. Through the Observatory, it will be possible to link the resulting observations to other datasets in a creative and innovative manner.

7. Modelling the Study Areas as an Ecosystem

7.1 Monitoring and Evaluation through the Observatory

An urban digital ecosystem provides a framework to add value and design an innovative evolution of the existing and planned investment of a city. It enables interoperability between different entities through common guidelines, technologies, standards, etc. that foster the participation of various stakeholders with a particular focus on governance process, adaptability and replicability, citizen engagement, and sustainability in the long term.

Data collection is an important function in a digital ecosystem, and in fact, it is the most important piece of the big monitoring and evaluation puzzle. A complete monitoring and evaluation process requires connecting methods' impact framework with other supporting partners, cities, and aggregate results and data from many online and offline data collection sources. The Observatory platform provides both data collection and tools to facilitate the Monitoring and Evaluation process by mitigating the limitations of data collection and data aggregation (Ferilli, Alamolhoda, 2021). Therefore it makes the process faster to achieve results with a modular design and ontology-based approach.

Traditional Monitoring and Evaluation frameworks excessively focus on activity reporting. The URBiNAT Monitoring and Evaluation framework enables stakeholders to express their voice so that the program, service, and provider have a short feedback loop. Accordingly, it reduces the distance between partners, cities, top-level, and downstream institutions.

The URBiNAT project employs a distributed, decentralized and hierarchical approach. This brings challenges for all the stakeholders, both internals (cities and partners) and external (scientific members, other institutes).

Challenges

- ❏ Inconsistent reporting to cities
  It is difficult to get a clear, transparent image of what, how, and how much impact an implementation is achieving. An added difficulty is if different standards are used at each level of data collection, analysis, and reporting.

- ❏ Inconsistent data collection processes at multiple locations
  If partners of the project are using different tools for data management, it can create huge reliability issues within data sets.

- ❏ Long reporting cycle
  Often projects may not be considering the Monitoring and Evaluation framework from the start and often enough. This could reduce the visibility of the impact generated, while also making it near impossible to have it in a dynamic contextual manner.

Data source

Data originates from a very wide range of topics (territorial, social, economic, cultural, natural/environmental) with the successful combination of statistical and on-the-ground gathering from the secondary data of the local diagnostic and the methods designed and developed by the URBiNAT project to collect data are the other sources populating the Observatory platform. On the other hand, some tasks of the WP5 (Observatory) such as 5.3, 5.4 and 5.5 are producing new data with the aims of monitoring and evaluation (MS 5).

7.2 Data Management, assisting monitoring and evaluation process

Data management is the most crucial phase of a monitoring and evaluation process. In the URBiNAT Observatory platform, it is required to fill multiple inputs as metadata characterizing the uploading resource. Therefore, all data available on the Observatory platform follows a set of standards and protocols. They will address the concerns of privacy of data, uniformization, and homogenization. Furthermore, these standard attributes and metadata facilitate data retrieval and assessment (Ferilli, Morello, Alamolhoda, 2020). The attributes that now actively be used as filters on the platform (Figure 11):
Such as City, Level of accessibility, Methods, Geographical level, Categories, Keywords, Title, Date, and NBS

Figure 11: Filters to help data retrieval

7.3 Methods framework

There is no limitation of software choice to be used by the methods as far as it is being used by all front runner and follower cities where the methods are implemented. So that the results of the method can be interpreted, analyzed, and assessed. The Observatory platform makes sure that data is being uploaded in a standard format with sufficient metadata and information. Therefore the Observatory presents a set of standards and metadata to be filed so that data becomes easy to retrieve in the first place and interpretable for the analysis tools and software. Moreover, Observatory is able to export geodata to different formats and it does the same for all metadata as well. The latter means that regardless of the formats of the file at the time of uploading, it can be exported to standard formats such as CSV, GeoJSON which are more straightforward for analyzing tools and software.

The Observatory platform has approached monitoring and evaluation as a living tool to be evolved in the lifetime of the project and even after. In order to do so, the platform has provided several API endpoints for both internal and external uses. Having a powerful API paves the way for adding features and tools based on the data management system to support and facilitate the monitoring and evaluation more than before. Publishing data via API endpoints, in so-called formats such as CSV, GeoJSON by the core module of the Observatory enables easy integration of the software with modern architectures. Therefore, the Observatory could evolve and install tools and instruments to satisfy unseen needs of the monitoring and evaluation framework in the rest of the life of the project without changing the code base and architecture of the platform.(Ferilli, Alamolhoda, 2021)

7.3.1 Coding Approach for monitoring and evaluation (Modular Design Approach)

A set of keywords could work as a cohesive unit. In other words, a set of keywords are the modules and codes that we use in modelling and observation of the ecosystem to support monitoring and evaluation in the study area.

The essence of modular design consists of dividing a complex objective into a number of simpler subtasks and measurable actions to solve it independently of each other. Modularity is one of the basic principles of interpreting big projects. In the general case, a module is a separate functionally complete unit, in some way identified and combined with others, a means for defining a logically related set of objects, a means for their isolation and detachment. The module is a means of decomposition not only of control structures but also of data structures.

Modular Design provides high variety and flexibility with reduced cost (Fisher et al., 1999). A modular process is formed by several independent sub-assemblies (or subroutines), known as modules or blocks of code, that can be treated as logical units yet perform as a whole (Baldwin et al., 2000 and Simpson et al., 2007).

Regarding the objectives of Modular Process Design, one can say that a modular process is a function-oriented design, in which each module is responsible for storing and managing one or more functions, that can be integrated into distinct systems with small changes (Chang et al., 1995 and Ulrich et al., 2009).

Reconfigurable manufacturing and cellular manufacturing share the principle of modularity in their design. Moreover, RMS can be constructed from cells as presented by Koren et al., 2010. The RMS presents the characteristic of flexibility. It means that those systems are able to improve their capabilities to produce different mixes and volumes of productions (Kia et al., 2012).

A set of keywords could work as a cohesive unit. In other words, a set of keywords are the modules and codes that we use in modelling and observing the ecosystem of the study area process.

#	Step	Description
1	Cells Definition	Establishing a cluster of actions that composes a cell.
2	Cells platform design	Selecting cells (keywords) that will be used for a product (anticipated outcome)
3	Configuration	Selecting and rearranging cells based on the changes

Table 1: Modular Process Design

7.3.2 Ontology-based GeoData Fusion

The Observatory presents a general framework based on the Ontology of Geodata Fusion for integration, analysis, and visualization geospatial data.

The Ontology-based geodata fusion defines high-level concepts that model the domain of interest in the co-creation process of the healthy corridor in the study area in terms of an OWL ontology. The ontology models the fundamental semantic concepts of the geospatial data and can support the formulation of queries for the given purpose and data.

The Geospatial data fusion consists of two phases. The first phase is importing data into a geospatial database, after preprocessing. In some cases, it is required to convert formats automatically to ensure the efficiency and sustainability of the database. The second phase provides the data fusion in which all metadata entered at the time of uploading, with the variables form an ontology. This semantic declaration of data represents the relationship of the datasets on a digital ecosystem. Moreover, It is important to note that, on the Observatory platform, resources (geodata and others)

can be connected and related to each other. The generated ontology reflects the nature of the study areas' phenomena.

Primarily for each uploaded resource, we create a small scale ontology which describes the content and metadata of the resource. In the second step, we build a general ontology over all uploaded resources based on the relations and connections between them. Then, according to the observation queries, users' behaviour, and results, we reform the ontology.

In this way, the ontology is created in both bottom-up and top-down approaches. It is worth mentioning within this approach, once a new resource with a set of metadata got appended or relation to other resources got changed in the digital ecosystem, the ontology, instead of reconstruction from scratch would update itself automatically with a light cost.

The key concept is that we are creating an open-source, data-driven environment, which is formed by metadata including keywords and categories, which are used through a modular design approach for monitoring and evaluating the study areas.

The monitoring and evaluation of the anticipated outcomes of the healthy corridor that unfolded earlier in the chapter “The Ecosystem of the Study Areas” would be approached as a modular process where modules are the keywords which contain data in an ordered and structured manner. As shown in table 1, the first step of the monitoring and evaluation process was defining and designing keywords (modules) which were done by the responsible for the methods and tasks of the URBiNAT project. The second step is appointing a cluster of keywords to direct one anticipated outcome. And last but not least, the configuration step is the validation of the clusters backed by artificial intelligence analysis.

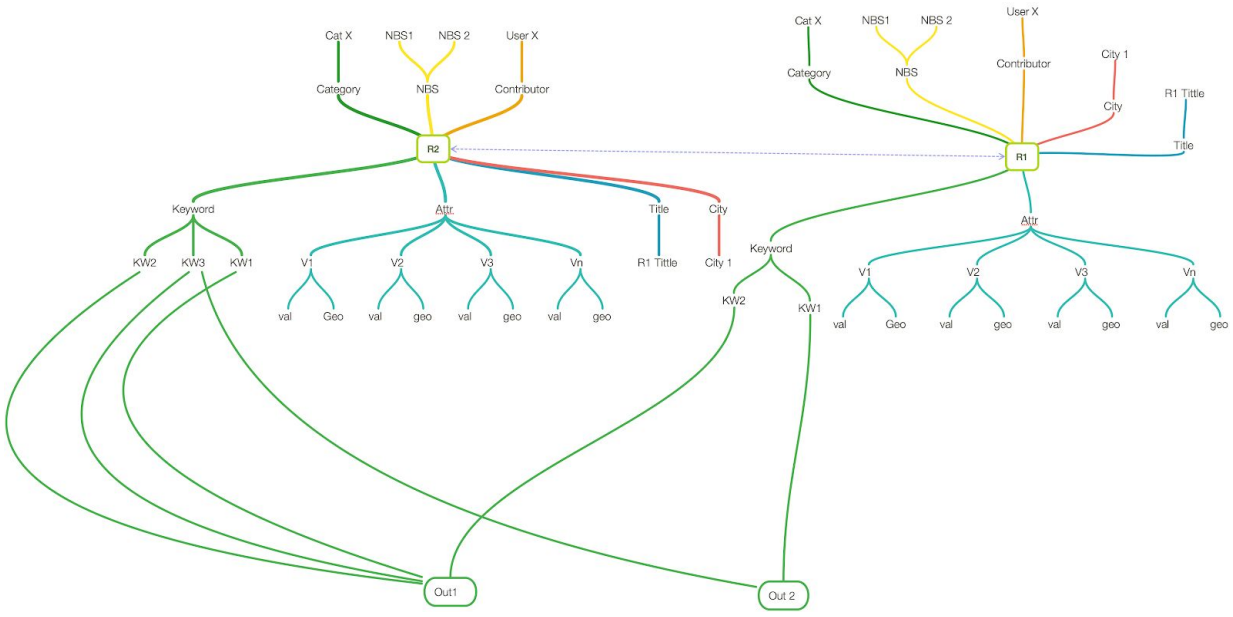

Figure 12: Two Resources with metadata and corresponding outcomes

In addition, a keyword is designated to one or many of the anticipated outcomes of the healthy corridor. The table below depicts the three-dimensional matrix of the relation of methods, keywords and outcomes in a 2D visualization. Outcomes are specified by colours.

Method 1	Method 2	Method N
KW	KW	KW
KW	KW	KW
KW	KW	KW

Table 2: An example of a coloured 3D Matrix in 2D visualization

Figure 12 presents the relation of the outcomes within the graph of the resources. By selecting the outcome node as the root of the graph, we can reach to resources contributing to an outcome and then we can reach certain variables or geospatial information. In the new tree, roots are the anticipated outcomes and the leaves are the variables of the resources.

The generated graph represents a living ecosystem in a hyperspace environment which makes it possible to track every change in the ecosystem in both bottom-up and top-down monitoring approaches.

7.4 Oppla, Website

The Observatory platform is able to disseminate information through the designated API, to external services such as the website of URBiNAT project and the OPPLA platform. The Observatory platform does not interact directly with citizens, apart from specific cases when it is required the involvement of some stakeholders for sharing and commenting on specific profiles of the city/study area. The API of the Observatory platform enables the website of the URBiNAT project to provide tools and interactive interfaces in a citizen-centred approach.

Oppla is a virtual hub where the state of the art on nature-based solutions is brought together from across Europe.

All content on the Oppla website will be openly accessible. The API will be protected by a system of API keys (although this may only apply to editing), but keys will be easy to obtain, and available to all legitimate consumers of the content. Access to datasets themselves will be controlled by the dataset providers, but they will be encouraged to make the data as open as possible and to specify any restrictions in the metadata.

In other words, the datasets will be stored online on a semantic web. All the data will be findable both on the web and via API. All contents will be openly accessible. Only widely recognised open formats will be implemented to maximize interoperability. This will allow others to use remote data and metadata. The use of widely used standards will be encouraged and controlled by dataset providers.

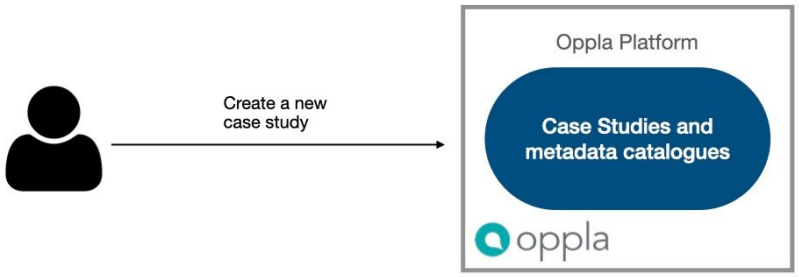

Figure 13: Initialize a case study on the OPPLA platform

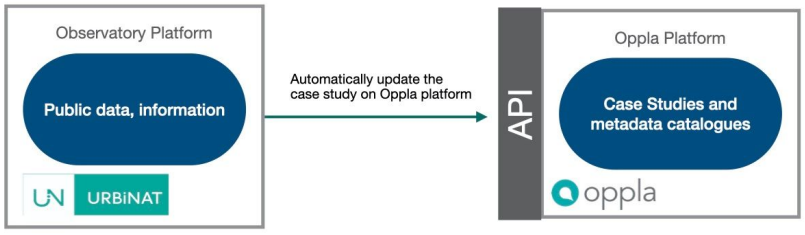

Figure 14: Schematic representation of the Observatory and Oppla interaction

In order to publish and disseminate information to the Oppla platform, the first step is to register a new case study on the Oppla platform (Figure 13), then with having a set of API of Oppla platform, the Observatory can interact programmatically with the Oppla platforms (Figure 14)

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Annex 1: User Manual and general guidelines

Manual of the Digital platform of URBINAT Observatory

Leading partner	IULM University
Type	Manual
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Deliverable	Internal document available for the project partners
Due date	September 2019
Version	1.2

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Acronym	*URBiNAT - Urban inclusive and innovative nature*
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13 January 2020	1.1	IULM	First draft shared with Front runner cities
21 April 2020	1.2	IULM	Second draft with the software architecture stable
24 December 2020	1.3	IULM	Final version submitted

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1. Introduction

The URBINAT Digital Observatory is a platform for developing geospatial information systems (GIS) and for deploying spatial data infrastructures (SDI). It is designed to be extended and modified, and can be integrated into existing platforms. It is a Web Application used for

- ❏ Upload, manage, and share geospatial data
- ❏ Create and share interactive maps
- ❏ Collaborate and interact with other users

The overall purpose of this guide is to provide a comprehensive manual on how to use the observatory more effectively and provide practical training on how to achieve this.
At the end of the training modules, it is expected that UNBINAT platform users will be able to:

- ❏ Understand basic concepts of using an observatory web-based system for sharing geospatial information;
- ❏ Upload and view various data;
- ❏ Produce comprehensive and illustrative maps by using existing data layers or by creating new data layers.

2. Explore Homepage, Maps and Layers

2.1 Explore Homepage

On insert the url http://urbinatobservatory.eu/ in browser the Observatory homepage will appear. The Observatory Homepage (Figure 2-1) offers a few options to start navigating the system. Users can change the language of Observatory from Language Option from the bottom of the Homepage. There are seven main links at the top of the homepage: Home, Layers, Maps, Documents, People, Groups, and Search. These links are permanent, allowing you to easily navigate between different interfaces without necessarily returning to the homepage. There are also three quick-links at the bottom of the page:

1. Data – user can explore layers, maps and documents
2. About – users can see a list of registered users and levels.
3. Help - users can access and read guides and instructions

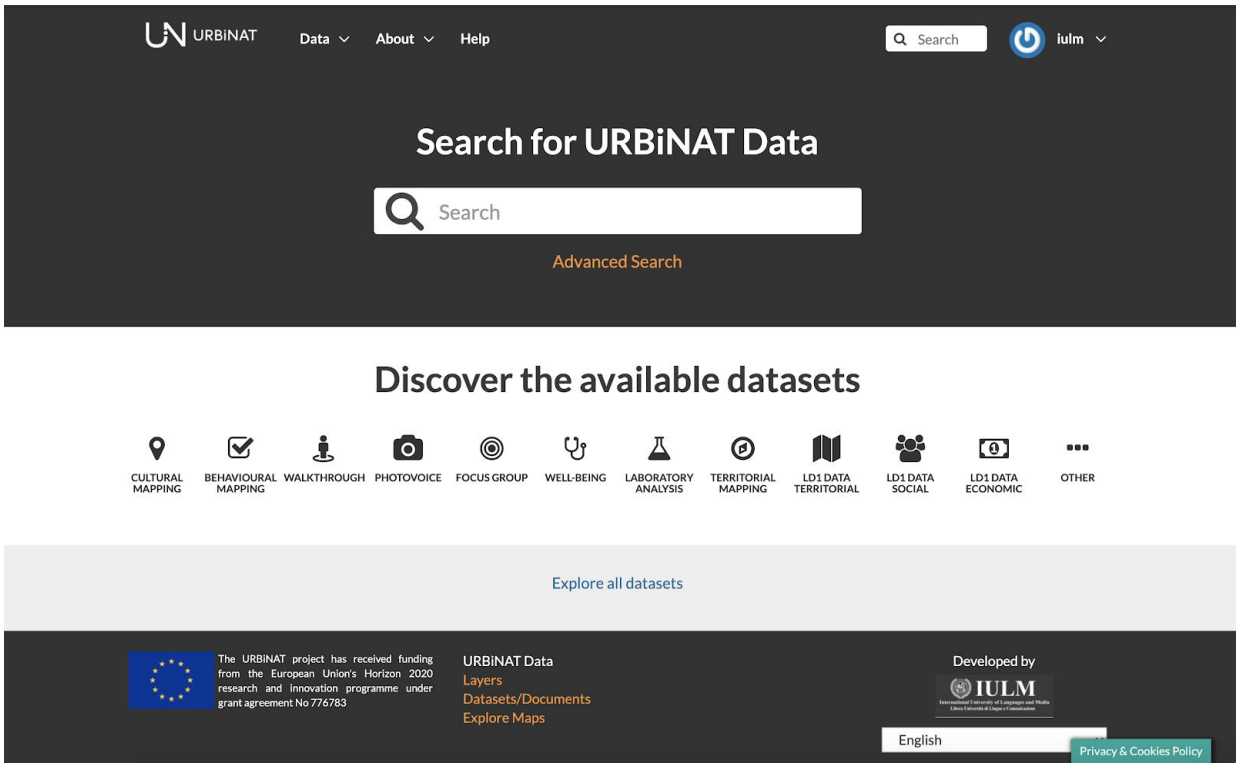

Figure 2-1: Homepage (Signed in)

2.2 Explore Map

To access maps stored in the Observatory use the quick-link Maps at bottom of the homepage, or Maps in the permanent link section.

Specific maps can be found by typing in the Search-field (e.g. a transportation subway) at the top of the homepage.

Following either of these methods to access maps, a list of results will appear (Figure 2-2) sorted according to when the data was shared (Most recent and Less recent) as well as alphabetically (A-Z and Z-A) or by order of importance (Most Popular and Relevance). The results can be filtered according to Categories, Date, and Keywords by using the left-side panel.

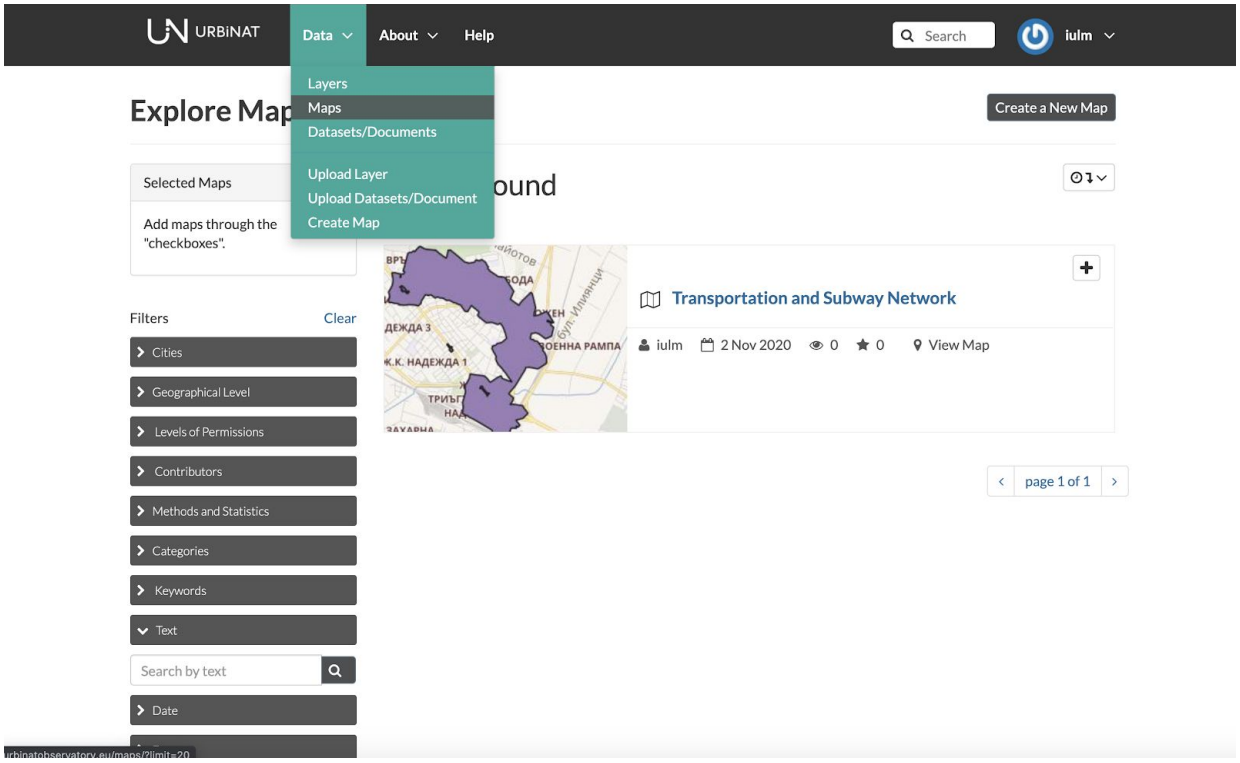

Figure 2-2: Explore maps interface with filters

2.2.1 Access Map Details

1. By clicking on the title user can visualize and access all detailed information about any map, enter the Map View interface (Figure 2-2).
2. It is then possible to pan the map by holding down the mouse button and moving the cursor, or by using the arrows and zoom tools on the left side of the map (Figure 2-3).
3. In the Map View interface, there is also a tab section below the map where you can view more info about the map such as all the metadata, Share the map through social media, use the Ratings and leave Comments.
4. On the right side of Map Layers, there is a list of the data layers used for composing the map (Figure 2-3).
5. At the top right of the page, use Download Map to extract all the data layers used for composing the map and save it on your computer

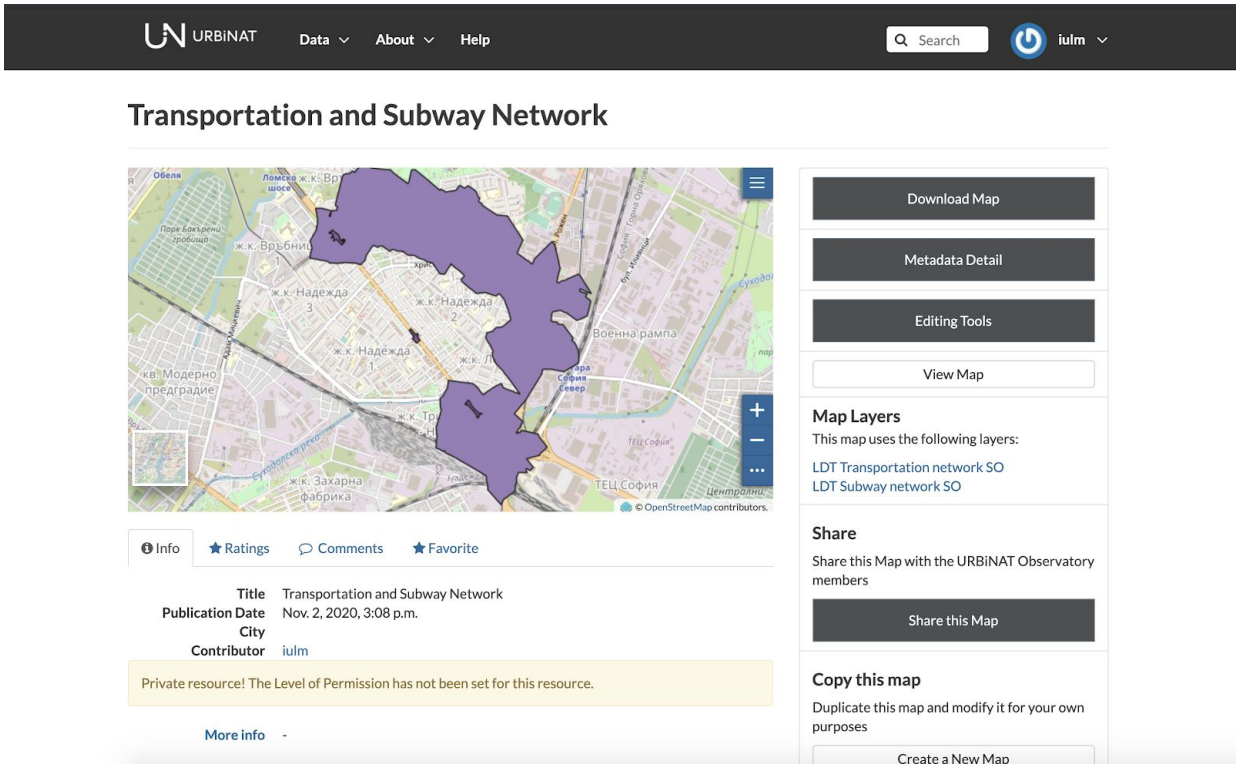

Figure 2-3: Maps details view with different functions

2.2.2 Map composer and tools for map management

1. By clicking View Map in the Map View interface a larger version of the map will appear in the Map Composer interface, as well as tools for changing the map and a list of layers used for that specific map (Figure 2-4 and Figure 2-9)

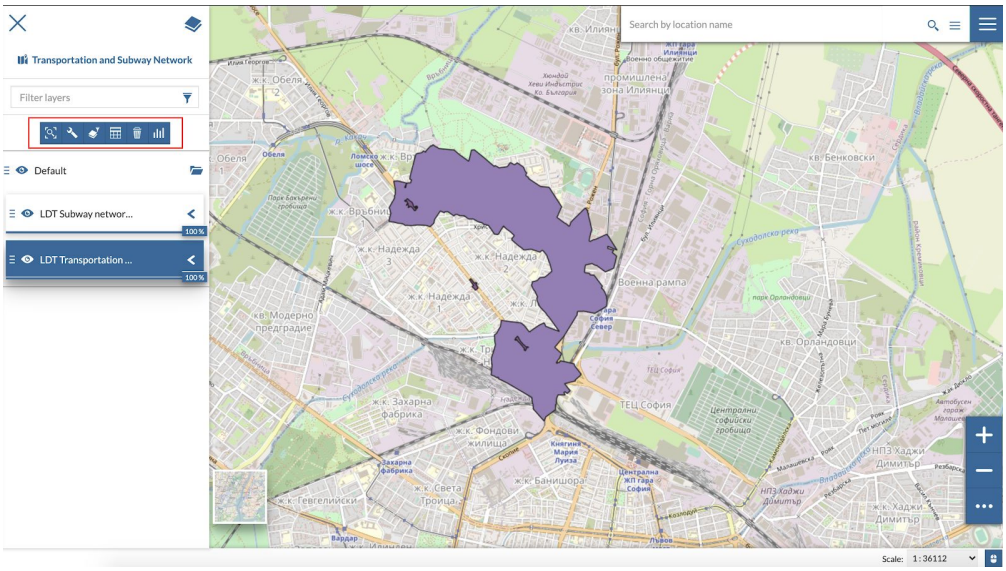

Figure 2-4: Map composer interface with map management tools

The toolbar on the up left of the screen in figure 2-4 (red rectangle) provides different functionalities such as real-time styling with SLD code and open up attributes(variables) table. Creating a widget is another functionality which makes maps more informative (Figure 2-5). Widgets could be in the formats of table, charts and text based on the variables of the layer.

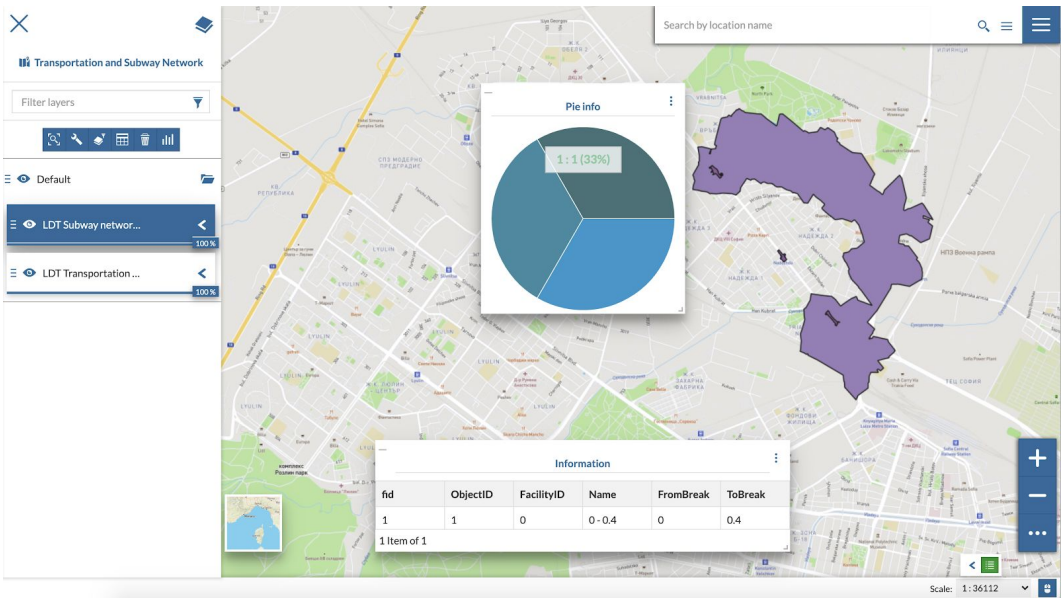

Figure 2-5: Widgets in map view

The widgets can be downloaded as an image or as a dataset in csv format. The toolbar just right bottom the map is used to easily navigate between different extents and scales

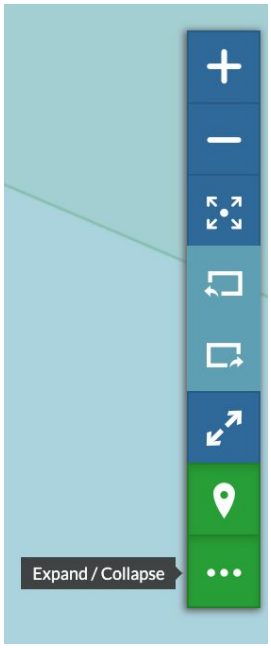

Figure 2-6: Toolbar for map navigation

The toolbar on the top-right side is used for editing and managing the map (Figure 2-7). Here you may:

A. Save or Publish the map on a website by using Map (only for registered users),
B. Print the map by saving it in pdf-file format,
C. Measure a specific length or area on the map, and

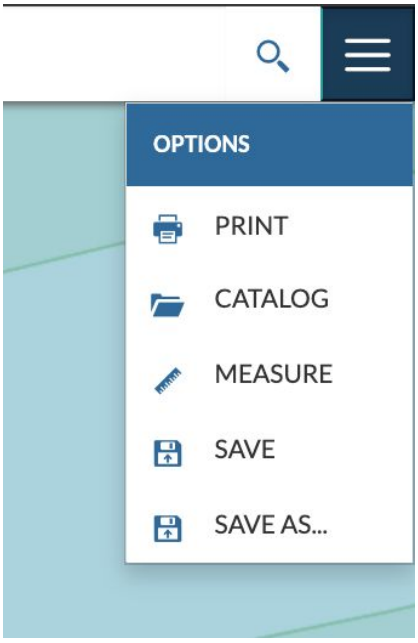

Figure 2-6: Toolbar for map editing

2. To measure the distance or area between specific points on a map use the Measure option and click on the first location. A pop-up window indicates the distance in meters, and additional distances can be measured by clicking on more locations. To calculate the final distance, double-click on the last location. In (Figure 2-7) the approximate length of a road between two warehouses has been measured and the distance in meters is visible.

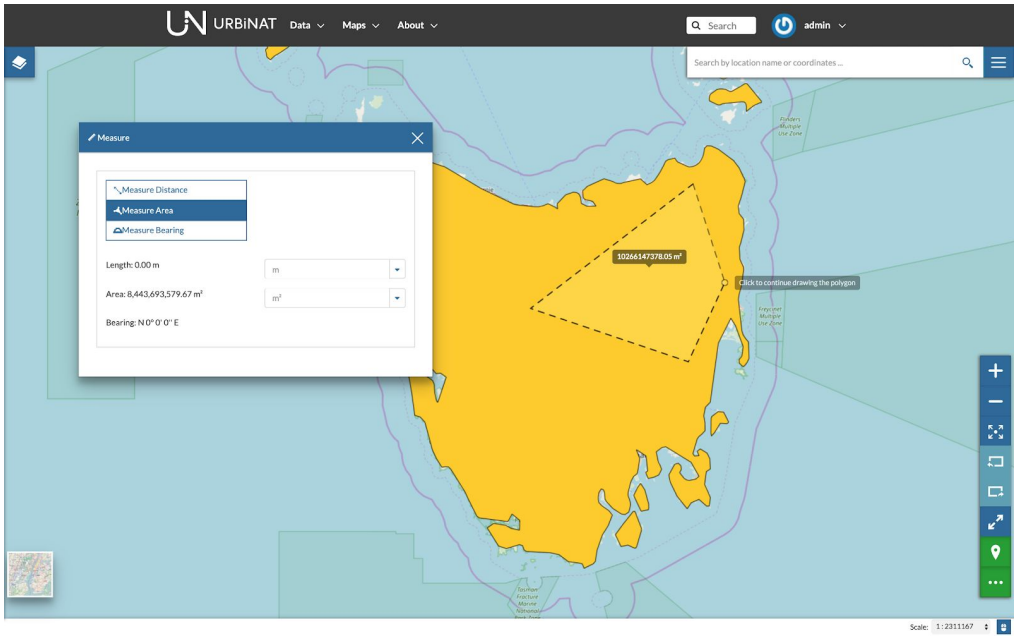

Figure 2-8: Measure area

3. You will find various pre-set Base Maps in the panel on the left side of the page (Figure 2-8), which can be altered depending on how you would like the base layer to be displayed.
4. The Overlays are the layers used for composing the map. By ticking the box on the left side of a layer title, you can turn it on, or off, in order to either display it, or hide it, on the map. The layers are displayed on the map according to their order in the panel list, where layers on top have visual precedence in ascending order. To change the display order of the layers, simply drag-and-drop them up or down. The toolbar symbols at the top allow you to Add or Remove Layers, and change Layer Properties. The Style palette symbol is only active if a user with the right permissions has signed in.

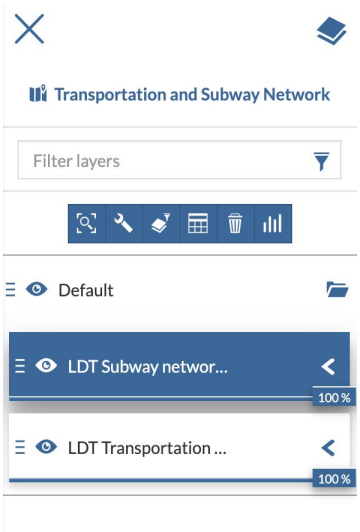

Figure 2-9: Layer selection and toolbar

With Layer Properties, it is possible to adjust and save the display of that layer in the Map Composer without actually changing the original style of the layer. This function is useful if e.g. you do not have permissions to save or edit a layer but still would like to modify the appearance of a layer for a specific map you are creating. To use Layer Properties select the layer and click on the wrench symbol in the toolbar. Under the tab About, you can provide a title for the display of the layer as well as a description. Under the Display tab user can modify the transparency of a layer by defining the Opacity percentage, as well as constrain certain aspects of the layer by using Limit with filters and Limit by scale.

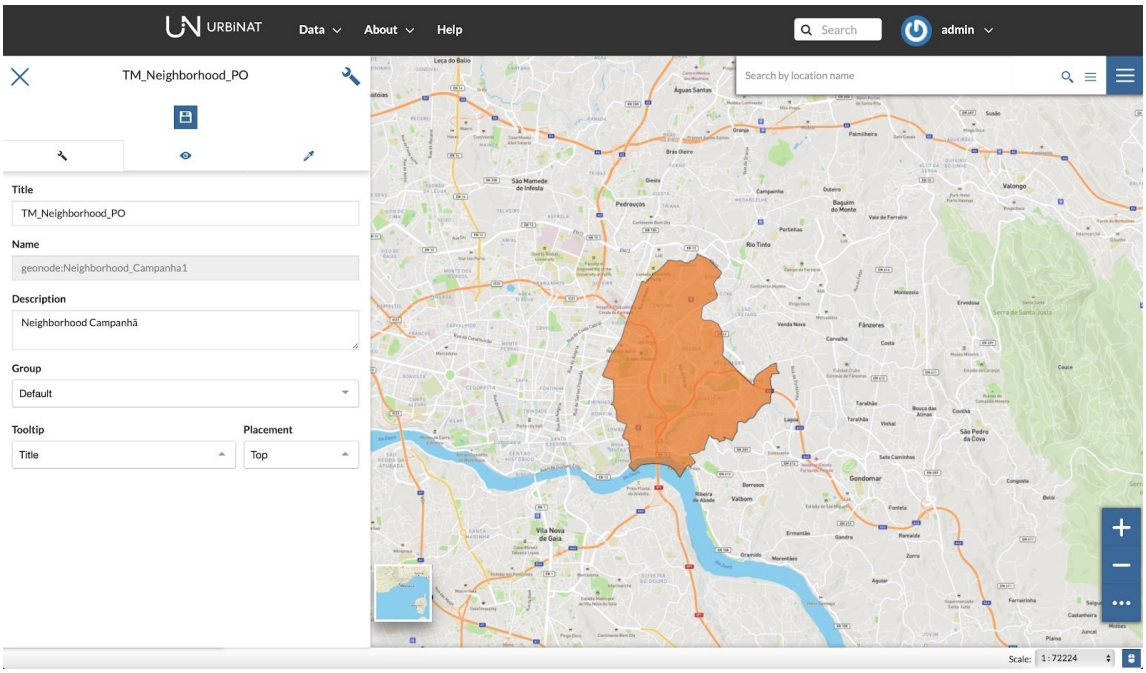

Figure 2-10: Layer properties

2.3. Explore Layers

To find the layers stored in the observatory you can use

1. Quick-link Layers at the Bottom of the homepage, or
2. Link Layer in the permanent tab section. It is also possible to Search for layers using the search-field.

2.3.1 Access Layers Details

Click on the title of the layer to visualize the layer and access more detailed information. The interface (Figure 2-10) is very similar to the map interface, including the navigation toolbar and information about the owner.

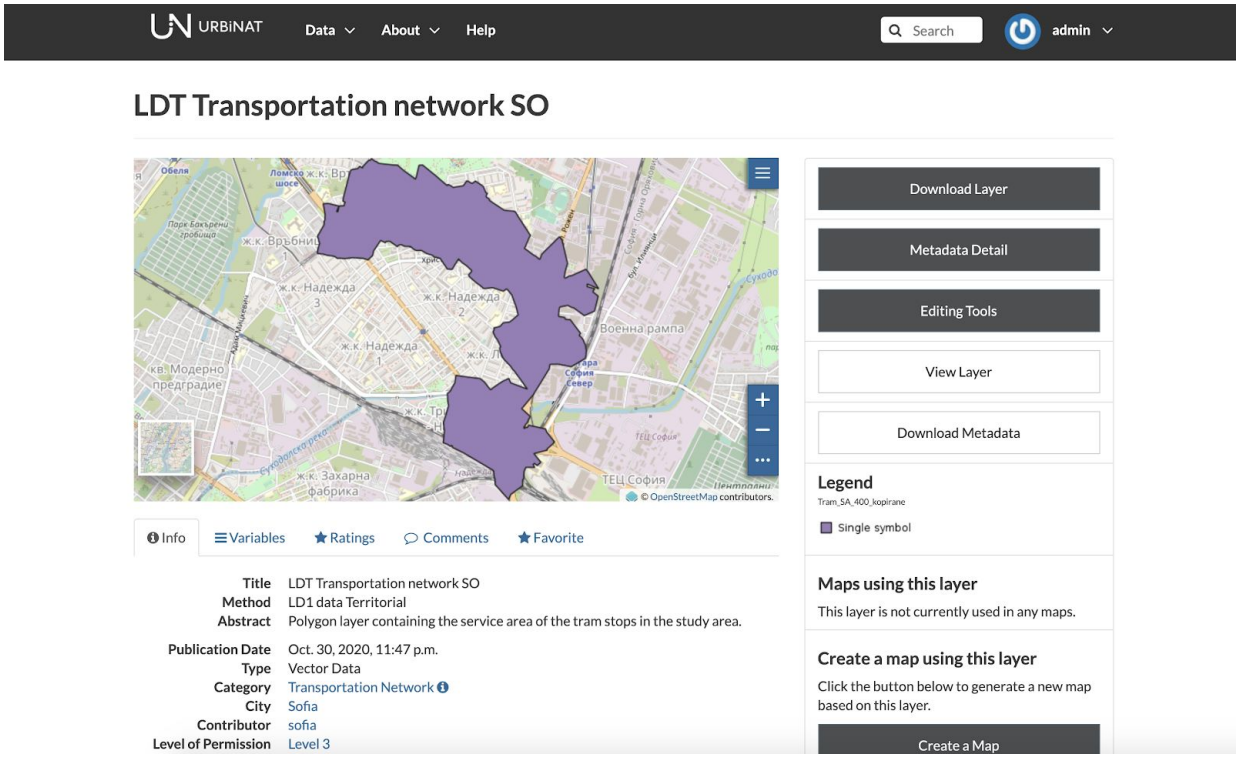

Figure 2-11: View layer

There is an additional tab in the tab section below the map for

A. All the Attributes associated with the layer. In addition, on the right side
B. The Legend is visible after a Style has been associated with the layer under the Maps using this Layer

It is possible to quickly navigate to the maps where the layer is being applied and by using Create a map the current layer will automatically appear in a map for continuous map creation. It is possible to extract the data of a vector layer in different file formats (KML, GeoJson, Excel, CSV or Zipped Shapefile) as well as the data of a raster layer (GeoTIFF, ArcGrid, KML, PNG or JPEG), by using the Orange button Download Layer at the top Center. This is useful in case you would like to send data, or need to use data offline with other GIS software such as QGIS or ArcGIS.

2.3.2 Create A Map Using Layer

URBINAT Platform allows you to easily create a map using layers already saved into the platform. You can choose between two simple procedures to create a map this way:

1. Find the layer you would like to use for the map either through a search or by clicking on Layers, and then use the blue button Create a map In (Figure 2.11) the layer containing

Bridge Details of Timor-Leste). Your chosen layer will automatically appear in a new map and as an overlay in the side panel.

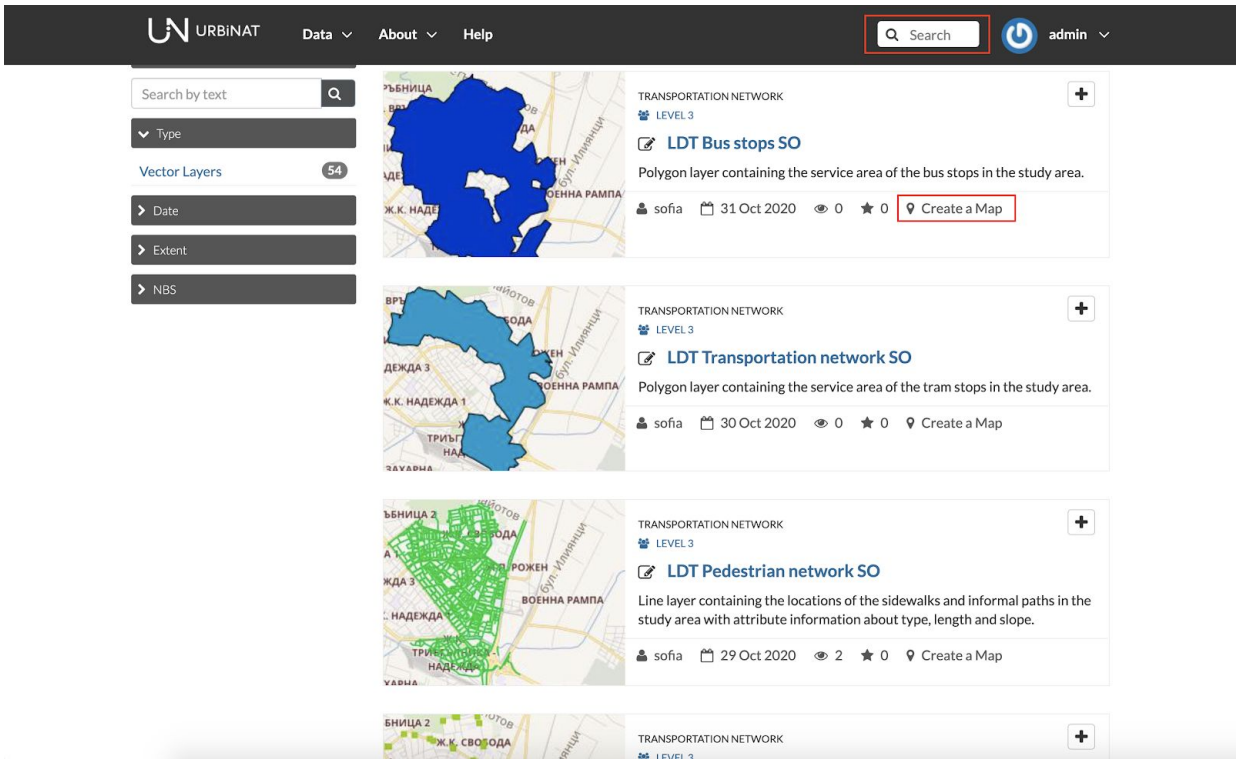

Figure 2-12: Create map by starting search

2. You can also use the permanent link Maps and click on the blue button Create a New Map. No layer will appear automatically, instead you have to choose a layer by clicking the button Add Layers -> Add layers (Figure 2-12). Ensure My GeoServer WMS is selected in the drop-down box at the top of the panel, then select your layers and click Add Layers at the bottom (Figure 2-13). When you have added all your selected layers click Done and your layer will appear in the map and as an overlay in the side panel.

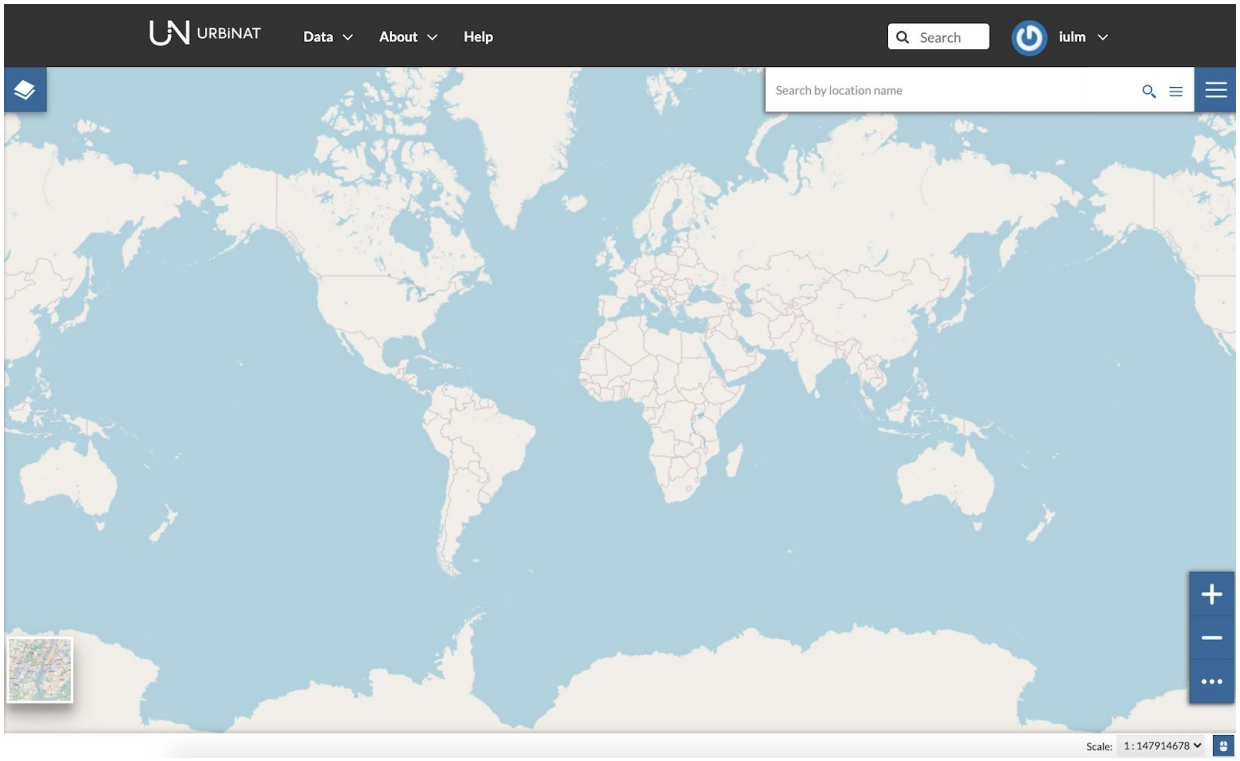

Figure 2-13: Add Layer

Figure 2-14: Select and add layers

In Figure 2-14, the layer of Tasmania state is visible. Another layer displaying the location of water bodies of Tasmania has been added using the Add Layer function. This map is not saved yet, and unless you sign in with a user account you will not be able to save it on Observatory.

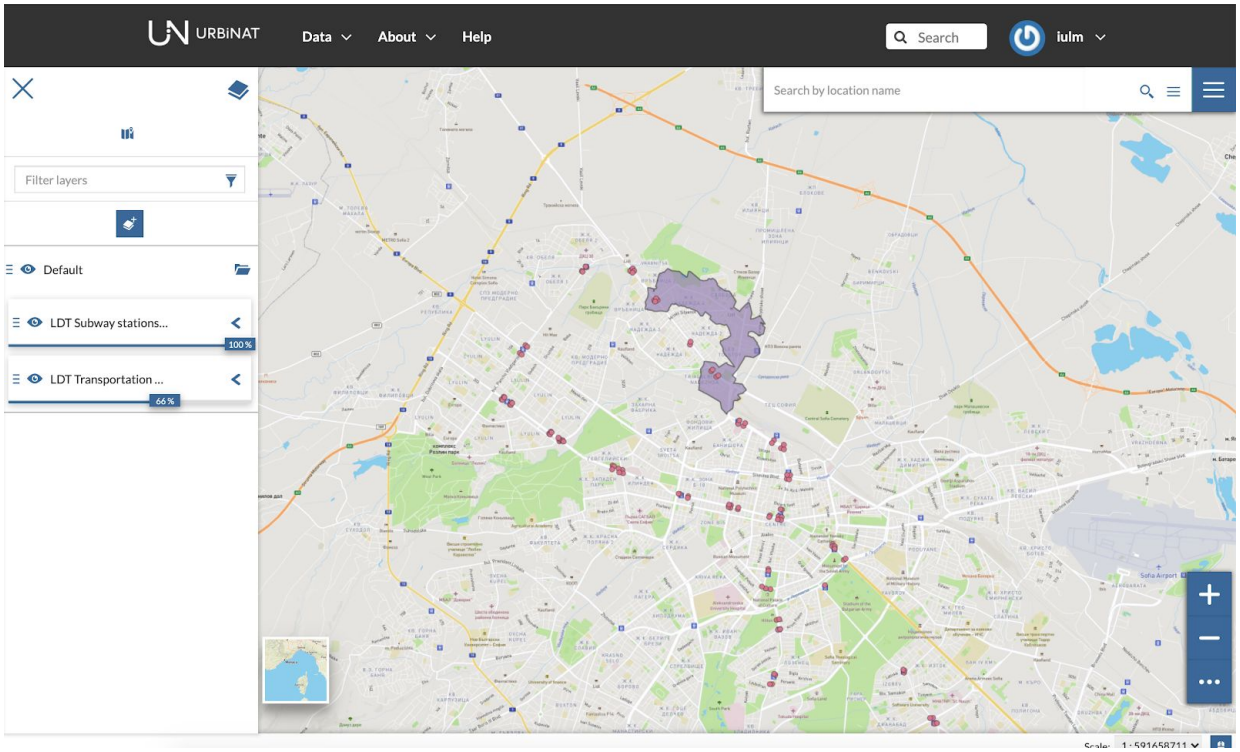

Figure 2-15: Modified unsaved map

2.4 Explore Documents

The observatory allows users to upload documents and link these to existing layers or maps in order to enrich the resources by adding additional relevant information. The permanent link Documents takes you to explore Documents interface where all existing documents in the system can be found. An example of a document can be a spreadsheet which explains the variables and attributes of a layer.

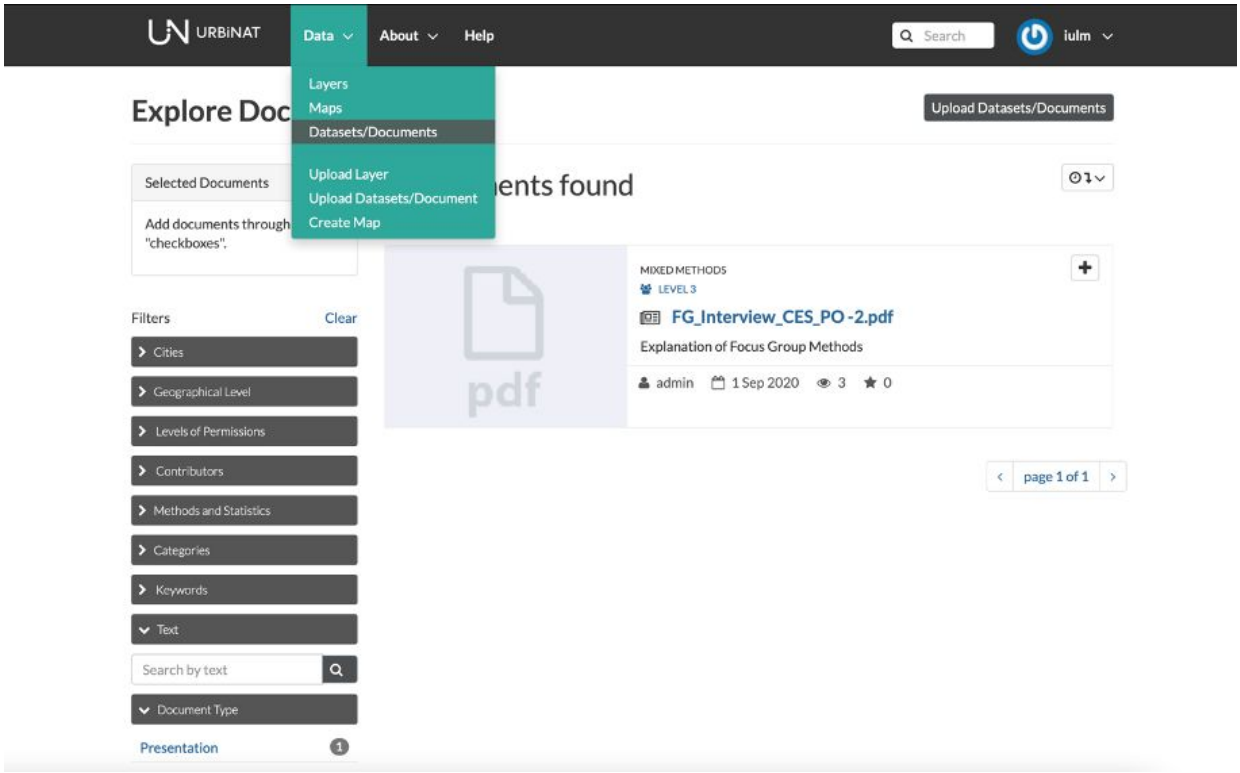

Figure 2-16: Explore documents interface

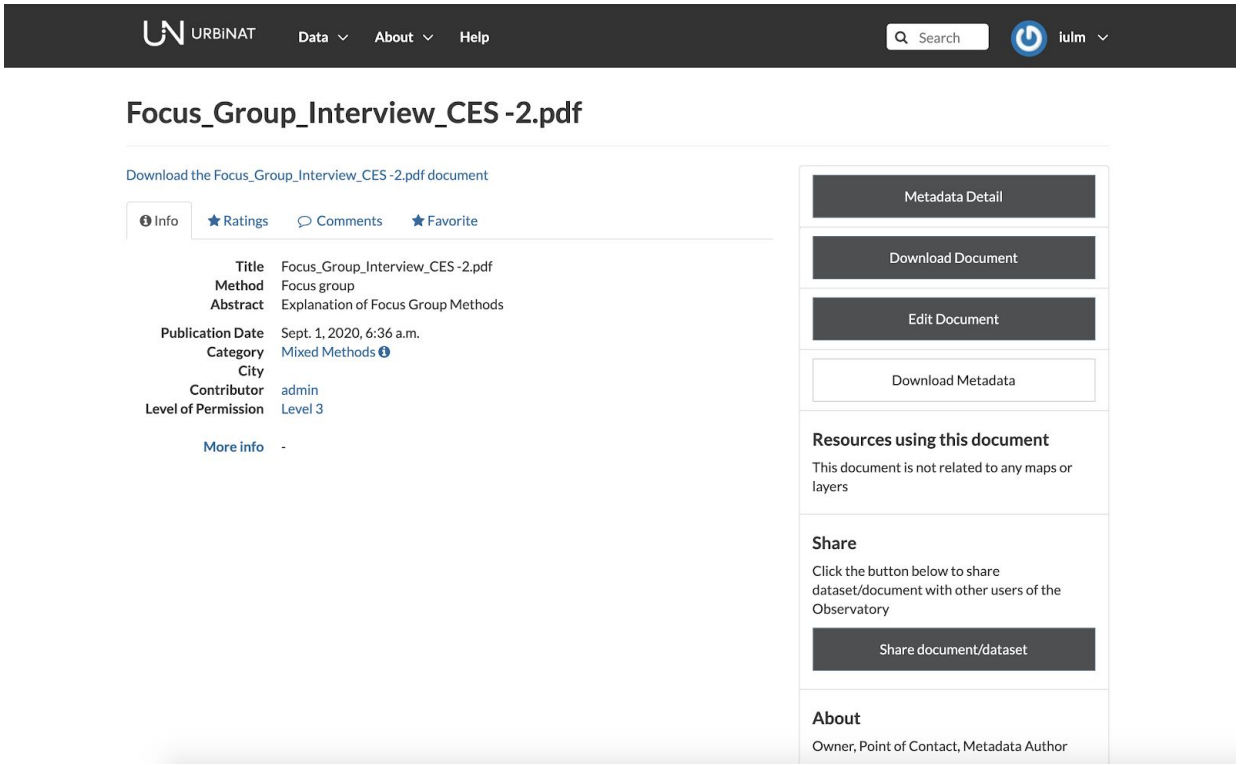

Figure 2-17: View document and find linked layers/maps

2.5 Sign in and edit profile

Users can log in to URBINAT Platform with the received credential by using Sign in in the top-right corner on the homepage

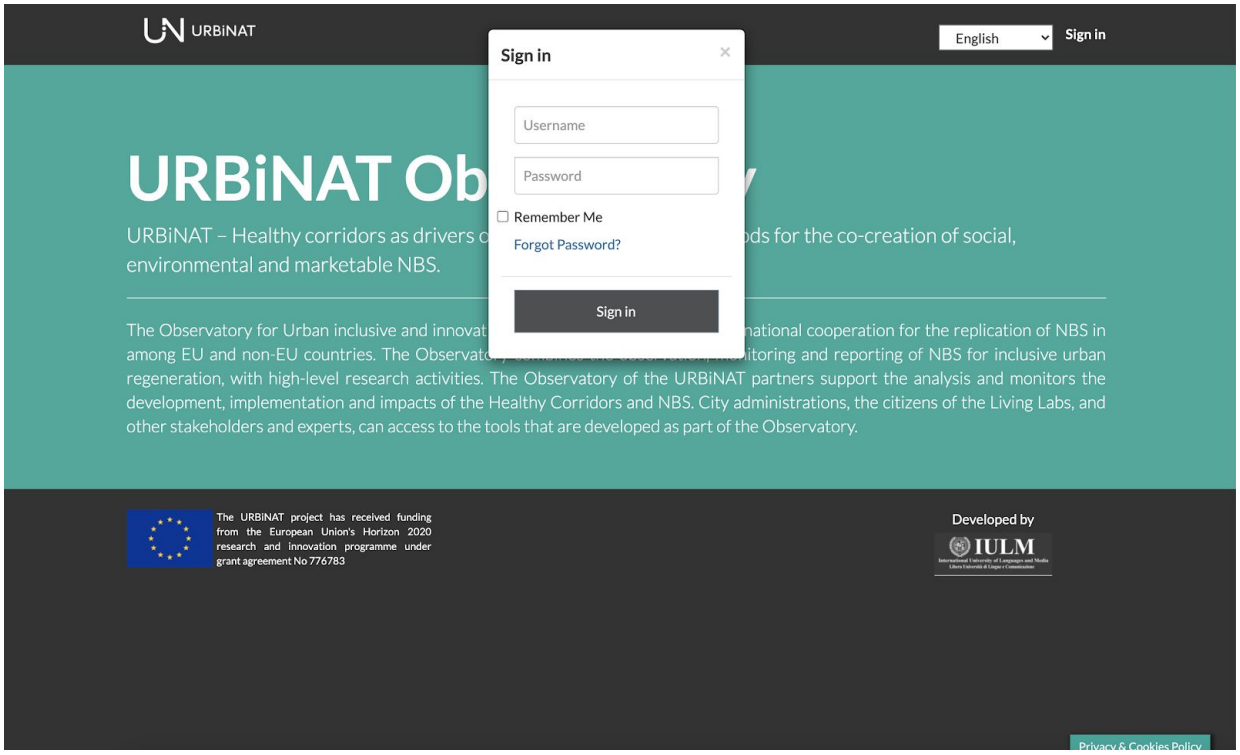

Figure 3-1: Sign in drop-down box

Once you are signed in, you can access your profile by clicking on your name in the top-right corner and using Profile in Figure 3-2

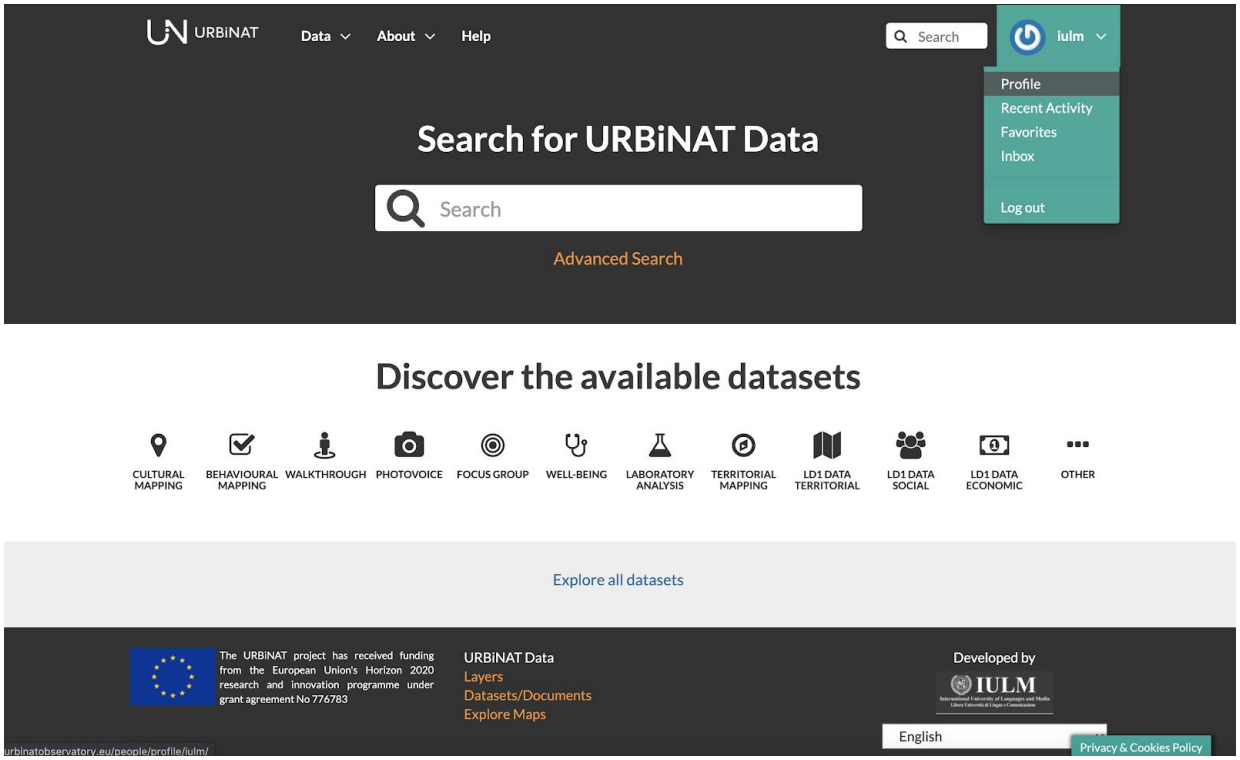

Figure 3-2: Profile editing

In the profile interface you can view detailed information about your user account, as well as Edit Profile Information, manage Account Settings and Change Password. All layers/ maps/ documents that have been uploaded and created by the specific user are visible in the content list under Resources. Use Edit Profile Information to manage information on e.g. your organization, location, job description and contact details, and to upload your picture in figure 3-3.

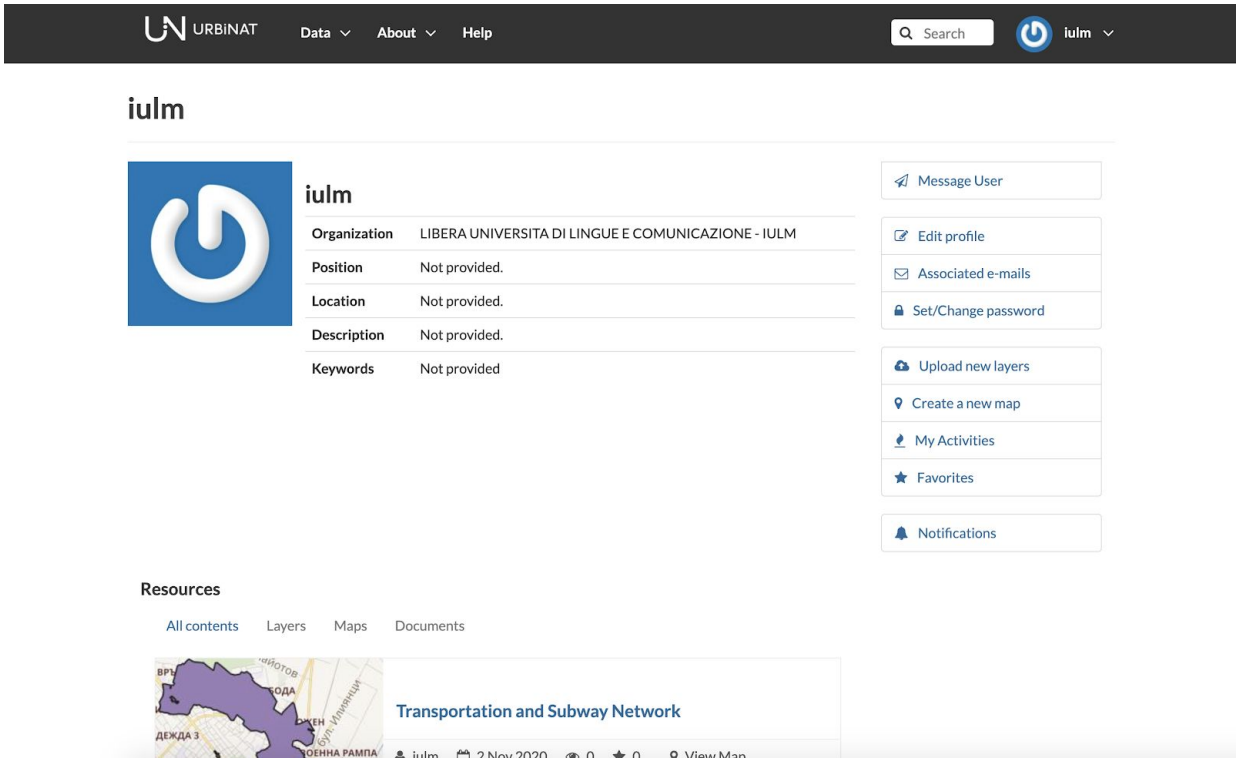

Figure 3-3: Edit profile information

Furthermore, there are more functions on the right side of the interface (Figure 3-3), such as changing password and sending messages to the other users of the platform. The Favorites option is a way for the user to bookmark the resources.

3. Permissions

Permissions determine who can view, download, edit and manage layers, maps and documents. It is important to understand the differences between these settings since neglecting specifying permissions can result in giving unintentional access to layers/maps.

3.1 Seven levels of permission

Seven different levels of access and permission is applied to use a preferred choice of access rights along with conditions of sharing, and protecting data privacy.

The platform will give authorized users the permission to use data. However, there will be seven different levels of permission which will restrict the access to certain data information in order to protect and secure classified and sensitive data. Some users will be able to edit and share data, whereas others will only be authorized to view certain information that is needed for work related purposes.

Level 1: Data is only visible and accessible to the person who has uploaded the data.

Level 2: Only partner cities of URBiNAT (front-runner, follower and observer cities) who produce content and/or need to use and exchange data between municipalities can access data.

Level 3: Only project partners who produce data and/or need the data for treating and creating results are allowed to access data

Level 4: Users who are not involved in URBiNAT activities, but produce relevant content and non URBiNAT users that are invited to join the platform and need to access some data for project activities, are able to view data.

Level 5: Data is open for non-partners of URBiNAT (i.e. sister projects) and experts (i.e. members of the Scientific committee) to ask questions, sharing ideas, and evaluation.

Level 6: Enables URBiNAT partners to use the UBRINAT website to publish specific content for the public. The owners of files can provide temporary access to specific residents.

Level 7: Data is open for the public through open-access permission, e.g. OPPLA, sister project platforms.

To ensure correct permissions are selected, adjust them before uploading new layers, creating maps or uploading documents (Figure 4-1). You can change these settings later in the Layer View, Map View and Document View interfaces, by using the Edit Layer/Edit Map/Edit Document form.
The level of permission is set to level 3 by default.

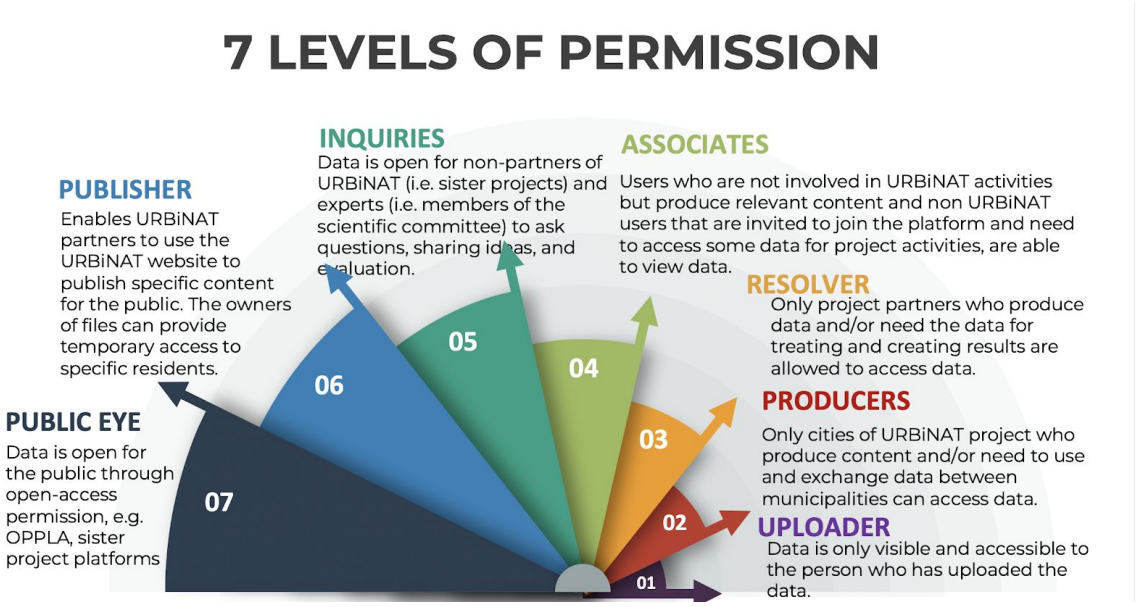

Figure 4-1: Seven level of permission and accessibility

3.2 Exclusive Sharing

In every resource details page, there is a button for managing permission in an exclusive manner by which one resource can be shared among partners beyond the seven levels limitations, ie: a user from level two shared a resource with a user from level 5.

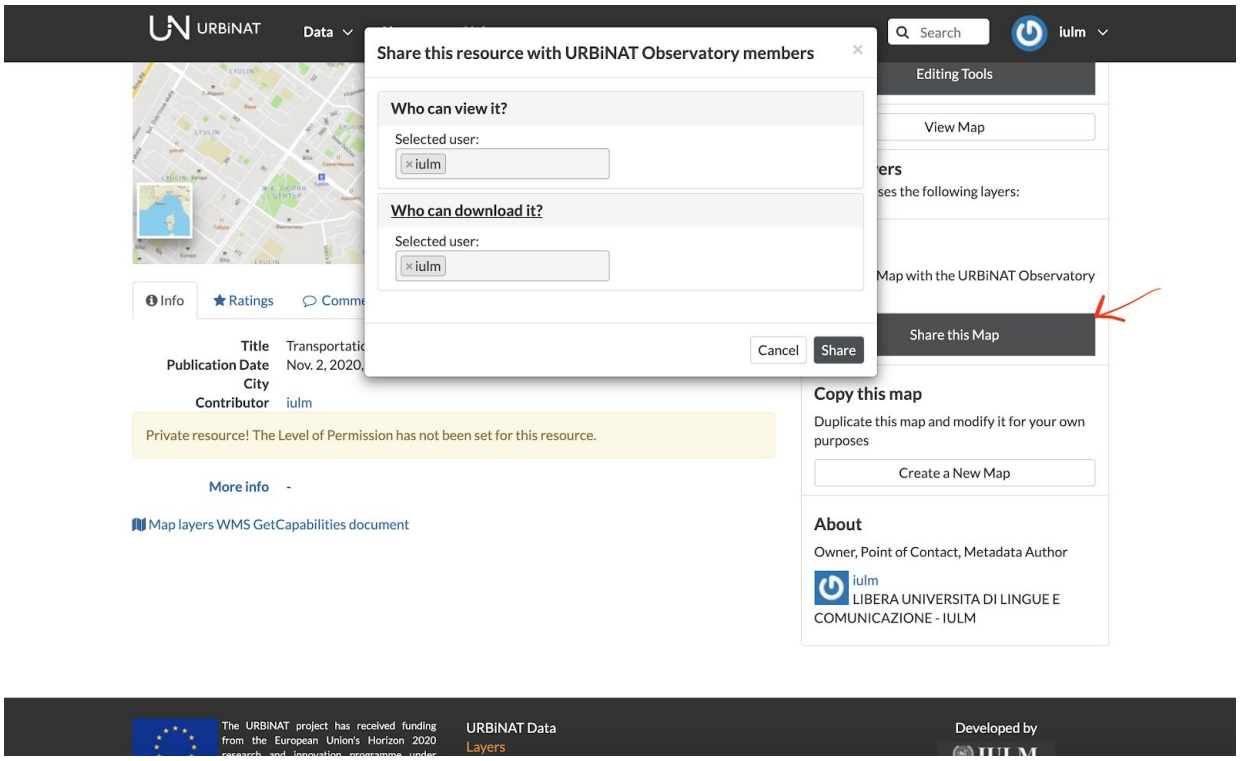

Figure 4-2: Exclusive sharing interface

4. Upload Layers and Documents

4.1 Upload Layers

Geofiles such as shapefiles are uploaded to create vector layers that can be shared or used to create maps.

First, click on Layer button on the homepage, then by clicking Blue color Upload Layers button Figure 1:

Upload layer interface to select the date you would like to upload, simply

1. Drag-and-drop your files onto the gray area or
2. Browse and select the files from your file system.

The files will appear below the drag-and-drop area, and the system will automatically specify the file format as Shapefiles or GeoTIFF (Figure 1). In case a required file is missing (for shapefiles) you will be requested to add the file before you can proceed to upload.

On the Explore Layers interface by using Upload Layers, users can upload the Layer by clicking on *Upload Files* the process of uploading the files will start and as soon as it is done a message will appear whether the upload was successful or an error has occurred.

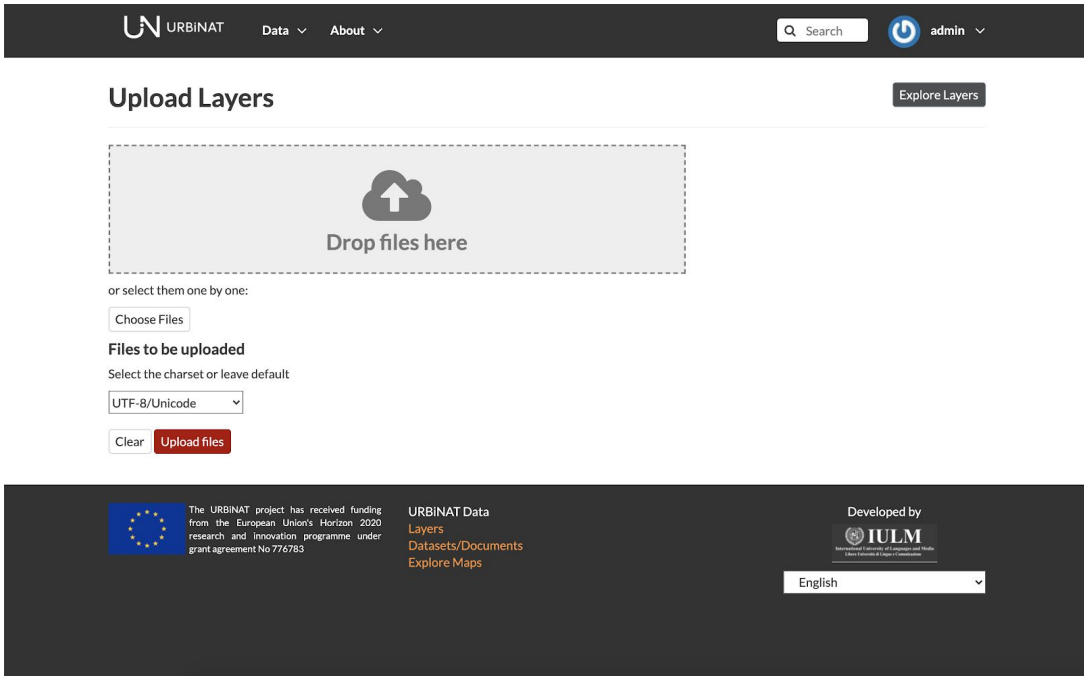

Figure 4-1: Upload layer interface

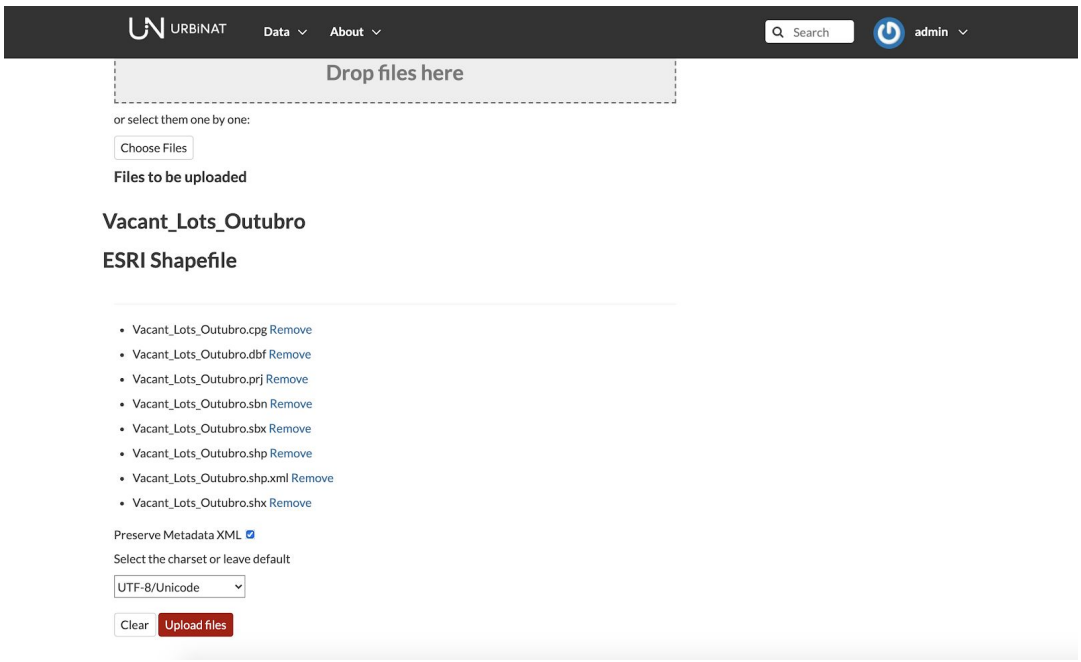

Figure 4- 2: Upload in progress

After a successful upload, three options on how to continue managing the data will appear (Figure 4-3):

Edit Metadata
Takes you to an interface where detailed information on the layer should be provided. In the section below, this function will be explained in more detail.

Figure 4-3: After successful upload

By providing additional information about the layer after it has been uploaded, you are able to specify the data and make the layer more accessible to other partners.
Providing metadata thereby helps contextualize layers and aims to increase the overall user experience of the URBINAT Platform community.
After a layer has been uploaded, or if you are in the Layer View interface, you can use Edit Metadata to start providing more information about your layer. Some fields are automatically filled in, but most are left empty for you to provide information (Figure 4)

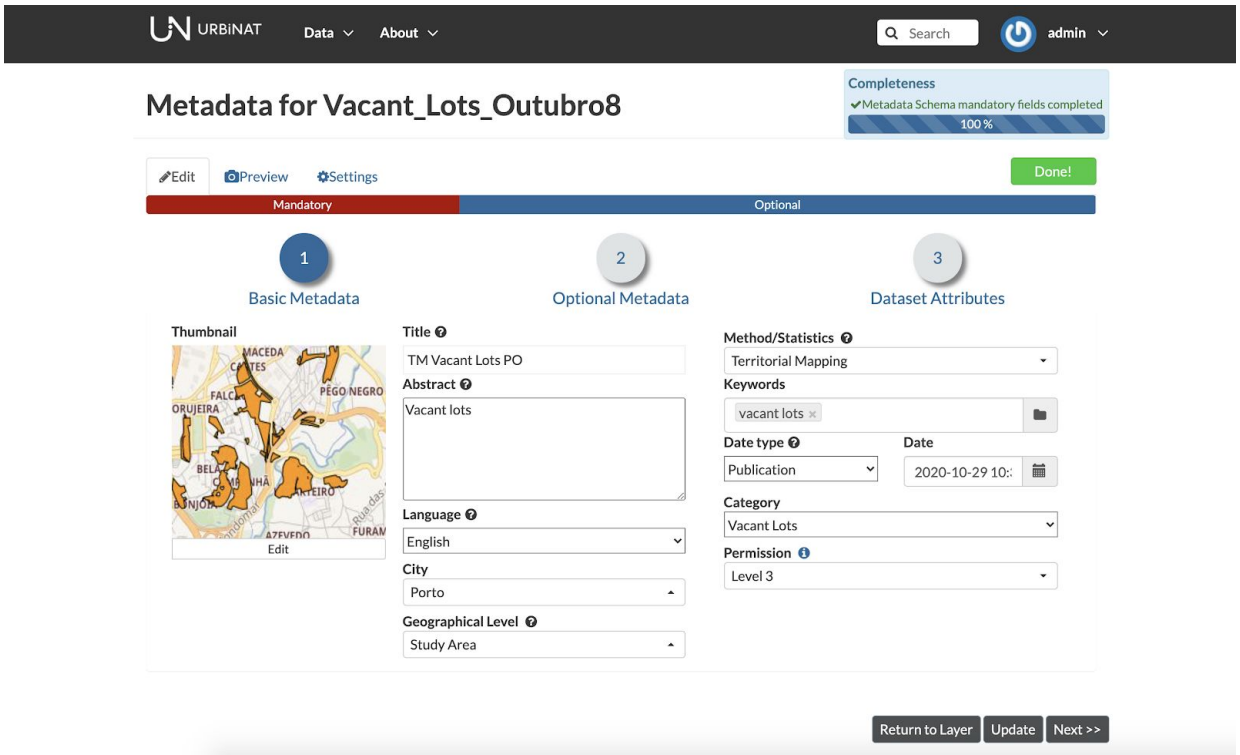

Figure 4-4: Metadata interface (Layer) - Information to be provided

Below are a few comments on different types of metadata that will greatly enhance the quality of your layer and help contextualize it for other users:

- Title: Provide an explanatory name for your layer. The name should follow the standard of naming which is concatenation of the "abbreviation of the LD method", "one of the most important keywords that you are using for presenting the content of the file" and "the name of city (abbreviation)". *For instance: TM Vacant Lots Porto*

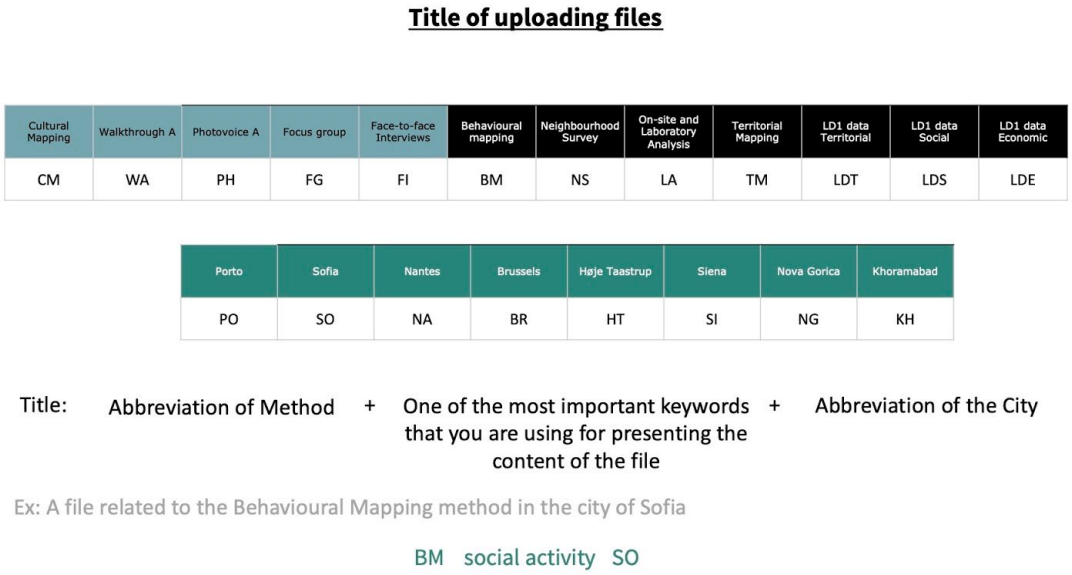

Figure 4-5: The standard of naming

- Abstract: Provide a brief description for the resource. This text will appear together with your layer e.g. in the search results.
- City and geographical level: Select the city and geographical level of the file presenting.
- Methods/statistics: Select the local diagnostic methods that the file has been produced with.
- Keywords: Specify keywords for your layer with the predefined set of keywords.
- Category: Specify the category for your layer with the predefined set of keywords
- Level: Assign a level of permission to the file from 7 levels of accessibility.

- Level 1: Data is only visible and accessible to the person who has uploaded the data.
- Level 2: Only partner cities of URBiNAT (front-runner, follower and observer cities) who produce content and/or need to use and exchange data between municipalities can access data.
- Level 3 (Default): Only project partners who produce data and/or need the data for treating and creating results are allowed to access data
- Level 4: Users who are not involved in URBiNAT activities, but produce relevant content and non URBiNAT users that are invited to join the platform and need to access some data for project activities, are able to view data.
- Level 5: Data is open for non-partners of URBiNAT (i.e. sister projects) and experts (i.e. members of the scientific committee) to ask questions, sharing ideas, and evaluation.
- Level 6: Enables URBiNAT partners to use the UBRINAT website to publish specific content for the public. The owners of files can provide temporary access to specific residents.
- Level 7: Data is open for the public through open-access permission, e.g. OPPLA, sister project platforms.

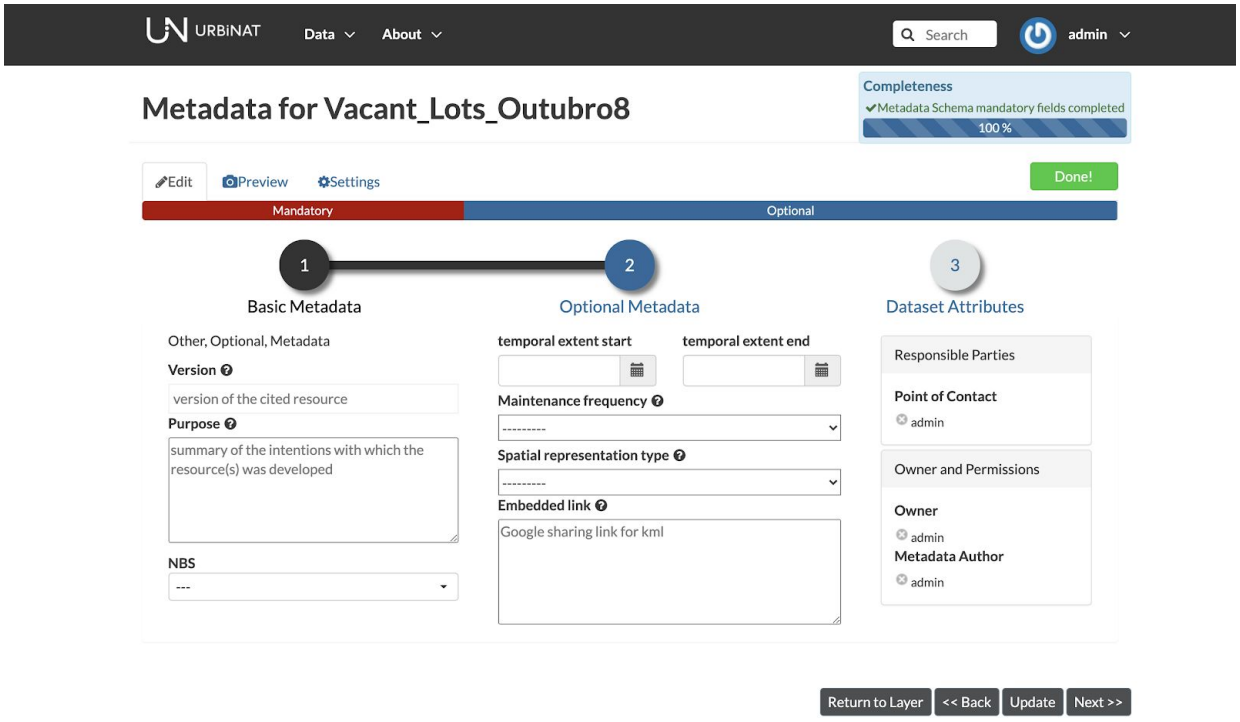

Figure 4-6: Metadata interface (Layer) - Optional information

- Attributes: Provide further descriptions of all the attribute short names or change the display order of the attributes.
- Click Update at the bottom to save and enter the Layer View interface.

4.2 Upload Dataset/Documents

In the Observatory platform, it is possible to upload documents and dataset (without coordination) related to a particular layer or any general document to the platform.

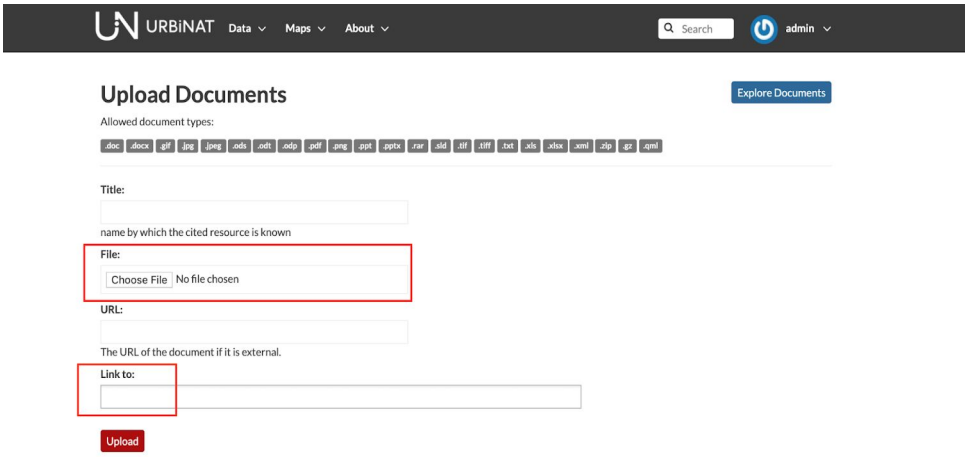

Figure 4-7: Upload document interface

4.3 Link Documents to a Layer or Map

In the Observatory platform at upload time users can link the Document to the related Layer or map (Figure 4-8) or it can be linked just right after uploading in the metadata information editing form.

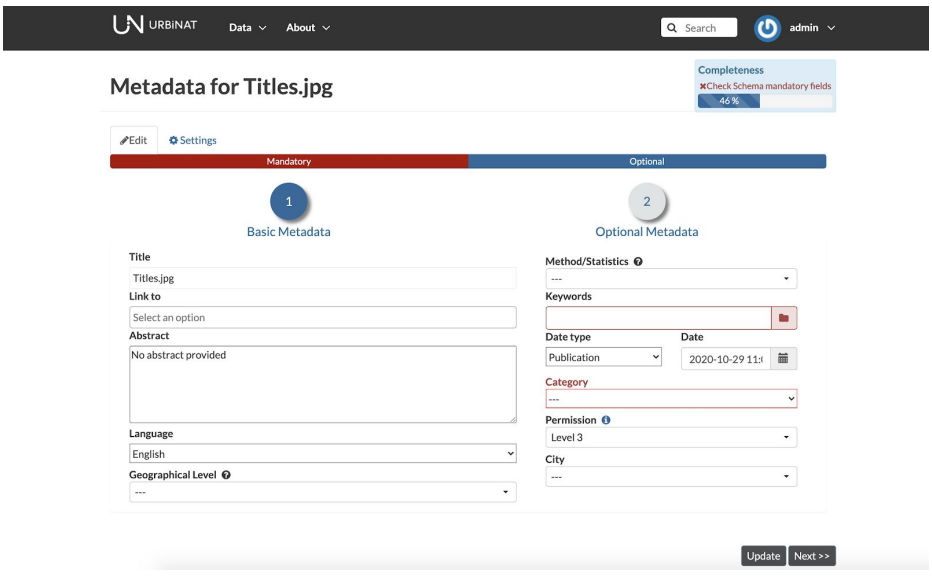

Figure 4-8: Metadata interface (Document)