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D1.4.1
5 Action Plans for Open Data and IoT usage for territorial governance in project Pilot Areas

Version 1.0

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A. Foreword

The Deliverable 1.4.1 of the Project EnCLOD marks and important milestone in the development of its workplan: starting from a survey of the international best practices in the usage of Open Data (D1.1.1) and an analysis of the actual state-of-the-art in the pilot territories (D1.2.1), the project Partners devised a set of guidelines to advance the use of Open Data for public governance (D1.3.1). Within this deliverable, they are **identifying the strategic measures for achieving a significant impact in the Pilot Areas.**

The document collects **5 Local Action Plans (LAPs)** designed by the Partners for advancement of the usage of Open Data in **such action fields as traffic control and environmental monitoring, road management and adaptation to climate changes**. Each one contains a summary of the information elaborated in the previous activities which are then turned into a set of local and regional actions for the enhancement and improvement of territorial governance through the use of Open Data.

The last chapter of each Local Action Plan outlining the actions designed to unlock the potential of the Pilot Areas in utilizing Open Data: **both medium-term measures, implemented during the project duration, and long-term purposes, which represents fundamental prompts to trigger a step forward in the use of IT tools**. These strategic proposals will go through a path of negotiation with the public authorities and through the involvement of local communities, that Project EnCLOD will launch and support, to find application in the pilot territories and achieve the lasting impact on their territorial governance.

B. Local Action Plan of the Province of Vicenza

Introduction

Data are a fundamental resource in our digital age, an essential material for territorial governance, innovation and economic growth. Open Data are made freely available to the public, without restrictive licenses: they represent an opportunity for territorial governance as they allow informed decision-making by the public authorities, awareness raising and involvement of the community, innovation among the actors of the economic system. The Local Action Plan for the Province of Vicenza developed by the Project EnCLOD describes a path to increase and advance the use of Open Data in this territory, with the aim of supporting territorial governance by public administrations and have a positive impact on everyday organisation in such fields as road management and environmental monitoring, traffic control and adaptation to climate change.

The Local Action Plan was born from an analysis of the actual state-of-the-art of Open Data in the Province of Vicenza, considering both the strengths and weaknesses of this territory, that in the last decades had opened increasingly to innovation and digital administration. Furthermore, the best examples in the use of Open Data for territorial governance have been examined throughout Europe and beyond, from Spain to Check Republic, from Great Britain to France. A set of guidelines were defined and shared between the international partners of EnCLOD Project, to identify common goals to achieve and open the way to concrete measures.

The result is a Plan collecting a set of actions able to improve the quality and accessibility of Open Data in the Province of Vicenza both for the decision-makers and for the population, to further empower them in dealing with the critical choices that our challenging period presents. Some of the actions proposed by the Plan will be pilot tested during the ENCLOD project lifespan. Other actions included in the document are long-term purposes that need negotiation with the authorities and involvement of the community to find an application. All in all, the Local Action Plan is a comprehensive proposal to improve territorial governance through an advanced use of the Open Data, to make us all more aware in the decisions that every day we take.

Overview of Open Data in the Province of Vicenza

1. Institutional framework of Open Data

The diffusion of Open data in the territory of the Province of Vicenza was driven between 2005 and 2015 by the legislation approved first at national and then at regional level: the "Code of the digital administration" approved by the Italian Government in 2005 and the "Regulations on pluralism of information" approved by the Regional Government in 2008. These regulations came to have an important impact on the availability of Open Data in the Province of Vicenza: they concretely promoted the diffusion of digital format for data of public authorities and their open publication online (which was before very limited). Many municipalities have since started to digitalize their documents and to publish yearly open datasets online. The Province of Vicenza itself started to provide data to the public through its "Geoportal", which makes available geographic data concerning territorial planning and environmental monitoring projects.

Nonetheless, the available Open Data in the majority of cases are only static and updated yearly, therefore not suitable for usage in territorial monitoring and by the private sector. The use of dynamic Open Data focuses particularly on weather stations and environmental monitoring, for other aspects the use of Open Data and IoT represents still a new way of thinking.

2. Open Data providers and tools

The main Open Data providers for the provincial territory of Vicenza are the Regional Government of Veneto (Regione Veneto), the Regional Environmental Agency of Veneto (ARPAV), an important provider is also the Province of Vicenza itself.

The most comprehensive tool for the collection and consultation of data is the web portal "Open Data Veneto", established in 2011 by Veneto Region, which gathers and makes available the data from many public authorities (see dati.veneto.it). This portal collects currently 1.589 datasets for the territory of the Province of Vicenza: the data comes mainly from 67 municipalities and from the Regional government. The quality of data varies, from high-resolution to low-resolution or even quantitative ones from municipalities. The data from the Regional Environmental Agency can be found on their web portal and geoportal (www.arpa.veneto.it; gaia.arpa.veneto.it), including dynamic high-quality data from the weather and water stations. Finally, the data from the Province of Vicenza are made publicly available on their geoportal (geoportale.provincia.vicenza.it), which provides geographical data concerning particularly territorial planning, along with environmental monitoring from specific projects. The data on the geoportal are static and date back to the period from 2010 to 2022.

While the open data culture has been developing in the Province of Vicenza during the last 10 years, the cooperation among different providers at national, regional and local level is still a challenge, with the lack of a strategy to share and integrate Open Data from different sources.

3. Open Data use cases

While the Open Data for the territory of Vicenza provided by public authorities are quite numerous, the number of use cases of OD for this territory is still limited. From 2010 to 2022 only a limited number of experiences carried out by European projects and hackathons have put the available Open Data to use.

The Regional Government of Veneto (Regione Veneto) took part in a series of European cooperation projects that supported the diffusion of Open Data. The European project "Homer" promoted trans-national interoperability of Open Data in the Mediterranean basin (2011-2014); Project "Odeon" supported the empowerment of SMEs through the use of the available Open Data (2018-2020); project "DEAS" aimed at exploiting Open Data in the fields of environment and tourism (2019-2022). The support to Open Data is nowadays still supported by public authorities through the participation to European cooperation: projects OD4GROWTH and SATDISFACTION, beside Project EnCLOD, allows the Regional Government and the Province of Vicenza to support Open Data advancement.

Another interesting activity to support the diffusion of Open Data is the organization of annual hackathons that took place from 2018 to 2022 by the Digital Innovation Hub of Vicenza (digitalinnovationhubvicenza.it/hackathons). In 2018 was held a "NASA Space App Challenge" (with 200 participants), in 2020 a "Copernicus Hackathon", while in 2021 and 2022 the "VI Challenge Hackathons" established an example for Open data use to involve the IT community. All these hackathons were organized in collaboration with the Vicenza University Foundation, which provided the location and the prizes. These activities point out potential actors for the development of future activities to promote Open Data.

4. Open Data maturity assessment

From the beginning of 2000s an increasing diffusion of Open Data coming from public authorities can be recorded in the Province of Vicenza, as in the whole Venetian Region, regarding topics as environment, transports and urban planning, after the national and regional legislation started promoting their diffusion. Nowadays a good amount of data are available through the regional Open Data portal and through the website of the Environmental Agency, while the Province of Vicenza and the municipalities are further important sources. Nonetheless the quality for the open datasets varies greatly, from dynamic and high-quality data regarding environment to low quality for other topics as traffic and waste disposal.

Furthermore, even if the number of available Open Datasets is significant, their usage in the Province of Vicenza is still occasional, both by the research institutions and by the companies of the private sector, due both to the lack of visibility of Open Data for the regional audience and to the lack of IT tools that allow an easy access to the data, appealing the citizens to approach the available information.

Open Data emerges therefore at the moment as a significant potential for the Province of Vicenza, but to increase the diffusion of their use, both for territorial governance and for the private sector, increased activities for communication and knowledge transfer about Open Data are required, along with the development of tools for an easier access, able to make them increasingly a commodity for the citizens.

Dimension	**Initial**	**Emerging**	**Established**	**Leading**
Data Availability	Limited	Moderate	Broad	Comprehensive
Data Quality	Low	Moderate	High	Excellent
Data Use	Minimal	Growing	Active	Highly Active
Governance	Informal	Initial	Formal	Advanced
Impact	Low	Some	Clear	Significant

Orienting the Open Data in the Province of Vicenza

Developing a strategic orientation for Open Data in the pilot area requires aligning its application with local priorities and challenges, as identified in **Activities 1.1 and 1.2**. The strategy focuses on establishing a robust framework to guide data use in support of urban governance and sustainability goals.

1. **Strategic Objectives**
    - **Enhancing Decision-Making:** Use Open Data to inform policies in key areas, such as traffic management, environmental monitoring, and urban planning.
    - **Promoting Transparency:** Ensure that datasets are accessible, fostering trust among citizens and stakeholders.
    - **Enabling Innovation:** Encourage public and private sector innovation through the availability of high-quality, interoperable datasets.

Strategic objectives in the Province of Vicenza:

a) Develop IT tools for the use of Open Data, both existing and specifically acquired, **in the sectors of weather/environmental monitoring, mobility management, territorial planning**.

b) Involve stakeholders, both public bodies and private companies, **to build a community in the Province of Vicenza that can benefit from the use of Open Data**.

c) **Making the Province of Vicenza an Open Data provider for the territory**, both for public administrations (municipalities and others) and for citizens.

2. **Key Pillars of Strategy**
    - **Data Governance:** Define clear policies for data ownership, management, and sharing to ensure consistency and accountability.
    - **Data Accessibility:** Prioritize the publication of datasets in user-friendly formats (e.g., APIs, CSV) with regular updates and comprehensive metadata.
    - **Stakeholder Engagement:** Establish partnerships among government, businesses, academia, and civil society to co-create solutions based on Open Data.
    - **Technical Enablement:** Build technical infrastructure to support IoT integration and interoperability across sectors and profit from AI tools.

Key Pillars of Strategy in the Province of Vicenza:

a) **Survey and mapping of Open Data available for the Province of Vicenza**, both internal and external data, both static and dynamic, geolocalized and divided into zones for analysis, to specify the coverage of the governed territory, identifying the missing spots/data gaps.

b) **Contact and establish relationships with key data providers** at provincial and regional scale, both public bodies and private companies or associations.

c) **Identify a technological infrastructure for the distribution of Open Data from the Province to municipalities and/or citizens**, first at a pilot level and then at an institutional level.

3. **Alignment with Pilot Area Needs**
    - **Mobility and Climate Focus:** As identified in Activity 1.2, traffic and environmental data should be prioritized for immediate action, possibly leveraging existing sensor networks.

- **Scalability and Transferability:** Develop solutions that can be adapted to other contexts and scale to larger regional or national initiatives.
- **Citizen-Centric Approach:** Incorporate citizen feedback through participatory methods, such as workshops and hackathons, to identify priorities and improve engagement.

Alignment with the needs of the Province of Vicenza:

a) **Weather monitoring and mobility management can be identified as the main fields** for the development of Open Data, including their effects on land management.

b) **Open Data must be developed and used in a holistic way**: integrating existing data with acquired ones and enabling the use of new data for multiple purposes.

c) **The coherence of the collected Open Data with the requests coming from the territory must be verified**, both with public authorities (municipalities) and with the civil society.

4. **Immediate Actions**

- Conduct stakeholder workshops to identify data priorities and gaps.
- Initiate pilot studies focused on traffic and climate data collection, ensuring compliance with privacy regulations.
- Design communication strategies to promote the benefits of Open Data and address resistance among stakeholders.

Immediate Action in the Province of Vicenza:

a) **Pilot activities with data collection and usage for weather monitoring and mobility management,** along with development of analysis models and sharing of results.

b) **Organization of workshops in the municipalities involved in the pilot activities,** using the ongoing work to raise awareness among public authorities and citizens on Open Data and IoT.

c) **Organization of further communication opportunities on Open Data, with training and information activities**, both internal and external, connected to other events when possible.

This strategy serves as a roadmap to integrate Open Data into each pilot area's governance structure, ensuring its utility for current needs while laying a foundation for future advancements.

Activities of the Local Action Plan for Province of Vicenza

Note: Medium term activities: before the end of the Project; Long term: after the end of the project.

Activity ID	Activity title	Activity description/result	Medium/long term action
0. Open Data Strategy			
0.1	*Definition of strategic objectives for the Province of Vicenza in the field of Open Data*	- Definition of objectives and potential actions to make the Province of Vicenza a data collection and distribution centre for municipal administrations and citizens - Identification of some thematic areas for the development of OD (e.g. weather information and mobility) - Identification of needs of region offices/departments to identify and specify potential future digital services	Medium term
0.2	*Internal sharing of strategic objectives*	- Sharing at administrative level with the offices interested in the collection and dissemination of Open Data - Sharing among all ongoing Open Data projects - Sharing of OD objectives with policy makers	Medium term
0.3	*Adoption of strategic objectives by the Province*	- Inclusion of the objectives for OD in an official document (Act/Decree/Planning document) - Optional implementation of the guidelines of Regional Law 14/2008	Medium/ Long term
1. Open Data Sources			
1.1	*Survey of data available in the Province suitable for being made Open*	- Inventory of data collected by the Province that can be made Open Data: from the Geoportal, from planning, from other specific activities and projects	Medium/ Long term
1.2	*Survey of existing Open Data for the provincial territory*	- Inventory of OD already available from the web and other channels: from the regional portal Open Data Veneto, from the Environmental Agency, from other sources	Medium term
2. Design of territorial governance			
2.1	*Zoning of Open Data in the provincial territory*	- Georeferencing data identified in the previous surveying activities - Division of georeferenced data into zones and inventory for each zone (on a municipal, census area, or other to be defined)	Medium/ Long term
2.2	*Sensor data collection for specific projects*	- Acquiring territorial data from sensor networks for specific projects in the Province of Vicenza (e.g. Pilot Action of the EnCLOD Project)	Medium term
3. Open Data Community			
3.1	*Public meetings on Open Data*	- Meetings with stakeholders and citizens to promote knowledge and awareness on Open Data, their availability and their use (e.g. EnCLOD Project Pilot Action, other projects)	Medium term
3.2	*Web pages for the dissemination of Open*	- Creation of a web page on the website of the Province of Vicenza (or on the Geoportal) to make available the OD	Medium term

	Data for specific projects	from specific projects (e.g. environmental data about roads of EnCLOD Project)	
3.3	*Training for Representatives of Public Administrations on Open Data*	- Organization of information and training meetings on the role of Open Data in the PA: for officers of the Province of Vicenza, of the Municipal Administrations in the provincial territory, of the Administrations involved in specific projects (e.g.: Pilot Action EnCLOD Project)	Medium term
3.4	*Meetings with companies and associations interested in Open Data*	- Meetings for the involvement in specific projects of subjects in the territory of the Province interested in OD: companies in the IT sector, associations and "communities" (e.g.: Digital Innovation Hub VI), other referents (e.g.: Vicenza University Foundation)	Medium term
3.5	*Organization of Hackathons on topics of interest for the Province*	- Involvement of IT companies, associations and communities - Organization of hackathons on shared thematic fields, oriented to specific projects (e.g.: Prog. EnCLOD)	Medium term
4. Digital tools			
4.1	Open Data providing from Specific Projects to public authorities and Citizens	- Development of IT systems for the distribution to municipalities and/or citizens of data collected by the Province for specific projects, via portal or App (e.g.: EnCLOD Project App)	Medium/ Long term
4.4	Contribution to Open Data Project Guidelines	- Summary of the experience carried out by the Province of Vicenza in specific projects (e.g. EnCLOD Project) - Drafting of the contribution for the final guidelines of projects (e.g. EnCLOD Project)	Medium term
4.2	Citizen Alert Systems Based on Open Data	- Development of alert or warning systems via SMS or Whatsapp based on open environmental data (e.g. frost on the road surface)	Long term
4.3	Provincial data distribution center for Administrations and citizens	- Identification of a distribution portal for data collected by the Province of Vicenza (previously catalogued) aimed at municipal administrations and/or citizens	Long term

C. Local Action Plan of the City of Debrecen

Introduction

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The Local Action Plan was born from an analysis of the actual state-of-the-art of Open Data in the City of Debrecen, considering both the strengths and weaknesses of this territory, that in the last decades had opened increasingly to innovation and digital administration. Furthermore, the best examples in the use of Open Data for territorial governance have been examined throughout Europe and beyond, from Spain to Czech Republic, from Great Britain to France. A set of guidelines were defined and shared among the international partners of EnCLOD Project, to identify common goals to achieve and open the way to concrete measures.

The result is a Plan collecting a set of actions able to improve the quality and accessibility of Open Data in the City of Debrecen both for the decision-makers and for the population, to further empower them in dealing with the critical choices that our challenging period presents. Some of the actions proposed by the Plan will be pilot tested during the ENCLOD project lifespan. Other actions included in the document are long-term purposes that need negotiation with the authorities and involvement of the community to find an application. All in all, the Local Action Plan is a comprehensive proposal to improve territorial governance through an advanced use of the Open Data, to make us all more aware in the decisions that every day we take.

Overview of Open Data in the City of Debrecen

1. Institutional framework of Open Data

Key insights:

- Open data agenda on national level is well defined, instructionally settled and develops quite well.
- Open data is mainly static, IoT open data is totally new way of thinking.

Hungary has taken gradual steps to be aligned with the current EU regulations on open data and at the same time Hungary had a gradual realization on how valuable open data can be for economic growth. The EU legislation (2019/1024/EU: https://eur-lex.europa.eu/legal-content/HU/TXT/?uri=CELEX:32019L1024) wanted to further help businesses operating in the field of public data recycling by making the so-called access to large pools of value. This includes geospatial, remote sensing, meteorological, statistical, company registration and traffic public data, which is why they are of great value because, according to experience, they have great commercial potential. Transport further broadened the range of reusable public data, which includes transport and utility companies that have been involved since then, as well as data from research published with public funds. The above-mentioned legislation's policies have been implemented in the XCI. of 2021. law of Hungary: https://njt.hu/jogszabaly/2021-91-00-00

2. Open Data providers and tools

Key insights:

- No open data provided, no specific supportive programmes running
- Silo based thinking still at place, initial attempts of national strategy on IoT data collection in the public space
- Private open data integration is still not the issue
- no technical standard for open IoT/dynamic data

In Debrecen, Hungary, the municipality owned Debrecen Asset Management holding company oversees the operations of member companies that are responsible for tasks that support the public, including water and waste. Holding company: Debrecen Asset Management Company/Debreceni Vagyonkezelő Zrt. (https://www.dvrt.hu/)

1, Water: Debreceni Vízmű Zrt. (https://www.debreceni-vizmu.hu/)

2, Energy: Debreceni Hőszolgáltató Zrt. (http://www.dhrt.hu)

3, Public transport: DKV Debreceni Közlekedési Zrt. (http://www.dkv.hu)

4. Parking: DV Parking Kft. (http://www.dvparking.hu/)

Municipality owned but not under the holding company:

4, Waste: AKSD Kft. (https://www.aksd.hu/)

5, Environment and other relevant urban operations: Debreceni Városüzemeltető Kft. (https://dvu.hu/)

No data published by any of the companies. No specific programmes have been found in Debrecen or its region.

National initiatives:

1. The National Public Data Portal

NPDP is the platform for the electronic provision of information and data sharing functions related to the re-use of data belonging to the national data repository, as well as for the electronic provision of tasks supporting the exploitation of the national data repository.

The National Public Data Portal provides an interface for those interested in public data, as well as for private individuals and organizations initiating the further use of data belonging to the national data assets, through which the metadata of the bodies handling the data are published in a uniform, structured form, in a machine searchable manner. Information on the further use of data belonging to the national data assets can be found, as well as data utilization support services can be used.

2. Hungarian Central Statistical Office (KSH)

One of the main objectives of the Hungarian Central Statistical Office as a professionally independent government office responsible for official statistics is the coordination of the Official Statistical Service's activity, publication of guidelines and recommendations relating to official statistical activities.

3. Herman Ottó Institute Nonprofit Ltd. / HungAiry project

National and regional weather data (temperature, moisture, air pressure, precipitation…etc)

https://legszennyezettseg.met.hu/ and https://odp.met.hu/

3. Open Data use cases

Until now no real use cases can be mentioned in Debrecen, but a promising future can be seen ahead.

The Smart City division of Economic & Urban Development Centre of Debrecen (EDC) established an open data portal back in 2016 with the aim of collecting all relevant and available data sources of the city and the University of Debrecen. Keeping the data up-to-date and measuring its value has always been a challenge.

The **Innovation Ecosystem Centre** and the **Faculty of Informatics at the University of Debrecen** shows evolving interest in knowledge transfer (hackathons) and the use of open data. (data asset management, national data assets, open data portal, sensitive data processing, cloud solutions etc)

Using **Waze data provided through Connected Cities Program,** in-house as a PTO, we can complement the decision making by data from traffic at specific sites to have the knowledge on traffic load and the ability to compare it to the bus occupancy to enable to improve the governance.

Parallel to the economic development of the city, the need for sustainable transport solutions and precise monitoring of environmental pollution grows. In order to have a clear view on the status of the city's environment, the **Environmental Monitoring System** (Környezeti Ellenőrző Rendszer – KER) is deployed and running. Besides air pollution level, other meteo data sets are collected. Altogether 18 monitoring stations were placed around the city, which provide data not only for the authority and the university (the owners of the system), but for the public as open data.

There is another climate related project running in Debrecen, along with other municipalities, called the **HungAiry project**. The scope here is to improve air quality at eight Hungarian regions through the implementation of air quality plan measures. It is realized through the development of **emission databases**, the establishment of a national network of experts, consultants and comprehensive awareness raising activities. To reduce air pollution caused by transport various awareness-raising activities and local pilot actions will be launched, such as the implementation of public bicycle system (existing bike route network (with bike counter) will provide a perfect ground for this initiative) and the development of intelligent urban transport system where EnCLOD traffic sensors will complement the data provided by pollution stations.

The EnCLOD project actions in Debrecen should initiate a potential cooperation with the above mentioned projects so that all project scopes could fulfil all requirements.

4. Open Data maturity assessment

Key insights:

The open data maturity of Debrecen is at an early stage. Availability of data is moderate, while the quality of data is moderate to high. The use of open data is still emerging but shows signs of growth. The impact of open data remains limited in most areas. Debrecen could benefit from a city with more advanced open data practices, like Olomouc.

Debrecen is relatively passive in making datasets publicly accessible. The municipality owned companies do have datasets generated, but not yet made available for public or scientific use. The city lacks a comprehensive open data concept but has developed an IT system strategy and working on the conduction of an inventory of data sources.

Currently, open data usage is minimal, with decisions often based on ad hoc, non-public data. Although there is national-level support for open data, local municipalities frequently meet only the basic requirements. By participating in the EnCLOD project, Debrecen has shown a growing commitment to advancing open data initiatives.

- Action plan should start the activities, twinning is very important, Olomouc represents a partner who has great advance in building open data strategy.
- Other cities' training materials could be tested on Debrecen
- It can be expected that the Action plan of Debrecen will be completed much later than the others

Based on our judgement, Open Data in the city of Debrecen and its region definitely has a lot of room for improvement. Currently, the options to access Open Data in Debrecen is very limited, especially if someone is looking for certain kinds of datasets to use for software development or other kind of purposes. The entities that possess data have not yet reached a state to provide the data for the public. Some open data sets were published on the city's open data portal, but it is now not online.

Dimension	Initial	Emerging	Established	Leading
Data Availability	Limited	Moderate	Broad	Comprehensive
Data Quality	Low	Moderate	High	Excellent
Data Use	Minimal	Growing	Active	Highly Active
Governance	Informal	Initial	Formal	Advanced
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Orienting the Open Data in the City of Debrecen

Debrecen is the fastest developing city in economic terms among all the Hungarian rural cities. High level of investment is typical, especially car industry oriented: BMW Group, Schaeffler and battery industry such as CATL, EVE Power, Semcorp, and which is going to be one of the largest investments in the whole EU.

The city's population is expected to grow with 50.000 people with the new developments. Their mobility patterns can significantly influence sustainability and so the city is planning new bus lines supported with MaaS features. Using Waze data already, the city/bus operator will complement the decision making by data from traffic at specific sites to have the knowledge on traffic load and the ability to compare it to the bus occupancy, to improve the governance. Most public transport vehicles already have passenger counting systems, supplementing the data driven decision making. Regarding the development of the PT network, one of the most significant measure is going to be the construction of tram line 3 (Debrecen currently has two tram lines) which is under planning and once done, it's going to have a major role in the city's sustainable mobility scheme.

A "Living lab" in Debrecen will address the collection of territorial data with regard to the public transport system and set up a PT data portfolio, needed for public transport and MaaS development. The follow-up action plan can be a good practice on how PT company can profit from data driven management and how to use various data to support sustainable and clean mobility.

Debrecen lacks a systematic approach to comprehensively address its data agenda, including open data. Currently, there is a plan to establish a central data repository where data, which the city owns or has access to, would be systematically stored via defined interfaces. To achieve this, a detailed and comprehensive inventory of the city's data resources will need to be conducted.

The city acknowledges the need to address this issue comprehensively and to systematically set up the necessary processes. It also recognizes the potential of systematic data collection, data opening, and their use for data-driven decision-making across a wide range of city agendas.

Opening datasets to the public also presents an opportunity to accelerate civic society, nonprofit organizations, and, of course, the innovation industry (companies and the university) A separate chapter in this area is the potential for research, development, and innovation at the university level, where the city could serve as a living urban laboratory.

Indirectly, this could:

- unlock the societal and commercial value of data,
- increase transparency and accountability,
- enhance the quality and efficiency (value for money) of city services, or facilitate the introduction of new services,
- improve public transport and urban mobility planning processes
- improve urban development planning and prepare the city for future challenges.

Selected pillars of the framework of Open Data and Smart Governance are outlined in Debrecen city's SUMP and Green Codex, as internal documents of the Municipal Office.

Developing a strategic orientation for Open Data in the pilot area requires aligning its application with local priorities and challenges, as identified in **Activities 1.1 and 1.2.** The strategy focuses on establishing a robust framework to guide data use in support of urban governance and sustainability goals.

5. **Strategic Objectives**
    - **Enhancing Decision-Making:** Use Open Data to inform policies in key areas, such as traffic management, environmental monitoring, and public transport/urban mobility planning.
    - **Promoting Transparency:** Ensure that datasets are accessible, fostering trust among citizens and stakeholders.
    - **Enabling Innovation:** Encourage public and private sector innovation through the availability of high-quality, interoperable datasets.

Strategic objectives in the City of Debrecen:

- **Designing a comprehensive Open Data strategy for the city of Debrecen**

  Establish a formal strategy tailored to the city's needs. This includes defining objectives for data collection, publication, and usage, ensuring alignment with national EU standards. The strategy should address dynamic IoT data, data quality assurance, and public engagement to enhance transparency and utility.

- **Strengthening data interoperability**: Develop frameworks and standards to ensure seamless integration and sharing of datasets across concerned municipal departments and external stakeholders, enabling more effective collaboration.
- **Encouraging innovation through Open Data**: Based on the existing organization network, create an ecosystem that supports innovation by providing high-quality, accessible datasets to local businesses, universities, and civic organizations for developing solutions to urban challenges.
- **Mitigate the dependency on external partners** by building local capacity for Open Data management.

  This might include:

  - **Inhouse trainings**: Enhancing the expertise of city employees so they can effectively manage, publish, and analyse OD
  - **Developing internal tools and infrastructure**: Creating or improving technical platforms and systems for data collection, management, and publication, enabling the city to operate more independently, investigating AI tools benefits.
  - **Engaging local partners**: Collaborating with Debrecen University, SMEs and non-profit enterprises to build a local ecosystem of experts who can support Open Data initiatives.

  Integrate the city's traffic, energy, meteo, and environmental datasets to support holistic urban planning and sustainability initiatives. Debrecen should integrate new datasets on traffic to support comprehensive PT planning with focus on new industrial areas of the city. Meteo, energy and environmental datasets will support sustainability initiatives (SUMP, Green Codex) The overall goal is to enhance mobility in the city while promoting sustainable urban development.

  Specifically, this includes:

  - **Supporting efficient PT planning**: traffic sensor data will enable planners to optimize public transport to new industrial zones. This way can improve traffic management, minimize environmental impacts, such as reducing emissions.
  - **Sustainable transport initiatives**: The data can support projects like smart traffic lights, the electrification of public transport, or better connectivity between industrial zones and urban infrastructure.

6. **Key Pillars of Strategy**
    - **Data Governance:** Define clear policies for data ownership, management, and sharing to ensure consistency and accountability. This includes ensuring compliance with the GDPR and national IT standards, as outlined in Hungary's regulatory framework.
    - **Data Accessibility:** Focus on the publication of datasets in user-friendly formats (e.g., APIs, CSV) with regular updates and comprehensive metadata. This includes creating a platform for all sources of data, made accessible in a user friendly way, with different access levels/rights.
    - **Stakeholder Engagement:** Establish partnerships between government, businesses, academia, and civil society to co-create solutions based on Open Data. Set up a collaboration strategy with the city governance, University of Debrecen, SMEs and non-profit enterprises. Workshops, hackathons, meetups will effectively enhance collaboration.
    - **Technical Enablement:** Build technical infrastructure to support IoT integration and interoperability across sectors. The idea is to set up a network of traffic counter sensors, traffic monitoring cameras, meteorological stations, air quality monitoring sensors, collect and process their datasets, and integrate them into complex platform.
      Development of a roadmap for microzoning will provide further insights into urban dynamics.

7. **Alignment with Pilot Area Needs**
    - **Mobility and Climate Focus:** As identified in Activity 1.2, traffic and environmental data should be prioritized for immediate action, possibly leveraging existing sensor networks.

      Debrecen Urban Management Centre (DUMC) will be the reflex of the city in the management of Debrecen's road and energy networks. It will collect and analyse data and information that will enable real-time traffic management and energy management. The data will be used to create a new traffic model that will allow dynamic traffic control and the development of green waves.
    - **Scalability and Transferability:** Develop solutions that can be adapted to other contexts and scaled to larger regional or national initiatives.
    - **Citizen-Centric Approach:** Incorporate citizen feedback through participatory methods, such as workshops and hackathons, to identify priorities and improve engagement.

Alignment with the needs of the City of Debrecen:

Debrecen is the economic hub of Eastern Hungary and one of the fastest developing regions of the country. It plays a significant role in fostering innovation and digital services. The city hosts traditional industrial sectors such as medicine and food production, IT services, but recently, due to governmental ambitions, there has been a concentrated automotive and battery industry development running. BMW Group, CATL, EVE Power, Schaeffler, Semcorp Hungary, etc.

Innovation and development in the city can be advanced by such entities, that are engaged in research and development, with access to modern technologies and specialized human resources.

The city's entrepreneurial environment is further supported by organizations established by the City of Debrecen, the regional government, and the University of Debrecen, with a focus on supporting startups and innovative projects, providing expert consulting, access to the latest technological trends, and facilitating the establishment of important connections within the business community. The goal is to create

conditions for sustainable economic growth and to encourage new, innovative businesses that will generate new job opportunities for the city and contribute to its overall development.

As a result of industrial development, environmental pollution and protection has become a key issue. In order to keep the city's environment safe, there has been an Environmental Monitoring System deployed in the city. The monitoring system not only supports the city authorities but provides information for citizens about the status of their environment. Data from the monitoring system, along with available weather data provided by the Hungarian Meteorological Service can be integrated into the EnCLOD project work on open data.

8. **Immediate Actions**
    - Conduct stakeholder workshops to identify data priorities and gaps.
    - Initiate pilot studies focused on traffic and climate data collection, ensuring compliance with privacy regulations.
    - Design communication strategies to promote the benefits of Open Data and address resistance among stakeholders.

Immediate Action in the City of Debrecen:

- Design microzones in Debrecen focusing on traffic monitoring, incorporating urban and traffic-specific data for zoning. *(the first version has been designed)*
- Deploy a traffic counting sensor network focusing on newly developed industrial zones *(already deployed, the connectivity issue with the local LoRawan connectivity city operator is still being tackled, a good lesson learnt from the start)*
- Map existing and planned data sources (weather, environment, traffic, other) that can be integrated into the EnCLOD project scope *(initial steps mapping the potential sources, e.g. mentioned projects)*
- Begin mapping existing digital tools in the city to identify gaps and opportunities for integration into the EnCLOD framework.
- Explore modal share towards industrial zones, using employer head counts, private car usage, PT passenger count. Measure demand and optimize PT schedule accordingly.
- Organize targeted workshops with municipal departments, local businesses, and community groups to define key data priorities, especially for urban mobility and climate-related challenges.
- Establish partnerships with local universities and technology providers to support pilot initiatives and data analysis

This strategy serves as a roadmap to integrate Open Data into each pilot area's governance structure, ensuring its utility for current needs while laying a foundation for future advancements.

Activities of the Local Action Plan for City of Debrecen

Note: Medium term activities: before the end of the Project; Long term: after the end of the project.

Activity ID	Activity title	Activity description/result	Medium / Long term activity
0. Open data strategy			
0.1	*Identification of working groups*	Establish an informal working group with the city. Define the open data ecosystem, including competencies, coordination rules, networking events, partnerships, and funding models as prerequisites for the open data strategy. Prepare meetings and communication with the city.	Medium term
0.2	*Formalization of the program /agenda*	Establish the working group and appoint a leader for the open data initiative. Start negotiations with the city about preparing the framework for the city's adoption of the open data strategy.	Medium term
0.3	*Set up of the Open data strategy*	Finalize and adopt the open data strategy based on the EnCLOD project's inputs and city negotiations. Identify potential financial sources for the integrated data platform. Result ideally as an official open data strategy of the city.	Long term
0.4	*Other expected activities*	Public transport	Long term
1. Open data sources			
1.1	*List of national statistics*	National Public Data Portal - national data repository Hungarian Central Statistical Office - official statistics Hungarian Meteorological Services – weather data (temperature, precipitation, moisture, air pressure etc)	Medium term
1.2	*List of existing local open data*	Environmental Monitoring System - air pollution, meteo data Debrecen Asset Management Ltd. – energy, water consumption, traffic flow, parking, city related data Waze – traffic data	Medium term
1.3	*Mapping of other potential OD sources*	The Innovation Ecosystem Centre and the Faculty of Informatics at the University of Debrecen	Medium term
1.4	*List/contact with other data providers*	Hungarian Public Roads Ltd – non-municipality owned road traffic data Transport companies (National Railways, Volán Bus, Debrecen Airport) transit data	Long term
2. Design of territorial governance			
2.1	*Design of microzoning for the Pilot Area*	Design microzones of Debrecen focusing on traffic count and management and environmental monitoring, incorporating urban and traffic-specific data for zoning.	Medium term
2.2	*Mapping of the Open Data sets for the microzones*	Identify and map open data sets, relevant to each microzone, including static and dynamic data sources, main focus on defined industrial zones of the city.	Medium term
2.3	*Data sensing for traffic*	Plan and implement the deployment of traffic sensors aiming for optimal data collection and analysis.	Medium term
2.4	*Holistic sensing of traffic and climate*	Map and table of holistically designed sensing of the pilot area. Additional result: definition of the minimum (IoT) sensor network of the municipality	Long term
3. Open data community			

3.1	*Activities with EnCLOD working group*	Open discussions on open data agenda and organize the first local EnCLOD event. Result: defined topics for investigation and identification of key persons.	Medium term
3.2	*List of local potential partners*	City governance University professionels Representatives of other related projects	Medium term
3.3	*EnCLOD local website*	Dedicated EnCLOD project subpage on Debrecen SmartCity website, regular updates about project progress https://smartcity.debrecen.hu/en/projects/enclod	Medium term
3.4	*Pilot EnCLOD dashboard*	Incorporate pilot action data into the EnCLOD website and publish it as a public dashboard showcasing results.	Medium term
3.5	*Local events*	Partner meeting in Debrecen (2-3 April, 2025) presenting project status, actions taken and future targets	Medium term
3.6	*Hackathon preparation*	Defining topics, agenda Negotiation with stakeholders, local SME's, civic groups, university of Debrecen in participation, data sources	Medium term
3.7	*Hackathon activities and evaluations*	Organize and conduct hackathon; evaluate the outcomes and provide feedback to participants. Outputs report and the list of available sets of data used by hackathoners.	Medium term
3.8	*Training preparation*	Prepare for open data training sessions by identifying participants, creating training materials and provide a list of to-be-trained staff.	Medium term
3.9	*Training sessions of the project*	Training session should require participation of city governance. Analyzing outputs new sessions can be altered in ordert o reach maximum goals.	Medium term
3.10	*Other training activities in the Pilot Areas*	Organize workshops and events to introduce open data topics, raise awareness, and engage local stakeholders	Long term
4. Digital tools and twinning – specific activities			
4.1	*Existing use cases collection*	Collect and document use cases addressing the needs of data-driven governance, including PT optimization and climate-related challenges in Debrecen	Medium term
4.2	*Identification of specific needs*	Identify specific needs for Debrecen, focusing on public transport and urban mobility and evaluate data sets.	Medium term
4.3	*Development of digital services (Apps, warnings, etc.)*	Propose and develop digital tool for traffic flow monitoring city wise and special focus on industrial zones, as a contribution to EnCLOD's common pool.	Medium term
4.4	*Provided digital services in the Pilot Areas*	Test and finalize the digital tool for traffic monitoring, environment monitoring, including its interface and integration into municipal systems, and train users for effective adoption.	Medium term
4.5	Twinnings	Facilitate twinning between project partner cities, focusing on traffic management and climate topics, including procedures, testing, and knowledge exchange.	Long term
.6	Contribution to EnCLOD final guidelines	All learnings from Debrecen pilot activities must be shared so it can contribute to EnCLOD's final recommendations and guidelines for municipalities.	Long term

D. Local Action Plan of the City of Olomouc

Introduction

Data are a fundamental resource in our digital age, an essential material for territorial governance, innovation and economic growth. Open Data are made freely available to the public, without restrictive licenses: they represent an opportunity for territorial governance as they allow informed decision-making by the public authorities, awareness raising and involvement of the community, innovation among the actors of the economic system. The Local Action Plan for the City of Olomouc developed by the Project EnCLOD describes a path to increase and advance the use of Open Data in this territory, with the aim of supporting territorial governance by public administrations and have a positive impact on everyday organisation in such fields as road management and environmental monitoring, traffic control and adaptation to climate change.

The Local Action Plan was born from an analysis of the actual state-of-the-art of Open Data in the City of Olomouc, considering both the strengths and weaknesses of this territory, that in the last decades had opened increasingly to innovation and digital administration. Furthermore, the best examples in the use of Open Data for territorial governance have been examined throughout Europe and beyond, from Spain to the Czech Republic, from Great Britain to France. A set of guidelines were defined and shared between the international partners of EnCLOD Project, to identify common goals to achieve and open the way to concrete measures.

The result is a Plan collecting a set of actions able to improve the quality and accessibility of Open Data in the City of Olomouc both for the decision-makers and for the population, to further empower them in dealing with the critical choices that our challenging period presents. Some of the actions proposed by the Plan will be pilot tested during the ENCLOD project lifespan. Other actions included in the document are long-term purposes that need negotiation with the authorities and involvement of the community to find an application. All in all, the Local Action Plan is a comprehensive proposal to improve territorial governance through an advanced use of Open Data, to make us all more aware of the decisions that we take every day.

Olomouc is a frontrunner in the project, showing the path to the others. So the Local Action Plan itself is complemented with the first achievements in the Annexes.

Overview of Open Data in the City of Olomouc

1. Institutional framework of Open Data

Key insights:

- Open data agenda on national level is well defined, instructionally settled and develops quite well. At the state level, there is an institution (The Digital and Information Agency) as well as a national coordinator covering open data activities.
- Open data is mainly static, IoT open data is totally new way of thinking, with big potential to boost.
- UPOL is a very advanced partner for the pilot area having real experience with open data concept, local data knowledge, its application and hackathons organization and is also a methodological partner for the city as well as the region.

In Czech legislation, the issue of open data is anchored in Act No. 106/1999 Coll., on free access to information, which deals with the obligations of state entities to provide information, the rights of free access to this information and the rules for providing it. For the purpose of this Act, the obligation to provide information is incumbent on state bodies, bodies of territorial self-government units (regions and municipalities) and public institutions, either on the basis of a request or by publication. In the case of provision of information on the basis of a request, the information shall be provided in the formats and languages requested in the request, or in the original formats and languages if the translation would be too complex for the provider. Where information is provided by electronic publication, it shall be retained in the original formats and languages, but at least one of the formats in which the information is published must be open. In both cases, metadata should be provided along with the data, in accordance with established standards. The latter uses open data, which the law defines as 'information published in a way that allows remote access in an open and machine-readable format, which is not restricted in its manner or purpose of subsequent use and which is recorded in a national open data catalogue'. In the Olomouc Region there is also the methodological framework (Concept of the Open Data Portal of the Olomouc Region), which was created by Palacký University in Olomouc. According to this document, the open data portal of the region has been created this year.

2. Open Data providers and tools

Key insights:

- The open data culture is developing, the broader cooperation among the national level, regional and local level is still a challenge, no supportive program on national level settled
- Silo based thinking still at place, no national strategy on IoT data collection in the public space
- Private open data integration is still not the issue
- The majority of open data is static, no technical standard for open IoT/dynamic data
- UPOL can share the result and the process of creating a regional strategy on open data with the project partners and prepare an Internal training session for the project partners.

At the national level, there are several government institutions dealing with data in these areas (in particular Environment and Water). These data are mainly published at national level due to their importance and type. The data are provided for the whole territory of the Czech Republic and then it is possible to select from them at regional and municipal level. These institutions publish open data on their portals and in their local catalogues and the data are further linked to the National Catalogue of Open Data

where they are available without any restrictions. At the regional level, the Statutory City of Olomouc and the Olomouc Region are the main ones.

1. Olomouc Region - partly available on the portal - no registration required, part of the data is not publicly available (only on request for academics) - https://www.dataok.cz/

2. Coordinator of the Integrated Transport System of the Olomouc Region - not publicly available (only on request for academia and the Olomouc Region)

3. Statutory City of Olomouc - partly available on the portal - no registration required, part of the data is not publicly available (only on request for academia) - https://opendata.olomouc.eu/

4. Olomouc City Transport Company - not publicly available (only on request for academics and the City of Olomouc)

5. Ministry of the Environment of the Czech Republic (national coverage) - partially available on the portal - no registration required, part of the data is not publicly available (only on request for academia) - https://opendata.mzp.cz/

6. Agency for Nature and Landscape Protection (national coverage) - available on the portal - no registration required, most data publicly available without restrictions - https://gis-aopkcr.opendata.arcgis.com/

7. Czech Hydrometeorological Institute (nationwide coverage) - partially available on the portal - no registration required, most of the data is not publicly available (some data charged, some data free for public administration) - https://open-data-chmi.hub.arcgis.com/, https://www.chmi.cz/historicka-data/pocasi/zakladni-informace, https://www.chmi.cz/informace-a-sluzby/nabizene-sluzby/produkty-a-sluzby

8. T.G.Masaryk Water Research Institute (nationwide coverage) - partially available on the portal - no registration required, some data not publicly available (only on request for academia) - https://heis.vuv.cz/default.asp?typ=00

9. Ministry of Transport of the Czech Republic (nationwide coverage) - partially available on the portal - no registration required, part of the data is not publicly available (only on request for academics)

10. Directorate of Roads and Motorways (national coverage) - partially available on the portal - no registration required, part of the data is not publicly available (only on request for academics) - https://www.rsd.cz/silnice-a-dalnice/scitani-dopravy

3. Open Data use cases

Key insights:

- Smart agenda is financially supported so there is an opportunity to set up terms for open data collection support
- There is a strategy and hackathons are organized with various topics
- The relevant topics for EnCLOD project are urban development, sustainable mobility, public safety/health/education and green infrastructure and sustainability
- The key open data for data driven urban development besides IoT, selected by UPOl, are 3D city model, satellites readings, localization of national open data for urban planning

There is no program focused exclusively on open data. However, it is a very attractive topic that fits very well into the smart city concept. Therefore, the Olomouc Region is offering for the second year in a row the possibility for individual municipalities in the region to apply for financial support for smart projects within the SMART Region Olomouc project. One of the areas for which funding is allocated is open data. Information

about the region's grant programme is available only in Czech: https://udeska.olkraj.cz/dokument?ude?KUOL0B5VGK28-0

The organisation of hackathons was recommended by the document "Concept of the open data portal of the Olomouc Region", which was prepared in 2022 by the Department of Geoinformatics of Palacký University in Olomouc. The event was recommended to be organised in the greatest possible synergy between the city, the region and the university. The Olomouc Region initiated the organisation of the first edition in 2023, which was organised by Palacký University in cooperation with the Olomouc Region, the City of Olomouc and the Innovation Centre of the Olomouc Region. The event will take place again this year (18-20 October) with the financial support of more than 20 partners. The organisation of the event is mainly provided by the staff of the Department of Geoinformatics and the Science and Technology Park (both from Palacký University), while the financial support (mainly catering and promotion) is provided by the Olomouc Region and the City of Olomouc. The prizes are obtained mainly from commercial partners (mainly small HW) and from the city and the region (e.g. tickets to the zoo, aquapark, etc.). The total amount of prizes is approx. 5K Euro. More information is available on the event website: https://hackathon.upol.cz/.

Last year's hackathon dealt mainly with the topics of **cycling, quality of life and urban development (urban planning)**. This year's hackathon themes are **education, safety, health, sustainability and green infrastructure.**

4. Open Data maturity assessment

Key insights:

- Data availability can be evaluated at moderate level
- Data quality on moderate-high level
- Data use is growing so on emerging level
- Governance established (portal, staff, strategy, events)
- Impact is low to some

Open data is a new topic in the region and is developing very rapidly. Last year, the city of Olomouc developed its open data portal and this year the technological background is changing and a new version of the portal is being created. The Olomouc Region is following the Open Data Portal Concept developed by Palacký University. Two full-time positions have been dedicated to open data issues and the region made the first live version of the portal available with the first data during the summer. A publication plan has been developed and the region is actively developing the portal. The state of the city open data portal is rather weak (when compared to other regional cities), however some comparable cities in the Czech Republic do not have a portal yet. The region portal is very new, but it has already become one of the most successful in the Czech Republic. If the region maintains the set pace of data publication, it will be a very good example of what region portals should look like. However, a whole range of data is still waiting to be published, both at the city and region level. So overall, the state of open data in the region is mediocre, but developing very quickly.

The high-level governance in Olomouc area is a major power for open data agenda and the project EnCLOD can be successful in real use of open IoT data from the pilot action in Olomouc for practical SW tools. The major step now is to introduce the topic to a wider local audience and prepare the agenda of hackathon 2025 with challenges and topics to solve with the support of open IoT data. Olomouc can play a leading role in the project EnCLOD. The way forward consists in the focus on data availability and data use, and grow the impact so these three dimensions can be improved even within the timeframe of the project.

Dimension	Initial	Emerging	Established	Leading
Data Availability	Limited	Moderate	Broad	Comprehensive
Data Quality	Low	Moderate	High	Excellent
Data Use	Minimal	Growing	Active	Highly Active
Governance	Informal	Initial	Formal	Advanced
Impact	Low	Some	Clear	Significant

Orienting the Open Data in the City of Olomouc

Developing a strategic orientation for Open Data in the pilot area requires aligning its application with local priorities and challenges, as identified in **Activities 1.1 and 1.2**. The strategy focuses on establishing a robust framework to guide data use in support of urban governance and sustainability goals.

1. **Strategic Objectives**
    - **Enhancing Decision-Making: Use Open Data to inform policies in key areas, such as traffic management, environmental monitoring, and urban planning.**
    - **Promoting Transparency: Ensure that datasets are accessible, fostering trust among citizens and stakeholders.**
    - **Enabling Innovation: Encourage public and private sector innovation through the availability of high-quality, interoperable datasets.**

Strategic objectives in the City of Olomouc:

a) Prepare a thorough open data overview, mainly for urban planning a define the first digital services that open data can support

b) Create a strong community of users focusing on enhancing territorial governance

c) Create a digital tool for heating islands related to traffic/parking impacts

2. **Key Pillars of Strategy**
    - **Data Governance: Define clear policies for data ownership, management, and sharing to ensure consistency and accountability.**
    - **Data Accessibility: Prioritize the publication of datasets in user-friendly formats (e.g., APIs, CSV) with regular updates and comprehensive metadata.**
    - **Stakeholder Engagement: Establish partnerships between government, businesses, academia, and civil society to co-create solutions based on Open Data.**
    - **Technical Enablement: Build technical infrastructure to support IoT integration and interoperability across sectors.**

Key Pillars of Strategy in the City of Olomouc:

a) Microzoning and showing all potential open data in relation with the microzones, providing first heatmaps

b) Holistic design of climate and traffic sensing, identifying the existing technologies, focusing on opening data from the technologies and working out a strategy on the deployment and its funding

c) CityOne and UPOL expertise to guide the works on data opening, community building and close cooperation with the city as well as the region

d) New digital services: co-design of a potential heat island digital tool with the use of expert knowledge and AI approach as an example for the hackathoners

3. **Alignment with Pilot Area Needs**
    - **Mobility and Climate Focus: As identified in Activity 1.2, traffic and environmental data should be prioritized for immediate action, possibly leveraging existing sensor networks.**

- **Scalability and Transferability: Develop solutions that can be adapted to other contexts and scaled to larger regional or national initiatives.**
- **Citizen-Centric Approach: Incorporate citizen feedback through participatory methods, such as workshops and hackathons, to identify priorities and improve engagement.**

Alignment with the needs of the City of Olomouc:

a) Support for parking strategy extension and sustainable mobility measures, mainly focused on cycling and traffic safety

b) Climate data opening, raise awareness on climate impacts related to parking and car oriented behaviour

c) GIS tools support, connecting data with measures

d) Closer cooperation on open data agenda with the city and the region

4. Immediate Actions

- **Conduct stakeholder workshops to identify data priorities and gaps.**
- **Initiate pilot studies focused on traffic and climate data collection, ensuring compliance with privacy regulations.**
- **Design communication strategies to promote the benefits of Open Data and address resistance among stakeholders.**

Immediate Action in the City of Olomouc:

a) Complementing microzones with overview on open data availability, potential for comparing the zones as well as investigation of potential new data sources

b) Planning of another event and preparation for the autumn hackathon

c) Open data list investigation and selection of key open data sets for microzoning territorial governance

This strategy serves as a roadmap to integrate Open Data into each pilot area's governance structure, ensuring its utility for current needs while laying a foundation for future advancements.

Activities of the Local Action Plan for City of Olomouc

Activity ID	Activity title	Activity description/result
0.1	Set up an informal working group with the city	an open data ecosystem, define/describe competencies scheme, coordination rules, networking events, partnership and funding model as a prerequisite for the open data strategy
0.2	Formalize agenda	Starting a negotiation with the city, set of challenges and the partnership in hackathon
0.3	Water and energy data aggregation	Verify a feasibility of gathering data of sensitive nature in an aggregated way by microzones
0.3	Set up an open data strategy	Concluded strategy based on inputs of EnCLOD project partners and the negotiation with the city Result ideally as an official open data strategy of the city
1.1	National statistics	List of national data statistics to be applied in Olomouc
1.2	Local static open data	List of existing data sets to be applied in Olomouc, assessment of its UpToDate and accuracy
1.3	Mapping all the existing technologies, registry of potential dynamic data sources	A map of places, types and providers of data collection technology List of potential data providers, types of data, dynamic data sets definitions and where they are placed in the area
1.4	Data providers	- traffic control loops data opening session with the operator - hospital traffic data from barrier system
2.1	Microzoning Olomouc	holistic view on municipality microzoning to define “digital urban planning units” result: map of Olomouc microzones
2.2	Mapping all the available open data sets to the microzones	create first heatmaps result: List of microzones and their available open data sets (i.e. Map of open data per microzone and brief comparative analysis of open data coverage of Olomouc)
2.3	Holistic sensing of traffic and climate	Result: Map and table of holistically designed sensing of a pilot area, second result: the minimum (IoT) sensors network of the municipality
2.4	Design potential of sensing in Olomouc matched with available technologies (1.3)	set up a strategy and Action plan of the area on “sensed places”; climate and traffic as the minimum.
3.1	Internal EnCLOD working group	open a discussion on open data agenda and organizing the first local event on EnCLOD, result: Set of topics to be investigated in open data agenda and key persons interested in the agenda
3.2	List of potential partners	to map partnership and content of the hackathon(s) list of partners and their typology
3.3	EnCLOD local website	
3.4	Pilot EnCLOD dashboard	Incorporating data from EnCLOD pilot action in the local website and publish it as public

Activity ID	Activity title	Activity description/result
3.5	Local events	Organize workshops to introduce the topic and raise attention and awareness
3.6	Hackathon prep	find partnerships of data providers and data users to define challenges for local hackathons. Result: table of contents for the hackathon
3.7	Hackathon organization and evaluation	Outputs report and the list of available sets of data used by hackathoners
3.8	Training	Identify the key persons and provide a list of to-be-trained staff
3.9	Training session 1	Local workshop as an introduction to the agenda
3.10	Training session 2	Training on the use of the tool on heating islands governance
4.1	Use cases collection contribution	List of use cases beyond Olomouc case to address the needs of data driven governance with specific agendas, especially the challenges of green transition and climate change impacts
4.2	Specific needs for heat island topic	List of specific use cases the heating island topic is related to, and the data sets needed for it
4.3	Digital services	List of potential/existing digital services as an output of 4.1 and 4.2, as a contribution of Olomouc to the “common pool” of EnCLOD
4.4	Heat islands digital service	A final service to be trained, from design to final user interface
4.5	Twinning	Potential of twinning with Žilina in both directions (heart islands and traffic safety tools), design of the procedure, testing, training final report
4.6	Specific pilot on university buildings heating	Specific pilot as a side effect of EnCLOD deploying special façades sensors system on selected university
4.7	Final EnCLOD guidance contribution	Methodology on microzoning and urban planning units’ digitization, including technical terms on IoT sensors

E. Local Action Plan of the City of Nova Gorica

Introduction

Data are a fundamental resource in our digital age, an essential material for territorial governance, innovation and economic growth. Open Data are made freely available to the public, without restrictive licenses: they represent an opportunity for territorial governance as they allow informed decision-making by the public authorities, awareness raising and involvement of the community, innovation among the actors of the economic system. The Local Action Plan for the City of Nova Gorica developed by the Project EnCLOD describes a path to increase and advance the use of Open Data in this territory, with the aim of supporting territorial governance by public administrations and have a positive impact on everyday organisation in such fields as road management and environmental monitoring, traffic control and adaptation to climate change.

The Local Action Plan was born from an analysis of the actual state-of-the-art of Open Data in the City of Nova Gorica, considering both the strengths and weaknesses of this territory, that in the last decades had opened increasingly to innovation and digital administration. The strategy emphasizes positioning Nova Gorica as a resilient, border-connected, student-centric, and post-carbon city. The goals are clearly defined and are divided into two categories: short-term and long-term goals. Furthermore, the best examples in the use of Open Data for territorial governance have been examined throughout Europe and beyond, from Spain to Check Republic, from Great Britain to France. A set of guidelines were defined and shared between the international partners of EnCLOD Project, to identify common goals to achieve and open the way to concrete measures. The focus is on EnCLOD Open Data, IoT, and local governance initiatives.

The result is a Plan collecting a set of actions able improve the quality and accessibility of Open Data in the City of Nova Gorica both for the decision-makers and for the population, to further empower them in dealing with the critical choices that our challenging period presents. Some of the actions proposed by the Plan will be pilot tested during the ENCLOD project lifespan. Other actions included in the document are long-term purposes that need negotiation with the authorities and involvement of the community to find an application. All in all, the Local Action Plan is a comprehensive proposal to improve territorial governance through an advanced use of the Open Data, to make us all more aware in the decisions that every day we take.

Overview of Open Data in the City of Nova Gorica

1. Institutional framework of Open Data

Slovenia has a well-defined open data agenda at the national level, supported by the Open Data and Intellectual Property Institute (ODIPI), established in 2023. This institute coordinates open data activities and ensures alignment with national strategies. The country's Access to Public Information Act (ZDIJZ) implements the EU's Open Data and Public Sector Information Directive, mandating transparency and promoting the re-use of public sector information.

Key measures include:

- **Open Data Portal (data.gov.si):** A central platform for accessing public sector data.
- **Digital Slovenia Strategy:** Aims to enhance digital transformation through open data initiatives.
- **Guidelines by the Ministry of Public Administration:** Encourage public institutions to publish data in accessible formats.

Despite progress, most open data remains static, with limited integration of IoT-based dynamic data. Initiatives such as Nova Gorica's road speed meters demonstrate potential but highlight the need for broader adoption.

2. Open Data providers and tools

The open data culture is developing, the broader cooperation among the national level, regional and local level is still a challenge, various supportive program on national level settled, UL could focus on description of supportive programmes

In Slovenia, several national and regional organizations are responsible for collecting and providing data on the environment, water, energy, waste, and transport.

Various national and regional organizations collect and provide data across key sectors:

- **Environment:** Slovenian Environment Agency (ARSO) provides air quality, climate, and biodiversity data.
- **Water:** ARSO and the Water Directorate (DRSV) oversee water quality, river flow, and groundwater levels.
- **Energy:** The Energy Agency and Statistical Office (SURS) offer data on energy markets, renewable sources, and consumption.
- **Waste:** ARSO collects waste generation and recycling data, while the Ministry of the Environment manages national waste policies.
- **Transport:** The Ministry of Infrastructure and Slovenian Infrastructure Agency (DRSI) gather data on roads, railways, and traffic.

Key insights:

- A siloed approach persists, with limited cooperation between national, regional, and local levels.
- Technical standards for IoT and dynamic data are lacking.

- Private sector open data integration remains underexplored.

Supportive initiatives include:

- **Ministry of Public Administration:** Oversees the national open data portal and organizes training.
- **Digital Innovation Hub Slovenia (DIH):** Assists businesses in leveraging open data.
- **Technology Park Ljubljana:** Supports startups and innovation through open data use.
- **Chamber of Commerce and Industry:** Promotes open data use among businesses.

3. Open Data use cases

Open data is increasingly used to address urban development, sustainable mobility, public safety, and green infrastructure challenges. Relevant data sources include:

- 3D city models: Enable better urban planning and support sustainable development.
- Satellite imagery: Useful for monitoring environmental changes, agriculture, and urban spaces.
- Meteo station readings (rain, solar radiation): Aid in analyzing climate conditions and forecasting adaptation needs in urban environments.

Hackathons are occasionally organized, often focusing on data-driven innovation. Examples include events hosted by the University of Primorska and the Primorska Technology Park. These initiatives foster collaboration and promote open data for sustainable urban development.

4. Open Data maturity assessment

Key insights:

- Data availability can be evaluated at moderate level
- Data quality on moderate-high level
- Data use is growing so on emerging level
- Governance established (portal, staff, strategy, events)
- Impact is low to some

The Nova Gorica region, located in the Primorska area of Slovenia, has shown interest in embracing Open Data initiatives, but its level of Open Data maturity can be considered developing. While Slovenia has made significant progress in promoting Open Data at the national level, the implementation and utilization at the regional and municipal levels, including Nova Gorica are still evolving.

Numerous examples of open data usage can be observed.

The city/region's strategy provides political and financial support for the open data agenda, a staff training system is in place, and a process for opening city agenda data has been established.

Dimension	Initial	Emerging	Established	Leading
Data Availability	Limited	Moderate	Broad	Comprehensive
Data Quality	Low	Moderate	High	Excellent
Data Use	Minimal	Growing	Active	Highly Active
Governance	Informal	Initial	Formal	Advanced
Impact	Low	Some	Clear	Significant

Orienting the Open Data in the City of Nova Gorica

Developing a strategic orientation for Open Data in the pilot area requires aligning its application with local priorities and challenges, as identified in **Activities 1.1 and 1.2.** The strategy focuses on establishing a robust framework to guide data use in support of urban governance and sustainability goals.

1.1 Strategic Objectives

- **Enhancing Decision-Making:** Use Open Data to inform policies in key areas, such as traffic management, environmental monitoring, and urban planning.
- **Promoting Transparency:** Ensure that datasets are accessible, fostering trust among citizens and stakeholders.
- **Enabling Innovation:** Encourage public and private sector innovation through the availability of high-quality, interoperable datasets.
- **Priority Directions and Goals of TUS Nova Gorica 2030:**

1. SMART AND ENTREPRENEURIAL CITY

- **Goal 1:** An economically dynamic university city.
- **Goal 2:** A rejuvenated city with young talents and innovative enterprises.
- **Goal 3:** A center for green technologies.

2. FAIR AND ATTRACTIVE CITY

- **Goal 1:** A supportive work and living environment for all generations.
- **Goal 2:** Care for the elderly and vulnerable population groups.
- **Goal 3:** Creative social engagement and a high-quality living environment.

3. GREEN AND HEALTHY CITY

- **Goal 1:** Sustainable mobility with e-mobility, public transport, and cycling routes.

- **Goal 2:** A healthy environment through carbon footprint reduction and efficient energy use.
- **Goal 3:** A city in a park – a green tourism destination.

4. CONNECTED AND ACCESSIBLE CITY

- **Goal 1:** A cross-border Gorica connected with modern transport infrastructure.
- **Goal 2:** An efficient cross-border sustainable mobility system.
- **Goal 3:** A shared cross-border ecosystem and cultural habitat.

5. WELL-GOVERNED METROPOLITAN AREA

- **Goal 1:** Efficient city systems and processes.
- **Goal 2:** Digital transformation and smart resource management.
- **Goal 3:** Participatory decision-making by active citizens.

Description of Priority Directions and Goals:

1. SMART AND ENTREPRENEURIAL CITY

Nova Gorica aims to become an economically progressive city by integrating the university environment, young talents, and innovative enterprises. The goal is to promote sustainable investments, revitalize degraded areas, and develop green technologies.

2. FAIR AND ATTRACTIVE CITY

The city seeks to ensure a high-quality living environment for all generations, with a focus on social inclusion, affordable housing, and well-designed public spaces. Additionally, it aims to promote cultural and artistic creativity as well as sports activities.

3. GREEN AND HEALTHY CITY

Nova Gorica is committed to reducing its carbon footprint, optimizing energy use, and promoting sustainable mobility. The goal is to become a green tourism destination by preserving the natural environment and developing sustainable tourism.

4. CONNECTED AND ACCESSIBLE CITY

The city aims to improve transport connectivity with modern infrastructure, including rail and road networks. The goal is to establish an efficient cross-border sustainable mobility system and strengthen connections between Nova Gorica and Gorizia in Italy.

5. WELL-GOVERNED METROPOLITAN AREA

Nova Gorica strives for efficient urban management, digital transformation, and citizen participation in decision-making. The objective is to ensure transparent and effective governance of city processes.

Key Performance Indicators:

For each priority direction, key performance indicators are defined to measure progress in achieving the goals. These indicators include the number of new jobs, the unemployment rate, the share of renewable energy sources, the number of cycling routes, the level of citizen participation in decision-making, etc.

1.2 Strategic objectives in the city of Nova Gorica

Building up on what works..

Nova Gorica's potential and why it is an ideal candidate for growth

The city is unique in multiple ways, it is a post-WWII city, uniquely located on the border with Italy. Its blend of Slovenian and Italian influences, coupled with its history of dividing and reuniting, gives it a distinct cultural and geopolitical identity.

The city of Nova Gorica can become a city that leverages certain opportunities and become a leading smart city.

1. **Relatively Small and Manageable**
   As a smaller city, Nova Gorica offers a controlled environment, ideal for piloting innovative smart city solutions and testing new technologies efficiently.
2. **A New and Flexible City**
   Founded post-WWII, Nova Gorica's modern infrastructure allows for quick adaptations and seamless integration of smart systems, making it a model for forward-thinking urban planning.
3. **Abundant Development Space**
   The city's large number of vacant and underused spaces provide opportunities for smart infrastructure, including urban agriculture, renewable energy projects, and sustainable housing.
4. **Leveraging the Border**
   The proximity to Gorizia allows both cities to capitalize on cross-border cooperation, sharing resources and data to enhance transportation, energy systems, and cultural innovation, setting a precedent for international smart city models.
5. **Increased urban development department budget**

   The city requires more resources to implement innovative projects, develop infrastructure, and optimize public spaces. This budget increase would also help address new opportunities in sustainable urban development, technology integration, and enhancing the quality of life for residents.

Nova Gorica, with its unique combination of geographical, historical, and spatial advantages, has an excellent starting point for transforming into a leading smart city in Europe. Its location, rich heritage, and manageable scale create a foundation for sustainable development and technological innovation that could serve as a model for the wider region.

2.1 Key Pillars of Strategy

- **Data Governance:** Define clear policies for data ownership, management, and sharing to ensure consistency and accountability.
- **Data Accessibility:** Prioritize the publication of datasets in user-friendly formats (e.g., APIs, CSV) with regular updates and comprehensive metadata.
- **Stakeholder Engagement:** Establish partnerships between government, businesses, academia, and civil society to co-create solutions based on Open Data.
- **Technical Enablement:** Build technical infrastructure to support IoT integration and interoperability across sectors.

2.2 Key pillars of Strategy in the City of Nova Gorica:

1. **Strengthening Cross-Border Cooperation with Gorica through EGTC Integration**

Nova Gorica should actively develop its partnership with neighboring Gorica and promote a unified approach to regional development. The **European Grouping of Territorial Cooperation (EGTC)** plays a key role in aligning policies, coordinating joint planning, and implementing projects in culture, economy, and urban planning. Closer cooperation would enhance the area's competitiveness and strengthen urban cohesion, while joint initiatives and projects would create sustainable solutions benefiting residents on both sides of the border.

2. **Leverage smart technologies** (IoT, GIS, Open Data).

By integrating smart technologies, Nova Gorica can improve urban management and service delivery. Initiatives include deploying IoT sensors for data collection and utilizing GIS and Open Data platforms to support transparent and efficient decision-making.

3. **Promote resilience, sustainability and carbon neutrality.**

Nova Gorica is actively committed to sustainable development by introducing policies aimed at **reducing carbon emissions and increasing the use of renewable energy sources**. These efforts reflect the city's ambition to become a regional leader in environmental responsibility while contributing to the long-term well-being of its residents and the preservation of natural resources.

4. **Engage citizens through participatory governance.**

The city prioritizes citizen involvement in decision-making processes to ensure inclusivity and transparency. Public forums, digital platforms, and participatory budgeting are key tools used to involve residents in shaping their community.

5. **Modernizing Infrastructure for Smart Management**

Development plans include **upgrading urban infrastructure** and establishing capabilities for **real-time data analysis**, enabling faster and more informed decision-making. Planned investments in smart systems focus on **traffic management, environmental monitoring, and improved emergency response**. These measures will increase the city's resilience and contribute to greater efficiency and quality of services for residents.

3. Alignment with Pilot Area Needs

- **Mobility and Climate Focus:** As identified in Activity 1.2, traffic and environmental data should be prioritized for immediate action, possibly leveraging existing sensor networks.
- **Scalability and Transferability:** Develop solutions that can be adapted to other contexts and scaled to larger regional or national initiatives.
- **Citizen-Centric Approach:** Incorporate citizen feedback through participatory methods, such as workshops and hackathons, to identify priorities and improve engagement.

4.1 Immediate Actions / Plans:

- Conduct stakeholder workshops to identify data priorities and gaps.

- Initiate pilot studies focused on traffic and climate data collection, ensuring compliance with privacy regulations.
- Design communication strategies to promote the benefits of Open Data and address resistance among stakeholders.

4.1.1 Ensuring data visualization of existing data nad data collected in the first phase – Long-Term goal: establishing a Geoportal for OD

In the first phase, it is necessary to ensure the visualization of already existing data and project-related data. The long-term goal is to establish a geoportal for open data (OD), which would provide residents and businesses in Nova Gorica and Gorizia with access to shared data, fostering transparency and cooperation with Gorizia.

Key activities:

- **Development of a geoportal for OD:** In the short term, the development of a user-friendly geoportal should begin, accessible to the residents and administrations of Nova Gorica. The portal must provide easy access to key data, such as traffic information, environmental indicators, and cultural content. Over time, the goal is to expand the geoportal into a unified cross-border system integrating open data from Nova Gorica and Gorizia.
- **Cultural and economic integration:** Use the portal to promote cross-border cultural and economic activities, particularly in the context of the European Capital of Culture project.
- **Citizen participation:** Enable the collection of feedback from residents on both sides of the border and include them in shaping the future of the cross-border urban region.

4.1.2 Foster Public-Private Partnerships for Technological Innovation

Public-private partnerships will be essential for implementing cross-border smart city initiatives and fostering innovation in the region.

Key activities:

- **Cross-Border Innovation Partnerships**: Collaborate with technology companies in both Slovenia and Italy to develop and implement IoT, AI, and smart city solutions that benefit both cities.
- **Smart City Hackathons**: Organize cross-border hackathons that engage innovators from both countries to solve urban challenges related to transportation, energy efficiency, and public services.

Private Sector Investment: Encourage investment in smart city infrastructure from private companies in both Slovenia and Italy, focusing on IoT, AI, and smart utilities.

Hackathons

A **hackathon** is an event where people engage in rapid and collaborative engineering over a relatively short period of time such as 24 or 48 hours.

Empower citizens through Open Data and participation, provide workshops, build up the digital literacy for residents as well as municipal staff.

Two hackatons are planned: one hackathon will focus on the **potential of open data**, exploring ways to structure, improve, and utilize data for public benefit. The other will center on the **development of a geo-portal**, enabling better visualization, interaction, and integration of spatial data for both citizens and decision-makers.

4.1.3 Capacity Building for Digital and Data Literacy

Capacity building will be essential for both cities' staff and residents to fully capitalize on smart city technologies and the benefits of cross-border collaboration.

Key activities:

- **Training for City Staff**: Provide joint training programs for municipal employees in Nova Gorica and Gorizia to ensure both cities' staff have the skills needed for GIS, data management, and IoT integration.
- **Public Awareness Programs**: Organize workshops for citizens from both cities to raise awareness of the benefits of Open Data, smart city technologies, and cross-border urban integration.
- **Collaboration with Universities**: Establish partnerships with universities in Slovenia and Italy to research and develop innovative solutions for smart city governance, focusing on cross-border cooperation and cultural integration.

4.1.4 Deploy IoT Sensors for Real-Time Data Collection

IoT sensors will provide dynamic, real-time data to support various aspects of city management. Cross-border data integration will ensure seamless urban management across both Nova Gorica and Gorizia.

Key activities:

- **Install Smart Sensors**: Deploy IoT sensors across the city and coordinate sensor data sharing with Gorizia for traffic flow, environmental monitoring, and public safety across the border.
- **Data Integration**: Link sensor data with the GIS platform for better cross-border data analytics and coordination.
- **Cross-Border Mobility**: Collaborate with Gorizia to monitor and optimize cross-border transportation networks, ensuring efficient mobility for residents and visitors during the European Capital of Culture event and beyond.
- **Smart Utilities**: Implement shared systems for monitoring water and energy usage, creating efficiencies and reducing resource consumption across the region.

Potential result: Circular city - Eliminating the waste management problems

This whole region faces a **waste management challenge**, but this can be addressed by integrating **IoT and sensor technology** into its waste collection systems. By installing sensors in waste bins, the city can monitor real-time fill levels and optimize collection routes, reducing operational costs and minimizing environmental impact. IoT solutions can also provide data on waste generation patterns, enabling more efficient resource allocation and waste reduction strategies. This smart approach would lead to a cleaner, more efficient urban environment and promote sustainable waste management practices.

4.1.5 Continuous Improvement and Open Data Maturity

Nova Gorica and Gorizia must continually improve their Open Data maturity to ensure transparency, accessibility, and innovation.

Key activities:

- **Data Quality and Standards**: Collaborate on cross-border data standards to ensure high-quality data collection and integration for both cities.
- **Open Data Portals**: Regularly update Open Data portals in both cities, providing citizens, researchers, and businesses with the information they need to drive innovation.
- **Feedback Loops**: Establish feedback mechanisms where citizens, businesses, and cultural organizations from both cities can suggest improvements to the Open Data system.

This strategy serves as a roadmap to integrate Open Data into each pilot area's governance structure, ensuring its utility for current needs while laying a foundation for future advancements.

5. Long Term Actions/Plans:

5.1 Investments in Computer and Sensor Infrastructure

Significant investment in computing and sensor networks is required to support joint data collection and AI-driven decision-making across the Nova Gorica-Gorizia region.

Key activities:

- **Expand IT Infrastructure**: Invest in high-performance computing systems to support the data needs of both cities, including real-time processing for AI models and digital twin simulations.
- **IoT Network Expansion**: Deploy IoT devices across the border region to monitor environmental conditions, utilities, and traffic flows in both Nova Gorica and Gorizia.
- **5G Network Rollout**: Work with telecom providers to deploy 5G technology in the cross-border area, ensuring seamless data transmission and faster communication between both cities.

5.2 Development of a Digital Twin for Nova Gorica and Gorizia

A cross-border digital twin will allow both cities to simulate urban scenarios, optimize infrastructure, and coordinate responses to regional challenges.

Key activities:

- **Create a Digital Twin Platform**: Develop a digital twin that integrates real-time data from Nova Gorica and Gorizia, enabling simulations of urban planning, infrastructure management, and disaster preparedness.

- **Cultural Integration**: Use the digital twin to plan and manage cross-border cultural events, optimizing public spaces and infrastructure for the European Capital of Culture activities.
- **Cross-Border Disaster Management**: Simulate joint emergency scenarios (e.g., floods, traffic accidents) to improve preparedness and response across the border.

5.3 Utilizing Dynamic Data for Real-Time Decision-Making

Real-time data from IoT sensors and other dynamic sources will support responsive and adaptive governance across the Nova Gorica-Gorizia urban region.

Key activities:

- **Centralized Data Platform**: Create a centralized system that gathers and analyzes real-time data from both cities, enabling unified decision-making on transportation, utilities, and public safety.
- **AI-Powered Analytics**: Implement AI models to process cross-border dynamic data, offering insights into regional traffic, environmental conditions, and public safety management.
- **Real-Time Alerts**: Coordinate real-time alert systems for issues affecting both cities, such as air pollution spikes, traffic congestion, and emergency situations.

5.4 Implementation of AI-Driven Decision-Making Systems

AI will play a critical role in optimizing resource management and decision-making across Nova Gorica and Gorizia.

Key activities:

- **AI Integration**: Utilize AI to analyze data from both cities, optimizing resource allocation, transportation networks, and utilities management.
- **Automated Service Management**: Use AI to automate service management across borders, adjusting streetlights, energy distribution, and public services in response to real-time data.
- **AI for Cultural Event Management**: Leverage AI to manage large-scale cultural events related to the European Capital of Culture, optimizing public transport, crowd control, and venue management.

5.5 Establishing a local GIS department

In the first phase, a working group will be formed, which will, among other tasks, define the responsibilities of a potentially newly established geographic information systems (GIS) department. The working group will visit best practice examples, such as in Ljubljana, and prepare a plan for the integration of the GIS system, which will manage spatial data, monitor infrastructure, support policy design, and integrate cross-border data to support regional collaboration.

Key activities:

- **Build GIS Infrastructure**: Set up a GIS office to collect, manage, and analyze spatial data. Ensure the integration of cross-border data from Gorizia (Italy), creating a seamless, cooperative GIS platform.
- **Data Management**: Establish joint data-sharing protocols between Nova Gorica and Gorizia for regional planning, transport, and utilities, enhancing cross-border decision-making capabilities.
- **Cross-Border Collaboration**: Collaborate with Gorizia's urban planning and GIS departments to develop unified spatial strategies that support cultural, transportation, and economic growth in both cities.

5.6 Focusing on key urbanism concepts

Considering the long-term development opportunities, some key potentials are highlighted:

1. Reclaim and Revive - Reusing public space

A great potential is reusing public spaces more effectively. Many underutilized areas, such as vacant lots and disused urban spaces, can be transformed into vibrant community hubs, green spaces, or areas for cultural and recreational activities. By reimagining and repurposing these spaces, the city could create more inclusive environments for social gatherings, public art installations, and sustainable urban agriculture. This would not only enhance the city's liveability but also foster stronger community engagement and cultural expression. Additionally, empty parking lots could be repurposed for new uses, such as markets or event spaces.

2.Play & GO - Sports as an urban connector

Utilizing and developing sports as an urban connector can play a crucial role in fostering community engagement and enhancing public spaces in Nova Gorica. Sports infrastructure, such as bike paths, running tracks, and multi-purpose sports fields, can create vibrant, inclusive environments that encourage physical activity and social interaction. By integrating sports facilities into public spaces, the city can connect neighbourhoods, promote healthy lifestyles, and strengthen social cohesion. Transforming underutilized areas into sports hubs also provides opportunities for cross-border events with Gorizia, further boosting community ties and cultural exchange.

6. Urban branding

Urban branding refers to the strategic process of creating a unique and compelling identity for a city or urban area. It involves leveraging a city's characteristics, culture, history, and aspirations to promote its distinctiveness and enhance its reputation. Urban branding is often used to attract tourists, investors, businesses, and new residents, as well as to strengthen the sense of identity and pride among current residents.

1. Key Components of Urban Branding:

1. **City Identity**: Highlighting the unique traits of a city, such as its architecture, cultural heritage, or natural landscapes.

2. **Vision and Narrative**: Crafting a story or message that reflects the city's values, aspirations, and future direction.

3. **Stakeholder Engagement**: Collaborating with local communities, businesses, and policymakers to ensure the branding aligns with the city's authentic character.

4. **Visual and Verbal Elements**: Designing logos, slogans, and other visual representations that embody the city's essence.

5. **Targeted Campaigns**: Using media, events, and marketing initiatives to communicate the brand to specific audiences, such as tourists, investors, or residents.

9. Benefits of Urban Branding:

- **Economic Growth**: Attracts businesses, tourists, and investments by showcasing the city's potential.
- **Cultural Promotion**: Enhances global awareness of the city's cultural and historical assets.
- **Community Cohesion**: Fosters a sense of belonging and pride among residents.
- **Global Competitiveness**: Helps the city stand out in a globalized world by emphasizing its unique selling points.

Urban branding is increasingly seen as a vital tool for cities to compete and thrive in a dynamic global landscape, blending marketing strategies with urban development goals.

10. Branding Nova Gorica

*Nova Gorica is a city rich in potential and uniqueness, embodying key themes such as **resilience**, **sustainability**, and **cross-border collaboration**. Positioned at the intersection of Slovenian and Italian cultures, it serves as a vibrant hub for education and innovation. As a post-carbon city, Nova Gorica is committed to creating a greener future while promoting its identity as a student city, where young minds can thrive. This section explores how Nova Gorica aligns with these themes, highlighting its journey toward becoming a model for sustainable urban living.*

6.2 Nova Gorica as a:

6.2.1 Resilient city

Nova Gorica is a **resilient** city, marked by its ability to adapt and thrive despite historical and geopolitical challenges. Positioned on the Slovenian-Italian border, it embodies themes of **unity** and **innovation**, leveraging cross-border collaboration for growth. With a focus on **sustainability** and **smart city development**, Nova Gorica maximizes its unique geographical location and modern infrastructure. Its forward-thinking urban planning fosters **connectivity**, while empty spaces present a canvas for transformative, sustainable growth. As a hub of **culture** and **innovation**, it is a beacon of resilience.

6.2.2 Border city

As a border city, embodies the spirit of **connection** and **diversity**, straddling the line between Slovenia and Italy. This unique position allows it to serve as a bridge between cultures, fostering **cross-border collaboration** in everything from infrastructure to cultural exchanges. Its location offers endless potential for **innovation**, transforming challenges of division into opportunities for unity and growth. The border itself becomes a resource, opening doors for economic, social, and urban development, making Nova Gorica a true symbol of **integration** and **progress**.

6.2.3 Student city

Nova Gorica, as a **student city**, offers an inspiring environment for learning and innovation. Its proximity to major educational institutions and cross-border connections with Gorizia enhance access to diverse academic and cultural experiences. With a growing focus on smart city development and sustainability, Nova Gorica provides students opportunities to engage in forward-thinking projects. The city's vibrant cultural scene, green spaces, and affordable living make it a dynamic, supportive hub for students seeking both personal and professional growth in an international setting.

The **University of Nova Gorica** (UNG) is a young, research-oriented institution with a focus on interdisciplinary studies. Founded in 1995, it offers programs in natural sciences, engineering, humanities, and arts, with strong ties to local industries and international institutions. UNG places a strong emphasis on research in fields such as environmental sciences, physics, and viticulture. The small student population allows for close mentorship, and the university's proximity to the Italian border fosters cross-cultural academic exchange. It also collaborates with Gorizia and hosts international students.

6.2.4 Post-carbon city

Nova Gorica is positioning itself as a **post-carbon city**, focusing on reducing carbon emissions and embracing sustainable development. With initiatives aimed at enhancing energy efficiency, renewable energy integration, and sustainable urban planning, the city is working toward a carbon-neutral future. The abundance of green spaces and opportunities for eco-friendly projects, such as the transformation of empty areas into sustainable developments, underscores its commitment to sustainability. This vision aligns with broader European goals, making Nova Gorica a model for future **resilient** and **sustainable** cities.

Nova Gorica's forward-thinking approach, combined with its strategic location, makes it a city ready to embrace the challenges of the future.

Conclusion:

This local action plan positions Nova Gorica and Gorizia as model smart cities with cross-border collaboration at their core. By integrating Open Data and IoT solutions, both cities can enhance governance capabilities, improve public services, and strengthen cultural and economic ties. The European Capital of Culture event provides a unique opportunity to showcase the power of smart city technologies in fostering regional unity, cultural integration, and urban sustainability. Through joint investment in infrastructure, data-driven decision-making, and collaboration with universities and the private sector, Nova Gorica and Gorizia will become leaders in cross-border smart city governance, providing a blueprint for other European cities to follow.

Activities of the Local Action Plan for City of Nova Gorica

Activity ID	Activity title	Activity description/result	Timeframe, Responsibility
0. Open data strategy			
D.1.1	*Establish an informal working group in collaboration with the municipality.*	Develop an open data framework that encompasses a well-defined competency scheme, clear coordination rules, regular networking events, and a robust partnership and funding model. These components are essential prerequisites for implementing an effective open data strategy.	January 2025, UL + MONG
D1.2	*Development of the Draft of OD Strategy*	Initiating collaboration with the municipality, defining roles, identifying key challenges, and fostering partnerships	January 2025, UL + MONG
D1.3	*Planning and executing 2 hackathons*	The hackathons will serve as a platform to bring together diverse stakeholders, including municipal representatives, data experts, developers, and citizens, to collaboratively explore the potential of open data and digital tools. **Key Elements:** • **Workshops:** Introductory sessions to familiarize participants with open data, spatial data, and relevant digital tools. • **Mentorship:** Experts in GIS, urban planning, data science, and technology will support teams throughout the event. • **Challenges:** Predefined problem areas aligned with the city's digital transformation goals, such as data accessibility, urban planning, and citizen engagement. • **Networking:** Opportunities for participants to connect with potential collaborators, industry professionals, and municipal representatives. **Expected Outcomes:** • **Hackathon 1 – Unlocking Open Data:** Prototypes, guidelines, or tools that improve data transparency, quality, and usability. • **Hackathon 2 – Building a Geo-Portal:** Interactive solutions for visualizing and integrating spatial data to support informed decision-making. • Strengthened partnerships between the municipality and stakeholders. • Practical insights for refining the city's open data and digital strategy.	AUTUMN 2025, MONG
D1.4	*Collaboration with UL FA*	Joint efforts with UL FA to develop new and innovative urbanism concepts, exploring ideas both related to open data and independent of it. The collaboration aims to generate fresh perspectives on urbanism and development, with potential outcomes including an exhibition, public debates, and discussions to engage the broader community.	June 2025, MONG
D1.5	*OD strategy*	Develop a comprehensive open data strategy by incorporating inputs from EnCLOD project partners and fostering collaborative discussions with the municipality.	End of 2025, MONG + w.

		The process will aim to formalize the program/agenda and implement steps to track progress during the EnCLOD project, as well as long term after its conclusion.	assistance from UL
2. Open data sources			
D2.1	*National Statistics*	Compilation of relevant national statistical data to be utilized in Nova Gorica, focusing on key indicators such as population demographics, economic trends, mobility patterns, environmental metrics, and housing statistics. This data will serve as a foundation for informed decision-making and strategic urban planning.	Done by UL
D2.2	*List of Existing Local Open Data*	Compilation of available local open data sources, including datasets on transportation, infrastructure, public services, environmental conditions, and urban planning.	Done by UL
D2.3	*Mapping of Other Potential Open Data Sources*	Identification and mapping of additional potential open data sources, including data from local businesses, civic organizations, research institutions, and community-driven initiatives.	Duration of the project, MONG
D2.4	*List/Contact with Other Data Providers*	Compilation of a list of potential data providers, including government agencies, private sector companies, research institutions, and community groups. Establishing contact with these providers will facilitate partnerships, data sharing, and collaboration to enhance the city's open data resources and ensure comprehensive coverage across various domains.	Duration of the project, MONG
3. Design of territorial governance			
D3.1	*Microzoning Nova Gorica*	A holistic analysis of Nova Gorica's microzoning to define "digital urban planning units." The result will be a comprehensive map of Nova Gorica's microzones, providing a foundation for targeted urban planning and digital strategy development.	February, UL
D3.2	*Mapping Available Open Data Sets to Microzones*	Mapping existing open data sets to the defined microzones of Nova Gorica, aligning relevant datasets with specific geographic areas. This will include integrating data related to transportation, environment, demographics, infrastructure, and public services into the corresponding microzones, enabling more localized, data-driven urban planning and decision-making. The result will be a visual representation that ties open data to specific urban areas for better analysis and targeted	June 25, UL
D3.3	*Traffic*	Implementation of a comprehensive traffic sensing system to monitor and analyze traffic flow, congestion, and patterns across Nova Gorica. This system will integrate various sensor technologies such as IoT sensors, cameras, and GPS data to gather real-time information on traffic conditions. The result will be a dynamic, data-driven view of traffic behavior, enabling more efficient urban mobility solutions, better traffic management, and informed decision-making for city planning.	February/March 2025, Outside colaborator
D3.4	*Air quality*	Deployment of a network of sensors to monitor air quality across Nova Gorica, capturing data on pollutants. This will provide real-time insights into air quality levels throughout the city. The result will be an accessible, comprehensive air quality map for citizens and city officials	February/March 2025, Outside colaborator

4. Open data community			
D4.1	*Activities with EnCLOD Working Group*	Initiate a discussion on the OD agenda within the EnCLOD working group and organize the first local event to raise awareness and foster collaboration.	January 2025, UL, MONG
D4.2	*List of Potential Partners*	Compilation of potential partners for the open data agenda, including local government bodies, research institutions, private companies, civic organizations, and tech startups. This list will identify organizations with expertise, resources, or interest in contributing to open data initiatives, fostering collaboration and ensuring the success of future open data projects.	Early 2025, MONG
D4.3	*EnCLOD Project Marketing*	Development and execution of a marketing strategy for the EnCLOD project to raise awareness, engage stakeholders, and promote open data initiatives. This will include creating promotional materials, leveraging social media, organizing events, and establishing partnerships to ensure broad visibility and active participation in the project's activities.	Early – Mid 2025, MONG ALDA
D4.4	*Local Events for EnCLOD Project*	Organization of a series of local events to engage the community, stakeholders, and experts in the EnCLOD project. These events will include workshops, seminars, and discussions focused on open data, urban planning, and innovation, fostering collaboration, sharing knowledge, and building momentum for the project.	Early - Mid 2025, MONG UL
D4.5	*Training and Education*	Training sessions will focus on open data management, urban planning, and related technologies. Targeting local stakeholders—government officials, community members, and professionals—they aim to build skills and promote data-driven decision-making in urban development.	Spring 2025, UL + MONG
D4.6	*Raising data literacy levels*	Initiatives will enhance community data literacy through workshops, seminars, and online resources. These activities will equip citizens, government employees, and organizations with skills to analyze and use open data, empowering informed decisions and supporting data-driven urban development.	Spring 2025, UL + MONG
D4.7	*1ST Hackathon Preparation Unlocking Open Data*	**Planning Phase:** Identify key datasets, engage experts, and define challenges related to data accessibility, quality, and integration.	Mid 2025, MONG
D4.8	*Hackathon activities*	**Hackathon Focus:** Participants will work on structuring, improving, and visualizing open data to enhance its usability for citizens, businesses, and local authorities. **End Goal:** Develop prototypes, guidelines, or tools that improve data transparency and facilitate new applications for public and municipal use.	Autumn 2025, MONG
D4.9	*2ND Hackaton preparation and execution Building a Geo-Portal*	**Planning Phase:** Define spatial data needs, involve GIS experts, and outline desired functionalities for an interactive geo-portal. **Hackathon Focus:** Teams will develop solutions for visualizing, analyzing, and integrating spatial data, making geographic information more accessible and actionable.	2026, MONG

		End Goal: Prototype or refine a geo-portal that supports decision-making, urban planning, and citizen engagement through intuitive digital tools.	
5. Digital tools and twinning – specific activities			
Short term goals			
D5.1	Existing Use Cases Collection	A compilation of use cases showcasing the practical application of open data and digital tools in urban planning and management. This collection will feature successful examples from other cities and projects, offering insights and inspiration for implementing similar strategies in Nova Gorica and shaping future use cases.	Done, UL
D5.2	Deployment of IoT Sensors for Real-Time Data Collection	Installation of Internet of Things (IoT) sensors across Nova Gorica to collect real-time data on various urban parameters, such as traffic flow, air quality, environmental conditions, and infrastructure usage. This sensor network will provide valuable insights for urban management, enabling data-driven decision-making and more responsive city services. The data collected will also feed into the city's open data platform, enhancing transparency and fostering innovation.	Februar - March 2025, Outside Collaborator
D5.3	Presentation of exhisting data and data from the project. long-term goal: establishment of a geoportal for access to od.	To ensure the presentation of existing data and data from the project. In the long term, work on the development of a geo-portal that will enable public access to spatial data, allowing citizens, businesses, and organizations to view, explore, and interact with geographic information.	Short term goal Mid – Late 2025, MONG
D5.4	Capacity Building for Digital and Data Literacy	A comprehensive initiative aimed at improving digital and data literacy across Nova Gorica, with three key components: • **Training for City Staff:** Offering specialized training programs for municipal employees to enhance their understanding of open data, GIS, and digital tools for urban planning and decision-making. • **Public Awareness Programs:** Organizing workshops, seminars, and outreach efforts to increase public awareness and skills related to data literacy, empowering citizens to engage with and utilize open data. • **Collaboration with Universities:** Partnering with local universities to integrate data literacy and digital skills into curricula, fostering collaboration between academia and the municipality to drive innovation and knowledge-sharing.	Spring 2025, UL + MONG
D5.5	Continuous Improvement and Open Data Maturity	A long-term strategy for continuous improvement of the open data infrastructure and processes, focused on enhancing the city's open data maturity. This will involve regular assessments of data quality, accessibility, and usage, as well as identifying areas for further development. The goal is to gradually advance the city's OD capabilities, ensuring that data is effectively utilized.	2026 – Beyond MONG
Longterm Goals			

D5.6A	Invest in Computer and Sensor Infrastructure	Strategic investment in advanced computer systems and sensor technologies to enhance the city's data collection, processing, and analysis capabilities. This infrastructure will support the deployment of IoT sensors, GIS systems, and data analytics platforms, enabling more efficient urban management and the creation of a robust, scalable foundation for future data-driven initiatives. The investment will ensure the city has the necessary tools to leverage technology for improved public services, sustainability, and urban planning.	Short – Long termn goal Late 2025? MONG
D5.6B	Possible results Circular city Eliminating the waste management problems	This whole region faces a waste management challenge, but this can be addressed by integrating IoT and sensor technology into its waste collection systems. By installing sensors in waste bins, the city can monitor real-time fill levels and optimize collection routes, reducing operational costs and minimizing environmental impact. IoT solutions can also provide data on waste generation patterns, enabling more efficient resource allocation and waste reduction strategies. This smart approach would lead to a cleaner, more efficient urban environment and promote sustainable waste management practices.	2026 and beyond MONG
D5.7	Digtal Twin	Development and implementation of a digital twin for Nova Gorica, creating a virtual representation of the city that integrates real-time data and models. This will enable better urban planning, simulation of scenarios, and informed decision-making by visualizing various urban systems, such as transportation, infrastructure, and environmental factors, in a dynamic and interactive digital environment.	2026-Beyond, MONG
D5.8	Utilize Dynamic Data for Real-Time Decision-Making	Leverage dynamic, real-time data from various sources, including IoT sensors, social media, and public feedback, to inform immediate decision-making processes. This approach will enable the municipality to respond quickly to emerging challenges, such as traffic congestion, air quality issues, and public service demands, ensuring more agile and effective urban management. By incorporating real-time data into decision-making, the city will improve operational efficiency and citizen satisfaction.	2026-Beyond, MONG
D5.9	Implement AI-Driven Decision-Making Systems	Introduction of artificial intelligence (AI) technologies to enhance decision-making processes within the municipality. These systems will analyze large datasets from various sources, including IoT sensors, public feedback, and urban models, to provide actionable insights and support predictive planning for urban development. AI-driven decision-making will improve the city's ability to optimize resources, anticipate challenges, and make informed, data-backed decisions for sustainable growth and efficient governance.	Late 2025, MONG
D5.10	Establish a Local GIS Department	In the first phase, a working group for Geographic Information Systems (GIS) will be established, tasked with preparing a proposal for the organization of a GIS service within MONG. This service will focus on the collection, management, and analysis of spatial data and will play a key role in supporting urban planning, infrastructure	2026, MONG

		management, and environmental monitoring. The service will enhance the city's ability to make informed decisions based on geographic data and integrate GIS technology with other city systems for more efficient urban management.	
D5.11	Final EnCLOD Guidance Contribution and report	Development of a comprehensive methodology for microzoning and the digitization of urban planning units, incorporating technical terminology related to IoT sensors. This contribution will provide detailed guidelines on how to integrate IoT technologies into urban planning, define digital urban units, and utilize real-time data for informed decision-making. It will serve as a key resource for municipalities seeking to implement advanced data-driven urban planning strategies, ensuring consistency and technical precision across projects.	End of 2026, UL outsorsing
D5.12	Urban Branding of Nova Gorica	Development of an urban branding strategy to position Nova Gorica as: 1. **Resilient City**: Showcasing innovation, green solutions, and adaptability to environmental and economic challenges. 2. **Border City**: Highlighting cultural diversity, its Slovenia-Italy connection, and cross-border collaboration. 3. **Student City**: Promoting educational opportunities, cultural events, and youth engagement to attract students and institutions. This strategy aims to define the city's identity, attract residents and visitors, and support sustainable development.	2026 – after conclusion of EnCLOD, MONG + outside contributors

F. Local Action Plan of the City of Žilina

Introduction

Data are a fundamental resource in our digital age, an essential material for territorial governance, innovation and economic growth. Open Data are made freely available to the public, without restrictive licenses: they represent an opportunity for territorial governance as they allow informed decision-making by the public authorities, awareness raising and involvement of the community, innovation among the actors of the economic system. The Local Action Plan for the City of Žilina developed by the Project EnCLOD describes a path to increase and advance the use of Open Data in this territory, with the aim of supporting territorial governance by public administrations and have a positive impact on everyday organisation in such fields as road management and environmental monitoring, traffic control, traffic safety and adaptation to climate change.

The Local Action Plan was born from an analysis of the actual state-of-the-art of Open Data in the City of Žilina, considering both the strengths and weaknesses of this territory, that in the last decades had opened increasingly to innovation and digital administration. Furthermore, the best examples in the use of Open Data for territorial governance have been examined throughout Europe and beyond, from Spain to Czech Republic, from Great Britain to France. A set of guidelines were defined and shared among the international partners of EnCLOD Project, to identify common goals to achieve and open the way to concrete measures.

The result is a Plan collecting a set of actions able to improve the quality and accessibility of Open Data in the City of Žilina both for the decision-makers and for the population, to further empower them in dealing with the critical choices that our challenging period presents. Some of the actions proposed by the Plan will be pilot tested during the ENCLOD project lifespan. Other actions included in the document are long-term purposes that need negotiation with the authorities and involvement of the community to find an application. All in all, the Local Action Plan is a comprehensive proposal to improve territorial governance through an advanced use of the Open Data, to make us all more aware in the decisions that every day we take.

Overview of Open Data in the City of Žilina

Institutional framework of Open Data

Open data initiatives are well-defined at the national level in Slovakia, supported by a national coordinator. Key national laws and frameworks include:

- **Constitution of the Slovak Republic:** Public authorities must provide information in an appropriate manner.
- **Act on GDPR:** Municipalities must ensure compliance with data protection laws.
- **Act on Free Access to Information:** Defines public information disclosure requirements.
- Regulation on Public Administration IT Standards: Sets technical requirements for publishing datasets.
- **National Concept of Public Administration Informatization:** Supports the publication of open data and provides methodological and technical assistance.

At the city level, Žilina is developing its open data strategy. While open data is generally static, the integration of IoT-based dynamic data remains a new challenge.

Open Government Initiative Action Plans in the Slovak Republic (usually in 2-year cycles): thanks to the implementation of the action plans, the portal data.gov.sk (later data.slovensko.sk) was established, technical standards for open data datasets were set, and the task of creating a publishing minimum was defined; the last action plan for 2024-2026 includes the task to increase the use, re-use of open government data and to produce **an annual report on the impact of open data in the Slovak Republic on selected areas**

Open Data providers and tools

Key providers of open data for the City of Žilina include:

- **City of Žilina and Subsidiaries**: Collect data on environment, water, energy, waste, and transport.
    - The Energy Company of Žilina (ESMŽ) manages energy-related data and smart technologies.
    - The public transport operator (DPMŽ) provides transport-related data, some of which are available on the city's portal (https://smart.zilina.sk/).

At the national level:

- **Slovak Hydrometeorological Institute (SHMÚ)**: Provides environmental and weather data (www.shmu.sk).
- **National Railway Company Slovakia (ZSSK)**: Shares train timetable data (www.zssk.sk).
- **Slovak Road Administration (SSC)**: Publishes road network data (www.ssc.sk).

The development of an open data culture in Žilina is progressing, but collaboration between the national, regional, and local levels remains challenging. The city still struggles with silo-based thinking, and there is no national strategy for IoT data collection in public spaces. Integrating private open data is not yet a priority. The majority of open data in Žilina is static, and there is no established technical standard for open

IoT or dynamic data. Additionally, the Energy Company of the City of Žilina (ESMŽ) could play a significant role in events like hackathons to foster innovation.

The quality of data in Žilina shows significant variation, with many datasets yet to be made available as open data. This underscores the need for better management and more systematic publication efforts. Capacity-building initiatives are essential to enhance data management and utilization. These challenges highlight the need for a comprehensive strategy and greater effort to leverage the potential of open data.

Open Data use cases

In Žilina, hackathons and other events are regularly organized, covering a variety of themes and involving both public and private sectors. A key challenge is to establish an appropriate portfolio of partners for the city's hackathons, focusing on open IoT data and assessing overall interest. This effort will help identify potential collaborations and foster innovation in the use of open data. Numerous funding opportunities are available in Slovakia to support open data initiatives, including national and EU grants, which contribute to digitalization and open data implementation in municipalities. Relevant topics for the EnCLOD project, such as urban development, sustainable and green mobility, traffic safety, climate change, and quality of life, are particularly important in guiding the city's open data efforts.

Open data in Žilina supports urban development, mobility, climate action, and quality of life. Key initiatives include:

- **Hackathons and Events:** Regular events like Startup Weekend Žilina (https://www.startupweekendzilina.sk/) and Citython Žilina (https://www.citython.sk/2022zilina/) foster innovation through open data use. Citython 2022, for instance, addressed urban mobility, smart mobility, and climate resilience. City representatives expressed strong interest in implementing the proposed solutions, highlighting the growing importance of data-driven approaches for urban challenges.
- **Funding Opportunities:** Several funding programs support open data initiatives. Slovakia's Recovery and Resilience Plan, including resources from Horizon projects, provides financial backing for local governments and municipalities aiming to use open data in urban planning and development. Innovation vouchers within the Slovak Recovery and Resilience Plan stimulate collaboration between municipalities and SMEs, encouraging digital transformation and the integration of open data into business processes. Digital vouchers also promote customized solutions for digitization, contributing to a more connected and digital future.
- **Support Organizations:** Several organizations support the adoption and use of open data. Alvaria (https://www.alvaria.sk/), for example, connects innovation-oriented communities and helps municipalities open their data through various educational and consulting activities. Alvaria's Open Data in Regions (https://www.alvaria.sk/) project, which was supported by the Operational Programme Efficient Public Administration, has been instrumental in advancing open data at the regional level. Similarly, Transparency International Slovakia (https://samosprava.transparency.sk/) regularly evaluates municipal open data and publishes transparency ratings for the 100 largest cities and municipalities, providing valuable insight into local data practices.

Examples of Available Data:

- 3D model of the city/area (with heights, etc.) available to the public or to professionals,
- meteo stations readings available to the public,

- high resolution satellites readings (1 m) available to the public,
- rain measurement available to the public.

Additional data is also being made available through initiatives like the Spaceport Hackathon (https://spaceoffice.sk/spaceport-hackathon/), organized by the Slovak Space Office, which encourages innovative solutions to urban challenges, such as smart mobility and climate resilience. This event helps to highlight Žilina's commitment to fostering technological innovation and integrating open data into city planning.

Žilina is progressing in its efforts to cultivate a robust open data culture by addressing data quality gaps, promoting collaborative partnerships, and exploring innovative data applications. These efforts are crucial in creating a smarter, more sustainable city where open data plays a central role in improving the quality of life and driving sustainable urban development.

Open Data maturity assessment

The open data maturity of Žilina is at an early stage. Data availability is moderate, while the quality of data is moderate to high. The use of open data is still emerging but shows signs of gradual growth. Governance structures are in place, including a dedicated portal, staff, strategies, and events. However, the impact of open data remains limited in several areas. Žilina could benefit from learning from Olomouc, a city with more advanced open data practices.

Žilina relies heavily on technical partners and is relatively passive in making datasets publicly accessible. The city lacks a comprehensive open data concept but has developed an IT system strategy and conducted an inventory of data sources.

Currently, open data usage is minimal, with decisions often based on ad hoc, non-public data. Although there is national-level support for open data, local municipalities frequently meet only the basic requirements. By participating in Clevernet and EnCLOD projects, Žilina has shown a growing commitment to advancing open data initiatives.

Dimension	Initial	Emerging	Established	Leading
Data Availability	Limited	Moderate	Broad	Comprehensive
Data Quality	Low	Moderate	High	Excellent
Data Use	Minimal	Growing	Active	Highly Active
Governance	Informal	Initial	Formal	Advanced
Impact	Low	Some	Clear	Significant

Orienting the Open Data in the City of Žilina

Foundations for Developing the City's Open Data Strategy

Previous analyses of open data usage for informing policies in key areas—specifically urban governance agendas (primarily those addressed by the EnCLOD project, i.e., transportation, environment, and urban planning)—reveal significant room for improvement.

The starting point is that the city possesses relatively extensive data resources in these areas; however, they are not readily available and are scattered across various systems. As a result, their use in practical city policymaking is limited and largely ad hoc.

The city lacks a systematic approach to comprehensively address its data agenda, including open data. Currently, there is only a plan to establish a central data repository where data, which the city owns or has access to, would be systematically stored via defined interfaces. To achieve this, a detailed and comprehensive inventory of the city's data resources will need to be conducted.

The city acknowledges the need to address this issue comprehensively and to systematically set up the necessary processes. It also recognizes the potential of systematic data collection, data opening, and their use for data-driven decision-making across a wide range of city agendas.

Opening datasets to the public also presents an opportunity to accelerate civic society, nonprofit organizations, and, of course, the innovation industry. A separate chapter in this area is the potential for research, development, and innovation at the university level, where the city could serve as a living urban laboratory.

Indirectly, this could:

- Unlock the societal and commercial value of data,
- Increase transparency and accountability,
- Enhance the quality and efficiency (value for money) of city services, or facilitate the introduction of new services,
- Improve urban development planning and prepare the city for future challenges.

Selected pillars of the framework for Open Data and Smart Governance are outlined in the city of Žilina's "Concept for the Development of Public Administration IT and Innovation" (KRIT), adopted in 2024 as an internal document of the Municipal Office.

The concept elaborates on plans to improve public services through the modernization and development of IT systems. It includes an analysis of the current state, strategic goals, and emphasizes the importance of engaging stakeholders in the transformation process. The strategic plan covers all aspects of digital transformation, including recommendations for system improvements, target architecture, action plans, timelines, pilot projects, and resource needs.

The strategic goals of the Municipal Office among others are:

a) Use of shared services—utilizing cloud services where they result in cost savings,

b) Data management—including publishing open data in an automated way without practical barriers to publication, as well as data ethics,

c) User-centered orientation—providing services based on life events,

d) Public procurement—eliminating vendor lock-in,

e) Human resources in public administration—defining key IT roles and capacities, strengthening professional staffing, and ensuring continuous employee training,

f) Cyber and information security.

These strategic goals will be addressed within the proposed future plan and reflected in specific action plans. The identified actions include:

1. Managing the digitalization and transformation of the Žilina Municipal Office,
2. Using data to enhance administration efficiency,
3. Training and development of human resources to support digital transformation,
4. Efficient use of joint procurement by the office and municipal organizations for digital tools,
5. Strategic use of resources among Slovak cities, including joint public procurement and the reuse of digital tools,
6. Strategic collaboration between the business, academic, and public sectors, including joint pilot projects,
7. Linking digital tools within new municipal competencies (objective responsibility, smart city initiatives, digital services),
8. Developing the city's digital services.

Unfortunately, the impact of this document is limited; to effectively implement this policy, it would be necessary to be adopted as binding at the City Council level.

Strategic Objectives

The strategy focuses on establishing a robust framework to guide data use in support of urban governance and sustainability goals, fostering digital transformation while addressing the unique needs of Žilina.

Horizontal aspects of Open Data in Žilina must include:

- **Enhancing Decision-Making:** Use Open Data to inform policies in key areas, such as traffic management, environmental monitoring, and urban planning. Leverage IoT sensor networks to provide dynamic datasets for real-time decision-making.
- **Promoting Transparency:** Ensure that datasets are accessible, fostering trust among citizens and stakeholders. Transparency builds trust and encourages public participation in urban governance.
- **Enabling Innovation:** Encourage public and private sector innovation through the availability of high-quality, interoperable datasets. Facilitate collaboration with academia, businesses, and civil society to develop innovative solutions. The city should utilize hackathons to generate impactful ideas and promote the practical application of Open Data.

Strategic objectives in the City of Žilina can be defined as follows:

- **Designing a comprehensive Open Data strategy for City of Žilina**: Establish a formal strategy tailored to Žilina's needs. This includes defining objectives for data collection, publication, and usage, ensuring alignment with national regulations and standards. The strategy should address dynamic IoT data, data quality assurance, and public engagement to enhance transparency and utility.
- **Strengthening data interoperability**: Develop frameworks and standards to ensure seamless integration and sharing of datasets across municipal departments and external stakeholders, enabling more effective collaboration.

- **Encouraging innovation through Open Data**: Create an ecosystem that supports innovation by providing high-quality, accessible datasets to local businesses, universities, and civic organizations for developing solutions to urban challenges.
- **Address the dependency on external partners** by building local capacity for Open Data management. City of Žilina should work on reducing its reliance on external partners for Open Data management while building its own capacity in this area.

  This includes, for example:

  - **Training internal staff**: Enhancing the expertise of city employees so they can effectively manage, publish, and analyse Open Data without constantly relying on external consultants or companies.
  - **Developing internal tools and infrastructure**: Creating or improving technical platforms and systems for data collection, management, and publication, enabling the city to operate more independently, investigating AI tools benefits.
  - **Engaging local partners**: Collaborating with local universities, non-profits, or small and medium-sized enterprises to build a local ecosystem of experts who can support Open Data initiatives.

  The goal is to reduce the city's dependency on expensive services or expertise provided by external vendors and instead leverage internal resources and local potential.
- **Integrate the city's energy, transport, and environmental datasets to support holistic urban planning and sustainability initiatives.** City of Žilina should integrate its datasets on energy, transport, and the environment, with a primary focus on transport, to support comprehensive mobility planning and sustainability initiatives.

  Specifically, this includes:
  - **Linking transport data with other datasets**: For example, combining information on traffic flows, air quality affected by transport, and energy consumption in transportation systems to analyse their interconnections.
  - **Supporting efficient transport planning**: Integrated data will enable planners to optimize public transport, improve traffic management, and minimize environmental impacts, such as reducing emissions.
  - **Sustainable transport initiatives**: The data can support projects like smart traffic lights, bike-sharing systems, the electrification of public transport, or better connectivity between industrial zones and urban infrastructure.
    The overall goal is to enhance mobility in the city while promoting sustainable urban development.)

Key Pillars of Strategy

- **Data Governance:** Define clear policies for data ownership, management, and sharing to ensure consistency and accountability. This includes ensuring compliance with the GDPR and national IT standards, as outlined in Slovakia's regulatory framework.
- **Data Accessibility:** Prioritize the publication of datasets in user-friendly formats (e.g., APIs, CSV) with regular updates and comprehensive metadata. Expand the scope of existing datasets, such as those hosted on the Smart Žilina portal, and ensure regular updates.
- **Stakeholder Engagement:** Establish partnerships among government, businesses, academia, and civil society to co-create solutions based on Open Data. Also co-create solutions through collaborative platforms and events.
- **Technical Enablement:** Build technical infrastructure to support IoT integration and interoperability across sectors. Develop a roadmap for microzoning to provide granular insights into urban dynamics.

Key Pillars of Strategy in the City of Žilina:

Žilina is the economic hub of the region and plays a significant role in fostering innovation and digital services. The city hosts traditional industrial sectors such as chemical production, woodworking and furniture manufacturing, engineering, and textiles. The surrounding area is home to a concentrated automotive industry.

The majority of businesses in Žilina are small enterprises. However, innovation and development in the city can be advanced by entities engaged in research and development, with access to modern technologies and specialized human resources, such as research institutes, science parks, innovation centers, and many innovative micro-enterprises.

The city's entrepreneurial environment is further supported by Inovia, an organization established by the City of Žilina, the regional government, and the University of Žilina (UNIZA). Inovia focuses on supporting startups and innovative projects, providing expert consulting, access to the latest technological trends, and facilitating the establishment of important connections within the business community. Its goal is to create conditions for sustainable economic growth and to encourage the emergence of new, innovative businesses that will generate new job opportunities for the city and contribute to its overall development.

The successful implementation of the Open Data strategy in Žilina requires a comprehensive and multidimensional approach. The following key pillars have been identified to guide the city's efforts toward achieving its strategic goals:

- **Data Governance:**

  Clear policies for data ownership, management, and sharing must be established to ensure consistency and accountability. This includes strict adherence to GDPR and Slovakia's national IT standards. Data governance provides the foundation for transparency and trust, creating an environment where data can be managed effectively and responsibly.

- **Data Accessibility:**

  Publishing datasets in user-friendly formats, such as APIs or CSV files, is a priority. Regular updates, along with comprehensive metadata, are essential to ensure the usability of datasets. This effort should expand the scope of existing datasets, including those hosted on the Smart Žilina portal. Enhancing data accessibility will empower stakeholders to leverage data for diverse applications, from public services to academic research.

- **Stakeholder Engagement:**

The success of the strategy depends on fostering robust partnerships between the government, businesses, academia, and civil society. Collaborative platforms and events should be established to co-create innovative solutions based on Open Data. Engaging stakeholders will ensure that the strategy addresses the needs of all sectors and maximizes the potential of Open Data.

- **Technical Enablement:**

Building and maintaining a robust technical infrastructure is critical for supporting IoT integration and ensuring interoperability across sectors. Starting with microzoning design and continuing with the mapping of open data and existing technologies that can open its dynamic data to the microzones provides the first picture on potential data sources, its typology and the reference to particular places, and as such identify the missing locations and prepare a strategy to fully cover the city.

- **Foundational Building Blocks for Implementation:**

The effective implementation of the strategy relies on four foundational building blocks:

a. Application Development

This involves the creation and maintenance of web portals and related applications designed to address specific agenda requirements. It also includes the development of application programming interfaces (APIs) to support seamless integration and data sharing.

b. Data for Application Development

Preparing datasets for immediate use and processing is essential. These datasets form the core component of the application platform, ensuring that data is readily available for various demands.

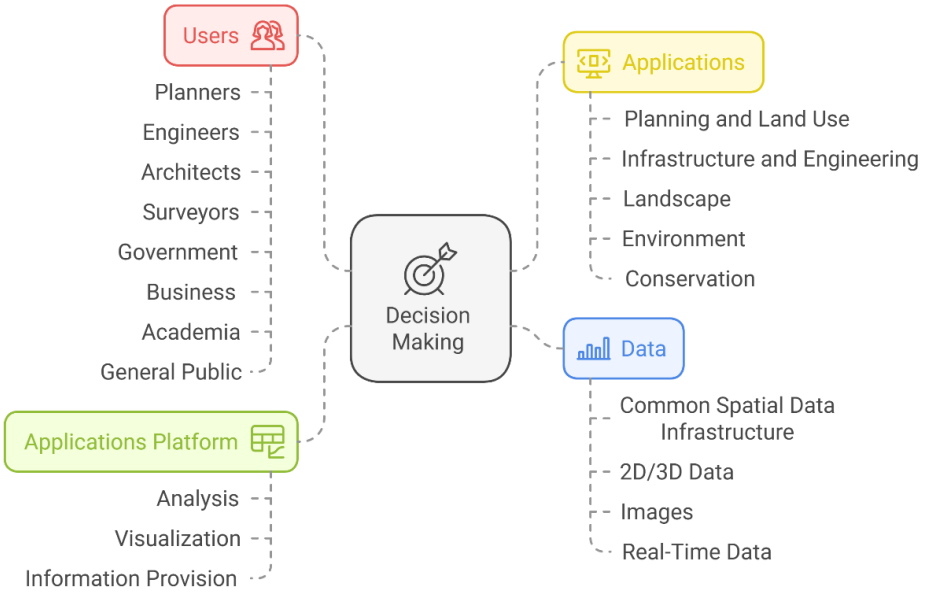
c. Technological Infrastructure

A robust combination of hardware and software is necessary for the operation of applications and data systems. This includes a comprehensive security infrastructure to safeguard data and ensure the reliability of the platform.

d. Business Architecture

The business architecture encompasses the services provided to various users, including municipal departments, academic institutions, and the general public. It requires an effective management and operational model to ensure the platform functions efficiently and delivers the desired value. The business architecture must also promote economic and effective use of resources.

By integrating these pillars and foundational components, the City of Žilina aims to create a cohesive and sustainable Open Data ecosystem. The strategy is designed not only to enhance the city's digital transformation but also to serve as a catalyst for innovation, transparency, and improved public services.



Spatial Data Infrastructure

Alignment with Pilot Area Needs

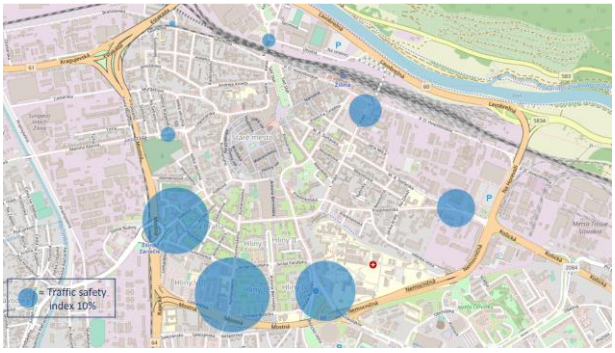
- **Mobility and Climate Focus:** As identified in Activity 1.2, traffic and environmental data should be prioritized for immediate action, possibly leveraging existing sensor networks.
- **Scalability and Transferability:** Develop solutions that can be adapted to other contexts and scaled to larger regional or national initiatives.
- **Citizen-Centric Approach:** Incorporate citizen feedback through participatory methods, such as workshops and hackathons, to identify priorities and improve engagement.

Basis for Assessing the Needs of the Pilot Area

The Clevernet project has demonstrated that there are significant issues in the key areas of transportation and climate in Žilina. Although on a smaller scale, it was evident that the city center faces problems not only with traffic volume but also with traffic safety. Furthermore, it was observed that there is a relevant environmental impact on the climate.

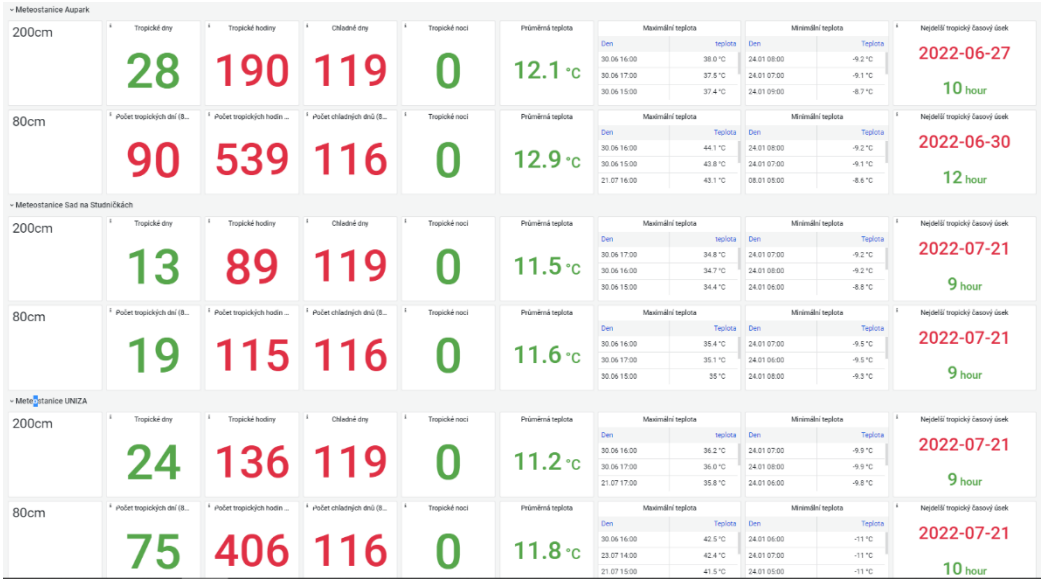
Traffic Clevernet sensors were deployed at 9 profiles in the city center of Žilina, creating a so-called geofence around the urban traffic ring. The data and processed statistics indicated a relatively high traffic volume (nearly 60,000 vehicles per day, equivalent to almost 4 entries per day for each inhabitant of this area) and significant speeding.

Smer	>60 km/h	Car >60 km/h	Van >60 km/h	Truck >60 km/h
IN	20,5%	17,8%	32,4%	18,3%
OUT	19,4%	13,1%	39,6%	22,6%



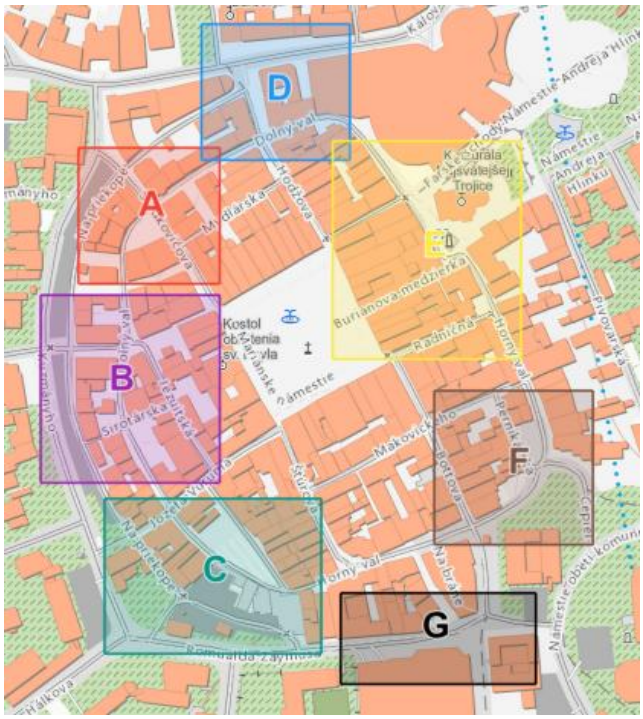
Traffic Safety Index overall and for vehicle categories and for individual profiles

Žilina cools very well due to its location and altitude, the heat island problem occurs in several places in the center, which require measures to improve the quality of public space. For example, data from microclimatic units show that the number of tropical days (above 30°C) varies significantly in all three monitored locations, indicating places that are affected by climate change and pose a higher burden on public health.



Climate conditions of the city of Žilina in 2022 (site/sensor, tropical days and hours, cold days, tropical nights, maximum and minimum temperature, longest tropical period)

By merging this data with other data, locations in the city centre at risk of heat islands were identified. A total of 13 areas were identified for which measures were proposed to reduce the impacts of climate change. An example of the seven identified zones directly in the city centre is shown in the following image.



Division of the subject areas of the center into locations A to G for their more detailed examination

Alignment with the needs of the City of Žilina:

Mobility and Climate Priorities:

- Focus on enhancing traffic safety through targeted data collection and analysis in critical hotspots, such as pedestrian crossings and intersections.
- Expand the existing IoT network to cover high-priority areas such as schools, industrial zones and city centers.
- Address urban climate challenges by initiating pilot studies on heat island effects and their mitigation, integrating data from meteorological stations and other climate monitoring tools.
- Interconnect city agendas like residential parking strategy (regulation extension since January 2025) with heating islands in residential areas to support data driven discussions and citizens awareness on positive impacts of the regulation to their public space.

Utilization of Existing Infrastructure:

- Leverage the city's existing IoT and sensor networks, expanding them to cover priority areas for traffic and environmental monitoring.
- Collaborate with local utilities and service providers to aggregate data for both municipal use and public transparency.

Scalability and Transferability:

- Design flexible solutions that can be implemented in similar-sized cities or scaled to larger regional initiatives, ensuring adaptability to varying technical and organizational contexts.
- Document best practices and lessons learned to contribute to the broader EnCLOD framework.

Engagement with Citizens and Stakeholders:

- Organize participatory workshops and hackathons to incorporate citizen input, raising awareness and fostering community support for Open Data initiatives.
- Promote co-creation efforts with local businesses, academia, and NGOs to align solutions with the real needs of Žilina's residents.

Immediate Actions

- Conduct stakeholder workshops to identify data priorities and gaps.
- Initiate pilot studies focused on traffic and climate data collection, ensuring compliance with privacy regulations.
- Design communication strategies to promote the benefits of Open Data and address resistance among stakeholders.

Immediate Action in the City of Žilina:

- Organize targeted workshops with municipal departments, local businesses, and community groups to define key data priorities, especially for traffic safety (BECEP) and climate-related challenges.
- Launch pilot projects for data sensing in selected traffic hotspots (e.g., pedestrian crossings) and areas impacted by urban heat islands, leveraging IoT sensors to ensure precise and actionable insights.
- Begin mapping existing datasets and digital tools in Žilina to identify gaps and opportunities for integration into the EnCLOD framework.
- Deploy a basic sensor network covering traffic and environmental hotspots. Prioritize areas identified in Activity 1.2, ensuring compliance with national and EU data standards.
- Establish partnerships with local universities and technology providers to support pilot initiatives and data analysis

This strategy serves as a roadmap to integrate Open Data into each pilot area's governance structure, ensuring its utility for current needs while laying a foundation for future advancements.

Activities of the Local Action Plan for City of Žilina

Note: Medium term activities: before the end of the Project; Long term: after the end of the project.

Activity ID	Activity title	Activity description/result	Medium / Long term activity
0. Open data strategy			
0.1	Identification of working groups	Establish an informal working group with the city. Define the open data ecosystem, including competencies, coordination rules, networking events, partnerships, and funding models as prerequisites for the open data strategy. Prepare meetings and communication with the city.	Medium term
0.2	Formalization of the open data program/agenda	Establish the working group (WG) and appoint a leader for the open data initiative. Start negotiations with the city about preparing the framework for the city's adoption of the open data strategy.	Medium term
0.3	Integration of Open Data agenda into city strategies	Ensure open data is embedded in all city strategies and concepts. Formalize the open data agenda, incorporating the city's requirements and vision for open data into strategic planning.	Medium term
0.4	Set up of the Open Data strategy	Finalize and adopt the open data strategy based on the EnCLOD project's inputs and city negotiations. Identify potential financial sources for the integrated data platform. Result ideally as an official open data strategy of the city.	Long term
1. Open data sources			
1.1	List of national statistics for the city's needs	List relevant national statistics for traffic data in the context of Žilina.	Medium term
1.2	List of existing local static open data	Document existing local static open data (e.g., traffic counts, infrastructure data).	Medium term
1.3	Mapping of dynamic data sources	A map of places, types and providers of data collection technology. List of potential data providers, types of data, dynamic data sets definitions and where they are placed in the area.	Medium term
1.4	Data providers and procurement standards	Engage with potential data providers, such as traffic control operators, and ensure procurement contracts specify open data requirements (ownership, format, interfaces).	Long term
2. Design of territorial governance			
2.1	Design of microzones for the pilot area – city of Žilina	Design microzones in Žilina focusing on traffic management and environmental monitoring, incorporating urban and traffic-specific data for zoning.	Medium term
2.2	Mapping of open data sets for microzones	Identify and map open data sets relevant to each microzone, including static and dynamic data sources. result: List of microzones and their available open data sets (i.e. Map of open data per microzone and brief comparative analysis of open data coverage of Žilina)	Medium term
2.3	Holistic sensing of traffic and climate	Result: Map and table of holistically designed sensing of a pilot area, second result: the minimum (IoT) sensors network of the municipality	Long term
2.4	Data sensing for traffic and climate	Plan and implement the deployment of traffic sensors and meteorological stations within microzones, focusing on high-need areas. Aiming for optimal data collection and analysis.	Long term

3. Open data community			
3.1	Activities with EnCLOD working group	Open discussions on open data agenda and organize the first local EnCLOD event. Result: Defined topics for investigation and identification of key persons.	Medium term
3.2	List of local potential partners	Map potential partnerships for hackathons and community events. Create a list of partners and their typology.	Medium term
3.3	EnCLOD local website	Develop and maintain a dedicated EnCLOD webpage for local community engagement and project dissemination.	Medium term
3.4	Pilot EnCLOD dashboard	Incorporate pilot action data into the EnCLOD website and publish it as a public dashboard showcasing results.	Medium term
3.5	Local events	Organize workshops and events to introduce open data topics, raise awareness, and engage local stakeholders.	Medium term
3.6	Hackathon preparation	Prepare for hackathons by designing the agenda, identifying participants, and coordinating resources	Medium term
3.7	Hackathon activities and evaluations	Organize and conduct hackathons; evaluate the outcomes and provide feedback to participants. Outputs report and the list of available sets of data used by hackathoners.	Medium term
3.8	Training preparation	Prepare for open data training sessions by identifying participants, creating training materials and provide a list of to-be-trained staff.	Medium term
3.9	Training sessions of the project	Conduct training sessions on open data for local authorities and stakeholders. Local workshop as an introduction to the agenda and followed up training on the use of the tool developed in EnCLOD project.	Medium term
3.10	Other training activities in the Pilot Areas	Deliver specialized training based on the specific needs of pilot areas, such as leveraging open data for local governance and IoT applications.	Long term
4. Digital tools and twinning - specific activities			
4.1	Existing use cases collection	Collect and document use cases addressing the needs of data-driven governance, including traffic safety and climate-related challenges in Žilina.	Medium term
4.2	Identification of specific needs	Identify specific needs for traffic safety in Žilina, focusing on hotspots (e.g., pedestrian crossings) and evaluate data sets for traffic safety and climate adaptation measures.	Medium term
4.3	Development of digital services (Apps, warnings, etc.)	Propose and develop digital tool for road safety improvement in urban areas, as a contribution to EnCLOD's common pool.	Medium term
4.4	Provided digital services in the Pilot Areas	Test and finalize the digital tool for traffic safety, including its interface and integration into municipal systems, and train users for effective adoption.	Medium term
4.5	Twinnings - optional	Facilitate twinning between Žilina and Olomouc, focusing on traffic safety and climate topics, including procedures, testing, and knowledge exchange.	Long term
4.6	Contribution to EnCLOD final guidelines	Share lessons learned from Žilina's pilot activities and contribute to EnCLOD's final recommendations and guidelines for municipalities.	Long term

Conclusions on the Local Action Plan of the City of Žilina

The Local Action Plan for Open Data and IoT usage in the City of Žilina, prepared by UNIZA in collaboration with the associated project partner, the City of Žilina, represents a comprehensive approach to leveraging data for improved territorial governance, innovation, and sustainability. The plan is current as of January 31, 2025, but may be updated during the EnCLOD project to reflect progress in planned activities or to incorporate new opportunities and potential data partners, such as those from network industries (e.g., energy), service providers (e.g., waste management), or usable infrastructure (e.g., communication networks).

Summary of Key Findings:

1. **Current State and Challenges:** The City of Žilina possesses valuable data resources and technological infrastructure. However, challenges persist in data integration, accessibility, and quality management. The lack of a centralized strategy for open data and IoT deployment limits the potential for data-driven decision-making.
2. **Strategic Objectives:** The plan aims to enhance transparency, strengthen decision-making processes, and foster innovation by establishing a robust framework for open data governance. Integrating IoT technologies and developing a culture of data sharing are key components.
3. **Actionable Steps:** Specific measures such as microzoning for targeted data collection, expanding IoT sensor networks, and promoting stakeholder engagement through workshops and hackathons form the foundation of this plan. These initiatives are designed to address priority areas such as traffic management, environmental monitoring, and urban planning.
4. **Alignment with Broader Goals:** The strategy aligns with national and European objectives, ensuring scalability and transferability to other municipalities. By integrating local priorities with best practices, Žilina positions itself as a forward-thinking, sustainable city.

Expected Impacts:

- **Improved Urban Governance:** The integration of open data and IoT technologies will enable more efficient resource management, transparent decision-making, and better public service delivery.
- **Innovation and Collaboration:** By engaging local stakeholders, including businesses, universities, and NGOs, the city fosters an ecosystem of innovation, encouraging the development of data-driven solutions.
- **Sustainability and Quality of Life:** The focus on mobility, climate action, and urban resilience ensures that the strategy contributes to long-term sustainability and enhances the quality of life for residents.

The overall summary of the sensory network in Žilina is presented in the table below. Each sensor is associated with a short description of its function, the frequency of data provided, the technology of data collection, the owner, the administrator, and the openness of the data. The detailed understanding of this network enables more informed decisions in traffic safety, environmental monitoring, and urban planning:

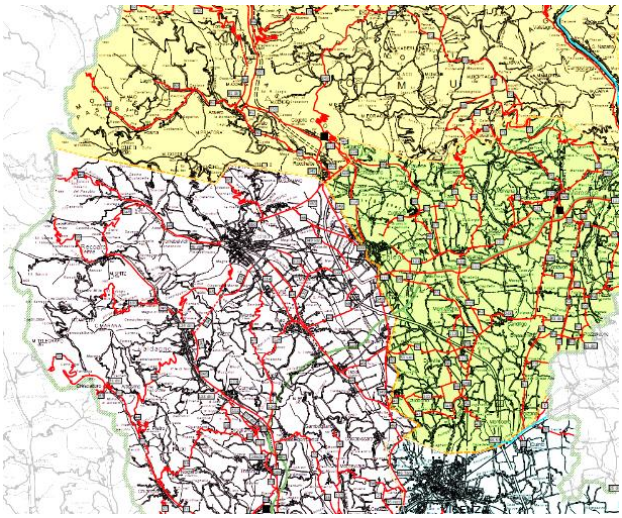
Identification of the sensor network	Description of the provided data	Granularity and frequency of data provided	Data collection technology	Data owner	Data/information system administrator	Openness of data	Comment
Clevernet - traffic	Traffic geofensing in the centre of Žilina - provided data on vehicle passes - number of vehicles, vehicle category, vehicle speed	Data is provided at intervals of 5 min (internally) or 15 min (on the portal) - at this interval it provides aggregated data	magnetometer	Clevernet Consortium	Citiq	Yes	https://dashboards.clevernet.sk

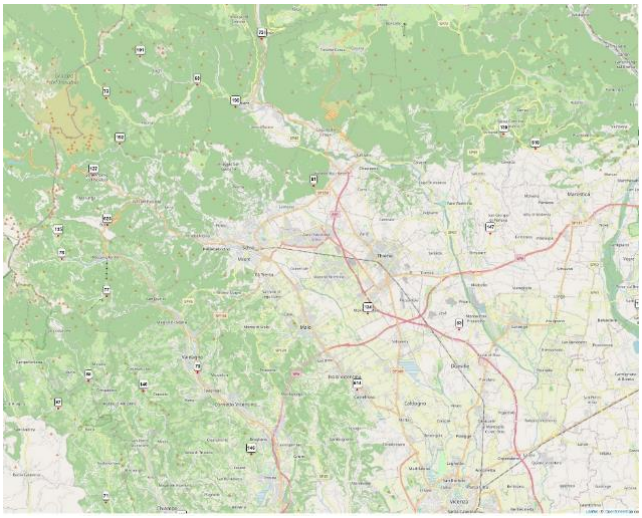
Clevernet - meteo	Data from : Meteostations, Façade sensors, Surface temperature sensor	5 min./ 5 min. /10 min	Different sensors/ temperature sensor/ sensor of temperature	Clevernet Consortium	Citiq	Yes	https://dashboards.clevernet.sk
EnCLOD	Traffic sensors in Žilina primarily for traffic safety - provided data on vehicle passes - number of vehicles, vehicle category, vehicle speed	Data is provided at 5 min intervals - at this interval it provides aggregated data	magnetometer	EnCLOD Consortium	Citiq	Planned	
NXTLVL Parking	Traffic sensors in the western part of Žilina - provided data on vehicle passes - number of vehicles, vehicle category, vehicle speed	Data is provided at 5 min intervals - at this interval it provides aggregated data	magnetometer	NXLVL Consortium	Citiq	Planned	
Parking system of the City of Žilina	N/A	N/A	N/A	N/A	N/A	N/A	Data on parking charges in Žilina
Traffic counters - entrance to the city	number of vehicles, category, speed	5 min	radar	City of Žilina	ZTS Elektronika	on demand	part of the INVIPO platform (Smart Žilina)
Speed Meters	number of vehicles, speed	30 min	radar	City of Žilina	ZTS Elektronika	on demand	part of the INVIPO platform (Smart Žilina)
Cyclist counters	number, speed and direction	N/A	magnetometer	City of Žilina	City of Žilina	on demand	
SOLEZ	Traffic sensors in part of the centre of Žilina	N/A	magnetometer	N/A	Citiq	N/A	At present, without support
AG DATA	The sensor network ensures continuous monitoring and provision of up-to-date environmental information. Carbon monoxide, nitrogen dioxide, particulate matter - PM1.0; PM2.5; PM4; PM10 and sulphur dioxide are recorded within the environmental frameworks. In addition, humidity, air pressure, air temperature, light intensity, precipitation, wind direction, wind movements and wind speed are recorded	N/A	N/A	City of Žilina		on demand	part of the INVIPO platform (Smart Žilina)
REMoT	The sensor network provides information on dust particles PM1, PM2.5, PM4, PM10, air temperature measurement, humidity measurement, air pressure measurement (atmospheric or barometric), solar radiation intensity measurement and noise measurement.	N/A (1 hour data displayed)	N/A	owner - project (UNIZA)	project (UNIZA)	on demand	

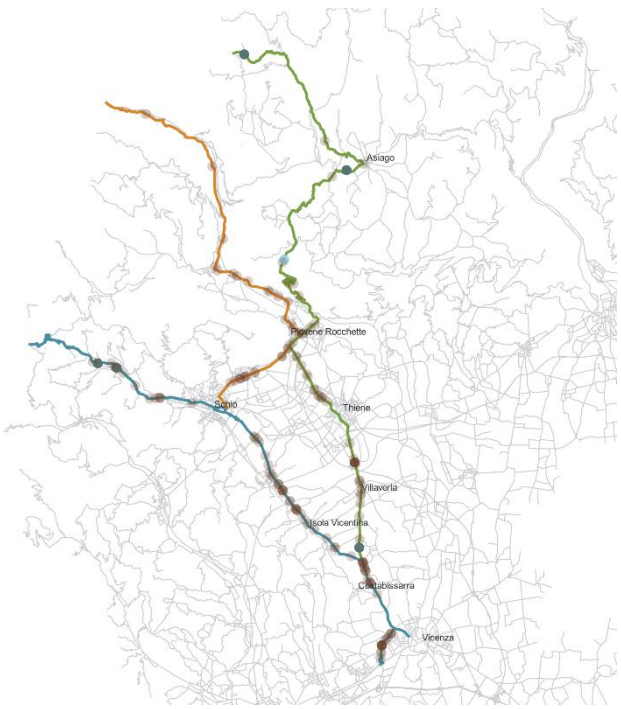
By implementing microzoning and integrating IoT technologies, Žilina can optimize its urban planning processes. These efforts allow for precise data collection tailored to specific areas, ensuring that environmental and traffic challenges are addressed efficiently.

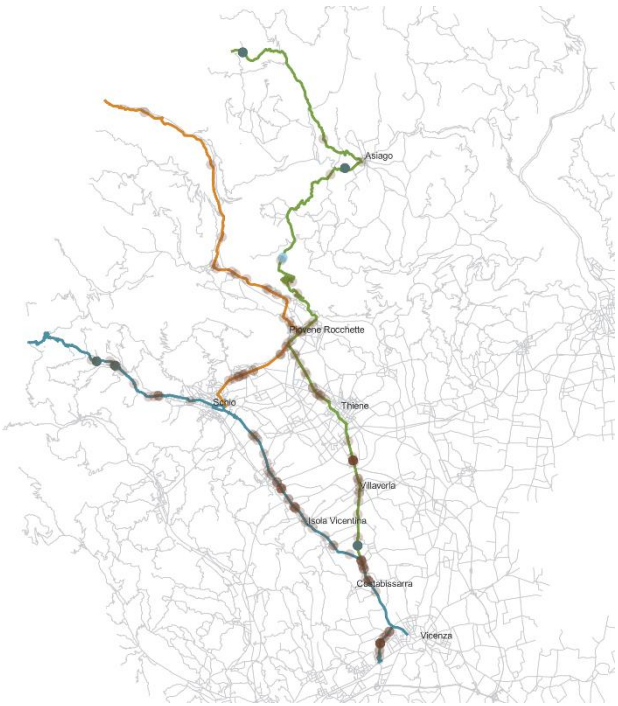
G. Technical Annexes

Province of Vicenza: Definition of the sensor network of Province of Vicenza

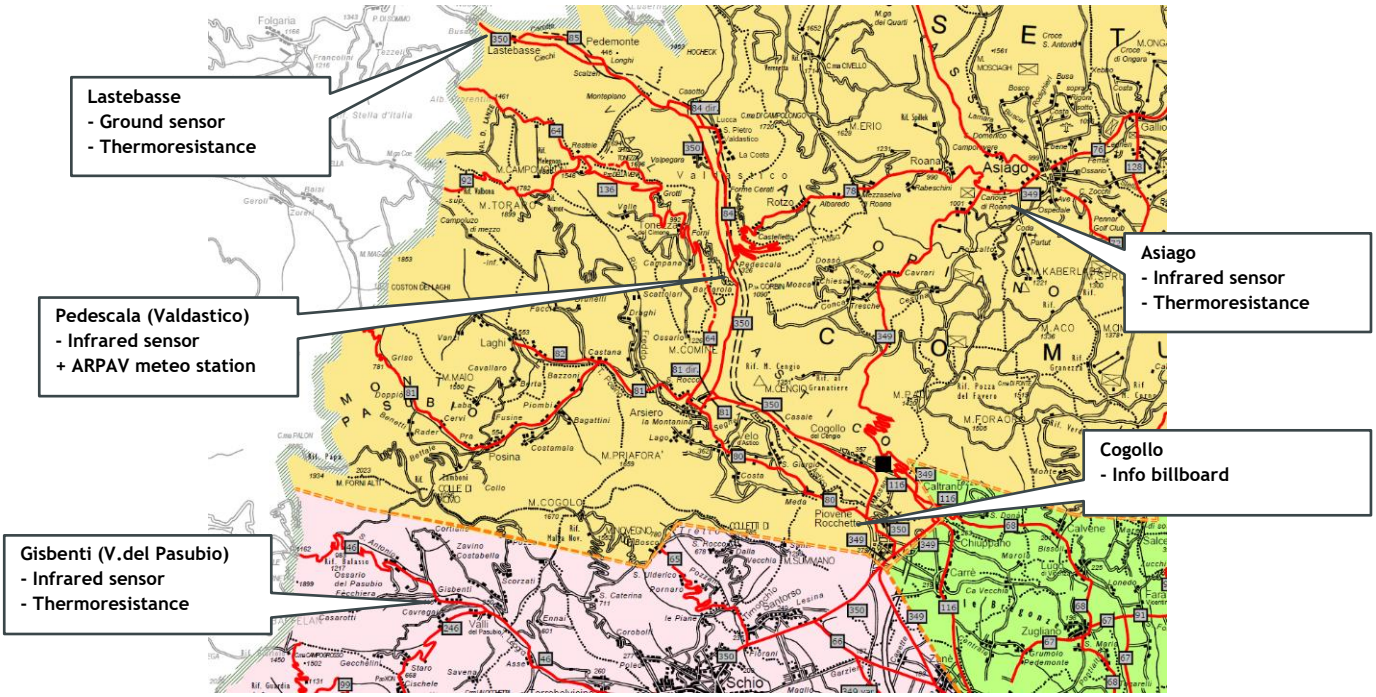








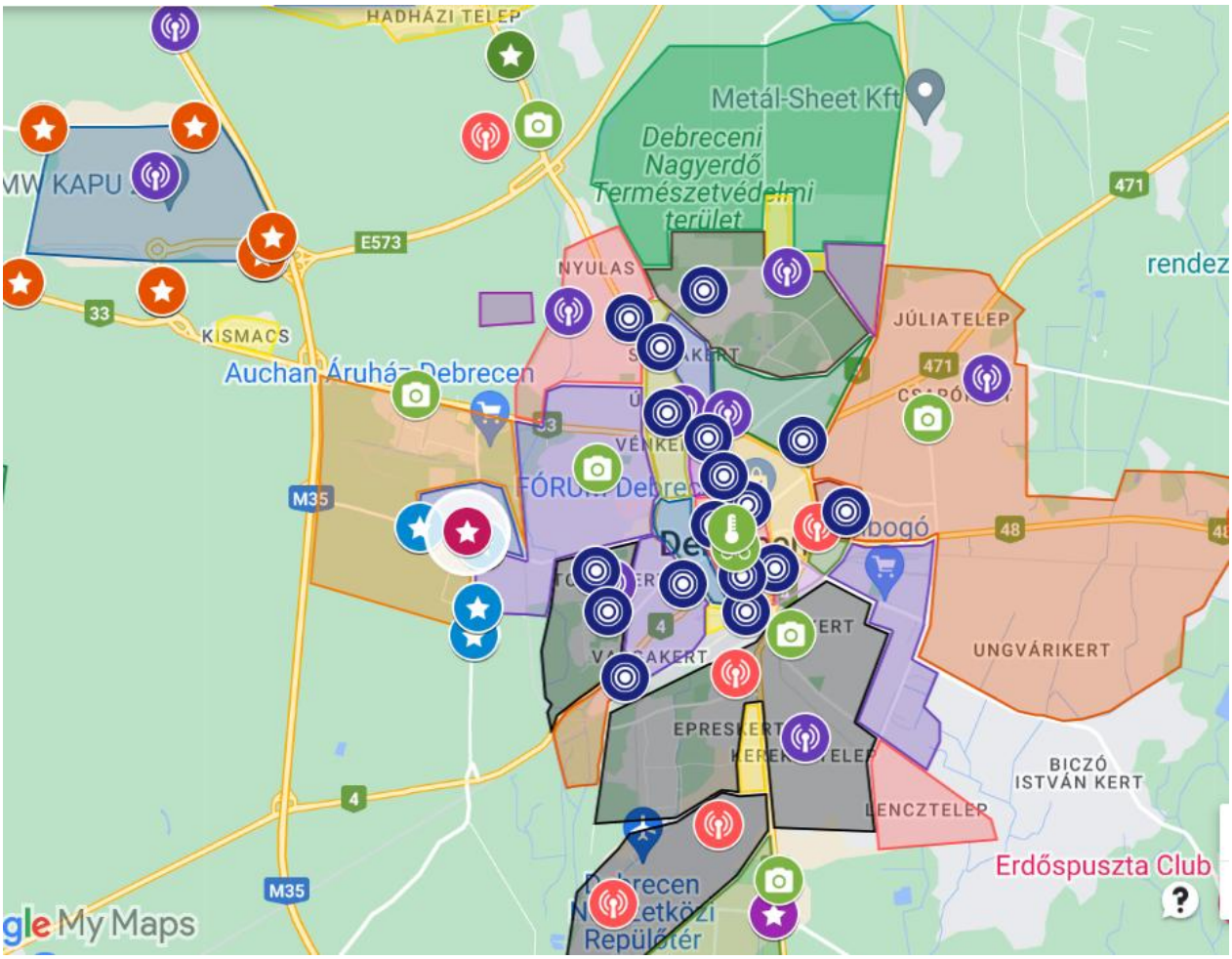
Maps analyzed to define the sensor network of the Province of Vicenza: 1) Provincial Roads; 2) Existing meteo stations; 3) Road accidents in 2023; 4) Status of the road at the moment of the accidents.



Sensor network of Project ENCLOD in the Province of Vicenza: map of the mountain areas of the Province with location and typology of the sensors designed for the project.

Sensor providers involved in the public procurement of the Province of Vicenza for the market survey.

City of Debrecen: First activities of the Local Action Plan



The first activities of the Local Action Plan for the City of Debrecen:
- Microzoning designed;
- Identification of dynamic data sources and their operators;
- LoRawan connectivity map and the EnCLOD deployed pilot action monitoring.

All integrated in a single map as the base for the follow-up activities of EnCLOD LAP

City of Olomouc: Microzoning in Olomouc

A.1. Microzoning – urban planning data units

There are various data available and also technology potential to collect data. What is missing is the referencing; simply said:

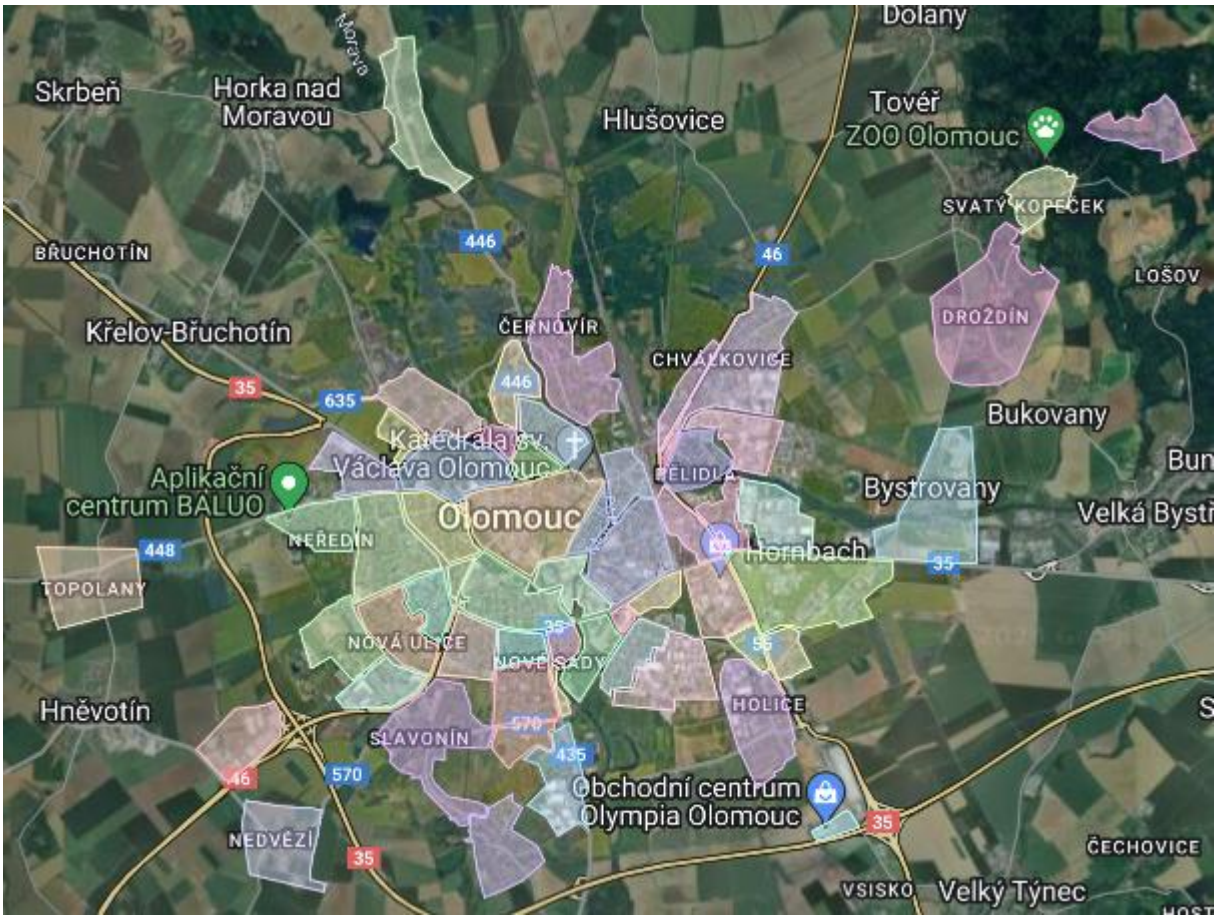
which data refers to which place (e.g. is meteostation data relevant to my place of living even it is 1km away?),
how the data is related to other data (e.g. census counting with traffic counting)
how to understand the data (potential for comparison and good interpretation of the data)

Microzoning is a concept developed within EnCLOD project by CityOne/UPOL to solve a problem of data collection for urban planning in a universal logic. It divides the municipality in zones which enables to apply all the available data per zone and make the zones to be compared. The design of microzones is also a prerequisite for IoT sensors deployment design as well as other data collection.

The design of microzones should respect the following rules:

- the zones can be of different size, respecting the census statistics data units (so no overlap of census units, i.e. each census unit belongs to just one microzone)
- the zones are designed in a traffic logic; i.e. there are natural boundaries like a river (bridges), other physical barriers as a railroad or main roads in the city (traffic collectors), adjacent villages are single zones
- climate IoT sensors are designed in a holistic way so a single sensor can serve for more zones (e.g. meteostations, rain meters, solar radiation etc. data can serve for more zones)
- traffic (IoT) sensors are placed in such a way that it covers entrances and exits of the zone so provide "a traffic geofencing" of the zone. It can be done by physical placement at entrances/exits to the zone or by a computation from main road profiles situated at the border of the zone
- microzones serve also for data aggregation. This is particularly needed for sensitive data like water or energy consumption. Such a data is a prerequisite for green deal investment planning. Their potential acquisition can be a challenge and can provoke the change of the microzones design

So **Microzoning** means identifying what and where data is needed and so designing zones for optimal data collection respecting census data units. Microzones can become a new statistics unit for urban development/digital urban planning and the traffic counting at entrances/exits provide a holistic (logical) design of places where the traffic data is needed and by climate sensor design logical places for climate measurements.



Feasibility of Microzoning in Olomouc

- The city has been divided into cca **60 zones**, aligned with national statistical cells (e.g., Census blocks).
- This zoning provides a **logical foundation for a citywide IoT network design**, integrating other data sources such as local research and questionnaires.
- Zones offer the potential for comparison based on metrics such as population, temperature, traffic, and other factors (e.g., number of registered dogs).

Purpose: Microzoning enables targeted data collection to provide actionable insights (e.g., heatmaps), facilitating research and future app development. For instance, UPOL is researching night parking in these zones to assess the number of cars, vans, and bikes, with a focus on their impact on traffic—a key preparation step for upcoming hackathons and applications.

So, the microzoning design simply provides a basis on how to collect data, how to map open data availability and most important for universities on how to engage students to collect data that area missing (missing use cases, missing places). Microzoning is a starting step for open data strategy for digital urban planning to enhance governance. Having such data in various municipalities means to profit from potential future AI tools (like it is in the 15min city Aino app). So, to have microzones means an advantage for a municipality to acquire and maintain data that are needed by digital services.

Open datasets overview for further selection of key datasets for territorial governance

The list of microzones with numbers and list of open data sets is one of the results, an overview in a heatmap should provide anybody with knowledge on strong and weak open data places/zones. This is an ongoing activity and the first step, an overview of existing sources, has been prepared.

Provider	Dataset	Thematic layer (level 1)	Thematic layer (level 2)	Territorial scope	Data form (details)
State Administration of Land Surveying and Cadastre	Basic geographic data base of the Czech Republic	Physical waters	–	Czechia	Polygons
		Hydrography – nets	–	Czechia	Line
		Transport networks	Air transport	Czechia	Line
		Transport networks	Cable car transport	Czechia	Line
		Transport networks	Rail transport	Czechia	Line
		Transport networks	Traffic	Czechia	Line
		Transport networks	Water transport	Czechia	Line
		Land use	–	Czechia	Polygons
	Digital Geographic Model of the Territory of the Czech Republic (Data50)	Residential, cultural and economic objects	–	Czechia	Polygons
		Communication	–	Czechia	Line
		Product pipelines and power lines	–	Czechia	Line
		Waters	–	Czechia	Polygons
		Vegetation and surface	–	Czechia	Polygons
		Terrain relief	–	Czechia	Polygons
Czech Statistical Office	Register of Census Districts and Buildings	Buildings and entrances	Habitual/permanent resident population	Czechia	Points, Polygons
		Multilayers	Number of addresses, number of buildings, number of apartments	Czechia	Polygons (basic settlement units)
	Population Census 2021	Number of apartments	–	Czechia	Polygons (basic settlement units)
		Population with residency	–	Czechia	Polygons (basic settlement units)
		Type and period of construction	–	Czechia	Polygons (basic settlement units)

		Houses	–	Czechia	Polygons (basic settlement units)
		Households	–	Czechia	Polygons (basic settlement units)
		Economic activity	–	Czechia	Polygons (basic settlement units)
		Age and gender	–	Czechia	Polygons (basic settlement units)
		Education	–	Czechia	Polygons (basic settlement units)
		Employment and economic activity	–	Czechia	Polygons (basic settlement units)
		Registered residence	–	Czechia	Polygons (basic settlement units)
		Apartments	–	Czechia	Polygons (basic settlement units)
		Equipment	–	Czechia	Polygons (basic settlement units)
		Commuting	–	Czechia	Points, lines (basic settlement units)
		Drive	–	Czechia	Points, lines (basic settlement units)
	Register of Economic Entities	Entity database	–	Czechia	Points
		Local reporting locations	–	Czechia	Points
Vodafone	Geolocation data (Palacký University Olomouc)	Population	Total number of persons	Olomouc Region	Polygons
		Population	Visitors	Olomouc Region	Polygons
		Population	Workers, students and pupils	Olomouc Region	Polygons

		Population	Residents	Olomouc Region	Polygons
		Commuting	Total number of persons	Olomouc Region	Polygons
		Commuting	Visitors	Olomouc Region	Polygons
		Commuting	Workers, students and pupils	Olomouc Region	Polygons
		Commuting	Residents	Olomouc Region	Polygons
Olomouc City	Open Data	Hydrants	–	Olomouc	Points
		Shared cycling (ReKoLa company)	–	Olomouc	Points
		Racks	–	Olomouc	Points
		Brownfields	–	Olomouc	Polygons
		Cycle paths	–	Olomouc	Line
		Public (cycling) service points	–	Olomouc	Points
		USES plan	–	City and Surrounding Area	Points, lines, polygons
		Price map	–	Olomouc	Polygons
		Production surfaces that can be absorbed	–	Olomouc	Polygons
		Paid parking zone, paid parking areas	–	Olomouc	Polygons
		No entry for vehicles over 6 tonnes	–	Olomouc	Polygons
		Accidents and closures	–	Olomouc	Points
	Street Furniture	Waste bins	–	Olomouc	Points
		Containers for sorted waste	–	Olomouc	Points
	Passport of greenery	Greenery, green areas	–	Olomouc	Polygons
	Traffic data from induction loops	Number of vehicles/passages per unit of time	–	Olomouc	Points
	Communication	Pavements	–	Olomouc	Polygons
		Street network	–	Olomouc	Polygons
	Background data for territorial analytical documents	Utilities - gas pipeline, water supply, sewerage, electrical wiring, heat pipeline	–	Olomouc	Line
Olomouc Region	Open Data	Kindergartens	–	Olomouc Region	Points, lines?
		Secondary schools	–	Olomouc Region	Points
		Primary schools	–	Olomouc Region	Points
		College	–	Olomouc Region	Points

		Art schools and language schools	–	Olomouc Region	Points
		Territorial system of ecological stability	–	Olomouc Region	Lines, Polygons
		Development areas and axes, specific areas	–	Olomouc Region	Lines, Polygons
		Educational and accommodation facilities	–	Olomouc Region	Points
Palacký University	Population Grid	Daily variant of the working day	–	Olomouc Region	Polygons (grid)
		Night variant of the working day	–	Olomouc Region	Polygons (grid)
OpenStreetMap	OSM Data	Road	–	World	Line
		Buildings	–	World	Polygons
		Intersections	–	World	Points (based on line intersections)
		Boundary	–	World	Lines, polygons
		Points of interest, POIs - restaurants, shops, playgrounds, parcelboxes, sports grounds, etc.	–	World	Points
State Administration of Land Surveying and Cadastre	Register of Territorial Identification, Addresses and Real Estate	Buildings – number of floors/floors	–	Czechia	Points
		Buildings – type of structure	–	Czechia	Points
		Buildings – the way of using a building	–	Czechia	Points
Czech Hydrometeorological Institute	Air quality	Concentrations of SO_2, NO_2, CO, PM_{10}, O_3, PM_{10}, $PM_{2.5}$, air quality index)	–	Czechia	Points (stations)
		PM10 particles, hourly average	–	Czechia	Points (stations)
	Station data	Air temperature	–	Czechia	Points
		Precipitation	–	Czechia	Points
		Daily sunshine	–	Czechia	Points
Olomouc City	Modelling results (station data interpolated, 3+1 station)	Fugitive dust PM_{10}	–	City and Surrounding Area	Points
		Fine particulate matter $PM_{2.5}$	–	City and Surrounding Area	Polygons
		Nitrogen dioxide NO_2	–	City and Surrounding Area	Polygons

		Benzo[a]pyrene	–	City and Surrounding Area	Polygons
		Sulphur oxide SO_2	–	City and Surrounding Area	Polygons
	Household heating method	Data from Population Census 2011	–	Olomouc	Polygons (basic settlement units)
		Calculation according to the 2018 survey	–	Olomouc	Polygons (basic settlement units)
	Transport level	Traffic density	–	Olomouc	Line
	Parking spaces	Capacity of slinging surfaces	–	Olomouc	Points
	Station data (6 stations)	Air temperature	–	Olomouc	Points
		Atmospheric pressure	–	Olomouc	Points
		Dew point	–	Olomouc	Points
		Wind direction and speed	–	Olomouc	Points
Transport company of the city of Olomouc	Tram and bus traffic	Scheme of DPMO lines in zone 71 IDSOK from 1.11.2022 - closure state	–	Olomouc	Points, lines
		Bus lines from 10.12.2023	–	Olomouc	Points, lines
		Tram lines from 10.12.2023 (valid from 4.9.2023)	–	Olomouc	Points, lines
Coordinator of the Integrated Transport System of the Olomouc Region	Integrated Transport System of the Olomouc Region	List of ticket sales points	–	Olomouc	Points
		List of lines in the Integrated Transport System of the Olomouc Region	–	Olomouc	Points, lines
		List of public road transport stops	–	Olomouc	Points
		List of stops Hranice, Olomouc, Prostějov, Přerov, Šumperk and Zábřeh	–	Olomouc	Points
		List of stops and stations of Czech Railways	–	Olomouc	Points
		List of tariff zones in the Integrated Transport System of the Olomouc Region	–	Olomouc	Polygons
		List of railway stops and stations	–	Olomouc	Points
		Transport Service Plan of the Olomouc Region 2019	–	Olomouc	Points, lines, polygons

European Union	Copernicus	CORINE Land Cover	–	World	vector, raster (100 m)
		NDVI	–	World	Raster
		Moisture index	–	World	Raster
		SWIR	–	World	Raster
		NDWI	–	World	Raster
		Forest Type	–	World	Raster
		Tree Cover Density	–	World	Raster
		Grassland	–	World	Raster
		Small Woody Features	–	World	Raster
U.S. National Aeronautics and Space Administration	Landsat	Surface temperature	–	Olomouc	Raster
European Space Agency	Sentinel	Land Cover	–	World	Raster
Ministry of Labour and Social Affairs of the Czech Republic	Register of Social Service Providers	32 types of services (Shelters, homes for elderly people, daily service centers, etc.)	–	Czechia	Points
Institute of Health Information and Statistics of the Czech Republic	National Register of Health Service Providers	Pharmacy	–	Czechia	Points
		Dentists	–	Czechia	Points
		General practitioners for adults	–	Czechia	Points
		General practitioners for children and adolescents	–	Czechia	Points
		Gynaecologists	–	Czechia	Points
		Physiotherapists	–	Czechia	Points
		Hospital	–	Czechia	Points
		Medical Center	–	Czechia	Points
		Outpatient service provider	–	Czechia	Points
		Other providers of health services	–	Czechia	Points
Czech Post	List of branches	Post offices	–	Czechia	Points
		Parcel boxes	–	Czechia	Points
		Technical establishments	–	Czechia	Points
		Partner Post Office	–	Czechia	Points
		Pit	–	Czechia	Points
		Pick-up point	–	Czechia	Points
		Post Office	–	Czechia	Points
Ministry of Culture of the Czech Republic	Library Records	Regional libraries	–	Czechia	Points
		Specialized libraries	–	Czechia	Points
		Basic libraries	–	Czechia	Points
		Basic libraries with specialized library collections	–	Czechia	Points

T. G. Masaryk Water Research Institute	DIBAVOD	Watercourses	–	Czechia	Line
		Flood plains	–	Czechia	Polygons
		Distribution boards	–	Czechia	Line
Czech Geological Survey	Maps and data	Soil types	–	Czechia	Raster

Match mapping to identify the existing data sources of dynamic data

A.2. Match mapping – to identify the existing data sources

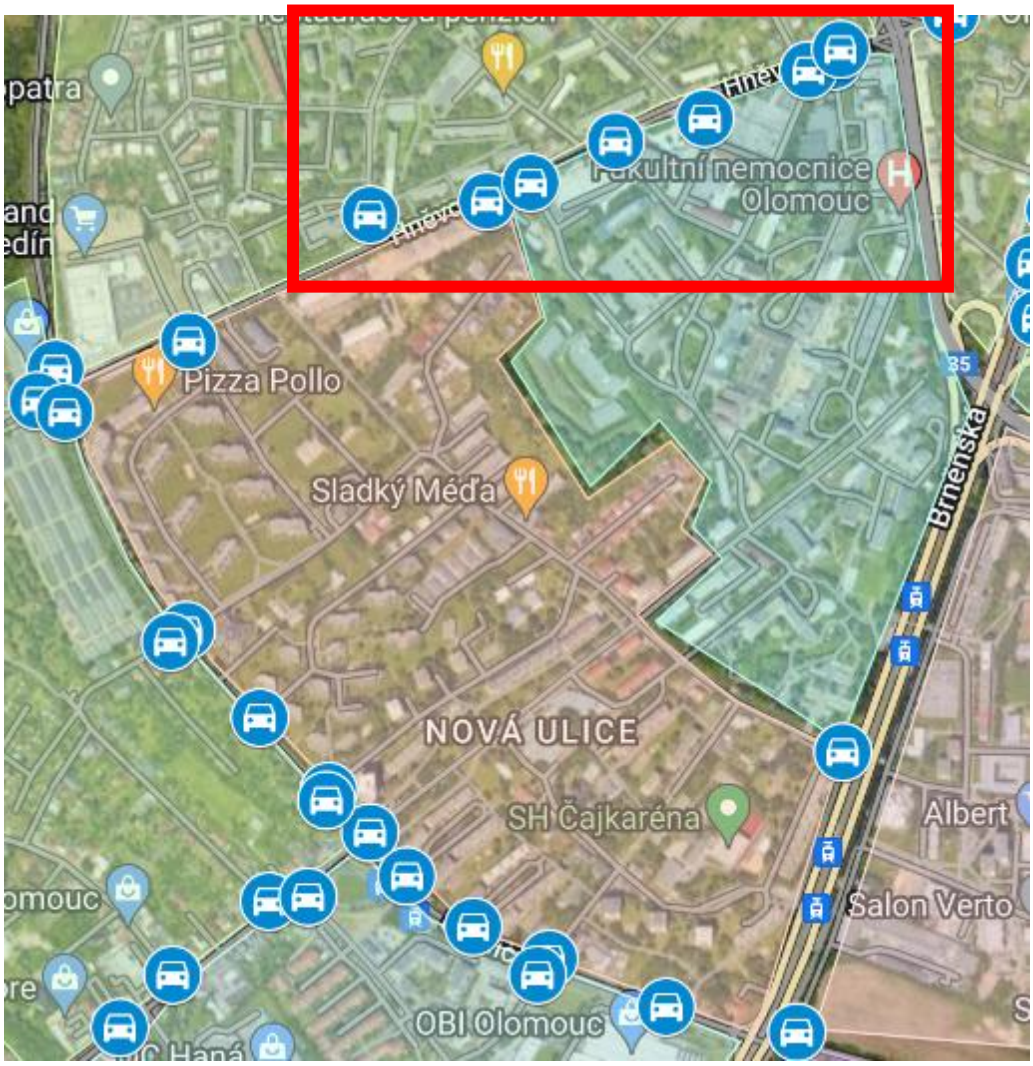
The natural follow-up activity is a **Match Mapping**. This means analyzing existing technologies that are already collecting data (e.g. traffic counting at the crossroads, meteonetwork). The outputs of this activity are:

- **map of existing data sources** with type of technology and identifying the share (share of existing technologies on logical measurement places, and share of EnCLOD, to identify what is missing for citywide sensor deployment)
- **specification of data output capabilities** (e.g. traffic counting every 10 minutes, or classification of vehicles in 5 categories every 15 minutes etc.), and pinpointing the organizations operating these systems, assigning them a role of "**data provider**" in the local open data ecosystem and a natural partner of the hackathons
- **the logical cost model** for citywide sensor deployment, i.e. numbering of places/types of sensors that are missing and provide an estimate of possible cost as a key input into Local Action Plan

A.3. Examples of Practical Implementation of Match-Making Existing Systems

Example: A hospital operates a barrier entrance system that is situated at the border of a zone. The task is to explore whether the system operator can create a non-personal open database from already collected data to contribute to Olomouc's future digital twin. This eliminates the need for additional sensors while providing valuable data for applications like a hospital mobility plan, parking policy or traffic management.

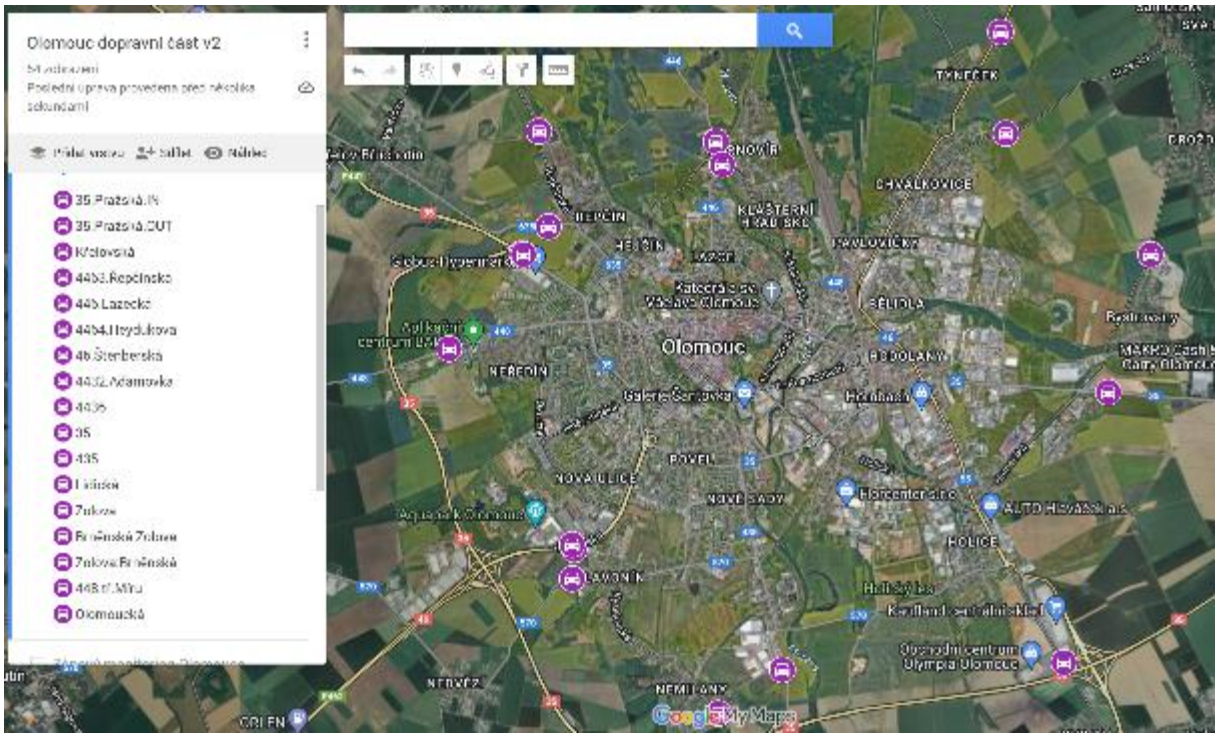
This is an example of how a potential open data ecosystem partner, a hospital, can contribute to reducing the numbers of sensors that are needed for citywide sensoring.



Olomouc zoning: a hospital zone entrances/exits are covered by a hospital barrier system and opening this data can be an action item of the LAP

Another example of a contribution to the future local open data ecosystem is a **Funding diversification** to cover a particular use case (based on the owning of infrastructure)

The holistic design approach identified potential for **traffic geofencing**, particularly on regional/state roads. An action plan item is to investigate whether the regional authorities could fund geofencing technologies or contribute with data from the existing systems in the form of open data. This aligns with the broader goal of creating a cost-efficient digital twin for the city and represents a showcase of close cooperation of a region and its metropole.

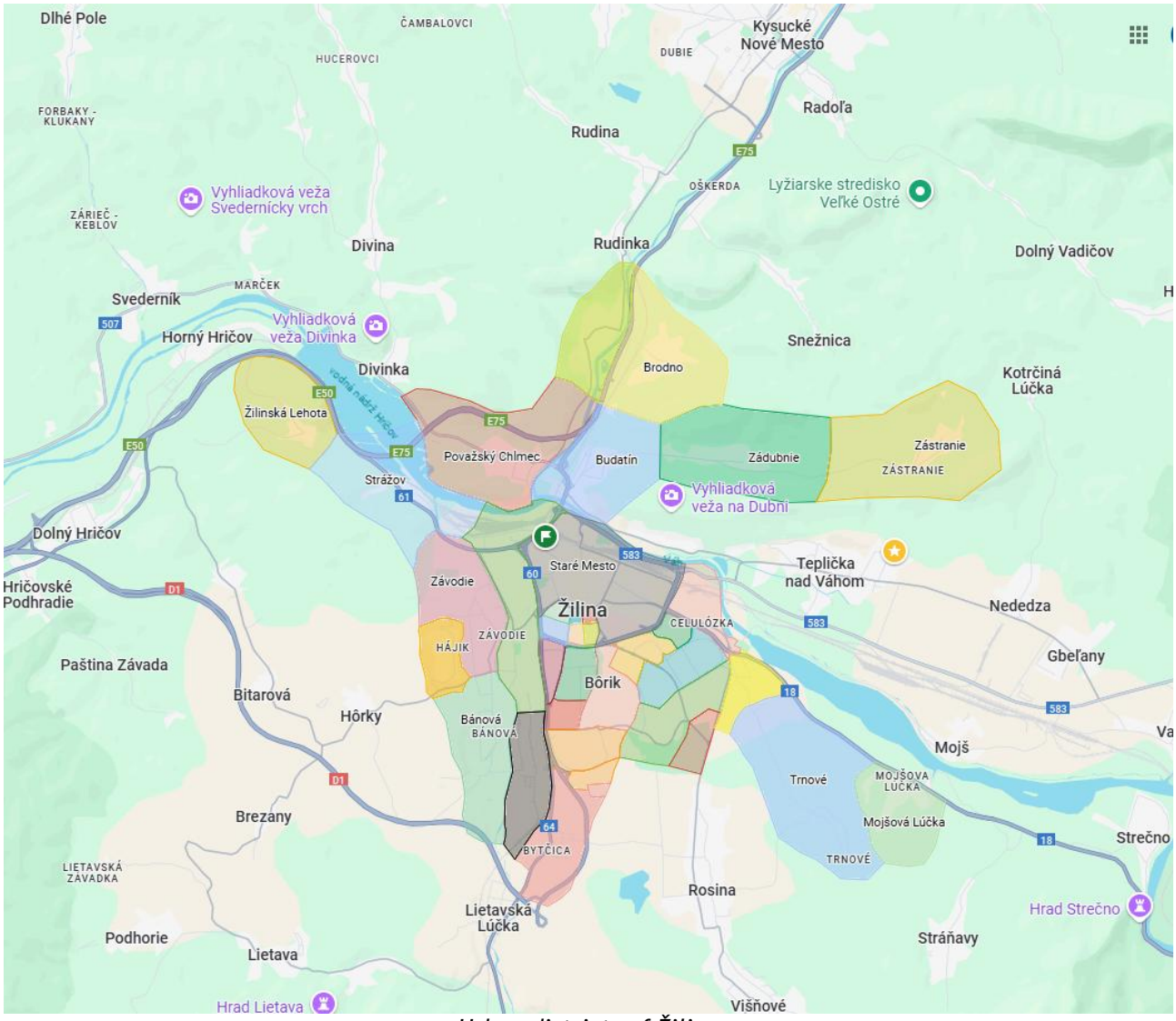


Traffic geofencing is a basic and universal use case of open dynamic data provision.
Olomouc city geofencing means 17 measurement profiles on the roads.

City of Žilina: Functional Analysis of Urban Zones in Žilina

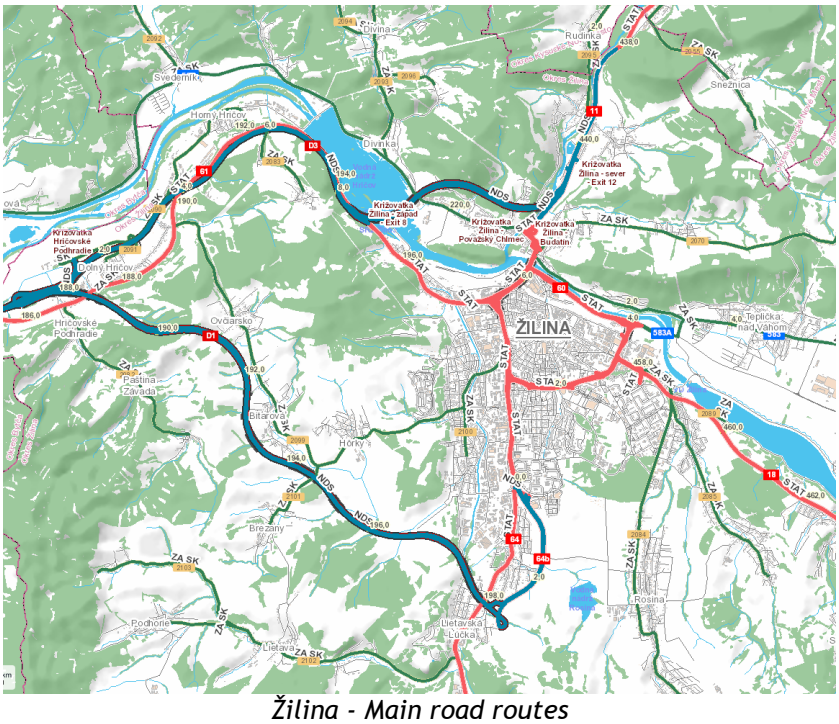
Urban Districts of Žilina

The territory of the city of Žilina is approximately 8,000 hectares (80 km2). The character of the individual areas of the city is largely a consequence of historical development.

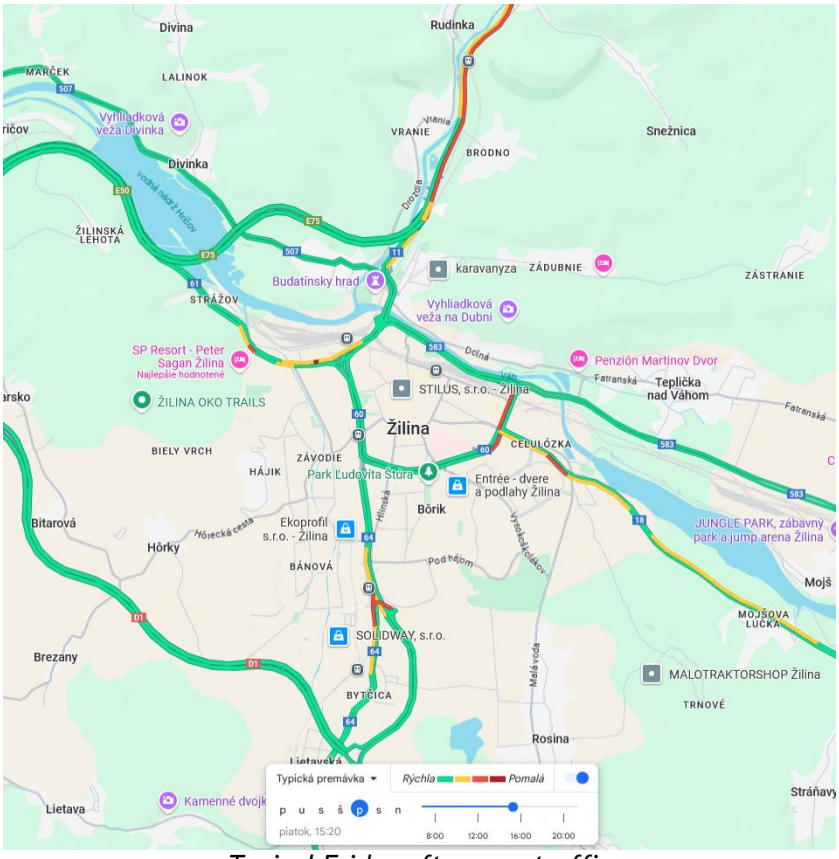


Urban districts of Žilina

The central part consists of historical buildings, later from the 1950s mass housing has been developing, the massive development of which ended with the Hájik housing estate at the beginning of the 21st century. The character of the mostly peripheral parts is formed by former independent villages, whose incorporation into Žilina took place in the 1970s and 1980s. Other significant elements of the city are industrial areas and also the fact that Žilina is an important transport hub for both rail and road transport. Insufficient road infrastructure mainly affects the quality of life in the city, which is caused by bottlenecks in the east, north and south directions. Žilina is also an important railway hub.



Žilina - Main road routes



Typical Friday afternoon traffic

From a spatial planning perspective, the territory of Žilina is divided into 11 urban districts, which are further divided into 53 urban precincts. An overview of urban districts and urban precincts is provided in the following table.

Urban district		Urban precinct	
1	Centrum (City Center)	1	Stred
		2	Hliny I.- IV.
		3	Malá Praha
		4	Frambor
		5	Prednádražie
		6	Predmestie
		13	Nemocnica
2	Vlčince	10	Vlčince I.
		49	Vlčince II.
		50	Vlčince III.
3	Veľký diel	11	Športový areál
		12	Partizánsky háj
		17	Chrasť
4	Južný obvod (Southern District)	14	Bôrik
		15	Hliny V. – VII.
		16	Solinky I.
		32	Bytčica
		51	Hliny VI.
		52	Solinky II.
5	Západ (West)	28	Závodie
		29	Hájik
		32	Hradisko
		33	Bánová
		34	Strážov
		46	Žilinská Lehota

Urban district		Urban precinct	
6	Sever I. (North I.)	35	Považský Chlmec
		38	Vranie
7	Sever II. (North II.)	23	Budatín
		24	Dubeň
		25	Hranice
		27	Kosová
		39	Brodno
		40	Zádubnie
		47	Zástranie
8	Juhovýchod (Southeast)	8	Rosinky
		9	Výskumné ústavy (Research Institutes)
		31	Trnové
		42	Mojšova Lúčka
9	Východné priemyselné pásmo (Eastern Industrial Precinct)	7	Východné priemyselné pásmo (Eastern Industrial Precinct)
10	Západné priemyselné pásmo (Eastern Industrial Zone)	18	Priemyselný okrsok Západ(Western Industrial Precinct)
		19	Priemyselný okrsok Severozápad (Northwestern Industrial Precinct)
		36	Priemyselný okrsok Bánová (Bánová Industrial Precinct)
		53	Priemyselný okrsok Juhozápad (Southwestern Industrial precint)
11	Severné dopravné pásmo (Northern Transport Zone)	20	Nádražie (Station Area)
		21	Priemyselný okrsok Slovena (Slovena Industrial Precint)
		22	Štadion (Stadium)

From a transport perspective, this division is insufficient and for the purposes of transport modelling, a more detailed division into transport zones (microzones) is used, the number of which in the Territorial General Transport Plan of the City of Žilina with the Sustainable Mobility Plan of the City from 2016 was 60. In this regard, it is necessary to point out the development of the population. The aforementioned document assumed that the number of inhabitants of Žilina in 2025 would be 100,142. The reality is that by the end of 2024 the number of inhabitants had fallen below 80,000 (31.12.2024: 79,967 inhabitants).
A new Territorial General Transport Plan is currently being drafted, which assumes a division into 61 transport zones. The New Hospital zone has been added, which reflects the planned development in part of the originally single Hospital zone.

Object	Zone name	Functional use of the territory *	Description
1	Stred (Centre)	publicly accessible areas facilities living	The historical core of the city, which is made up of the city monument reserve, its protective zone and adjacent areas. Characterized by areas of pedestrian areas, civic amenities, schools, mixed areas and public green areas.
2	Hliny I-II	living publicly accessible areas facilities	Zone with predominance of mass housing areas, with basic civic facilities, supplemented by higher civic facilities
3	Hliny III-IV	living publicly accessible areas facilities	Zone with predominance of mass housing areas, with basic civic facilities, supplemented by higher civic facilities
4	Malá Praha	living facilities	The zone is characterized by the original individual residential construction, this function is gradually replaced by buildings with the function of civic facilities
5	Frambor	living facilities manufacturing	The zone is typical for its functional diversity - residential functions are intertwined with civic facilities, non-hazardous manufacturing and services.
6	Prednádražie (The station front)	living facilities transport equipment	Zone adjacent to the railway station, also includes a bus station. Highly attractive mixed-use zone
7	Studničky	recreational vegetation and water living facilities	The central element is the Park na Studničkách (3919m2). The zone includes the Municipal Office and several buildings with housing and service functions
8	Areál PCHZ	manufacturing living facilities	A substantial part of the zone is the area of an industrial enterprise, the rest of the development has the purpose of housing and services
9	Predmestie (Suburb)	living facilities	It is an area of mass housing buildings and schools and civic facilities
10	Nemocnica (Hospital)	facilities living ecostabilization vegetation and water	The zone is formed by the premises of the University Hospital with polyclinic and smaller surrounding mixed areas (housing, amenities, isolation green)
11	Športová hala (Sports hall)	facilities	The zone is a mixed area of sports (mostly) and civic facilities
12	Bôrik - Nerudova	living facilities	The western part of the town district Bôrik with a predominance of family houses. On the outskirts there are UNIZA dormitories.
13	Hliny V a VII	living facilities	It is an area with predominantly mass housing area supplemented by facilities and schools
14	Hypertesco	facilities	The central element of the zone is a hypermarket with smaller shops in the vicinity and an adjacent car park
15	SAD, NAD (transport companies)	transport equipment	The zone is the seat of transport companies (suburban passenger transport, freight transport)
16	Vlčince - vybavenosť (Vlčince - facilities)	facilities	Business zone. On the edge of the zone there is a school, a company providing care for public space and a business centre.
17	OC Carrefour (Shoping centre)	facilities living	The central element of the zone is a shopping centre with smaller shops in the vicinity and an adjacent car park. On the edge of the zone there is a smaller residential complex

18	Partizánsky háj	ecostabilization vegetation and water living	Zone with predominance of greenery with gardening settlement and partial individual building
19	Bôrik - Čapajevova	living facilities	The eastern part of the Bôrik district with a predominance of housing (individual and mass) with facilities
20	Hliny VI	living facilities	It is a smaller unit with a mixed function - there is a set of commercial establishments, a school and in part is an area for mass housing
21	Priemyselný okrsok - východ (Industrial Precinct - East)	manufacturing living facilities	It is an area with a predominance of manufacturing and warehousing, contains mixed areas with a predominance of mass housing, manufacturing and warehousing and facilities, mixed areas of facilities and manufacturing, areas of facilities, mass housing, as well as individual residential development.
22	Vlčince I	living facilities ecostabilization vegetation and water	It is the urban precinct where the construction of the urban district began. It contains existing areas of mass housing, schools, public green space, shoreline and isolation green space and civic facilities
23	Vlčince II	living facilities ecostabilization vegetation and water	The predominant function are the areas of mass residential development, which are complemented by the areas of school, facilities, transport, road transport, public greenery and shoreline and isolation greenery.
24	Vlčince III	living facilities ecostabilization vegetation and water	The dominant function are the areas of mass residential development, which complement the areas of schools, civic facilities, public greenery and shoreline and isolation greenery.
25	Žilinská univerzita, Veľký Diel	facilities living recreational vegetation and water	In addition to the individual residential buildings in the east of the zone, the zone is built up with the infrastructure of the university (buildings for research and teaching, dormitories, canteen, sports grounds), a significant area is occupied by greenery.
26	Solinky I - centrum	living facilities publicly accessible areas	It includes the central and eastern part of the housing estate of the same name, represents the territory of mass housing as the predominant function, with the territory of schools and the main pedestrian area
27	Solinky II - Smrekova	living facilities publicly accessible areas	It is the western part of the Solinky housing estate. It contains the existing areas of the dominant mass housing areas of the school, civic facilities, static transport, road transport and green shoreline and isolation.
28	Chrasť, Žilinský lesopark	recreational vegetation and water	It contains a significant part of the existing territory of the forest park
29	Prielohy, Metro, OC Max	facilities living productive vegetation and water	In the zone there are shopping centres with associated parking lots, other trade and service establishments and also individual residential buildings. Part of the zone consists of agricultural land.
30	Rosinky - Hruštiny	living manufacturing technical facilities	Risinky has the character of a village. The part of Rosinky - Huštiny is formed by the stretch alongside the Žilina Waterworks, which has a mixed function. A small part of the territory is occupied by individual residential construction, in the other part the functions of facilities, manufacturing and sports and recreation prevail.
31	Rosinky - školy	living facilities	In the western part - closest to the city centre - individual residential construction, civic facilities, schools, mixed areas and service facilities prevail.
32	Výskumné ústavy (Research institutes)	facilities	The function of the zone is civic amenities supplemented by the existing shoreline and isolation greenery
33	Trnové	living facilities	The zone is dominated by areas of open countryside and green spaces of various types, also represented by gardening settlements. In the built-up area, individual residential construction prevails, supplemented by areas of sport and recreation, production areas, civic facilities, schools.
34	Mojšová Lúčka	living facilities manufacturing	The zone consists of the waterside part of the Žilina Waterworks and the surroundings of the main road to the east. It has a mixed function - it includes individual residential construction, areas of agricultural production and production and warehouses,

			supplemented by areas of green bank and isolation and green cemeteries, gardening settlements, sports and recreation, facilities.
35	Bytčica	living facilities productive vegetation and water	The zone consists of a former independent village of the same name. There are areas of mass housing, civic facilities, schools, sports and recreation, road transport, green bank and isolation and mixed areas of individual housing and civic facilities.
36	Priemyselný okrsok - sever (Industrial Precinct - North)	manufacturing living facilities	The predominant functions are production and warehouses, in some areas in polyfunction with civic facilities and elsewhere with individual housing. The north borders with the railway line, in the west with the Rajčianka river.
37	Kasárne (Barracks)	manufacturing living	The predominant area is production and warehouses, a significant area is occupied by the area of special purposes, mixed area of production, warehouses and individual housing and the area of public green space. The western boundary is formed by the Rajčianka River.
38	Elektrovod	manufacturing	Purely industrial zone with the function of production and warehouses or trade and services
39	INGEO	manufacturing	The predominant functions are manufacturing and warehouses, in some areas in polyfunctions with civic facilities (services and trade)
40	Priemyselný okrsok - juhozápad (Industrial Precinct - South West)	manufacturing facilities	These are mainly areas of manufacturing and warehouses, supplemented by a mixed area of manufacturing and warehouses with facilities
41	Nádražie-východ (Freight station - east)	transport equipment	The zone is bounded by the railway line - the main corridor to the east and the river Váh, and the road, which is part of the city ring road, also passes through here. It includes a small gardening settlement. The development of production and warehouses is possible.
42	Štadión (Stadium)	living facilities	It includes a mixed area of mass housing and civic facilities, an area of sports and recreation and an area of green shore and isolation
43	Priemyselný okrsok Slovena (Industrial Precinct - Slovena)	manufacturing transport equipment facilities	Size small zone with mixed area of manufacturing, warehouses and civic facilities, area of civic facilities, area of manufacturing and warehouses and area of transport areas, road transport
44	Nádražie - západ (Freight station - west)	transport equipment living	The zone is the area surrounding the railway line in all cardinal directions. The Váh river flows through the zone, a small part is made up of individual residential buildings
45	Strážov	living manufacturing productive vegetation and water	It has the character of a former village. It is dominated by individual housing and recreational construction, supplemented by sports areas, manufacturing and warehousing areas, gardening settlements and shore and isolation greenery.
46	Žilinská Lehota	living facilities productive vegetation and water	In terms of location, it is a satellite of the city, it has the character of a village. The main function is individual housing construction, sports and recreation areas. They are complemented by the existing areas of agricultural production, forest park and forest green
47	Hradisko	productive vegetation and water recreational vegetation and water	It is a functionally extremely diverse area with a predominance of woodland and open countryside, it is mainly represented by the area of special purposes, forest park, cemetery, public, shore and isolation greenery.
48	DPMŽ	transport equipment	Flat small zone. DPMŽ (public transport operator) and related infrastructure is located here
49	Závodie	living facilities ecostabilization vegetation and water	These are areas of predominantly individual residential construction, then areas of mass housing, schools, sports, main pedestrian areas, green shore and isolation and mixed areas of facilities and mass housing, as well as facilities and manufacturing.
50	Hájik	living facilities ecostabilization vegetation and water	The zone has a primary function in the existing areas of mass housing with additional facilities

51	Bánová	living facilities manufacturing	It is an urban precinct of a former independent village with significant areas of individual residential construction and manufacturing, warehouses and manufacturing administration.
52	Budatín	living facilities recreational vegetation and water	Former independent village with a predominance of existing areas of individual housing, supplemented by areas of sports and recreation, schools, green forest park, public green, shore and isolation green, green cemeteries and gardening settlements, static and road transport, relatively small areas of open countryside
53	Hranice	living recreational vegetation and water	Urbanistically it is a zone as an area of invidual housing, which is planned to be further expanded. In addition, in the intravillan (urban area) it still has the function of a gardening settlement and technical infrastructure. In the extravillane (rural area) it is a forest park.
54	Dubeň	productive vegetation and water recreational vegetation and water	The predominant territories are green forest parks and gardening settlements with small areas of individual housing, manufacturing and warehouses
55	Zádubnie	living facilities productive vegetation and water	It is originally an independent village with significant areas of forest park and open countryside. The territory has a composition - individual housing, sports and recreation, agricultural production, school, green cemeteries, shore and isolation greenery
56	Zástranie	living facilities productive vegetation and water	The largest area in the urban precinct has green forest parks and open countryside. In the built-up area, the largest area is the area of individual housing construction, which is complemented by the areas of sports and recreation, civic facilities, schools, green cemeteries and agricultural production.
57	Brodno	living facilities productive vegetation and water	It has the characteristic features of a former independent village. The predominant areas are forest park areas, significant are the areas of open countryside, which have an area larger than the area of individual housing construction. Other functions of the zone are: sports and recreation, agricultural production, manufacturing and warehouses, schools, cemetery greenery, shore and isolation greenery, technical infrastructure
58	Považský Chlmec	living facilities manufacturing	Formerly an independent village, but in addition to individual housing construction, it has significant areas of manufacturing and warehouses, forest park greenery, as well as areas of civic facilities, schools, sports and recreation, public greenery, cemetery greenery, shore and isolation greenery, and water areas.
59	Vranie	living facilities manufacturing	It has the character of a former village with individual housing and areas of agricultural production, sports and recreation, green cemeteries, gardening settlements.
60	Kosová	recreational vegetation and water productive vegetation and water manufacturing	It is characterized by two areas: wooded slopes (forest park supplemented by the territory of green gardening settlements and shore and isolation greenery and areas of individual housing, sports and recreation, agricultural production) and the valley of the Kysuca River (the territory of transport, production and warehouses, sports and recreation and open countryside).
61	Nová nemocnica (New Hospital)	facilities living ecostabilization vegetation and water	Newly created zone within the premises of the University Hospital with polyclinic with planned change of use of the area - construction of a new pavilion

* The functional use of the territory was defined in accordance with Decree No. 392/2023 of the Office for Spatial Planning and Construction of the Slovak Republic on the content and method of processing spatial planning documentation, spatial planning materials, and general requirements for the spatial organization and functional use of the territory. The possible types of use are: a) living, b) facilities, c) manufacturing, d) publicly accessible areas, e) productive vegetation and water, f) recreational vegetation and water, g) ecostabilization vegetation and water, h) transport equipment, and i) technical facilities.
Note: The depiction of these zones on the map can be found in the image in the following section of the document.

Designing Microzones for Holistic Traffic and Climate Sensing: Case of Žilina

Microzoning – urban planning data units

There are various data available and also technology potential to collect data. What is missing is the referencing; simply said:

- which data are relevant to which location (e.g. are the traffic sensor data relevant to the location, given the overall zone and the traffic behaviour of the population?)
- how the data is related to other data (e.g. census counting with traffic counting),
- how to understand the data (potential for comparison and good interpretation of the data)

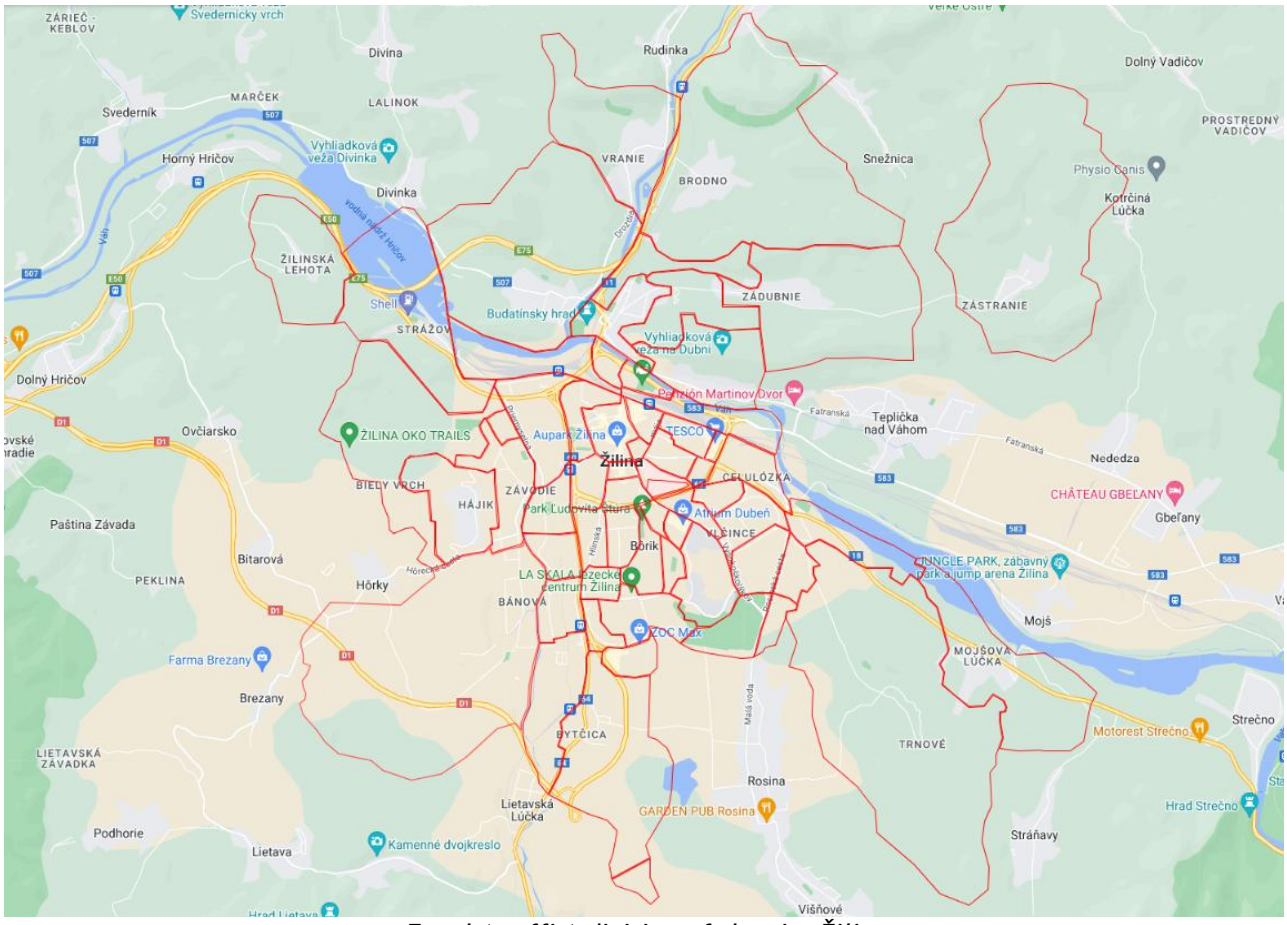
Microzonation is a concept developed within the EnCLOD project to solve the problem of data collection for urban planning in a universal logic. It divides a municipality into zones, allowing to use all available data per zone and to compare zones. The design of micro-zones is also a prerequisite for the design of IoT sensor deployment as well as for further data collection.

The design of microzones should respect the following rules:

- the zones can be of different size, respecting the census statistics data units (so no overlap of census units, i.e. each census unit belongs to just one microzone)
- the zones are designed in a traffic logic; i.e. there are natural boundaries like a river (bridges), other physical barriers as a railroad or main roads in the city (traffic collectors), adjacent villages are single zones
- climate IoT sensors are designed in a complex way, so that one sensor can serve multiple zones (e.g. meteorological stations, rain gauges, solar radiation gauges, particulate matter gauges, etc. can serve multiple zones)
- traffic sensors are designed in a complex way so that one sensor can serve multiple zones (e.g. traffic sensors or other technologies can monitoring entrance to a zone as well as the exit from the other zone, so one data source can serve two adjacent zones),
- traffic (IoT) sensors are placed in such a way that it covers entrances and exits of the zone so provide “a traffic geofencing” of the zone. It can be done by physical placement at entrances/exits to the zone or by a computation from main road profiles situated at the border of the zone
- microzones serve also for data aggregation. This is particularly needed for sensitive data like water or energy consumption. Such a data is a prerequisite for green deal investment planning. Their potential acquisition can be a challenge and can provoke the change of the microzones design

So Microzoning means identifying what and where data is needed and so designing zones for optimal data collection respecting census data units. Microzones can become a new statistics unit for urban development/digital urban planning and the traffic counting at entrances/exits provide a holistic (logical) design of places where the traffic data is needed and by climate sensor design logical places for climate measurements.

The town of Žilina is the administrative, economic and cultural centre of the north-western region of the Slovak Republic. Within the city's zoning plan, the territory is divided into 11 urban districts, which are further divided into urban districts. Within the city of Žilina, the neighbouring villages in close proximity are also important, characterised by a high percentage of commuters in relation to the city of Žilina.



Zonal (traffic) division of the city Žilina

Feasibility of Microzoning in Žilina

- The city has been divided into approximately **60 zones**, which in cooperation with national statistical cells (e.g. census blocks).
- The zoning is designed to reflect, as much as possible, the population's need for displacement.
- This city zoning provides a logical basis for the design of a citywide IoT network.
- Zones offer the possibility of comparison based on indicators such as population, traffic, etc.
- Purpose: Microzonation enables targeted data collection that provides actionable information (e.g. traffic situation), facilitating research and future application development. **UNIZA uses this zoning for traffic modelling and planning in the city of Žilina**

So, the microzoning design simply provides a basis on how to collect data, how to map open data availability and most important for universities on how to engage students to collect data that are missing (missing use cases, missing places). Microzoning is a starting step for open data strategy for digital urban planning to enhance governance. Having such data in various municipalities means to profit from potential future AI tools. So, to have microzones means an advantage for a municipality to acquire and maintain data that are needed by digital services.

Match mapping – to identify the existing data sources

The first important activity within the EnCLOD project is the mapping of the current situation. This means the analysis of existing technologies that already collect data, e.g. traffic counters, meteorological stations, etc. The output of this activity should be:

- **Map existing data sources** with technology type and identifying the share (share of existing technologies at metering sites and share of EnCLOD to identify what is missing for citywide sensor deployment)
- **specification of data output capabilities** (e.g. traffic counting every 10 minutes, or classification of vehicles in 5 categories every 15 minutes etc.), and pinpointing the organizations operating these systems, assigning them a role of "data provider" in the local open data ecosystem and a natural partner of the hackathons
- Proposing a logical cost model for citywide sensor deployment, i.e. the numbering of places/types of sensors that are missing, and provide an estimate of possible costs as a key input into the Local Action Plan

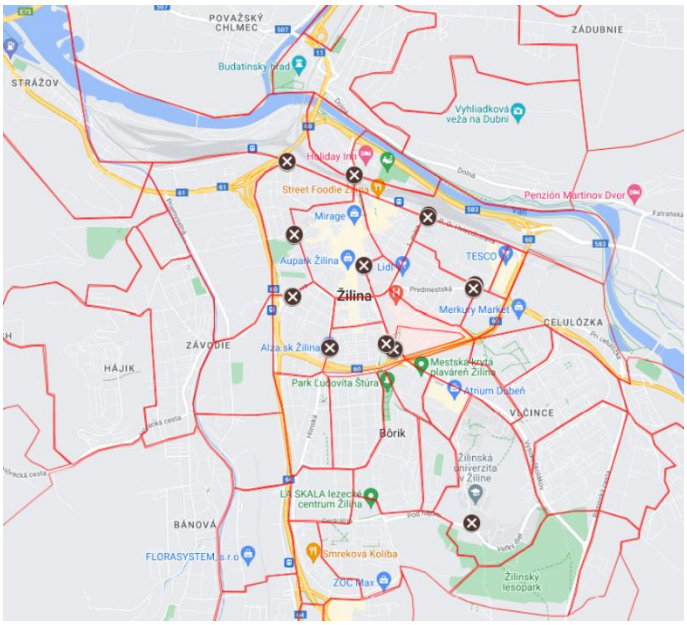
Existing technologies in the city of Žilina

The following section will describe the existing technologies implemented in the city of Žilina (the list of technologies listed is as of the date of submission of the Action Plan, if additional technologies are identified they will be added later on).

Traffic sensors

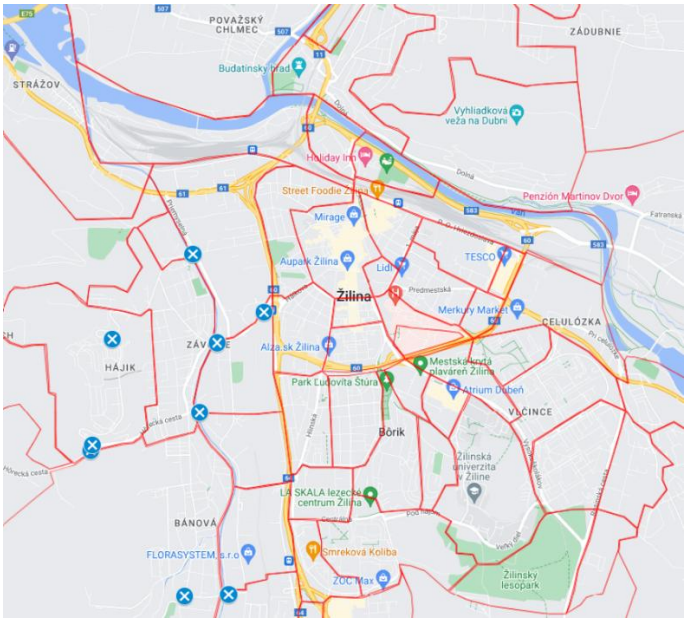
The first set is data from traffic sensors that are implemented within the city of Žilina. This is traffic geofencing in the centre of Žilina - it provides data on vehicle passes - number of vehicles, vehicle category and vehicle speed. Data is provided at 5 min intervals (internally) or 15 min intervals (on the portal) - aggregated data is provided at the 15 min interval. The data and information system manager is CITIQ. This type of sensors as well as the implementation within the city of Žilina can be categorized into three parts:

CLEVERNET project (https://clevernet.uniza.sk/) - a total of 28 traffic sensors were deployed at 12 locations. The strategic deployment provides important data at the main traffic entrances to/from the city centre. These sensors provide important traffic data with respect to the total volume of traffic entering and exiting the central part of Žilina. The location of the sensors is shown in the figure below.



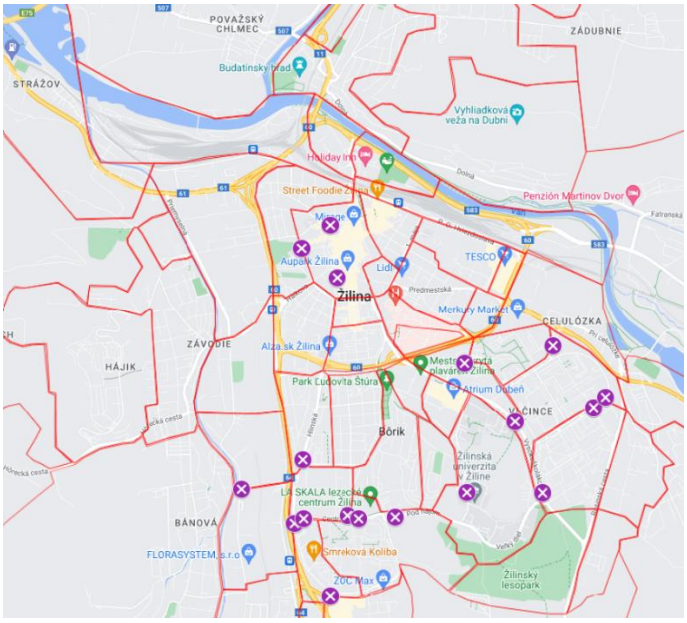
Location of traffic sensors - project CLEVERNET

- **NXTLVL Parking project** - 20 traffic sensors were deployed at 9 locations. The deployment and implementation of the traffic sensors provides traffic monitoring within the entry and exit of the various zones located in the western part of the city. The location were designed based on the city residential parking extension pilot starting with the residential area Hájik. The location of the sensors is shown in the figure below.



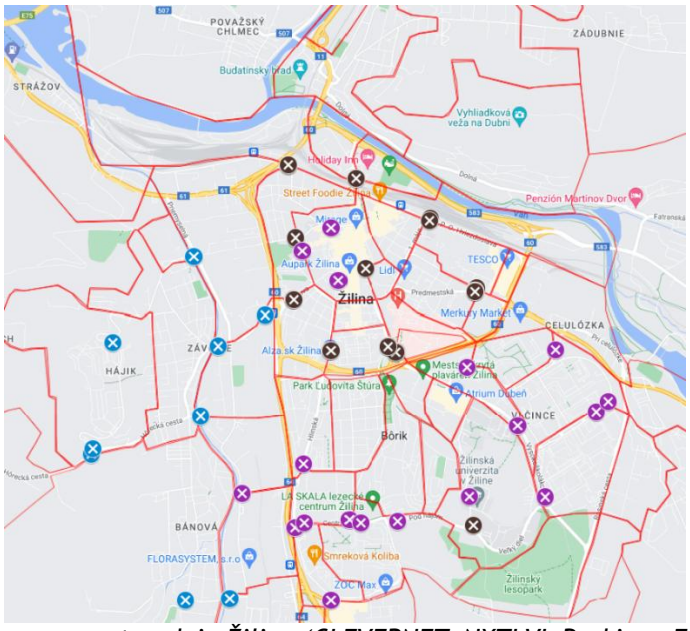
Location of traffic sensors - project NXTLVL Parking

- **EnCLOD project** - about 45 traffic sensors were implemented at 18 locations within this project. The location in relation to the city of Žilina is mainly in the South around the two biggest housing estates "Solinky" and "Vlčince" and in the city centre, focusing on pedestrian crossings. The location of the sensors is shown in the figure below.



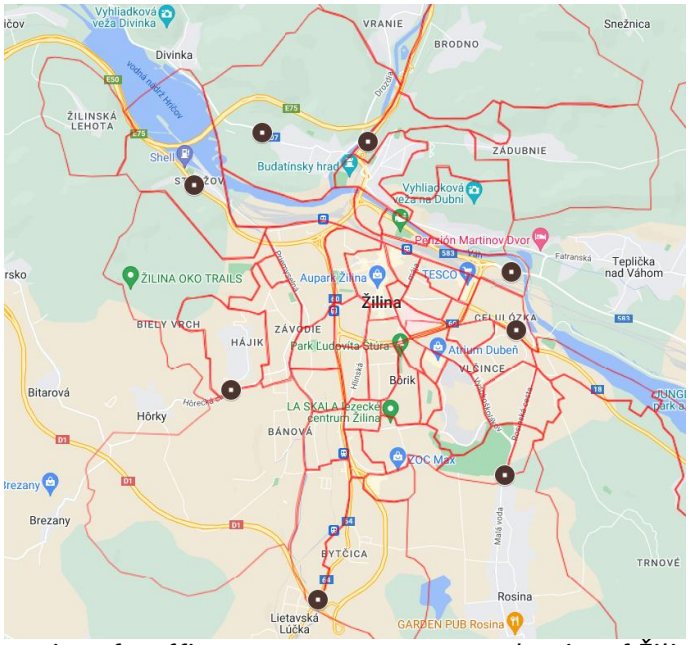
Location of traffic sensors - project EnCLOD

The total coverage of the city of Žilina using traffic sensors provided by CITIQ is shown in the figure below.



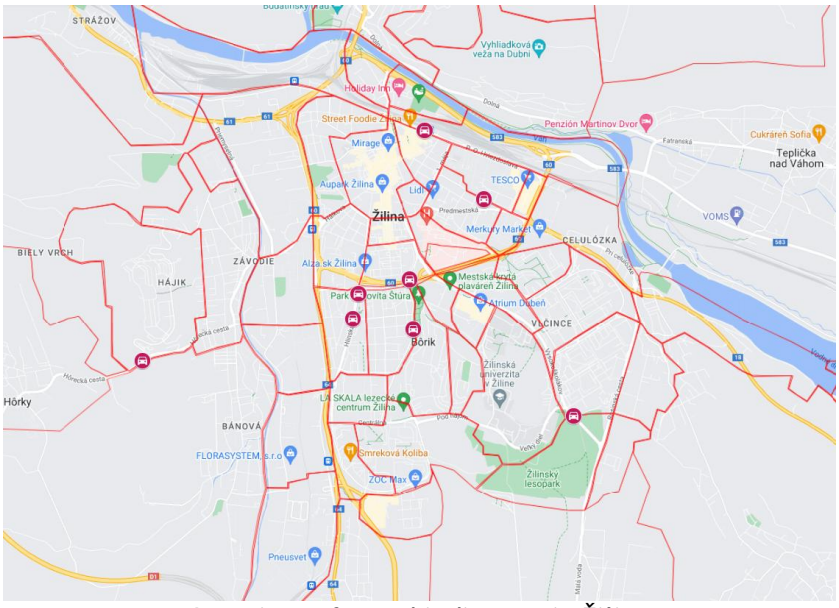
Traffic sensor network in Žilina (CLEVERNET+NXTLVL Parking+ EnCLOD)

The second important set of traffic data are traffic intensity counters - entrances to the city of Žilina. Using radar technology, all main entrances from the catchment areas entering the city of Žilina are monitored. A total of 8 entrances to the city of Žilina are monitored. The radar technology provides information regarding the number of vehicles, speed and category. Individual datasets are sent at 5 minute intervals. The total number of individual radar locations is shown in the figure below.



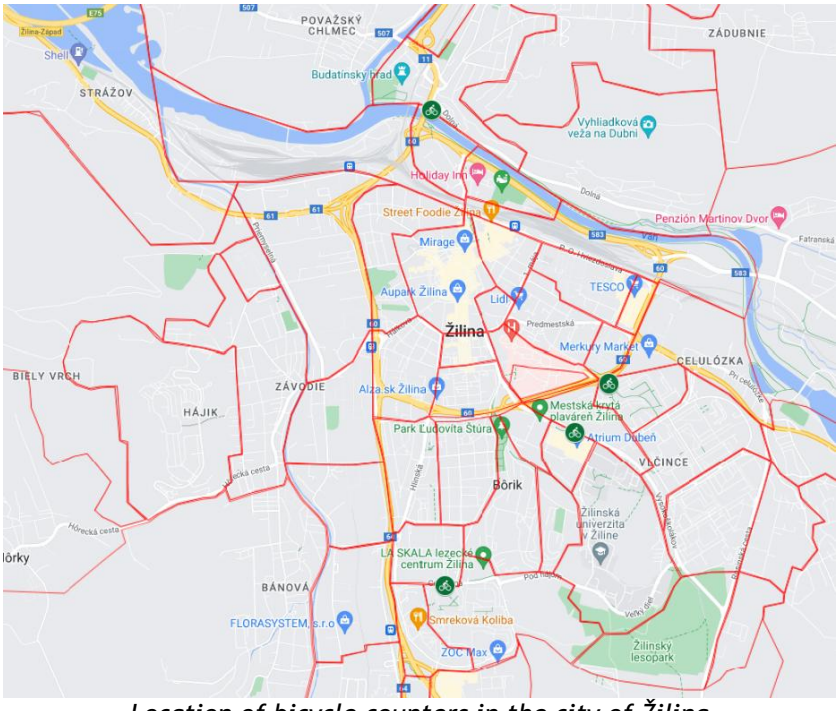
Location of traffic counters - entrances to the city of Žilina

Another technology located within the city of Žilina that provides information on the number of vehicles and speed are speed cameras. This type of technology also displays the speed of individual vehicles on a green/red LED panel. Within the city of Žilina there is a total of 8 speed cameras located in different places. The location of speed cameras within the city is shown in the figure below.



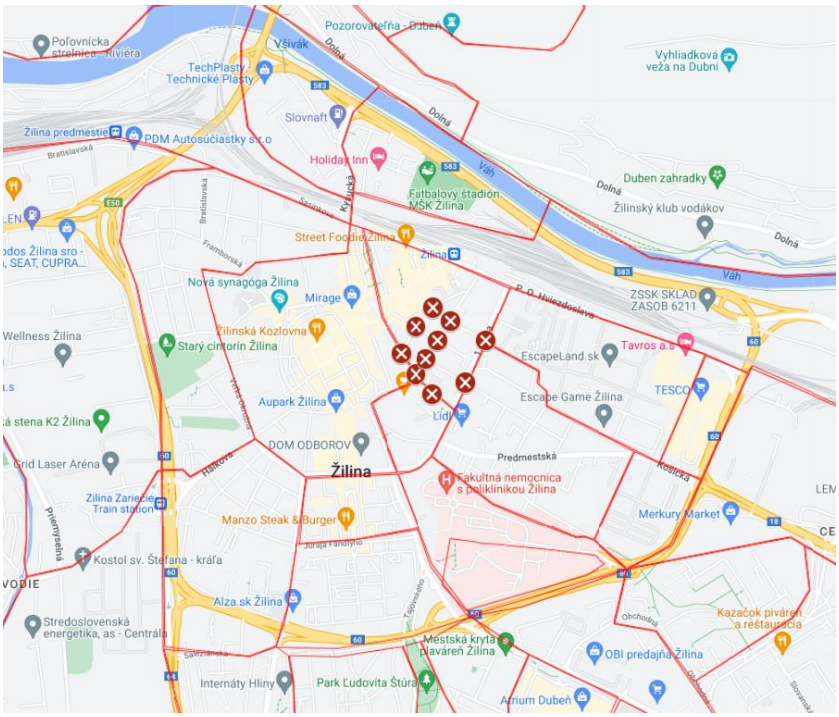
Locations of speed indicators in Žilina

The city also includes cycle routes that support green transport within the city of Žilina. In this respect, cycle counters are implemented at selected 4 locations. The technology records the number, speed and direction of cyclists, the technology itself works on the basis of a magnetometer. The location of the cyclist counters in the city of Žilina is shown in the figure below.



Location of bicycle counters in the city of Žilina

Another technology that is implemented within the city of Žilina are traffic sensors located in the central part of the city of Žilina. In total, the sensors cover 10 locations and should provide information on the number of vehicles passing through the area. This sensor network was built within the SOLEZ project. Currently, this sensor network is not used or has no support. The location is shown in the figure below.



Location of traffic sensors - project SOLEZ (currently no supported)

For transparency, a table containing traffic sensors deployed within the city of Žilina has been prepared. The content of the table is as follows:

- The name or title of the project under which the technology was implemented,
- Location, name of the local road (or road number) on which the technology in question is located,
- The number of sensors, the number located at a given location,
- Affected zones, determined according to the location of the technology and the zoning of the territory (e.g. in the case of the location of the technology on the border of zones - assignment of both zones for a given sensor),
- Comments.

List of traffic sensors in the city of Žilina

Network	Location	Direction	# Sensor	Zones affected	Comment
CLEVERNET	UNIZA_CAMPUS	OUT	1	Zones University of Žilina, Veľký Diel	
	street Martina Rázusa	IN; OUT	2	Zone Stred	
				Zone Frambor	
	street Bratislavská	IN; OUT	2	Zone Industrial area - North	
				Zone Nádražie - West	
				Zone Frambor	
	street Kysucká	IN; OUT	2	Zone Slovena industrial area	Currently non-functional, reconstruction of the area is in progress
				Zone Štadión	
				Zone Nádražie - East	
				Zone Nádražie - West	
	street Vysokoškolákov	IN; OUT	4	Zone Hliny III-IV	4-lane road (2 lanes per direction)
				Zone Hliny I-II	
				Zone Sports hall	
	street Tajovského	IN; OUT; OUT (right)	3	Zone Hliny III-IV	IN - direction V.Spanyola street, OUT - direction Tajovského street, OUT (right) - direction Vysokoškolákov street
				Zone Sports hall	
	street Hálkova	IN; OUT	4	Zone Malá Praha	4-lane road (2 lanes per direction)
				Zone Frambor	
	street Košická	IN; OUT	4	Zone Predmestie	

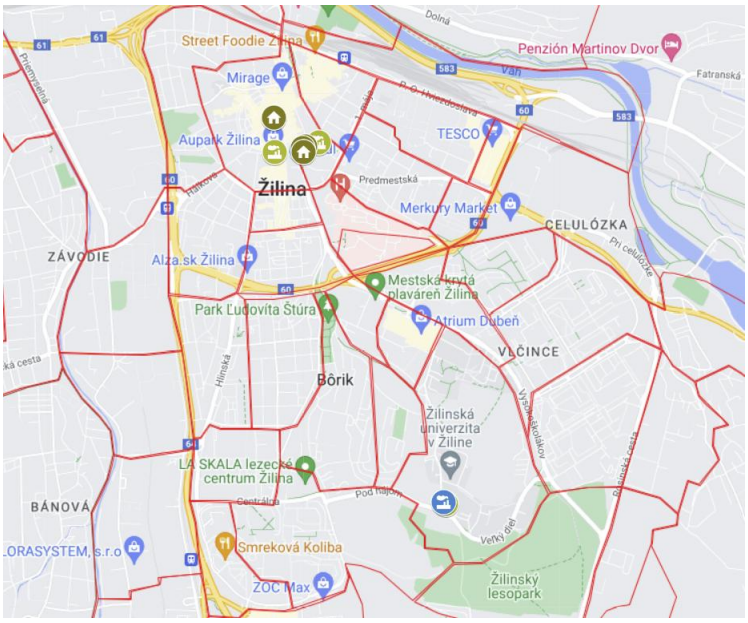
				Zone SAD, NAD	4-lane road (2 lanes per direction)
				Zone Area PCHZ	
	street M.R.Štefánika	IN	1	Zone Area PCHZ	one-way road, direction Štefánik Square
	street Komenského	IN; OUT	2	Zone Malá Praha	
				Zone Hliny III-IV	
	street P.O.Hviezdoslava	IN; OUT	2	Zone Area PCHZ	
				Zone Prednádražie	
	street Vojtecha Spanyola	OUT	1	Zone Stred	
				Zone Studničky	
Network	**Location**	**Direction**	**# Sensor**	**Zones affected**	**Comment**
NXTLVL Parking	street Kvačalova	IN; OUT	2	Zone DPMŽ	
				Zone Závodie	
				Zone Industrial area - north	
	street Závodská cesta	IN; OUT	4	Zone Kasárne	class III road no. III/2099
				Zone Industrial area – north	
	street Juraja Závodského	IN; OUT	2	Zone Závodie	class III road no. III/2099
				Zone Industrial area – north	
				Zone Kasárne	
	street Žitná	IN; OUT	2	Zone Kasárne	
				Zone Elektrovod	
				Zone Závodie	
	street Hôrecká cesta	IN; OUT	2	Zone Hájik	class III road no. III/2099
				Zone Bánová	
				Zone Hradisko	
	street Mateja Bela	IN; OUT	2	Zone Hájik	
	street Kvačalova	IN; OUT	2	Zone Hájik	
	street K cintorínu	IN; OUT	2	Zone Bánová	
	street Bitarovská cesta	IN; OUT	2	Zone Bánová	
				Zone Industrial area - south-west	
EnCLOD	street Svätého Cyrila a Matóda	IN; OUT	2	Zone Vlčince I	
				Zone Vlčince II	
				Zone Industrial area - East	
	street Matice Slovenskej	IN; OUT	2	Zone Vlčince II	
				Zone Vlčince III	
	street Veľká Okružná	IN; OUT	2	Zone Stred	Near the Gymnasium Veľká Okružná
				Zone Frambor	
	street Hlinská	IN; OUT	2	Zone Hliny V a VII	
				Zone Hliny VI	
	street J.M.Hurbana	IN; OUT	2	Zone Stred	
	street Vysokoškolákov	IN; OUT	2	Zone Vlčince II	near the forest park Chrast', bus turnaround
				Zone Vlčince III	
	street Vysokoškolákov	IN; OUT	2	Zone Vlčince II	at the Client Centre
				Zone Vlčince - facilities	
	street Obežná	IN; OUT	2	Zone Vlčince II	
				Zone Vlčince III	
	street Kamenná	IN; OUT	2	Zone INGEO	petrol station TANKER
				Zone Elektrovod	
	street Univerzitná	IN; OUT	2	Zona University of Žilina, Veľký Diel	
	street Komenského	IN; OUT	2	Zone Stred	Primary school R. Zaymusa
	street Obvodová	IN; OUT	2	Zone Solinky II - Smrekova	petrol station OMV
				Zone Hliny VI	
	street Centrálna	IN; OUT	2	Zone Hliny VI	petrol station OMV
				Zone Solinky I - centre	
				Zone Solinky II - Smrekova	
	street Alexandra Rudnaya	IN; OUT	2	Zone Hliny VI	
				Zone Solinky I - centre	
				Zone Bôrik - Čapajevova	
	street Pod hájom	IN; OUT	2	Zone Solinky I – centre	
	ulica Centrálna	IN; OUT	2	Zone Solinky I - centre	At the primary school Oravská, restaurant Drevená Krava
	Solinky- roundabout at METRO	IN; OUT	2	Zone Solinky II - Smrekova	roundabout at METRO
				Zone Prielohy, Metro, OC Max	
	street Obchodná	IN; OUT	2	Zone Vlčince – facilities	near the Church of the Virgin Mary of the Seven Sorrows, OBI department store
				Zone Vlčince I	

Network	Location	Direction	# Sensor	Zones affected	Comment
Traffic counters, entrance to the city of Žilina	road II/583	IN	1	Zone Nádražie - East	Entrance from Tepličky nad Váhom
	road I/18	IN	1	Zone Industrial area - East	Entrance from Mojšovej Lúčky
	road III/2084	IN	1	Zones Chrasť, Žilinský lesopark (Forest Park)	Entrance from Rosiny
				Zone Research institutes	
	road I/64	IN	1	Zone Bytčica	Entrance from Lietavskej Lúčky
				Zone Industrial area - south-west	
	road III/2099	IN	1	Zone Hradisko	Entrance from Hôrok
				Zone Bánová	
				Zone Hájik	
	road I/61	IN	1	Zone Strážov	Entrance from the D3 motorway (feeder)
	road II/507	IN	1	Zone Považský Chlmec	Entrance from Kotešovej
	road I/11	IN	1	Zone Kosová	Entrance from Kysuckého Nového Mesta
Speed meters (indicator)	street P.O.Hviezdoslava	IN	1	Zone Nádražie - East	Direction SAD
				Zone Prednádražie	
	street Tajovského (I.)	OUT	1	Zone Hliny III-IV	Park Ľ. Štúra, direction Bôrik
	street Tajovského (II.)	IN	1	Zone Bôrik - Nerudova	Park Ľ. Štúra, direction Vysokoškolákov street (petrol station SHELL)
	street Hlinská	IN	1	Zones Hliny V a VII	Direction Centre
				Zone Malá Praha	
				Zone Bôrik - Nerudova	
	street Hlinská	OUT	1	Zones Hliny V a VII	Direction Solinky
	street Hôrecká	IN	1	Zone Hájik	Direction to the town, road III/2099
				Zone Hradisko	
				Zone Bánová	
	street Vysokoškolákov	IN	1	Zone Chrasť, Žilinský lesopark (Forest Park)	Direction Centre
				Zone Vlčince III	
	street M.R.Štefánika	IN	1	Zone Area PCHZ	direction Štefánik Square
				Zone Predmestie	
Cyclist counters	street Hlboká cesta		1	Zone Vlčince I	route H3 - Hlboká street
	street Vysokoškolákov		1	Zone OC Carrefour	route H23 - Vysokoškolákov Street
				Zone Vlčince - facilities	
	street Borová, Solinky		1	Zone Solinky I - centre	route H2 - Borová Street, Solinky
				Zone Hliny VI	
	Budatín		1	Zone Budatín	route H4 - Budatín
				Zone Slovena industrial area	
SOLEZ - currently without support	crossroads Moyzesova/ 1. mája		N/A	Zone Prednádražie	
				Zone Predmestie	
	street Republiky		N/A	Zone Studničky	
				Zone Stred	
				Zone Prednádražie	
	crossroads Republiky/J. Reka/D. Dlabača		N/A	Zone Stred	
				Zone Studničky	
				Zone Prednádražie	
	crossroads D.Dlabača/Moyzesova		N/A	Zone Prednádražie	
	crossroads Republiky/Kukučínova		N/A	Zone Stred	
				Zone Prednádražie	
	crossroads M.R.Štefánika/D. Dlabača		N/A	Zone Prednádražie	
	crossroads M.R.Štefánika/Kukučínova		N/A	Zone Prednádražie	
	crossroads J.Milca/V. Tvrdého		N/A	Zone Prednádražie	
	crossroads D. Dlabača/J. Milca		N/A	Zone Prednádražie	
	crossroads 1. mája/J. Milca		N/A	Zone Prednádražie	
				Zone Area PCHZ	
				Zone Predmestie	

Meteorological stations

In terms of monitoring and informing the population in Žilina about the environment, a sensor network has been created. This sensor network ensures continuous monitoring and provision of up-to-date information on the environment. The sensor network can be divided into three groups:

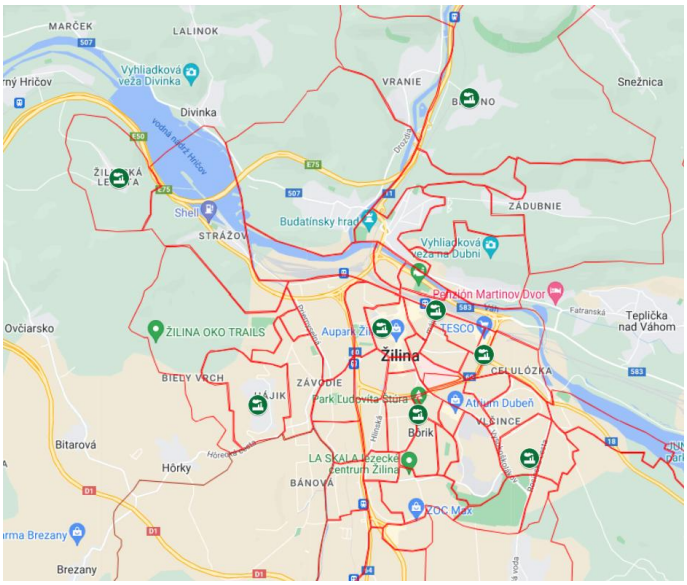
1. Sensor network built in the framework of the CLEVERNET project. Three types of sensors were implemented within this project:
   - meteorological stations - 3 locations in the city of Žilina,
   - surface temperature sensors - 2 locations in Žilina,
   - façade sensors - 4 sites in Žilina.



Sensor network – Meteostations, Façade sensors, Surface temperature sensor built by project CLEVERNET

2. Sensor network built by AG DATA. Within this sensor network, the following data are collected and provided:
   - Environment:
     - Carbon monoxide
     - Nitrogen dioxide
     - Particulate Matter - PM1.0
     - Particulate Matter - PM2.5
     - Particulate Matter - PM4
     - Particulate Matter - PM10
     - Sulphur dioxide
   - Meteorological station:
     - Air humidity
     - Air pressure
     - Air temperature
     - Light intensity
     - Rain gauge
     - Wind direction
     - Wind movements
     - Wind speed

In terms of number, there are a total of 8 meteorological stations deployed within the city. The location of the individual stations is shown in the figure below.

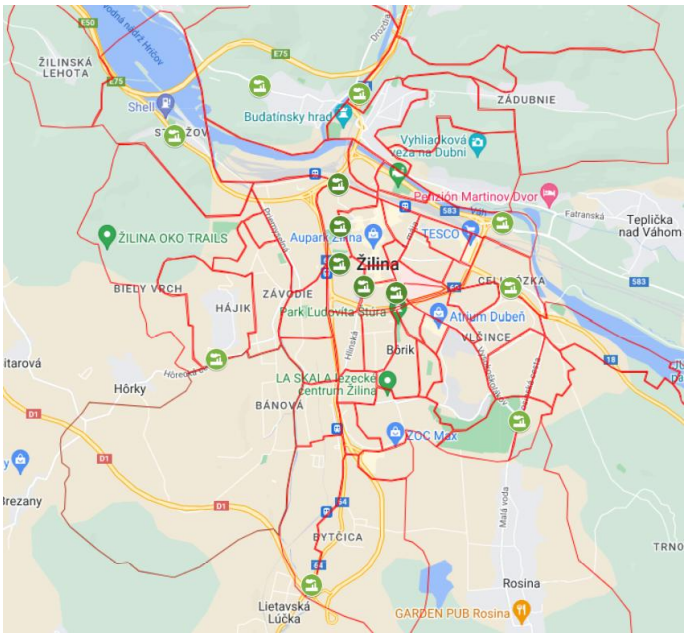


Sensor network – meteorological stations, built by AG DATA

3. Sensor network built within the REMoT project by Industry Solutions. The following data is collected and provided within this sensor network:

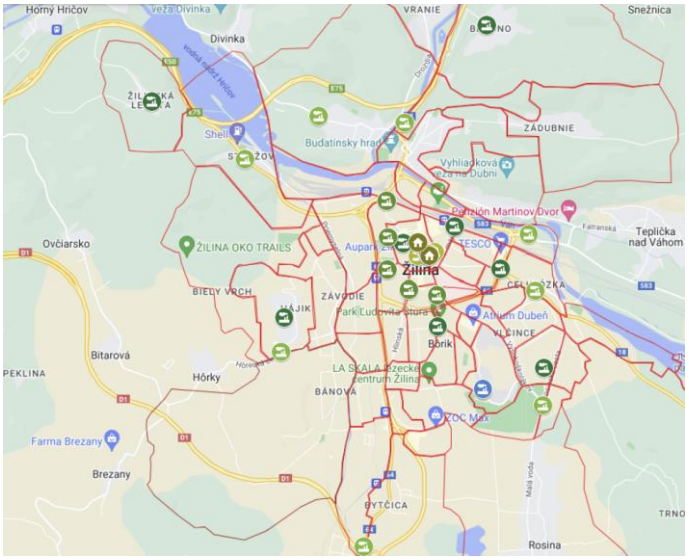
- Measurement of dust particles PM1, PM2.5 and PM4, PM10
- Air temperature measurement
- Measurement of air humidity
- Measurement of air pressure (atmospheric or barometric)
- Measurement of solar radiation intensity
- Noise measurement

The distribution of the sensor network is shown in Figure below. A total of 13 sites are monitored. In terms of location we can say that they are divided into two layers. The first layer is installed at the main entrances to the city of Žilina, in this case the location is identical to the radar technology for monitoring traffic intensity. The second layer is concentrated in the central part of the city.



Sensor network - meteorological stations, built within the REMoT project

The overall coverage of the city of Žilina in terms of environmental and air quality monitoring is shown in the figure below.



Sensor network of meteorological stations (total) built within the city of Žilina

For easier display, a table containing:

- The name or project under which the sensor network was built,
- Location, name of the zone in which the meteorological station is located.
- Affected zones, name of the zones affected by the meteorological station (e.g. if the meteorological station is located close to zone boundaries, then both zones are listed).
- Comments.

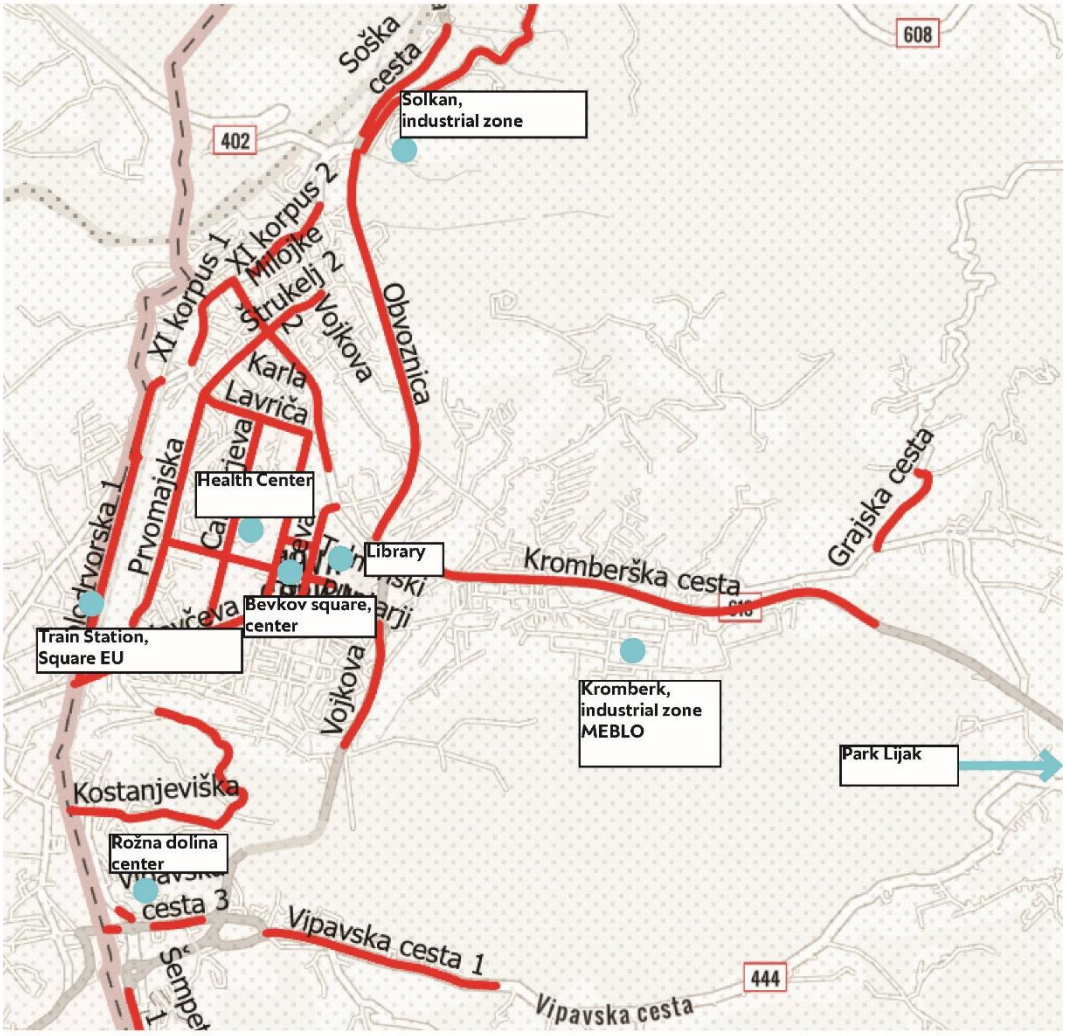
List of meteorological stations in Žilina

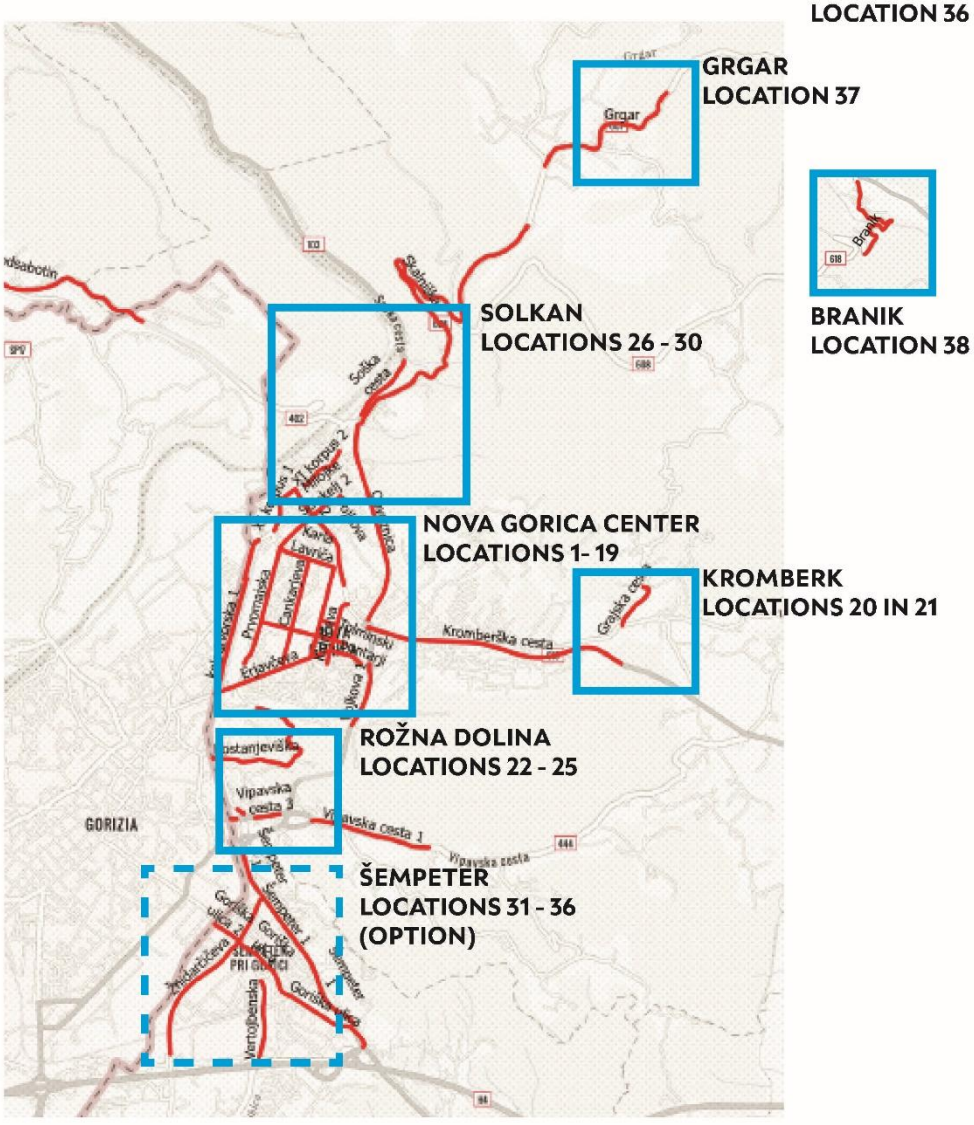
Project	Location	Zones affected	Comment
CLEVERNET	Meteostation_1- USP (UNIZA CAMPUS)	Zone University of Žilina, Veľký Diel Zone Solinky I - centre	near the building of University Science Park (USP) UNIZA
	Meteostation_2 - Street Romualda Zaymusa	Zone Centre	near the AUPARK Žilina (shopping centre)
	Meteostation_3 - Park Studničky	Zone Studničky Zone Centre Zone Prednádražie	Studničky Park, under the Municipal Office building
	Surface temperature sensor_1 – USP (UNIZA CAMPUS)	Zone University of Žilina, Veľký Diel Zone Solinky I – centre	next to the building of USP UNIZA
	Surface temperature sensor_2 – Municipality Office	Zone Studničky Zone Centre	in front of the Municipality Office building
	Façade sensor_1- Municipality Office	Zone Studničky Zone Centre	on the facade of the Municipal Office building - east side
	Façade sensor_2- Municipality Office	Zone Studničky Zone Centre	on the facade of the Municipal Office building - west side
	Façade sensor_3 - Municipality Office	Zone Studničky Zone Centre	on the facade of the Municipal Office building - south side
	Façade sensor_4 - City Hall	Zone Centre	on the City Hall building, south-west (direction to the square)
AG DATA	Urban area Žilinská Lehota	Zone Žilinská Lehota	street Kortinská
	Urban area Hájik	Zone Hájik	street Námestie Mladosti, at the primary school
	Park Ľudovíta Štúra	Zone Bôrik - Čapajevova Zone Bôrik - Nerudova	in the central part of the park
	housing estate Vlčince	Zone Vlčince III	street Karpatská, at the primary school
	hypermarket TESCO	Zone Hypertesco Zone SAD, NAD Zone Industrial area - East	street Košická a street Nemocničná
	Žilinská Diecéza	Zone Stred	Žilinská Diecéza, street Kuzmányho
	BUS station - SAD	Zone Prednádražie Zone Area PCHZ Zone Nádražie-East	Street P.O.Hviezdoslava
	Urban area Brodno	Zone Brodno	street Brodňanská, by the fire station
REMoT	road II/583	Zone Nádražie-East	entrance from Tepličky nad Váhom
	road III/2084	Zone Chrasť, Žilinský lesopark (Forest Park) Zone Research institutes	entrance from Rosiny
	Road I/64	Zone Bytčica Zone Industrial area - south-west	entrance from Lietavskej Lúčky
	road III/2099	Zone Hradisko Zone Bánová Zone Hájik	entrance from Hôrok
	road I/61	Zone Strážov	entrance from the D3 motorway (feeder)
	road I/11	Zone Kosová	entrance from Kysuckého Nového Mesta
	road I/18	Zone Industrial area - East Zone Vlčince I	entrance from Mojšovej Lúčky

		Zone Vlčince II	
	road II/507	Zone Považský Chlmec	entrance from Kotešovej
	streets Tajovského/ Vysokoškolákov	Zones Hliny III-IV	At the petrol station SHELL
		Zone Nemocnica	
	street Komenského	Zone Malá Praha	by the building of the Žilina Region headquarters
		Zone Hliny I-II	
		Zone Hliny III-IV	
	street Hálkova	Zone Malá Praha	at the roundabout Rondel
		Zone Frambor	
	street Martina Rázusa	Zone Frambor	at the Gymnasium Veľká okružná
		Zone Stred	
	street Bratislavská	Zone Frambor	at the petrol station JURKI
		Zone Industrial area - north	
		Zone Nádražie - West	

City of Nova Gorica:
Overview map of sensors location

OVERVIEW MAP OF PROPOSED SENSOR LOCATIONS FOR AIR QUALITY MEASUREMENTS




LOKVE
LOCATION 36
GRGAR
LOCATION 37
BRANIK
LOCATION 38
SOLKAN
LOCATIONS 26 - 30
NOVA GORICA CENTER
LOCATIONS 1- 19
KROMBERK
LOCATIONS 20 IN 21
ROŽNA DOLINA
LOCATIONS 22 - 25
ŠEMPETER
LOCATIONS 31 - 36
(OPTION)
GORIZIA


Erjavčeva cesta
NOVA GORICA - CENTER
1
sensor position
BUILDINGS SUITABLE FOR SENSOR INSTALLATION
Accessab e window between the 1st and 7th floors with a view of the road without any obstructions such as greenery and street lighting.
1. choice


Cankarjeva ulica
NOVA GORICA - CENTER
2
sensor position
BUILDINGS SUITABLE FOR SENSOR INSTALLATION
Accessab e window between the 1st and 7th floors with a view of the road without any obstructions such as greenery and street lighting.
1. choice


Bevkov trg
NOVA GORICA - CENTER
3
sensor position
BUILDINGS SUITABLE FOR SENSOR INSTALLATION
Accessab e window between the 1st and 7th floors with a view of the road without any obstructions such as greenery and street lighting.
1. choice


Gradnikove brigade
NOVA GORICA - CENTER
4
sensor position
BUILDINGS SUITABLE FOR SENSOR INSTALLATION
Accessab e window between the 1st and 7th floors with a view of the road without any obstructions such as greenery and street lighting.
1. choice