



Data catalogue of suitable and available (local) data sources/data sets

Deliverable 2.2
Version 1.0

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List of abbreviations

API	Application Programming Interface
CKAN	Comprehensive Knowledge Archive Network
DCAT-AP	Data Catalogue - Application Profile
POI	Point of Interest
T	Task
URL	Uniform Resource Locator
WP	Work Package

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Administrative information

Basic information on the SuCoLo project and this deliverable:

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Purpose of the document

This document explains the findings from Task (T) 2.2 with the aim to create a data catalogue of suitable and available (local) open data sources and/or data sets in general using open data from German cities – in particular, the city of Leipzig. The aim is to utilize these data sets in an Artificial Intelligence based simulation model (T2.3) to ascertain the most optimal placement of micro-hubs and cargo bike pick-up stations, and in a software prototype for routing and scheduling of delivery orders (T2.4). Although the simulation and prototype in T2.3 and T2.4 are trained from data from Leipzig/Germany, both would still be able to be extended for use in municipalities outside of this geographic area.

Executive Summary

This document describes the contents and handling of the data catalogue created in Task 2.2. The data catalogue is publicly available on GitHub in English and German. It will be updated at regular intervals. The data catalogue can be found under the following link:

https://github.com/Logistics-Living-Lab/SuCoLo_DataCatalogue

The data portals and datasets found are selected based on certain criteria, such as free to-use licence, machine-readability and open data from German cities and, in particular, on the city of Leipzig and its outskirts. Data sets that could be used include, but are not limited to, demographic data, economic data, land use data and social factors. Overall, 29 suitable databases were found to be used, which have differing attributes. For future use, these datasets will be technically and organisationally evaluated and prepared for use in the following T2.3 and 2.4 of the SuCoLo project.

1. Data analysis for sustainable delivery solutions

1.1 Description of Task 2.2

There are already numerous data spaces or platforms for the exchange of data sets of the city of Leipzig available on the Internet. At the moment, it is not possible to get a general overview of urban data regarding specific topics in Leipzig. Therefore, in T2.2, a data catalogue with suitable and available data sources and / or data sets will be created for selected urban areas in Leipzig, Germany. These districts are located on the outskirts of Leipzig in order to find a suitable location for a pick-up station for goods based on various criteria. In SuCoLo, goods from the city centre (see Figure 1, number 00) will be offered via a web shop and delivered by (cargo) bike to the suburbs – in particular, the districts of Lützschena-Stahmeln (no. 82) and Hartmannsdorf-Knautnaundorf (no. 55) will be examined (marked in green) (Figure 1). These districts are located on the outskirts of a larger city and are particularly suitable for the SuCoLo project because of their characteristics, such as the age structure, living properties and employment relation of their inhabitants and their geographical location (i.e., in urban outskirts, where the 15-minute-city can be realised by means of cargo bike delivery and cargo bike pick-up stations). The collection of this specific data, such as the combination of geographic and social status information of residents, is necessary because it can reflect important characteristics of the neighbourhood (Psyllidis et al., 2022), and to analyse whether there are important correlations which can be used later in the model.

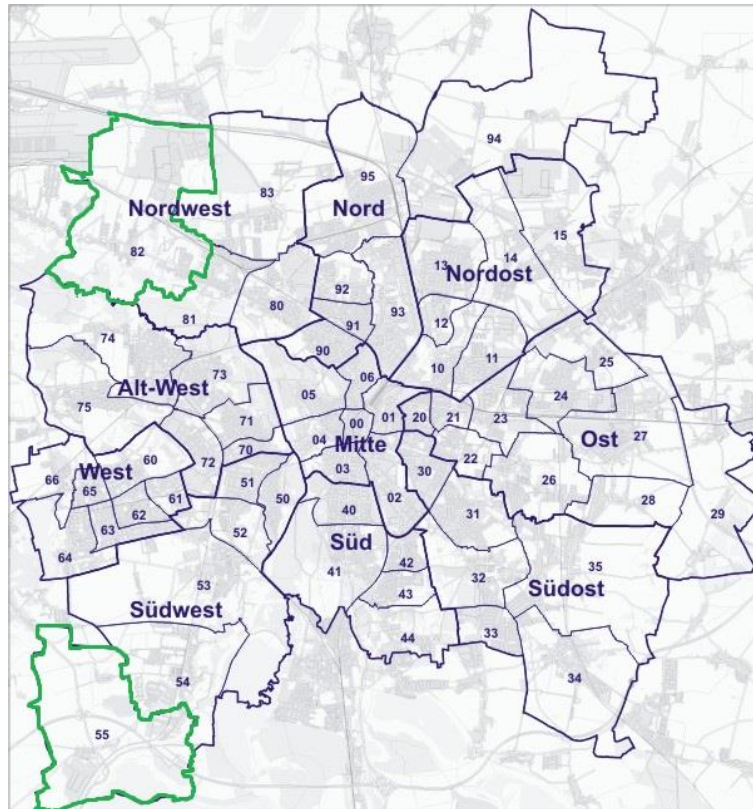


Figure 1 City districts of Leipzig (Stadt Leipzig, n.d.-a)

Suitable locations for central goods distribution points and last mile bike delivery should be determined by harnessing reliable local data. For this reason, a structured internet and scientific data base search was conducted for available information and data sets for Leipzig's outskirts. The data was then collected and analysed. The aim of this document is to explain the method of data identification and to provide a suitable data catalogue with specific aspects for the city of Leipzig. The overarching goal is to create a reliable data catalogue for training an AI-based model. The data catalogue includes existing open data, a short summary of the focus of the content, a link to the website or portal, and details for accessibility. T2.2 thus forms the basis for T2.3, the result of which is a simulation model for the optimal placement of pick-up stations in combination with bike delivery and a prototype for delivery routing optimization. By standardizing the necessary data, this AI-based model should also be transferable to other cities. Finding the optimal location for a pick-up station depends on multiple attributes and different types of data. Location information (map data) and geographic data points (GIS data) as well as socioeconomic information (tabular and text data) of the outskirts are required and mapped in the model.

1.2 Characteristics of the data search

The following chapter describes the approach for creating a data catalogue for T2.2. The first step to find data is the conduction of a database search with specific, thematic keywords on the internet. The next step is the documentation of the retrieved information in relation to predefined requirements. The results are collected and structured according to data-based and content-related criteria (see Table 1). The structure of the table is based on the specifications of Publications Office of the European Union (2022) for clear identification of the sources. The data catalogue contains the following attributes: Name, Source type, Number of data records, Data type, Focus, Categories, Application Programming Interface (API), Publisher, License, Primary /secondary Source, and Uniform Resource Locator (URL).

Table 1 Structure of the data catalogue

Headline	Definition	Example
Name	Unique identifier of the instance.	Open Data-Portal Leipzig
Source type	The type of data provided online, e.g. Factsheet, Dataset, Repository.	Dataset, Repository
Number of data records	Size of the database (and date of determination).	301 (23/08/2024)
Data type	A data type is a format of machine-readable information.	CSV, JSON, SHP, WMS, WFS, GeoJSON, DXF, GPKG, Zip, 3DS, CityGML, dbf, DWG, HTML, ODS, prj, RDF, shp, shx, TXT, WMTS, XLSX, XML

Focus	Integrated (primary) data sources.	City of Leipzig
Categories	<p>Classification of the available content.</p> <p>Metadata is data that describes and provides information about data to make it easier to find, use, and manage.</p>	<p>Population and society, education, culture and sport, economy and finance, government and public sector, regions and cities, transport, environment, science and technology, international issues, energy, agriculture, fisheries, forestry and food, justice, legal system and public safety, health</p>
API	<p>The Application Programming Interface (API) is a software interface for the automated uploading and downloading of data.</p> <p>Available interfaces:</p> <p>CKAN API, HTML, WMS services, REST, SPARQL, OpenAPI (RESTful), SOAP, FTP, NetCDF, OpenDAP, OAI-PMH, SWORD, SwaggerUI</p>	CKAN API
Publisher	Describes which institution published the data (imprint).	City of Leipzig
License	<p>A license specifies what may or may not be done with a source.</p> <p>For available licenses see Table 2, p.8.</p>	dl-by-de/2.0
Primary / secondary Source	<p>Classification as primary and/or secondary source.</p> <p>The primary source is the original source, i.e. the direct reference itself, not using a reference from another source.</p> <p>A secondary source uses another primary source (mostly origin) as data base.</p>	Primary source
URL	The Uniform Resource Locator (URL) refers to the web address via which the data source can be accessed.	https://opendata.leipzig.de/

The data search concentrates on specific data about the city of Leipzig, especially the two outskirts Lützschena-Stahmeln and Hartmannsdorf-Knautnaundorf as stated above. For the publication of city data, there is an e-government law in Germany concerning the accessibility, content and instructions for providing the data (Bundesverwaltungsamt, 2022). The city of Leipzig publishes data for further use by citizens, the economy, the media, scientists and other institutions. The data set provided is open for use, i.e. free data provided via German data licenses. There are different licenses for the open data use available. Table 2 lists the license models identified by the internet search and used in the data catalogue. There are also some sources that use private licenses, special terms of use or a reference to the primary source for secondary sources.

Table 2 Overview of the most common used open data licenses (DCAT-AP, n.d.)

Name of the license	License code	Openness of the license
Data license Germany Naming 2.0	dl-by-de/2.0	Free use
Data license Germany - Zero - Version 2.0	dl-zero-de/2.0	Free use
Creative Commons Naming (CC-BY)	cc-by	Free use
Creative Commons Naming - Sharing under equal conditions 3.0 Germany	cc-by-sa-de/3.0	Free use
Creative Commons Naming - Sharing under equal conditions 4.0 International	cc-by/4.0	Free use
Creative Commons CC Zero License	cc zero	Free use
Open Data Commons Open Database License	ODbL	Free use

1.3 Dependencies of the data portals

The European data portals are mainly used due to good specifications and high level of maturity (Publications Office of the European Union, 2023). Germany's common metadata model for open government data exchange is the Data Catalogue - Application Profile (DCAT-AP). It ensures direct compatibility with the EU standard and must be used for data exchange within the GovData network. DCAT-AP specification defines semantic rules for communication from and to the GovData portal and for communication with the European data portal and in the GovData portal network (see Figure 2) (DCAT-AP, 2022). The purpose is the exchange of metadata of open administrative data for German open data portals, whose data is provided centrally in GovData for the federal, state and municipal levels (DCAT-AP, 2022).

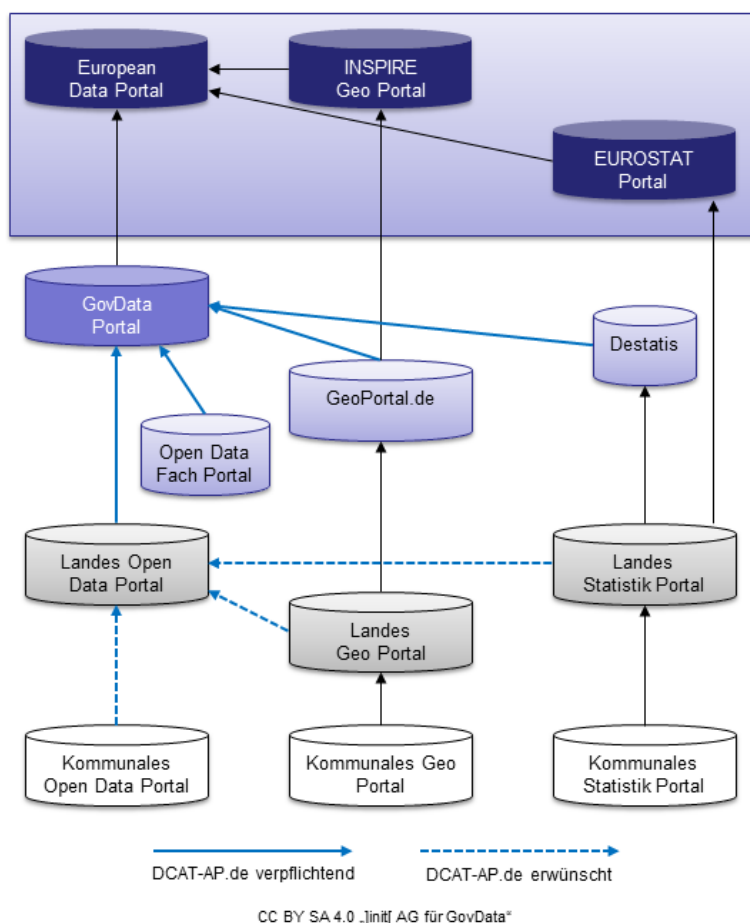


Figure 2 Open data meta data construct in Germany (DCAT-AP, 2022)

The Leipzig Information System (Stadt Leipzig, n.d.-b) enables automated import from specialist procedures into the Open Data Portal Leipzig. The portal data is automatically published in the Open Data Portal of the Free State of Saxony (Sachsen.de, n.d.) and exported from there to the next stage, the federal portal GovData (Govdata, n.d.), and then to the European Data Portal (European data, n.d.).

In addition, the portal catalogue can be queried using the DCAT-AP standard via a SPARQL endpoint. A SPARQL endpoint is an interface for highly structured data queries. These can be triggered both manually or automatically by software applications (Govdata, n.d.).

The open source CKAN (Comprehensive Knowledge Archive Network) platform (CKAN, n.d.), used by German cities like Berlin (Berlin, n.d.), Karlsruhe (Karlsruhe, n.d.) or Leipzig (Stadt Leipzig, n.d.-c) can be used as a data catalogue for local specific data and provides an API for data retrieval. These portals make data from German cities on a wide range of topics accessible to the public in machine-readable formats. (Stadt Leipzig, n.d.-b)

Open data is compiled in some reference data catalogues, which can be accessed on the GovData.de portal. However, some federal states do not yet have an open data portal that forwards metadata to GovData. In some cases, GovData has started to connect municipalities directly. This data is also included in the reference data catalogue (Govdata, n.d.).

A Comparison of the Open Data Portals for Merano, Italy

Furthermore, the model for T2.3 will be completed and transferred with data from Merano, Italy. Based on the European data portals (see Figure 2), such as the European Data Portal, the INSPIRE Geo Portal and the EUROSTAT Portal, data sets are provided for the province of Bolzano (South Tyrol). In addition, the Open Data Portal of South Tyrol provides specific datasets (a total of 617 datasets as of 23.09.24) for the province of South Tyrol. The Bolzano Open Data Portal (Südtirol, n.d.) contains data from the Autonomous Province of Bolzano, the Civil Protection Agency, Südtiroler Informatik AG, the Municipality of Merano, the South Tyrolean Health Service and the Provincial Environmental Agency, Autonomous Region of Trentino-Alto Adige, South Tyrolean Broadcasting Corporation, South Tyrolean transport companies, South Tyrolean Association of Municipalities and the Municipality of Bolzano. These include various topics related to spatial planning, economy, health, environment, administration, agriculture, climate, tourism, weather, politics, culture, mobility, welfare and demography. The offered data types and licensing is similar to the Leipzig Information System (Stadt Leipzig, n.d.-b).

For the mobility data of South Tyrol, there is also a platform called Open Data Hub, which makes the data sets available in a simple way (Open Data Hub, n.d.). The provision of data can therefore accelerate the more innovative and faster development of ideas, which can lead to local app development and other business ideas for South Tyrol. The Open Data Hub contains 149 data sets in the domains of tourism, mobility and weather (as of 26.09.24).

The *astatdata* portal of the Statistical Office of the Autonomous Province of Bolzano - South Tyrol offers the possibility to view and customize statistical data in tabular form. The open source database contains datasets on demographic and social statistics, economic statistics and environment, as well as cross-sector statistics (*Astatdata*, n.d.).

For clarity, only data portals that can be used for Germany, specifically Leipzig, are listed in the data catalogue. Listing the data portals for Merano would make the data catalogue too complex and, in particular, there is insufficient data for the municipality of Merano. Furthermore, the focus is on the model development of T2.3 for the urban outskirts of Leipzig, and data sets from the whole province of Bolzano are used as a comparison for the model.

1.4 Data catalogue, findings and future use

A number of quality assurance measures and procedures have been implemented to present the most valid data possible. These include duplication reduction, community and expert feedback, quality checks, and mapping. The best data is data that is consistent, free from duplication and ready for machine consumption. If the data is well prepared, it is easier to use. Important qualitative metrics for best data quality for the use case of Task 2.2 is: open license (free for use), machine readability, availability and metadata completeness. Providing metadata can be an advantage.

Due to the use case, data from Leipzig or about Leipzig is classified as very important for the data search. Therefore, the aim is to create a suitable, update capable and freely accessible data catalogue that presents the relationships of the Open Data databases and refers to city specific data sets of Leipzig. The data catalogue can be found on GitHub in English and

German in different file formats (xlsx and JSON). It will be updated at regular intervals. The data catalogue can be found under the following link:

https://github.com/Logistics-Living-Lab/SuCoLo_DataCatalogue

The data catalogue serves in the project as a data basis for training a simulation model (T2.3). After an evaluation and weighting of the topics, the collected data can be processed. The focus will be determined on the basis of existing and already tested models, e.g. Psyllidis et al., 2022, as well as a survey will be carried out in Leipzig's outskirts. It should be possible to use the model to determine which location is a suitable place to pick up goods in Leipzig's outskirts. This can be achieved by setting up a pick-up station or a meeting place (e.g. community centre). Consequently, the model should use selected features for individual geographical points in Leipzig as well as some Points of Interest (POI) of the citizens (Psyllidis et al., 2022). POIs are geographical points of locations that are of interest for the Task 2.3 due to their characteristics, such as community centres. The aim of the model is to find out:

1. where to build a suitable location for a parcel pick-up station, social impact,
2. how to deliver goods in an economical way from the city centre by cargo bike in combination with micro-hubs to Leipzig's outskirts, and
3. how points 1 and 2 can be combined (cargo bike delivery to a pick-up station).

Therefore, data from outskirts' citizens as well as geographical data are needed to classify the location. By standardizing the data, the model will be transferable to other cities. A list of relevant indicators (selected features) was created for this purpose (see working document in Appendix).

Furthermore, the data catalogue, and the retrieved data sets, will be used as a basis for the development of a software prototype in T2.4 to create an app, which proposes the optimal (cargo) bike route and a schedule planning for a local courier service in Leipzig.

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Appendix

List of indicators

(last updated 27/08/2024)

Nr.	Category	Short Name	Description
0	Descriptive Data	Name of the area to be considered	Name of the province, district, municipality, commune, city, etc. being considered
		If available: Name(s) of the smaller territorial units included	Listing of the names of the e.g. province, city, city districts, associated municipalities, which are considered
1	Maps (Geodata)	Area	Area (province, city, municipality, district), which is considered as geographical coordinates
		Transport routes	Marking of transport routes in the area (e.g. for cars, trams, trains, etc.) as geographical coordinates
		Cycle paths	Marking of cycle paths in the area (cycle city map, coordinates)
		City centre	Marking of the city centre with geographical information (as geographical coordinates)
2	Geographic structure	Total land area (km ²)	Cadastral area of the area in km ²
		Total living space (km ²)	Settled and populated area of the region in total in km ²
		Population density (km ²)	Land area per inhabitant per km ²
		Floor area Traffic routes (km ²)	Surface area of trafficable roads (public) in km ²
		Floor area cycle paths (km ²)	Floor area of cycle paths (public) in km ²
		Barrier-free footpaths (km ²)	Floor area barrier-free footpaths (public) in km ²

3	Infrastructure	Average distance to the city centre (km)	Average distance from the centre of the outskirts to the city centre in km by public transport (not as the crow flies)
		Public transport stops	Name (type, address or coordinate) of public transport stops in the area; includes bus, train, tram, underground, tram, etc.
		Average distance to public transport stop (km)	Average distance in kilometres to the nearest public transport stop
		Public transport departures	Average number of departures to public transport stops on a working day per hour per mode of transport
		Local public transport stops Average distance (km)	Linear distance to the nearest public transport stop with at least 20 departures per day or availability of bike hire systems (e.g. NextBike) in the area
		Accessibility of S-Bahn/regional/IC/EC/ICE stations (km)	Average distance to the nearest S-Bahn/regional/IC/EC/ICE station (km)
		Local supply retail Average distance (km)	Linear distance from the town centre to the nearest retail store (supermarket or discounter) in km
		Availability of (communal) meeting places	Number of available communal meeting places in the area, such as cafés, citizens' office, (neighbourhood) libraries, community centres, etc. for contacts and gatherings
		Meeting places offered by/in the municipality	Name (type, address or coordinates) of available local meeting places in the area, e.g. cafés, citizens' office, (neighbourhood) libraries, community centres, etc. for contacts and gatherings

		Availability of recreational areas	Number of available recreational areas in the area, including green spaces including parks, allotments and the like as well as sports areas and camping sites, etc.
		Recreation areas	Name (type, address or coordinates) of available recreational areas in the area, including green spaces including parks, allotment gardens and the like as well as sports areas and camping sites, etc.
		Total number of companies located in the retail sector	Number of companies located in the city's retail sector (e.g. for clothing, food, restaurants, cafés, etc.)
		Number of companies located in the retail sector	Number of companies located in the retail sector per neighbourhood/district/community
		Total number of companies in the retail sector	Name (type, address or coordinates) of retail companies located in the area
		Companies located in the retail sector	Name (type, address or coordinates) of companies located in the retail sector per urban neighbourhood/district/community
4	Population	Total population in the area	Total number of inhabitants in the area
		Population per neighbourhood/district/community	Total number of inhabitants divided into city neighbourhoods/districts/communities
		Average age of the population in total	Average age of the population in the area in years

		Average age of the population per urban district/township/community	Average age of the population in the area broken down by neighbourhoods/districts/communities in years
		Age structure from 0-18 years in the area	Number of residents aged 0-18 years
		Age structure from 19-30 years in the area	Number of residents aged 19-30 years
		Age structure from 31-45 years in the area	Number of residents aged 31-45 years
		Age structure from 46-65 years in the area	Number of residents aged 46-65 years
		Age structure from 66-99 (and older) years in the area	Number of residents aged 66-99 (and older) years
		Working-age population (15 to under 65 years) in the area	Number of employable residents aged 15 to 65 years
		Age structure from 0-18 years in neighbourhoods/districts/communities	Number of residents aged 0-18 years
		Age structure from 19-30 years in neighbourhoods/districts/communities	Number of residents aged 19-30 years
		Age structure from 31-45 years in neighbourhoods/districts/communities	Number of residents aged 31-45 years
		Age structure from 46-65 years in neighbourhoods/districts/communities	Number of residents aged 46-65 years
		Age structure from 66-99 (and older) years in neighbourhoods/districts/communities	Number of residents aged 66-99 (and older) years
		Working-age population (15 to under 65 years) in urban	Number of employable residents aged 15 to 65 years

		neighbourhoods/districts/communities	
		Immigration rate in the area	Number of residents moving into the area annually over the past 5 years (year and number)
		Movement rate in the area	Number of departures of residents in the area per year over the past 5 years (year and number)
		Population development in the area (past 5 years)	Development of the number of registered residents in the area annually over the past 5 years (year and number)
		Immigration rate to city neighbourhoods/districts/communities	Number of residents moving to neighbourhoods/districts/communities per year over the past 5 years (year and number)
		Movement rate to city neighbourhoods/districts/communities	Number of residents leaving the neighbourhoods/districts/communities per year over the past 5 years (year and number)
		Population development in neighbourhoods/districts/communities (next 5 years)	Forecast of the number of registered residents in neighbourhoods/districts/communities annually over the next 5 years (year and number)
5	Wealth / purchasing power	Average household income in total (in euros)	Average household income in € per inhabitant in the area (gross)
		Average household income per urban neighbourhood/district/community (in euros)	Average household income in € per inhabitant per urban neighbourhood/district/community (gross)
		Total purchasing power of resident population (in euros)	Purchasing power per inhabitant in euros in the area; purchasing power describes the disposable income of the resident population.

		Purchasing power of resident population per neighbourhood/district/community (in euros)	Purchasing power per inhabitant in euros per urban neighbourhood/district/community
		Employees subject to social insurance contributions in the area	Total number of employees subject to social security contributions living in the area
		Employees subject to social insurance contributions per urban neighbourhood/district/community	Number of employees subject to social security contributions residing in each urban neighbourhood/district/community
		Total number of unemployed people	Total number of unemployed people living in the area
		Number of unemployed per neighbourhood/district/community	Number of unemployed residents per neighbourhood/district/community
		Gross domestic product in the area	Gross domestic product (GDP) in the region in euros
		Gross domestic product per urban neighbourhood/district/community	Gross domestic product (GDP) per neighbourhood/district/community in euros
6	Housing structure	Single-person households in the area	Number of single-person households in total households
		Single-person households per neighbourhood/district/community	Number of single-person households as a proportion of households per neighborhood/district/community
		Two-person households in the area	Total number of two-person households
		Two-person households per neighbourhood/district/community	Number of two-person households per neighbourhood/district/community
		Three or more person households in the area	Total number of households with three or more people

		Three or more person households per neighbourhood/district/community	Number of three-plus person households per neighbourhood/district/community
		Average household size	Average number of people per household in the area
		Household size per neighbourhood/district/community	Average number of people per household per neighbourhood/district/community
7	Tax	Total tax revenues (in euro)	Tax revenue in the region in euro per resident
		Tax revenues (in euro)	Tax revenue in the neighbourhood/district/community in euro per resident
		Total income tax (in euro)	Income tax in € per resident in the area
		Income tax (in euro)	Income tax in € per resident in the neighbourhood/district/community
		Total trade tax (in Euro)	Trade tax in € per resident in the area
		Trade tax (in Euro)	Trade tax in € per resident in the neighbourhood/district/community
		Total sales tax (in Euro)	Sales tax in € per resident in the area
		Sales tax (in Euro)	Sales tax in € per resident in the neighbourhood/district/community
8	Post Office infrastructure	Postal offices / post offices in total	Number of post offices and parcel stores in the area
		Postal offices / post offices	Number of post offices and parcel stores in the

			neighbourhood/district/community
		Barrier-free access to post offices in total	Number of barrier-free post offices in the area
		Barrier-free access to post offices	Naming (address or coordinates) of accessible post offices in the area
		Parcel stations in total	Number of available parcel stations
		Parcel stations	Naming (address or coordinates) of the parcel stations in the area
		Total number of barrier-free parcel stations	Number of barrier-free parcel stations
		Barrier-free parcel stations	Naming (address or coordinator) of barrier-free parcel stations
9	Transportation	Total car density	Number of registered cars in the area (per resident)
		Total car density per neighbourhood/district/community	Number of registered cars in neighbourhood/district/community (per resident)
		Cycle paths in side streets	Number of available cycle paths in side streets (street name or coordinate)
		Road traffic junctions	Number of identified road junctions with increased risk of congestion (address, street name or coordinate)
		Traffic lights in the area	Number of traffic lights in the area (address, street name or coordinates)
		Classification of the path condition	Assessment of the condition of the roads / cycle paths in the area (e.g. cobblestones, potholes, gravel, gravel, unpaved paths, ...) with street name or coordinates (in text form)