

# Methodology

## 1. Data Collection & Selection | 2. Data Processing | 3. Visualization

### 1. Data Collection & Selection

#### 1) Statistical Dataset

##### a. Bicycle Accidents Number in Hamburg

(website graph chart: “Number of Injured and Killed Cyclist in Hamburg”)

- Dataset Name: Hamburg\_bike\_accidents\_injured\_deaths.xlsx

- Source: “Statista” / “Polizei Hamburg: Behörde für Inneres und Sport”

<https://de.statista.com/statistik/daten/studie/1121982/umfrage/verunglueckte-und-getoetete-fahrradfahrer-hamburg/>

“Statistik Nord (Statistisches Amt für Hamburg und Schleswig-Holstein)”

<https://www.statistik-nord.de/>

“GOVDATA (Das Datenportal für Deutschland)”

<https://www.govdata.de/>

- Search Keywords: bicycle accidents Hamburg (Fahradunfälle Hamburg),  
bike victims Hamburg (Fahradverunglückte Hamburg),  
bike accidents statistics Hamburg  
(Fahradunfälle Statistik Hamburg)

Statistical dataset of cyclist accidents in Hamburg resulting in injury and death were searched and collected from ‘Statista’ and from its corresponding research data source ‘Police Hamburg (Polizei Hamburg)’. Main search keywords were ‘bicycle accidents (Fahradunfälle)’, and ‘bike accident victims (Fahradverunglückte)’. The period of time considered was from 2011 to 2024, to attain a comprehensive overview of the changes up till the most recent available data.

##### b. Bicycle Traffic Volume

(website graph chart: “Bicycle Traffic Volume and Injured Cyclists in Hamburg”)

- Dataset Name: Hamburg\_bike\_traffic\_volume.xlsx

- Source:

<https://www.hamburg.de/resource/blob/902152/19f1c55f73582332b30693733bbe787d/kurzbericht-rad-und-fussverkehr-2021-data.pdf>

- Search Keywords: Hamburg

Dataset of yearly bike traffic volume in Hamburg was collected to compare the rate of change in yearly bike accidents. The time frame of the data was expanded so that a

general overview could be given to how bike traffic had changed over a longer period of time.

## 2) Geo-spatial Dataset

### a. Protected Bike Lanes and Designated Bike Lanes

(website interactive map: "Bike Lanes and Biking Facilities in Hamburg 2024")

- Dataset Name: ("Designated Bike Lanes (Fahrradstraßen)")  
de\_hh\_up\_radwege\_fahrradstrasse\_EPSG\_4326.json  
("Protected Bike Lanes (Fahrradschutzstreifen)")  
de\_hh\_up\_radwege\_streifen\_EPSG\_4326.json
- Source: "Geoportal Hamburg (Open Geo-spatial Database Portal and Map Service)"  
<https://geoportal-hamburg.de/#>
- Search Keywords: bike(Rad, Fahrrad), bike network(Radnetz), bike lane (Radweg)

Geo-spatial dataset were searched and collected from "Geoportal Hamburg," the public open database of the city of Hamburg. Of the different dataset file format available (.csv, .json, .gml, .xsd), GeoJSON was chosen for better data processing and analyses. Also, the most recent updated datasets were selected to reflect current conditions of biking infrastructure.

### b. Bike Air-pump and Repair Stations

(website interactive map: "Bike Lanes and Biking Facilities in Hamburg 2024")

- Dataset Name: ("Bike Air pumps and Repair Stations (Luftstationen)")  
de\_hh\_up\_fahrradluftstationen\_EPSG\_4326.json
- Source: "Geoportal Hamburg (Open Geo-spatial Database Portal and Map Service)"  
<https://geoportal-hamburg.de/#>
- Search Keywords: bike air-pump stations (Rad, Fahrrad Luftstationen),  
bike (Rad, Fahrrad)

In order to examine corresponding auxiliary biking facilities, dataset on air-pump stations were searched and collected through the public open-data portal of Hamburg (Geoportal Hamburg). GeoJSON was chosen for easier work-ability and data processing as well. The most recent dataset from 2024 was also selected to have the most up-to-date representation of the infrastructural conditions.

### c. Bike Repair Shops

(website interactive map: “Bike Lanes and Biking Facilities in Hamburg 2024”)

- Dataset Name: (“Bike Air pumps and Repair Stations (Luftstationen)”  
repairshops\_export-3.json

- Source: “Overpass Turbo (web-based data filtering tool for OpenStreetMap)”  
<https://overpass-turbo.eu/>

- Search Keywords: bike repair shops Hamburg (Rad-, Fahrradreparatur Hamburg)

Geo-spatial dataset of bike repair shops were searched and gathered through public domain data-portal to examine and analyze the location of the shops in relation to bike infrastructures and particularly to bike lanes. GeoJSON data –file format was chosen as well for better workability and further research purposes.

#### d. Bike Accidents

(website interactive map: “Bike Accidents in Hamburg 2024”)

- Dataset Name: (“Places of Accidents in 2024 (Unfallorte 2024)”  
Unfallorte2024\_LinRef.csv

- Source: “German Accident Atlas (Unfallatlas Deutschland)”  
/ Federal and State Statistical Offices  
(Statistische Ämter des Bundes und der Länder  
<https://unfallatlas.statistikportal.de/>

- Search Keywords: Places of accidents involving bicycles  
(Unfallorte mit Fahrrad-Beteiligung),  
Accident frequencies involving bicycles  
(Unfallhäufigkeiten, Unfälle mit Fahrrad-Beteiligung)

Bike accident dataset was collected from the ‘German Accident Atlas (Unfallatlas Deutschland)’, a public government open-data portal specifically on the subject topic related to different types of transportation and traffic accidents in Germany. As available source file format were only shapefile (.shp) or CSV (.csv), the latter was chosen as it was easily compatible and convertible when working with GeoJSON (.json). The most recent dataset regarding of the year 2024 was also selected to provide an accurate up-to-date examination. The dataset however, compiles all data from all states and regions of Germany, as well as all types of accidents and therefore needed some post-process filtering in order to confine and match the scope of research area to Hamburg.

#### e. Bike Lane Widths

(website interactive map: “Bike Lanes and Accidents in Hamburg 2024”)

- Dataset Name: (“Bike Lane Networks (Radwegenetz)”  
de\_hh\_up\_radwegenetz\_gesamt\_EPSG\_4326.json

- Source: "Geoportal Hamburg (Open Geo-spatial Database Portal and Map Service)"  
<https://geoportal-hamburg.de/#>
- Search Keywords: bike lanes (Fahrrad-, Radweg), bike traffic (Radverkehr),  
bike (Rad, Fahrrad)

Width data of all bike lanes were defined within the dataset for 'Bike Lane Networks (Radwegenetz).' These data were used to further determine how infrastructural conditions relate to the occurrence of accidents, and as a consequence affect biking safety in the city. The original source file format (GeoJSON) was chosen to avoid possible data loss during format conversions, and to attain better compatibility and coherency among other datasets. The most recent dataset from 2021 was selected to represent the most up-to-date existing conditions.

#### f. Playgrounds and Elementary Schools

(website interactive map: "Biking and Children in Hamburg 2024")

- Dataset Name: ("Playgrounds (Spielplätze)")  
app\_gruenflaechen\_spielplaetze\_EPSG\_4326.json  
("Elementary Schools (Grundschule)")  
de\_hh\_up\_grundschulen\_EPSG\_4326.json

- Source: "Geoportal Hamburg (Open Geo-spatial Database Portal and Map Service)"  
<https://geoportal-hamburg.de/#>

- Search Keywords: playgrounds (Spielplätze), elementary schools (Grundschule)

To understand and analyze biking infrastructure in relation to children activities and facilities in Hamburg, dataset on the location of playgrounds and elementary schools in Hamburg was collected. These spaces are often used and visited by children either beginning to learn how to bike or able to actively engage in biking as a method of transportation and mobility. Therefore, examining the biking infrastructure, especially protected and secured bike lanes, and how it relates to these locations can provide overview how the conditions of biking safety can be for the younger age group.

## 2. Data Processing

### 1) Statistical Dataset

#### a. Bicycle Accidents Number in Hamburg

(website graph chart: "Number of Injured and Killed Cyclist in Hamburg")

'Datawrapper (<https://www.datawrapper.de/>),' a tool provided online for visualizing maps, charts and tables, was used to provide the data into a visible bar graph chart. Time period from 2011 to 2024 was defined to the Y-axis to show the changes during a relatively significant amount of time. Furthermore along the X-axis, both injuries and deaths in

accident numbers were separated to distinguish the differing types of bike accidents counted.

## b. Bicycle Traffic Volume

(website graph chart: "Bicycle Traffic Volume and Injured Cyclists in Hamburg")

Dataset of yearly traffic volume count was recalculated and converted to percentage of change(%) compared to count number in initial year 2000, in order to emphasize the rate of change between two data subjects(bike traffic volume and bike accidents). The newly processed data was then input into 'Datawrapper' and visualized into line chart to depict an accurate rate of change over the time period.

## 2) Geo-spatial Dataset

### a. Protected Bike Lanes and Designated Bike Lanes

(website interactive map: "Bike Lanes and Facilities in Hamburg 2024")

Collected GeoJSON dataset files for both 'protected bike lanes(Fahrradschutzstreifen)'

and 'designated bike lanes (Fahrradstraßen)' were imported into 'Kepler.gl

(<https://kepler.gl/>)', an online open-source geo-spatial analysis tool for visualizing

interactive maps. For aligning coordinate systems, dataset files created with the EPSG

4326(WGS 84) system was chosen. Layer type definition were given as 'polygon' for both datasets and no further data processing or filtering was conducted.

### b. Bike Air-pump and Repair Stations

(website interactive map: "Bike Lanes and Facilities in Hamburg 2024")

Dataset GeoJSON file with coordinate system EPSG 4326(WGS 84) were imported to

'Kepler' and layer type was defined as 'point' to give specific labels to 'self-service air-

pump and repair stations(Self-Service Luft- und Reparaturstationen).' No other data

processing or filtering was conducted.

### c. Bike Repair Shops

(website interactive map: "Bike Lanes and Facilities in Hamburg 2024")

After import to 'Kepler,' layer type was defined from 'polygon' to 'point' accordingly and no further data processing was done.

### d. Bike Accidents

(website interactive map: "Bike Accidents in Hamburg 2024")

Although the dataset file format was CSV, it was compatible with 'Kepler' and needed no

further format conversion. However, the file itself included both coordinate systems of

EPSG 25832 (ETRS89 / UTM 32N) and required some adjustments in order for the online

tool to read the data correctly. Column names 'XGCSWGS84' and 'YGCSWGS84' were

correspondingly renamed to 'lng' and 'lat', the fields in which the online tool recognizes. Additionally, the coordinate values were missing decimal points due to different numbering systems in Germany (ie. comma as symbol for the decimal point) and therefore  $10^{-15}$  was multiplied to the values.

After this preparation, the dataset was filtered for only 'Hamburg' with the defined value 2(Hamburg) under column 'ULAND (land and region definition)' and value 1(accident in which at least 1 bicycle was involved) under column 'IstRad (Accident with Bicycle).' Of the approximately 268,000 data rows, 2855 were correspondingly extracted. The dataset file was saved as 'Unfallorte2024\_LinRef\_Hamburg\_nurRad\_latlng2.csv' and imported to 'Kepler.'

In 'Kepler', the layer was defined as 'point' accordingly and categorized by fill color to indicate severity of injuries under defined column 'UKATEGORIE (road accidents involving personal injury).' Values 1 through 3 indicated beginning from the least numbering '1= accidents with persons killed', '2=accidents with seriously injured', '3=accidents with slightly injured.' Furthermore, the dataset layer was duplicated and defined as 'cluster' to indicate areas of concentrated of accidents. Color scale was given as 'quantize' and based on 'point count.' All other variable inputs were set at default.

#### e. Bike Lane Widths

(website interactive map: "Bike Lanes and Accidents in Hamburg 2024")

Dataset for 'Bike Lane Networks (Radwegenetz)' were imported to 'Kepler' with layer type definition as 'polygon.' Bike lanes classes irrelevant to the research scope, such as those in 'green areas (Grünflächen)', were filtered out. The remaining data of bike lanes were differentiated by color based on 'width (Breite)' field. 6 breaks were further defined on a 'quantile' scale with sequential color change from bright yellow to dark red. The colors were assigned with lowest value (narrowest) set to the brightest yellow and the highest value (widest) to dark red, in order to align to the color of accident locations and clusters.

#### f. Playgrounds and Elementary Schools

(website interactive map: "Bikes and Children in Hamburg 2024")

Both geo-spatial datasets did not require any preparation or filtering processes and were directly imported to 'Kepler'. Layer types for both were also defined from 'polygon' to 'point.'

### 3. Visualization

For clarity and consistency of the presented data, a color scheme was chosen and applied coherently throughout all visualizations. This was also reflected to the overall design direction of the website so that flow of information was not disrupted or contradicted. Colors for the maps were also consistent in providing the same color for the same subject data. This allows

not only a strong orientation between the differing maps and information, but also common grounds for cross reference for better analysis. Considerations were taken as well for simple labeling and clear indication of data by unified terminology and expression.

## 1) Statistical Data Visualization

'Datawrapper' was used as main and primary tool for visualization. The online tool provides comprehensive visualization options and variables, as well as extensive editing functions to create optimized and effective graphs and charts. These were utilized and aligned for the graphs used in the project and website.

## 2) Geo-spatial Data Visualization

The online map-visualization tool 'Kepler' was mainly used to create and design the maps for the project analysis and website production. All maps were saved temporarily by exporting as editable .html map format and finalized as 'view-only' .html map format for website publication. The interactive map format was decided over the image map format, as it allows the user to opportunity to explore the researched data for their own understandings.

### a. Interactive Map "Bike Lanes and Biking Facilities in Hamburg 2024"

Layers were first ordered with bike lanes both 'protected' and 'designated' as basis for the locations of 'air pump stations' and 'repair shops.' These bike lane layers were visualized consistently throughout all of the maps, as they serve as reference data across the different data subjects. Especially, 'designated bike lanes' were given stronger emphasis with thicker line-strokes to highlight the highest safety and priority in the traffic and transportation systems. Biking facilities 'air-pump stations' and 'bike repair shops' were given similar but distinct colors for comparison in relation to each other. Finally, legends were defined and the overall layout of the maps were refined.

### b. Interactive Map "Bike Accidents in Hamburg 2024"

Over-layered upon 'designated' and 'protected' bike lanes, the geo-spatial data layer for 'bike accidents' were color-coded by injury type using a warm tone scheme ranging from red(indicating 'death') to yellow('light injury'). Clusters of accidents however, were not assigned color scheme but rather was left to be visualized by the radius size of the shape. This is due to the map interactively creating different clustering of data at different zoom-scales.

### c. Interactive Map "Bike Lanes and Accidents in Hamburg 2024"

In order to overlay 'bike lane widths', visual readjustments were done on the 'designated' and 'protected' bike lane layers. These were first rearranged to the back and given more stroke thickness to clearly depict its relation to the other layers. As well, the 'accident cluster' layer was given less opacity to underline the information beneath.

d. Interactive Map “Bikes and Children in Hamburg 2024”

Point locations of playgrounds and schools were over-layered on bike lanes using different colors for better comparisons and comprehension. No specific differentiation were given between district or neighborhoods, as the purpose of the map was to visualize a general overview of the relation between children-centered places and secured bike lanes all throughout the city of Hamburg.