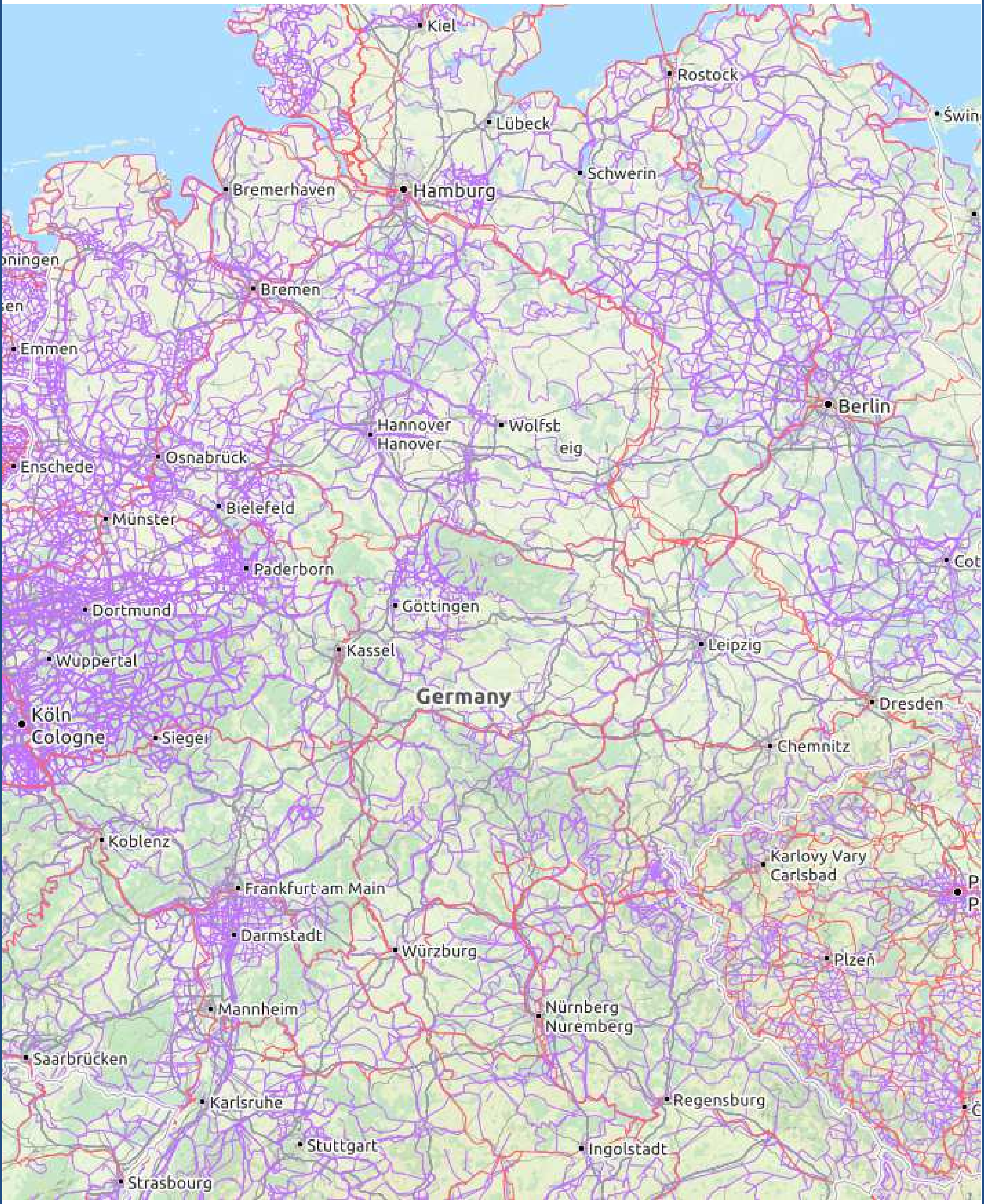
KOSIS Association Urban Audit

The German Urban Audit



Quality of Life: Establishing New Data Sources

Joint project with the German Federal Statistical Office and the Statistical Offices of the Federal States (Länder), promoted by Eurostat

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Quality of Life: Establishing New Data Sources

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Introduction

The term big data is no longer new, but it continues to be widely discussed, including, of course, by all those involved in the comparative database of cities, European City Statistics, and the Urban Audit. The statistical office of the European Union promotes the evaluation of new and alternative sources of data and methods for recording and observing the quality of life in cities through the European City Statistics project. The German Urban Audit project also aims to use innovative sources of data to facilitate comparison between European cities. Big data offers the potential of providing huge quantities of data almost in real time. As is often the case with promising terms like big data, it is nevertheless important to clarify their definition and potential uses despite the current ubiquity of the terms.

Change processes accumulate in cities and are often easier to control from there. The first part of this brochure, in particular, explores the challenges for cities in using new and alternative sources of data. First, the definition of big data and crowd data for urban development is explained in an overview article. The differentiation between user-generated, transaction-generated, and sensor-generated data is used to present several model projects based on the Urban Audit database and a number of cities.

The fact that the statistical office of the European Union (Eurostat) is constantly on the lookout for new sources of data is especially apparent in the field of tourism. In this context, user-generated, transaction-generated, and sensor-generated data will all provide new insights.

The previous brochure already examined whether user-generated crowd data could be used to measure the characteristic “length of cycle networks in kilometres”. After a successful test with sufficient data density and quality, the article in the current brochure explores the automation of these calculations and presents the OpenStreetMap data accessed on 31.12.2018, which will be permanently included in this form in the European City database.

By definition, surveys are not big data; they are, nevertheless, an important supplement, especially for the Urban Audit database, which is based on secondary statistics. Last year, the EU-wide survey on the quality of life in cities – the Perception Survey – was repeated. Once again, additional German cities participated in the survey. The initial findings – at least for participating German cities – could already be presented in this brochure. In line with the other articles, the focus here is also on the topic of traffic and includes the length of cycle networks calculated using crowd data.

Sensors collect a huge quantity of data (almost) in real time. The enormous number of potential applications is demonstrated in the use of mobile phone data for traffic analysis in Darmstadt, the City of Science, and the article on urban climate issues in Mannheim.

In addition to establishing new sources of data, the primary goal of the KOSIS Association Urban Audit is to ensure the general public has access to and can use this data. The last section of the brochure therefore presents the information portal and the Perception Survey Atlas in the hopes of encouraging readers to make good use of them.

I hope you enjoy reading this Urban Audit brochure!

Dr Ellen Schneider

City of Mannheim

Director, Municipal Statistics Office

Mannheim, 8 November 2019

I New data sources for cities

Chapter overview

The overview article by Thorsten Tonndorf, head of urban planning for Berlin, demonstrates the potential of using big data and crowd data for urban planning. By differentiating between user-generated, transaction-generated, and sensor-generated data, the article presents several model projects based on the Urban Audit database and a number of cities. The new data sources, which are primarily the result of digitisation, provide a wealth of information on urban space; at the same time, the need for much more evaluation is evident.

Tourism, in particular, will be able to profit from big data in numerous ways as the article by Christophe Demunter from Eurostat illustrates. In this context, user-generated, transaction-generated, and sensor-generated data will all provide new insights.

Calculating the length of urban cycle networks based on OpenStreetMap data is one example for how data that was acquired decentrally by volunteers and according to informal rules can be used. The transition to this data source has significantly improved the quality and availability of data for this characteristic. In his article, Sebastian Baur describes the strategic findings that were obtained by comparing these new data sources for the length of cycle networks with survey data.

Mobile phone data is one example for sensor-generated data. It enables personal information and places to be recorded based on mobile phone activities. Darmstadt, the City of Science, is a pioneer in the use of mobile phone data for traffic analysis. In his fascinating interim report, Günther Bachmann explains how mobile phone data can supplement existing data sources in order to provide detailed information about the mobility behaviour of commuters as well as visitors and tourists.

Big data and, especially, crowd data can supplement existing data sources to gain insights into the environment and close data gaps as the article by Christopher Barron on urban climate issues demonstrates.

1. Big Data and crowd data[1]

By Thorsten Tonndorf

In the digital age, data appears to be infinitely available everywhere. Digitisation produces data – the “new oil of the 21st century” – in unimaginable dimensions. What significance does big data have for society, our political system, and civil service?

Big data has set a great deal in motion at a breakneck speed, thereby awakening expectations; however, it is not yet possible to gauge the exact nature and scope of the changes it has triggered. The same is true for the opportunities, potential applications, and challenges that the future use of big data will pose for urban planning in Berlin.

The urban planning department is looking into how existing and new data and insights can benefit urban planning with the aim of using big data and crowd data to develop innovations for strategic planning.

It is safe to assume that big data will continue to develop at a rapid pace thanks to the increasing quantity of data, improved methods of analysis, and greater expertise in data evaluation. But an examination of the potential uses of big data for urban planning must also be embedded in the larger social discourse concerning data usage, data protection, and privacy.

1.1 Big data

No generally accepted definition

The term “big data” is used in a wide range of contexts that define and describe it in different ways. There is no generally accepted definition.[2]

Characterisation of the four V’s

However, the literature often uses four V’s to characterise big data (e.g. BITKOM 2014). This interpretation divides big data into different categories based on the special characteristics of a least one or a combination of the four V’s:

- **Volume**: Large sets of data.
- **Variety**: A wide range of different data sources, formats, and models, and unstructured data.

[1] This article is a greatly abridged version of a publication commissioned by the Berlin Senate Department for Urban Development and Housing, a project headed by Paul Hebes, Elke Plate, and Thorsten Tonndorf and carried out by EBP: Big Data and Crowd Data for Urban Planning in Berlin. Zurich/Berlin 27.04.2017. Accessible at: https://www.stadtentwicklung.berlin.de/planen/basisdaten_stadtentwicklung/big-data/downloads/big-data_crowd-data_berlin.pdf.

[2] Ward J., Barker A. (2013): Undefined By Data: A Survey of Big Data Definitions. School of Computer Science. University of St Andrews, UK.

- **Velocity**: The high velocity at which data is generated and evaluated, often in real time.
- **Veracity**: The generally uncertain veracity of the data.

Sometimes other features are included, for example value.

Utilisation for the Berlin urban development project

In this study, big data is defined as "large, extremely diverse, dynamically changing and often unstructured private and public data streams".[3]

The study distinguishes between three types of big data (in accordance with UNECE 2013) which differ in how they generate data:

Three different classifications

- **User-generated data:** User-generated data is created by human activities and, especially, interactions. Examples of this kind of big data include data from popular social media or social networks such as Facebook and Twitter, data from photo-sharing services such as Flickr, and data from Wiki platforms.
- **Transaction-generated data:** This type of data is generated more or less as a by-product of business transactions. Traditional examples include company data on customers and sales, data from trade, property, and mobility platforms, or data from online retail.
- **Sensor-generated data:** This data is not directly generated by the activities of natural or legal persons but rather by different kinds of sensors or sensor networks. Examples of sensor-generated data include traffic data generated by induction loops and traffic classifiers, data from surveillance camera systems, or mobile phone data.

These three types of data are not always clearly distinguishable; not all data clearly belongs exclusively in just one category.

1.2 Crowd data

No generally accepted definition

There is no distinct definition for the term "crowd data". Its meaning overlaps with those of related terms used in the literature (sometimes synonymously), for example: user-generated content (UGC), volunteered geographic information (VGI), Web 2.0, participative or participatory web, social web, produsage or produser.

[3] Other definitions may also include data analysis or the use of data, for example BITKOM (2014): "Big data [is the] use of large sets of data acquired from a wide range of sources and processed at a high velocity for economic benefit". Source: Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e. V. (BITKOM): (2014): Big-Data-Technologien – Wissen für Entscheider. Leitfaden. Berlin

The term “crowd data” refers to data from crowdsourcing. Crowdsourcing is the outsourcing of an activity to an often very large group of people (a crowd) (cf. e.g. Jeff Howe, 2006). Crowd data is data that is processed by a group of people, often decentrally and following relatively informal rules. The most well-known examples of crowdsourcing are likely Wikipedia, OpenStreetMap (OSM), and Amazon Mechanical Turk. The work carried out in a crowdsourcing project is usually unpaid and voluntary. But monetary or non-monetary incentives may also be offered, for example, a boost in status within a community via a ranking of the most industrious participants.

Definition of the specific type of data production

The term “citizen science” is understood as a type of public participation in scientific research. As opposed to crowdsourcing, however, the data for citizen science projects is gathered, observed, and/or evaluated with the help of or exclusively by interested amateurs. The distinguishing characteristic of citizen science projects in comparison to crowdsourcing projects in the narrower sense is that the process is more formalised, participants have more expertise, and they are more invested in the subject matter.

Citizen science data

Crowd data is therefore characterised by a specific method for gathering data. Because of how it developed, crowd data generally covers all four of the characteristic V’s (volume, variety, velocity, veracity) of big data.

Crowd data is big data

1.3 Data sources

Within the three types of data – user-generated data, interaction-generated data, and sensor-generated data – we differentiate between the following categories of data sources (cf. the table on the next page).

The difficulty of distinguishing between types of data and categories of data sources becomes particularly evident wherever transactions are carried out via platforms (accommodation, housing). We see this data as a subcategory of transaction-generated data because it is generated by the transaction (e.g. booking or reservation processes), even though some of these platforms contain components of social networks and the transactions often take place between users and not just between companies.

Category	Description	Potential uses for urban space
1) User-generated data		
Photo platforms	Users upload, share, and comment on photos.	The place where photos were taken provides information about trips; when they were taken provides information about chronological patterns (times of day, days of the week, etc.); the frequency of photographs provides information about the popularity of a place; photo tags make it possible to search for specific terms; users can be characterised based on what they upload (tourists/locals); trajectories show movement patterns through the city.
Rating platforms	Users rate places, services, and activities (restaurants, accommodations, cafes, sights, museums, etc.).	The place the rating refers to provides information about trips; the frequency of ratings provides information about popularity; the category of the rating provides information about appeal; when a rating was submitted provides information on chronological patterns (seasons); the characterisation of users (division into types, e.g. type of household or age).
Mapping portals	Users can retrieve information about an area (points of interest).	Points of interest (POI) can be extracted.
Social media	Users communicate online; exchange messages, photos, films, texts, events, etc.	The terms used and their frequency (e.g. hashtags, likes) provide information about current developments/trends/attention; if a place is geo-referenced, it provides information on trips; frequency and type of usage provide information about the users.
GPS tracking	Cyclists, joggers, swimmers, etc. can track routes.	Routes provide information about the appeal of public spaces/streets (for specific uses); characterisation of users based on their uploads (specific profiles); recognition of chronological patterns (times of day, week, seasonal).
Search engines	Users can search for all kinds of information.	The terms used and their frequency provide information about current developments/trends/attention; if a place is geo-referenced, it provides information on trips and if user profiles exist, they enable the characterisation of users.

Wikis	Users can compile and share knowledge in online encyclopaedias or encyclopaedic reference works.	Points of interest (POI) can be extracted.
Dating websites	Users can search for and find partners/relationships based on a variety of needs.	Number and georeferencing of users provide spatial information about household structures and lifestyles.
Business networks	Users can establish business contacts and create networks; share posts and communicate with one another.	CVs provide information about personal backgrounds/migratory movements/education levels/life stages; networks provide information about business and relationship networks; the information shared/terms used provide information about current developments/trends.
2) Transaction-generated data		
Mobility platforms	Users can search for and find public and private mobility/transport services.	The number of people using a service or how often it is used provide information about lifestyles; the location of services provides information about spatial differentiation; chronological patterns (when, how long); characterisation of providers; characterisation of users (user profiles: frequency, places, times).
Property platforms	Users can search for and offer flats, commercial spaces, buildings, properties for sale or rent/lease.	Number of advertisements (availability) and type of flats/commercial spaces offered (categories) provide information about the development of housing and commercial spaces; specific search profiles (categories) provide information about needs/demand; the duration of advertisements provides information on the ratio of supply/demand.
Accommodation	Users can search for and book accommodation.	Offers: places, number, and prices; search: preferred locations and search criteria; booking: number of bookings provides information on trips (time period, duration, frequency, capacity); ratings provide information about the quality of locations (location, accessibility, noise levels, etc.); in some cases, the characterisation of users provides information about the misappropriation of housing for touristic or commercial purposes.
Tendering platforms	Users can carry out searches and offer contracts for the provision of construction work or other services.	The number of tenders provides information on (sector-specific) economic development; the demand provides information about the competitive situation.

Exchange platforms	Users can trade and share objects and services of all kinds (except for transport and property).	Place, time, and type of objects offered and used provide information on current demand/needs. It may be possible to draw conclusions about users (lifestyle).
Job boards	Users can search for and publish job postings.	The number of jobs offered and the demand provide information about economic development; specific search profiles (categories) provide information about the demand; how long a job remains posted provides information about the ratio of supply/demand; jobs offered (categories) provide information about the development of sectors and job specifications.
Online retail	Private users and companies can search for and offer new and used products.	Type and scope of the articles offered/purchased enable conclusions to be drawn about demand and purchasing power.
Company data	Companies can record data on their turnover, customer structure, etc.	Statements can be made based on data for specific companies.
Mobility data	Users can record information about passengers (routes, turnover, customers, etc.).	Usage provides information about movement patterns.
3) Sensor-generated data		
Navigation systems	Users can record information about journeys.	The recorded journeys show the capacity of streets/places and enables conclusions to be drawn about traffic jams and air and noise pollution; situative chronological patterns (time of day, week, seasonal) can be used to manage traffic and public spaces; developments/effects on infrastructure planning can be subsequently measured.
Mobile phone data	Telecommunication companies can record personal information, the locations of mobile phone usage.	Data on places and movement indicates crowd density, whereabouts, chronological patterns (when and how long), commuter flows, pedestrian movements, and traffic behaviour.
Surveillance systems	Users can record film material from different locations and points of view.	Situative information about crowd and traffic density and behaviour; use of public space.
Building data	Users can record information about services/activities based on energy consumption, provisioning and disposal, emissions.	A building's "behaviour" provides information about the infrastructure of an area and the environmental situation; data enables conclusions to be drawn regarding users and user

		groups; basis for urban design, energy, sustainability, and efficiency projects.
Biometrical data	Users store information about physical features and behaviour (voice, weight, fingerprints, etc.).	By recording health parameters, broad statements can be made about the health of a person or group of people.

This list of categories is incomplete. The categories were selected and described with their significance for urban development in mind. In all categories, the emphasis was placed on platform-based data sources, under the assumption that this data is more accessible than other internal company transactions.

1.4 Supply channels

This section explains the five main supply channels of big data in more detail.

- **Programming interfaces and application programming interfaces (APIs):** Some data producers provide APIs for programming apps on their platforms. These data producers thus become providers of their own data: third parties can access and retrieve data and information via published APIs. Examples of APIs include Twitter, Flickr, and OpenStreetMap.
- **Web scraping:** Web scraping refers to the extraction of data from websites. Web scraping uses the structure of websites to find and save specific content. Often, the behaviour of human users is simulated to achieve this (e.g. by clicking links, filling in and sending forms, scrolling).
- **Purchasing from a data source:** The operator of a data source may have an interest in passing on the data recorded on their own platform. This may be for commercial reasons or to cultivate their image and establish themselves as a respectable organisation.[4]
- **Data brokers:** Some data sources give data brokers access to third-party data. Data brokering may also be an additional service offered alongside an API (examples of data brokers include AirDNA [for Airbnb)], Gnip [Twitter and various other data sources for user-generated data], and Quitly).

[4] For example, Uber decided to share the company's aggregated data with cities, a decision that was repeatedly interpreted as a political manoeuvre to underscore Uber's legitimacy and forestall regulatory measures; cf. e.g. http://citiscope.org/story/2017/ uber-shares-mobility-data-urban-planners.

- **Community:** Within the big data and crowd data environment, a community of enthusiasts and hobbyists as well as professionals provide access to processed data from public data sources on a regular basis. This community can include data journalists, researchers, hackathon participants, the startup ecosystem, and the Open Community, among others. Generally, the members of the community use one of the other four supply channels for their activities.

The quality of the data from these different supply channels must be viewed critically. The relevant quality criteria are:

- **Objectivity:** Is the information you wish to generate (sufficiently) representative? Are there any biases, e.g. in the group of users? It is important to note that an interest in biases may be the very reason for analysing data such as user-generated data (e.g. a study by Instagram or Foursquare in order to characterise the activities of relatively young people).
- **Suitability for longitudinal study** (long-term significance).
- **Quality assurance:** Does the data supplier explicitly list the steps taken to ensure quality?

1.5 Summary and prospects

The use of big data and crowd data means that additional data and information could potentially become available more quickly and cost-efficiently. Ultimately, new or improved findings could contribute to better planning. The fundamental potential and opportunities, however, are (still) constrained by numerous doubts.

Potential of time series is a critical factor for urban planning

From an urban planning perspective, time series are of particular interest because they can be used to map developmental trends. Considering the short lifespan and continuous development of many data sources – and thus their implicit dependency on the constant availability of data for describing specific phenomena – and based on previous experiences, this aspect must be classified as an especially relevant and critical factor. Depending on the respective questions/issues, it is important to evaluate whether time series can be used for urban planning beyond their function as snapshots of issues that are relevant for urban planning.

Potential uses for the three types of big data

User-generated data makes us believe that it represents "real" behaviour and preferences. However, this information requires an interpretation of the users' motives, which bears the risk of misinterpretation or overinterpretation. Numerous hurdles are currently restricting the wider use of this data. The use of *transaction-generated* *data* is dependent on a provider's business model. In view of its large and exponentially growing data sets, the validity of *sensor-generated data* means it has a great deal of potential. However, extensive skills and resources are required in order to be able to analyse and use this data. *Crowd data* or *crowdsourcing* offer a new or additional possibility of directly and deliberately interacting with the residents of cities.

Considering the rapid development of this topic, questions regarding the specific uses, the required skills and resources within the department, data protection, privacy, and any legal restrictions (for planning) have yet to be conclusively answered. It is safe to assume that big data will continue to develop at a fast pace. Consequently, a more in-depth discussion of big data and crowd data would be worthwhile.

Thorsten Tonndorf
is head of urban planning for the Berlin Senate Department for Urban Development and Housing

2. EUROSTAT: Usage of Big Data in the tourism statistics[5]

By Christophe Demunter, EUROSTAT

Big data in official statistics in the European Union

The strategic importance of big data for the European Statistical System (ESS) was recognised by the ESS Committee[6] (ESSC) in September 2013 in adopting the Scheveningen Memorandum (ESSC (2013)), which calls for an action plan for big data and official statistics to be addressed jointly by the ESS. As a follow-up, Eurostat created an internal task force on big data and an ESS task force. The latter brings together members from national statistical authorities, UN organisations, other European Commission services and scientific advisers. Its Big data action plan and roadmap (ESSC (2014)) was adopted by the ESSC in 2014.

The ESSnet[7] Big Data was launched in March 2016 and will run until mid-2018. At its heart is a set of pilots run by national statistical institutes. Their purpose is to explore the potential of selected big data sources to produce official statistics and apply the results to specific statistical domains. These source-oriented pilot projects include web scraping (for company characteristics and job vacancies), smart meters, mobile phone data and AIS data (automated tracking of ships).

Eurostat has also launched a study on ethics, communication, legal environment and skills (expected at the end of 2017). Since 2016, the European Statistical Training Programme (ESTP) has included five 3- to 4-day dedicated courses on big data. They have provided an introduction to big data and its tools, together with hands-on immersion on big data tools, big data sources (web, social media and text analytics), automated collection of online prices and advanced big data sources (mobile phone and other sensors).

Lastly, Eurostat has launched a series of in-house big data pilots to build internal technical expertise and infer from its own experience the implications at strategic level for official statistics in general, for the ESS, and for Eurostat and the European Commission.

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[5] This article is a condensed version of a publication by EUROSTAT, translated partly literally and partly in the sense of the text (Demunter, DG EUROSTAT, 2017: Tourism statistics: Early adpoters of big data? https://ec.europa.eu/eurostat/documents/3888793/8234206/KS-TC-17-004-EN-N.pdf/a691f7db-d0c8-4832-ae01-4c3e38067c54; edited by Tobias Link).
[6] European Statistical System Committee, composed of high-level representatives from Member States' national statistical institutes. For more information, see the ESS website.
[7] An ESSnet project consists of a network of several ESS organisations aiming to provide results that will be beneficial to the whole ESS.

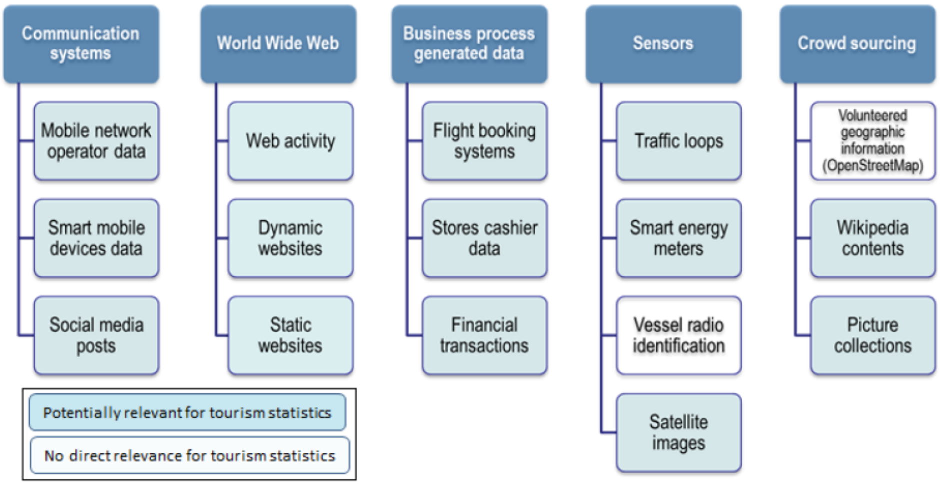
The underlying objective of all these activities is to pave the way for bringing big data sources into the regular production process for official statistics.

Given the borderless nature of these new data sources — available on the world wide web or held by organisations across the globe using somewhat comparable data structure definitions — international cooperation on statistics has never been more crucial. It can range from developing strategies for data access and handling to troubleshooting methodological issues and disseminating trusted statistics that meet the needs of 21st-century users.

The many facets of Big Data: Data sources with potential for measuring tourism

Many big data sources measure human activity or mobility — in other words, flows of people or the transactions they make. With primary tourism statistics measuring physical flows (and the corresponding monetary flows) of people, it comes as no surprise that tourism statistics have been on the frontline of big data-related innovations of statistical sources and methods.

The following diagram outlines the most commonly discussed sources of big data.



Taxonomy of big data sources

Just like any other classification, individual items can be allocated to different groups, depending on the viewpoint. The same is true for this taxonomy, as sources are interrelated and multifaceted. For instance, social media posts can be filed under both 'communication systems' and 'world wide web'; Wikipedia is web-based but also crowd-sourced.

Many of the sources listed are not new to (official) statistics: satellite images, scanner data and traffic loops have been used for a long time to feed geographic information systems, price statistics and transport statistics. The novelty is how to prepare the statistical systems for a large-scale, widespread, integrated use of these new (and not-so-new) sources of information — notwithstanding many countries' experiences with using administrative data.

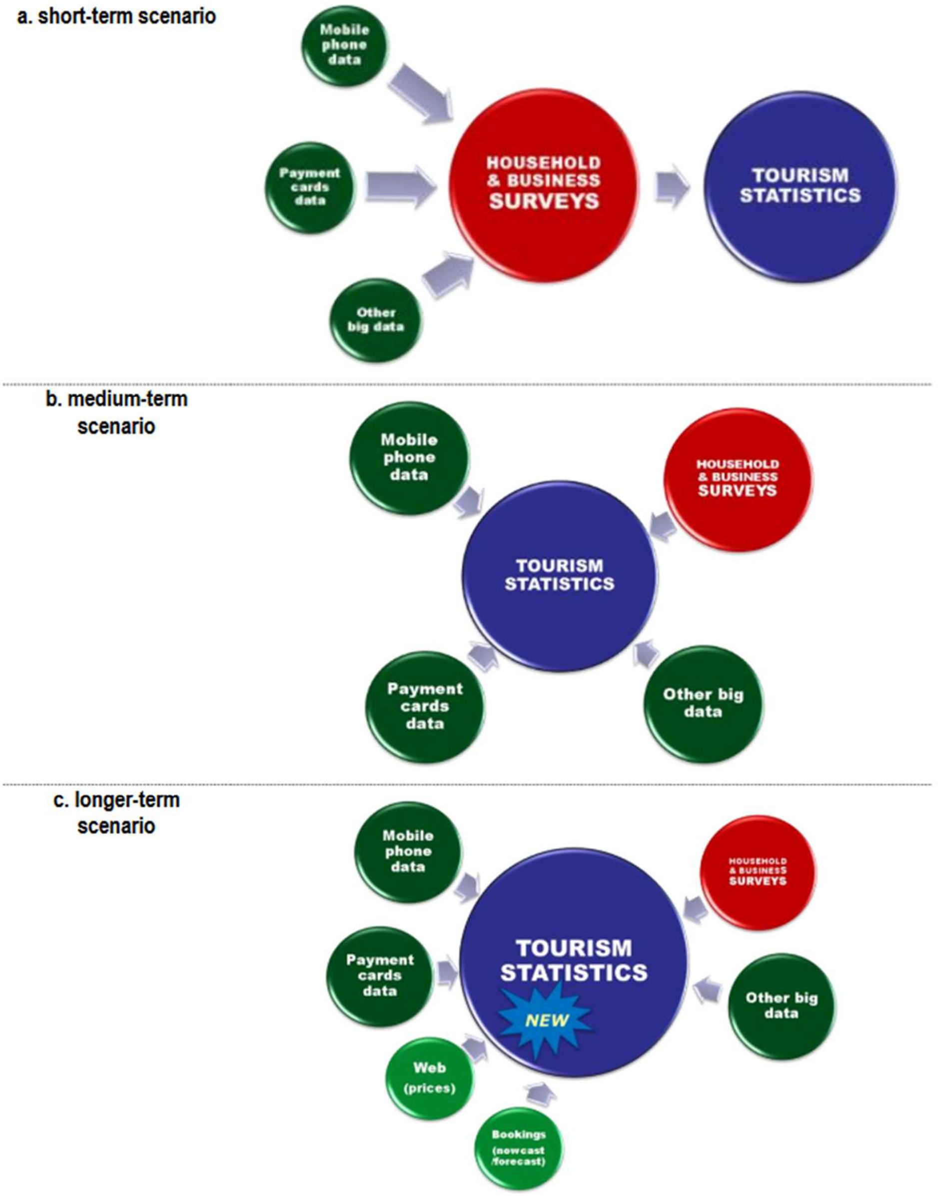
The influence of Big Data on the tourism statistics system

In the coming years we can expect three distinct stages to emerge.

In the short term, traditional surveys (household surveys, business surveys for the accommodation sector) will remain the main input for primary tourism statistics, but big data sources will slowly become important sources of auxiliary information (see scenario a in the following figure).

In the medium term, the influence of surveys is likely to decrease in favour of big data. In parallel, new sources will see their impact grow in a more integrated system (see scenario b in the following figure).

In the longer term, surveys will be gradually (partially) replaced by new sources (see scenario c in the following figure). In spite of the data deluge, big data cannot cover all aspects of tourism information for the time being. New sources will give insights into tourist flows (and spending?), with a revolutionary temporal and geographical granularity, but this information will be complementary to data collected via smaller scale surveys. Indeed, information on the traveller's socio-demographic features, the purpose of the trip, the means of transport, the means of accommodation, etc. is difficult to retrieve from big data. This phase is expected to give users of tourism statistics timelier and more cost-efficient data. Moreover, the current data will be enhanced with previously unavailable indicators or breakdowns.



How the tourism statistics system will evolve

The ultimate aim is to transform the tourism statistics system (or statistics in general) into a data factory using many input sources to serve many output needs simultaneously.

Objective: regular production of official statistics from a mix of sources

Mobile network operator data is an obvious source for measuring tourism flows. In the case of spending, payment card data is an obvious source.

Summary

The new sources are here to stay. If statistical offices miss the boat, others will serve user needs that official statisticians cannot or can no longer serve with the same detail and timeliness. The era of national statistical offices' monopoly on statistical information has gone for good. However, in any democratic society, objective and independent data is an essential public good.

Christophe Demunter
EUROSTAT

The abundance of big data sources capable of capturing facets of the tourism phenomenon makes it abundantly clear that the tourism statistician in 2017 — and in the coming decade(s) — will be on the frontline of an exciting but challenging data revolution.

3. Urban Audit: Using crowd data to calculate the length of the cycle network in German cities

By Tobias Link

In 2017, the KOSIS Association Urban Audit tested a new data source, here OpenStreetMap (OSM), as an alternative for calculating the variable "length of the designated cycle network". It also confirmed some of the challenges with the current method of acquiring data directly from cities.[8] The study came to an altogether positive conclusion. The deviations between the values calculated with OpenStreetMap data and the data obtained from the cities were quite heterogeneous, suggesting that the cities use different definitions for (designated) cycle networks. One advantage of OpenStreetMap is that it offers a consistent selection using a system of properties (tags), thus making it clear which cycle routes were included in each city and how their length was calculated. Furthermore, the OpenStreetMap data is constantly updated and regularly incorporates new information.

From the perspective of the KOSIS Association Urban Audit, these advantages outweigh the disadvantages of using this data, such as the fact that properties are freely assigned and therefore variable, making a uniform selection difficult. The consequence can be the unwanted omission or inclusion of data, which in turn can lead to potential inaccuracies. However, these errors are expected to be randomly distributed, affecting all of the cities to a similar degree. Since the Urban Audit only examines urban areas, it can also be assumed that the quality of data will not differ significantly between cities. This would not necessarily be the case if very rural areas were included because OpenStreetMap does not have the same level of data density for those areas as it does for cities.

Method of calculation

Based on this positive conclusion, the KOSIS Association has decided that, from now on, it will use OpenStreetMap data to calculate the variable "length of the designated cycle network". The calculations, which are automated and reproducible for all Urban Audit cities, are carried out using a script written in the Python programming language as well as the Python modules Pandas, Overpy, Fiona, Geopandas, and Earthpy, which must be installed before running

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[8] Sebastian Schmidt documented the results of the study in his article in the 2017 Urban Audit brochure "Quality of Life in the City and Suburban Areas". Accessible at:
https://www.staedtestatistik.de/fileadmin/media/Kosis/Urban_Audit/PDF/UA_Broschuere_2017_de.pdf

the script. The Overpy module enables the script to access OpenStreetMap data via the Overpass API, an interface that provides OpenStreetMap data filtered by a tag system. The script runs a query against the API by searching for the following key/value pairs:

- bicycle = designated
- highway = cycleway
- bicycle_road = yes
- cycleway = track
- cycleway = opposite_track
- cycleway:left = track / cycleway:right = track
- cycleway = lane
- cycleway:left = lane / cycleway:right = lane / cycleway:both = lane
- cycleway = opposite_lane
- cycleway:left = opposite_lane / cycleway:right = opposite_lane

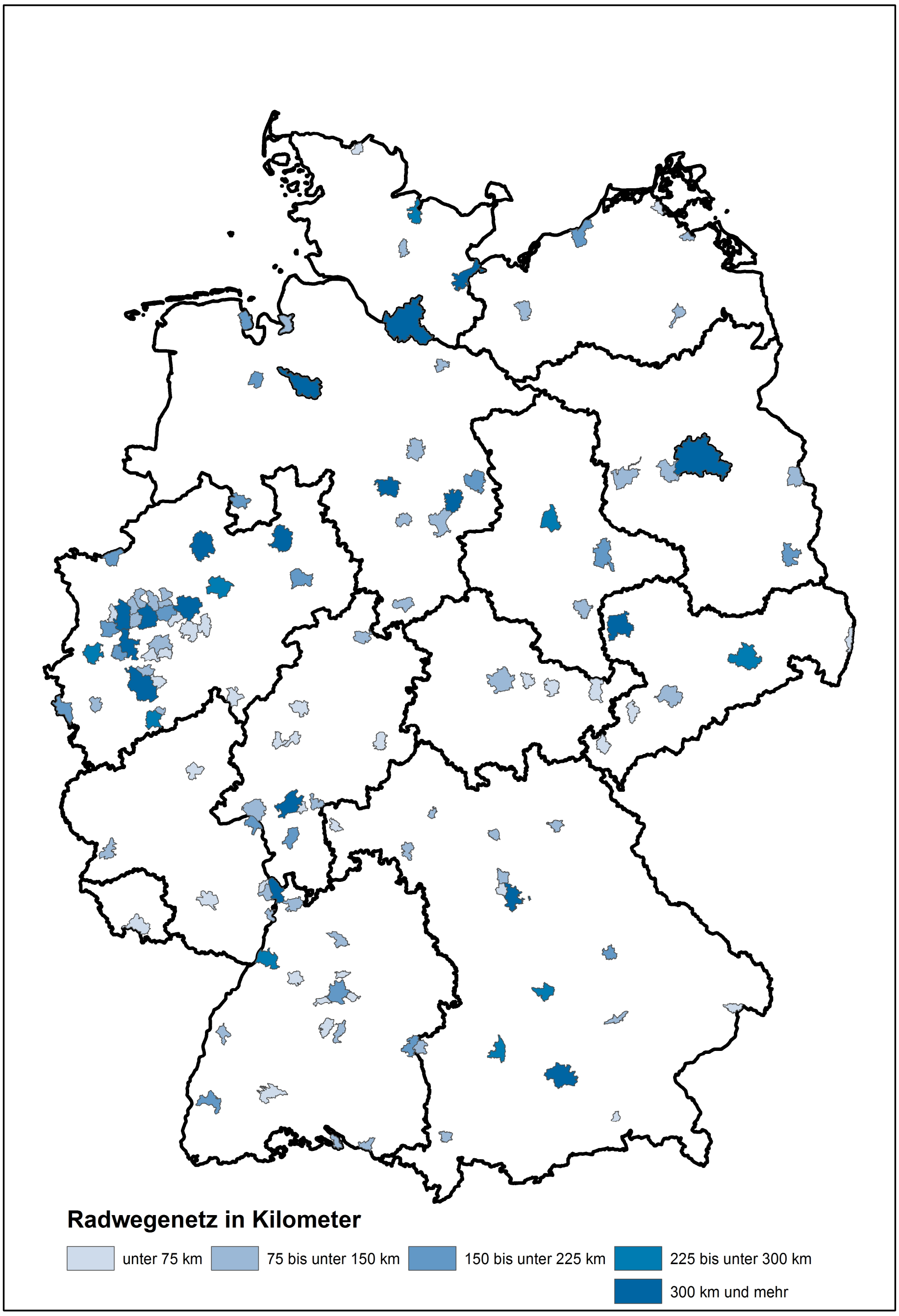
The following parameters must be specified to run the script:

- The path to the output folder, which also contains a shapefile of all the administrative units.
- The path to a text file in CSV (comma-separated values) format containing the names of the Urban Audit cities in the UA city column.
- The date for which data should be retrieved from OpenStreetMap in year-month-day format.

For each city, the polylines of the cycle routes produced by the key/value pair search are saved as a shapefile and intersected with the city's official administrative units from the shapefile in the output folder. Finally, the geometries in the shapefiles of the cities are isometrically re-projected and serve as the basis for calculating the length of the cycle networks. After a complete iteration, the script creates a CSV file of the results.

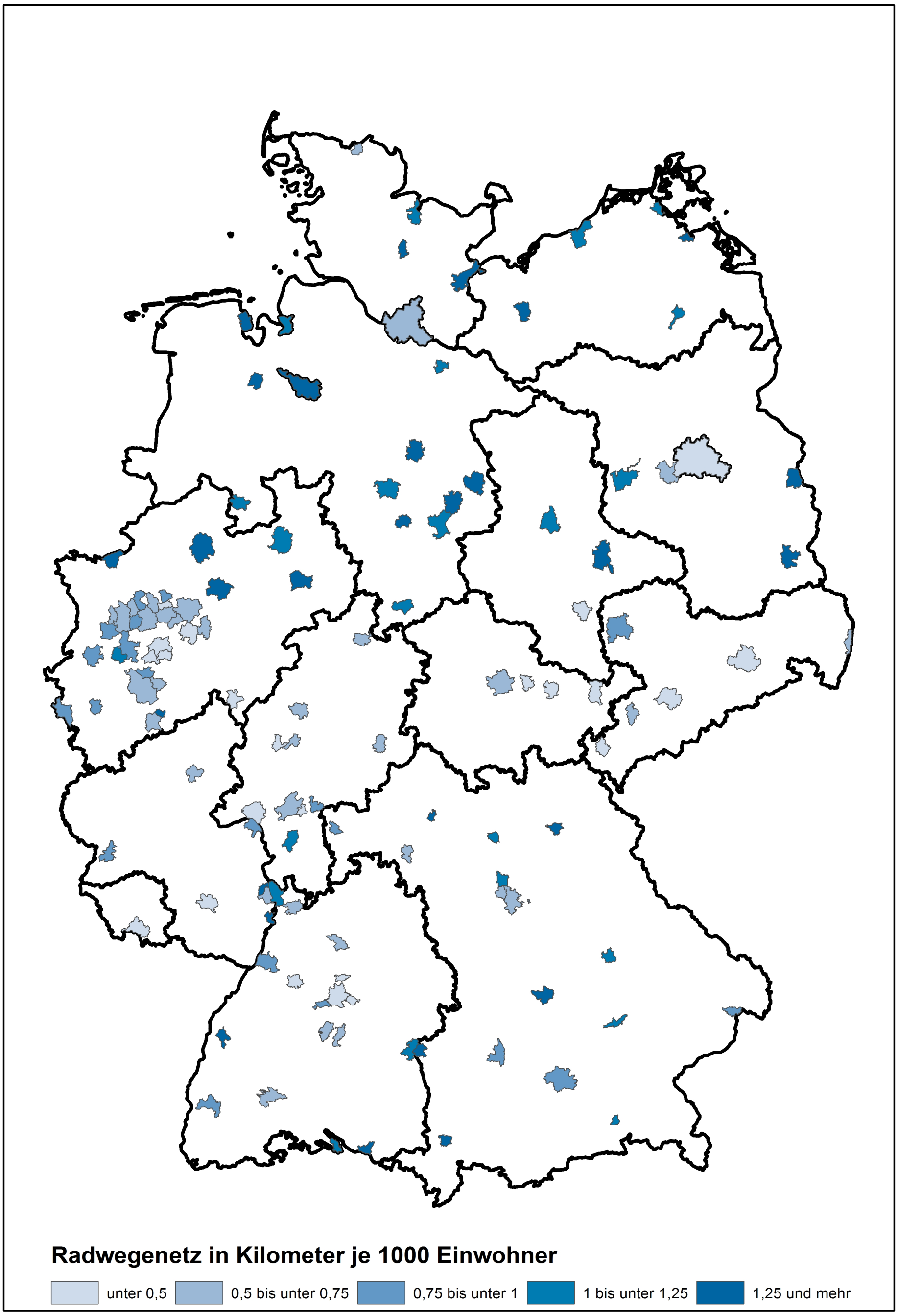
Summary and prospects

The following map shows the length of the cycle network in kilometres in the Urban Audit cities calculated according to the method described with a dataset from 31/12/2018. Cologne has the longest cycle network (792 km); the average cycle network of the German Urban Audit cities is 235 kilometres.



Length of the cycle network in kilometres
in the German Urban Audit cities for 2018

The second map shows the cycle network in km per 1,000 inhabitants. Here, Ingolstadt had the longest proportional cycle network with 1.76 km per 1,000 inhabitants.



Length of the cycle network in kilometres per 1,000 inhabitants
in the German Urban Audit cities for 2018

From now on, the KOSIS Association Urban Audit will calculate the length of the cycle networks in individual cities using the method described above. The values dated 31/12/2017 and 31/12/2018 that were calculated using the script will be relayed to the EU in late 2019 and subsequently published on the KOSIS Association Urban Audit's data providing websites. Those interested in the technical implementation of this project are welcome to contact the supervising office.

Tobias Link
is the national coordinator of the Urban Audit Project for Germany (urbanaudit@mannheim.de).

4. Selected German cities: Combining crowd data and survey data to analyse traffic

By Sebastian Baur

This article aims to illustrate how combining alternative and conventional data can produce valuable insights. To this effect, OSM data on cycle networks was used in combination with a coordinated survey on the quality of life in order to analyse the factors that influence which mode of transport residents prefer — in this specific case cycling.

Theory and method

Many cities want to promote cycling as a more attractive mode of transport. This raises the question of what factors encourage residents to consider cycling as a mode of transport. To be certain, many different factors play a role in this choice, such as the existence of bicycle rental systems, the topography of a city, the quality of the cycle routes, and the geographical coverage/range of the cycle network. The effect of the latter is the focus of analysis in this article.

As the previous article explains, since 2018, the length of cycle networks in German cities has been calculated based on OSM data using Python for the European City Statistics project. In order to enable a meaningful comparison of the cities, this article put cycle routes in relation to the population. In the next step, this data was compared to the results of the coordinated survey of the quality of life in which 15,716 residents of 24 German cities participated. The survey revealed which mode of transport residents use most often. It also examined other important factors that may be connected to the mobility behaviour of residents, making it possible to control these factors to ascertain potential differences between cities.

The following variables were chosen as possible explanatory factors for naming cycling as the most frequent mode of transport on a typical day:

- Cycle network in kilometres per 1,000 inhabitants
- Employment situation
- Gender
- Age
- Nationality
- Air quality
- Noise level
- Road conditions
- Safety in the city

- Safety in the neighbourhood

Logistic regression was chosen as the method of analysis. This model is suitable for analysing what effect different factors have on a binary dependent variable – as was the case here.[9]

Results

The length of the cycle network was compiled for all 127 Urban Audit cities. Data from the Perception Survey is currently only available for the 24 German cities that participated in the EU survey (referred to as the coordinated survey).[10]

The following table shows a descriptive overview of the length of the cycle network (absolute length and the length in relation to the population) and the proportion of cyclists in these cities. There were large differences between the cities regarding the proportion of residents who prefer cycling as a mode of transport. Freiburg had the highest proportion at 44.4 percent; Zwickau the lowest (11.4%). Unsurprisingly, a high variance was found in the length of the cycle network. According to the absolute figures, Cologne had the longest cycle network with 792 kilometres, significantly longer than the average of 235 kilometres for all 24 cities. At 51 kilometres, Zwickau had the lowest value. When the cycle network was examined in relation to population, by contrast, Ingolstadt had the highest value with 1.76 kilometres of cycle network per 1,000 inhabitants and Stuttgart the lowest value with 0.32 kilometres per 1,000 inhabitants.

[9] The regressors (independent or controlled variables) may have any level of measurement; discrete/categorical variables must be recoded as binary dummies.
This data is generally also suitable for a multilevel analysis. However, considering the composition of the independent variable cycle network and the low intraclass correlation (ICC) variable of 0.077, a multilevel analysis was not appropriate in this case; scientists recommend using multilevel analyses for values of 0.1 and above.
[10] The results of the Europe-wide survey are expected to be available in late 2019.

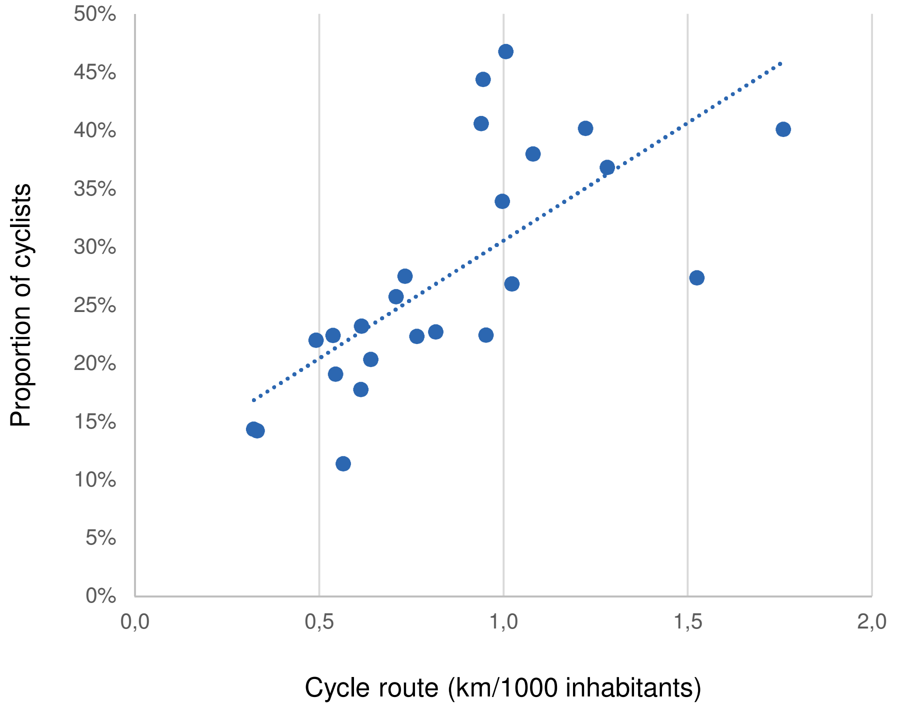
City	Cycle route (km)	Cycle route (km/1,000 inhabitants)	Proportion of cyclists
Aachen	201	0.82	22.7 %
Augsburg	292	1.00	33.9 %
Braunschweig	318	1.28	36.8 %
Darmstadt	171	1.08	38.0 %
Dresden	271	0.49	22.0 %
Düsseldorf	472	0.76	22.3 %
Frankfurt am Main	459	0.61	23.2 %
Freiburg	217	0.94	44.4 %
Fürth	68	0.54	22.4 %
Ingolstadt	238	1.76	40.1 %
Karlsruhe	293	0.94	40.6 %
Kassel	123	0.61	17.8%
Koblenz	62	0.54	19.1 %
Cologne	792	0.73	27.5 %
Konstanz	85	1.01	46.8 %
Mannheim	315	1.02	26.8 %
Nuremberg	365	0.71	25.8 %
Osnabrück	201	1.22	40.2 %
Recklinghausen	108	0.95	22.4 %
Saarbrücken	60	0.33	14.2 %
Stuttgart	204	0.32	14.4 %
Wolfsburg	189	1.53	27.3 %
Würzburg	81	0.64	20.4 %
Zwickau	51	0.57	11.4%
Total Ø	235	0.85	27.5 %

Cycle network and proportion of cyclists in 24 German cities

The following graph shows a clear correlation on the macro level: the longer the cycle network in relation to the population, the larger the proportion of residents who said cycling was their most frequent mode of transport.

These are, of course, only descriptive correlations. In the next step, the analysis aimed to demonstrate whether a positive correlation would persist when various characteristics were controlled on the individual level.

Correlation between the relative length of a cycle network and the proportion of cyclists
in 24 German cities



The final model of logistic regression is shown on the next page. The log-odds (the logarithm of the odds) are displayed; positive values indicate a higher probability of the occurrence of the observed characteristic of the dependent variable, negative values a lower probability. To facilitate interpretation, the effects have been added as change in percent.[11]

Positive correlation between cycle network and the proportion of cyclists confirmed

As the table clearly illustrates, the positive correlation between the cycle network and cycling as the preferred mode of transport was confirmed by controlling other characteristics. Increasing the length of a cycle network by one kilometre per 1,000 inhabitants, raises the odds that residents will choose cycling as their most frequent mode of transport by 357.7 percent. This was also the factor with the highest effect size in this model.

Significant effect of employment situation

The employment situation showed two significant characteristics: compared to employees, pupils/students were much more likely to choose to cycle, whereas residents who are unable to work were less likely to cycle.

[11] It is important to note that the effects refer solely to odds and probability ratios. Thus, effect sizes and directions are easy to interpret although no exact conclusions can be drawn about absolute probabilities (cf. e.g. https://www.statworx.com/blog/stolperfalle-logistische-regressionskoeffizienten-und-odds-ratios/).

	Most frequent mode of transport: Bicycle	
	Log-odds (std. errors)	Δ%
Cycle network	1.521 (.455)***	357.7%
Employment situation **(Ref. = employed)**		
Unemployed	.153 (.120)	
Retired/Pensioner	- .121 (.072)	
Unable to work for health reasons	- .535 (.229)*	-41.4%
Pupil/Student	.525 (.113)***	69.0%
Stay-at-home partner	- .159 (.115)	
Voluntary service	.930 (.607)	
Other	.176 (.145)	
Women	.049 (.040)	
Age	.107 (.018)***	11.3%
Age^2	- .001 (.000)***	-0.1%
Air quality (Ref. = Very satisfied)		
Moderately satisfied	.177 (.056)**	19.4%
Moderately dissatisfied	.375 (.066)***	45.5%
Very dissatisfied	.389 (.100)***	47.6%
Noise level (Ref. = Very satisfied)		
Moderately satisfied	.047 (.055)	
Moderately dissatisfied	.168 (.066)*	18.3%
Very dissatisfied	.263 (.097)**	30.1%
Road conditions (Ref. = Very satisfied)		
Moderately satisfied	- .039 (.145)	
Moderately dissatisfied	- .214 (.163)	
Very dissatisfied	- .321 (.246)	
Safety in the city (Ref. = Agree)		
Mostly agree	- .110 (.061)	
Mostly disagree	- .378 (.074)***	-31.5%
Strongly disagree	- .625 (.102)***	-46.5%
Safety in the neighbourhood (Ref. = Agree)		
Mostly agree	- .070 (.054)	
Mostly disagree	- .267 (.076)***	-23.4%
Strongly disagree	- .550 (.126)***	-42.3%
Nationality (Ref. = German)		
German and other nationality	- .392 (.060)***	-32.4%
Other nationality only	- .427 (.473)	
Cycle network X Age	- .039 (.018)*	-3.8%
Cycle network X Age^2	.001 (.000)**	0.1%
Cycle network X Road conditions (Ref. = Very satisfied)		
Moderately satisfied	.087 (.150)	
Moderately dissatisfied	.339 (.170)*	40.4%
Very dissatisfied	.448 (.261)	
Constants	- 3.886 (.453)***	

*p < .05; **p < .01; ***p < .001

Gender, by contrast, had no significant effect.

Age

In terms of age, both a significant linear and a quadratic effect were found: with increasing age, the probability of cycling being the most frequent mode of transport initially increased; at a certain age, the probability decreased again. In addition, there was a significant interactional effect between the length of the cycle network in kilometres per 1,000 inhabitants and age. Again, this effect was both linear and quadratic: the extent of the positive effect of the cycle network on the probability of cycling decreased with increasing age and became more important again at a certain age. This indicates that the length of the cycle network had a high relevance on the choice of mode of transport for very young and old people.

Nationality

People with a second nationality in addition to German, were significantly less likely to list cycling as their most frequent mode of transport than Germans without other nationalities. The effect for people without German citizenship was even larger, but due to the small sample size it was not significant.

Noise level and air quality

The higher the perceived noise level, the higher the probability of people choosing cycling as the preferred mode of transport. The same was true for air quality. This finding, which was initially surprising, could be explained as follows: on the one hand, residents may be more likely to prefer cycling the higher the air and noise pollution are; on the other, cyclists may have a more negative assessment of air quality and noise levels than other road users. An analysis of this correlation on a macro level was able to clarify this issue.

Correlation between proportion of cyclists and air quality and noise level

Correlation on the city level

	Satisfaction: air quality	Satisfaction: noise level
Most frequent mode of transport: Bicycle	0.11	0.07

There was a positive correlation between the proportion of cyclists and the assessment of air quality and noise level. While this correlation was not significant, it would seem to speak against the first of the two explanations given above: in cities where a higher proportion of residents preferred cycling over other modes of transport, air quality and noise levels were assessed more positively. Thus, the second explanation is more accurate on a micro level: cyclists were more critical of the air quality and noise levels.

Road conditions

Road conditions did not have a direct effect. However, they did have an interactive effect with the cycle network: the worse the road conditions, the more positive the effect of the cycle network on the probability of people preferring cycling.

Sense of safety

Residents' sense of safety in the city and in their own neighbourhoods had a significant effect on cycling as the preferred mode of transport. People who mostly or completely disagreed with the statements "I feel safe when I'm out alone in the city at night" or "I feel safe when I'm out alone in my neighbourhood at night" were significantly less likely to prefer cycling over other modes of transport.

Conclusion

This article demonstrated how combining alternative and conventional data can yield insights for strategic management in cities. In doing so, big data should not be understood as the improved successor to conventional tools. Both new methods from the field of big data and traditional methods such as surveys are useful for systematically compiling and processing information. Each differs in terms of strengths, limits, and fields of applications. It is therefore important to tap the full potential of both worlds.

Using OSM data for collecting European data results in higher-quality and more extensive data. At the same time, it is evident that the length of the cycle network has a large effect on the appeal of cycling as a mode of transport.

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5. Darmstadt, a City of Science: New traffic analyses using mobile phone data – an interim report

By Günther Bachmann[12]

One of the most important challenges for a city is facilitating mobility. Mobility comprises many spatial and social dimensions; however, the previously dominant form of mobility is undergoing a transformation in the 21st century as motorised private transport is increasingly becoming a significant problem for cities. Since the middle of the last century, cars have been the promising mode of transport for all classes, and urban development has been focussing on making places accessible to individual motor traffic – for everyday life, work, and shopping.

This urban model has reached its limits – and not just in recent years – as increasing traffic has led to conflicts between drivers, pedestrians, and cyclists as well as being responsible for a dramatic rise in air pollution, traffic noise, and time wasted searching for a parking space. New strategies for suitable transport infrastructure have therefore become the number one priority on the political and social agendas of many German cities.[13]

Differentiated and detailed studies on mobility behaviour in German cities are expensive and require costly surveys that would make it difficult to gather data frequently within a short period of time. Particularly small-scale mobility, which can be subject to dynamic changes within a very short period of time, e.g. when new roads or cycle routes are built, is difficult to represent in existing mobility surveys, if it is examined at all. Consequently, extensive studies of mobility in Germany were only carried out in 2002, 2008, and 2017.[14]

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[12] I would like to thank the Hessen State Statistical Office for sharing their experiences with "Data from Mobile Phone Networks" on Tuesday, 23 July 2019 at the Hessen State Statistical Office, Wiesbaden. I would especially like to thank my colleagues Tobias Gramlich and Patrick Vollmer. Furthermore, I would like to thank my colleagues Sandra Hadam and Natalie Rosenski from the Federal Statistical Office for our fruitful discussions and the other colleagues who participated in the workshop. My special thanks go out to Mr Nobert Weber and his colleagues at Motionlogic for the data they provided and the stimulating conversations throughout the data analysis.

[13] Cf. Günther Bachmann, Umweltqualität und Umweltgerechtigkeit – Zur Kombination von Internetdaten und Statistikinformationen am Beispiel der Wissenschaftsstadt Darmstadt, Stadtforschung und Statistik, Heft 1/2016, Stuttgart 2016.

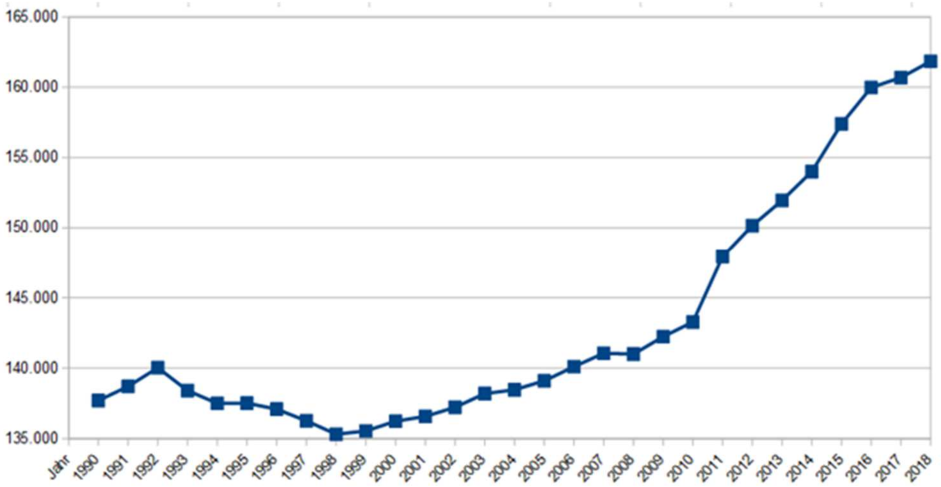
[14] Cf. BMVI 2018: Bundesministerium für Verkehr und digitale Infrastruktur, Mobilität in Deutschland (MiD), latest update: 26. August 2019, see https://www.bmvi.de/SharedDocs/DE/Artikel/G/mobilitaet-in-deutschland.html, accessed 2.10.2019.

Against this backdrop, the possibility of evaluating mobile phone data to analyse existing and changing mobility behaviour in German cities is an appealing option for urban development, urban planning, and traffic planning in the 21st century. This article is based on the first analyses of mobility behaviour in one city and aims to provide an overview of the opportunities and limits of this method.

Brief facts about the situation in Darmstadt

Since 1998: Large increase in population, students, and employees

Darmstadt is a mid-sized city to the south of the Frankfurt/Rhine-Main Metropolitan Region. Since 1998, the population has grown from 135,315 to 161,843 inhabitants.



Population development
in Darmstadt from 1990 to 2018

The population growth of about 20 percent is primarily the result of the large number of modern workplaces and the large increase in students and young employees. In 2016, the city counted over 131,000 employees, compared to 115,800 in 1998; and the number of employees subject to social insurance contributions grew from around 85,000 in 1998 to 103,242 in 2017, while the number of students increased to about 45,000. The large number of employees subject to social insurance contributions who have (at least) a university degree is particularly striking. This group makes up one third of the labour force in Darmstadt, the highest number in Germany after Jena and Erlangen.[15]

[15]Cf. the following publications:
Magistrat der Wissenschaftsstadt Darmstadt, Studierende in der Wissenschaftsstadt Darmstadt, Statistische Berichte 1. Halbjahr 2014, Darmstadt 2014.
Magistrat der Wissenschaftsstadt Darmstadt, Geringfügig Beschäftigte in der Wissenschaftsstadt Darmstadt, Statistische Berichte 1. Halbjahr 2015, Darmstadt 2015.
Magistrat der Wissenschaftsstadt Darmstadt, Demografiebericht 3, Darmstadt 2017.
Magistrat der Wissenschaftsstadt Darmstadt, Datenreport 2018, Darmstadt 2018 (ongoing).

The modern service sector as well as the industrial core of companies that form an internationally active business cluster of chemistry, pharmacy, and mechatronics companies are responsible for the large proportion of highly qualified employees. Furthermore, the excellent cluster of IT and software companies and the large cluster of scientific institutions, including space missions (ESA/ESOC), weather satellites (EUMETSAT), particle physics (GSI Helmholtzzentrum für Schwerionenforschung), etc. have contributed to Darmstadt's profile as a City of Science. In the field of research, the Fraunhofer institutes are just as important as the three universities (the Technische Universität, the Hochschule Darmstadt – University of Applied Sciences, and the Evangelische Hochschule).

Resulting costs of demographic growth and the increased labour force

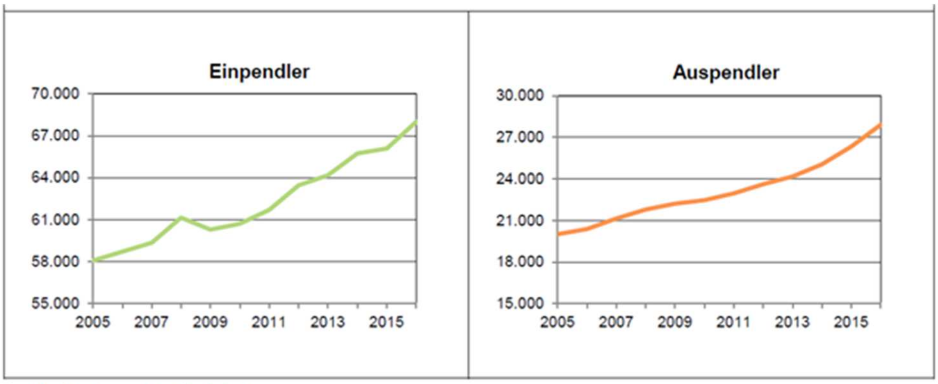
The extraordinary success that Darmstadt has enjoyed over the past 20 years has, however, come at a price: compared to other German cities, a very large number of commuters drives into the city to work or study every day and returns to the surrounding towns again in the evenings, thus resulting in very heavy traffic.

Significantly more commuters to than from the city

The number of commuters to the city who are employees subject to social insurance contributions is currently just under 70,000 people; the number of commuters from the city is just under 30,000.

Approximately 20,000 students in addition to self-employed workers, civil servants, unpaid family workers, pupils, shoppers, and tourists must be added to the number of commuting employees. Furthermore, the number of delivery cars and lorries into and within the city also contribute to the heavy traffic.

Number of commuters to and from Darmstadt since 2005

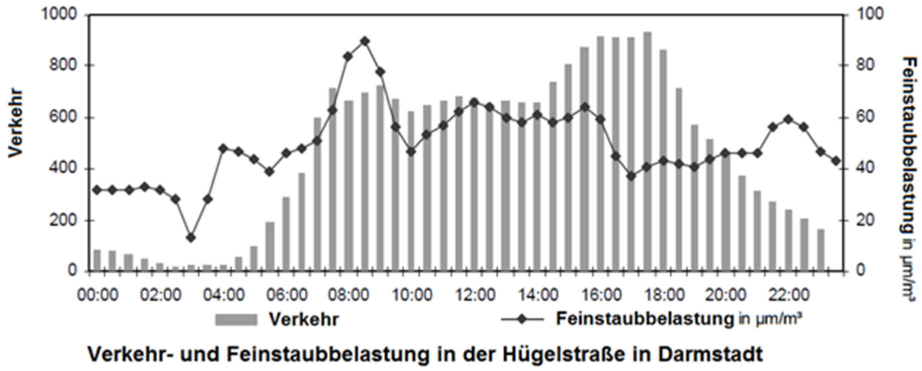


Quelle: Bundesagentur für Arbeit

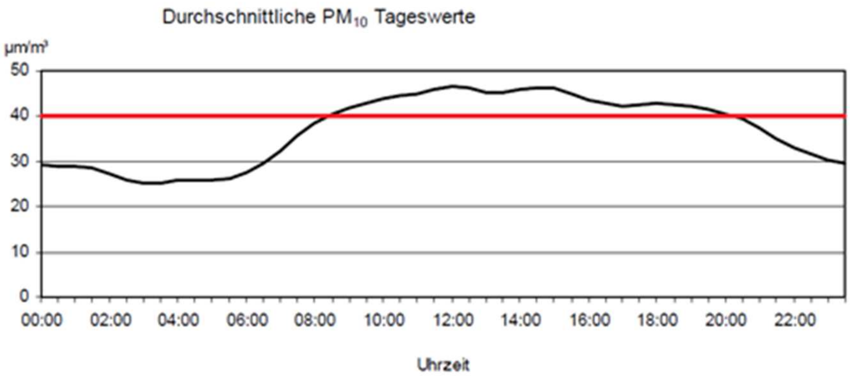
The dense traffic has caused high levels of particle pollution in the city centre (see the diagram below showing the heavily polluted

Magistrat der Wissenschaftsstadt Darmstadt, Sozialversicherungspflichtig Beschäftigte in Darmstadt, Statistische Berichte 1. Halbjahr 2018, Darmstadt 2018.

Hügelstrasse), noise pollution from the transport sector, and has resulted in subsequent costs.[16] Furthermore, it pushes the transport infrastructure to its limits on a daily basis, resulting in unwelcome traffic jams in the city and its outskirts as well as causing conflicts between road users. Darmstadt is one of ten German cities with the highest rates of particle pollution. The EU limit value of a concentration of 40 micrometres per cubic metre of ambient air is exceeded on a regular basis, for example on Hügelstrasse (EU Directive 99/30/EG of 1999, valid since 1 January 2005). Many cities in Germany and Europe are affected by similar levels of pollution.



Traffic and particle pollution
on Hügelstrasse in Darmstadt over the course of a day



Average particle pollution over the course of a day
in Darmstadt

Consequently, a modern mobility analysis of traffic into and within the city with a high spatial and temporal resolution is an important foundation for urban development and urban and traffic planning – not just for Darmstadt.

Basis for a mobility analysis using mobile phone data

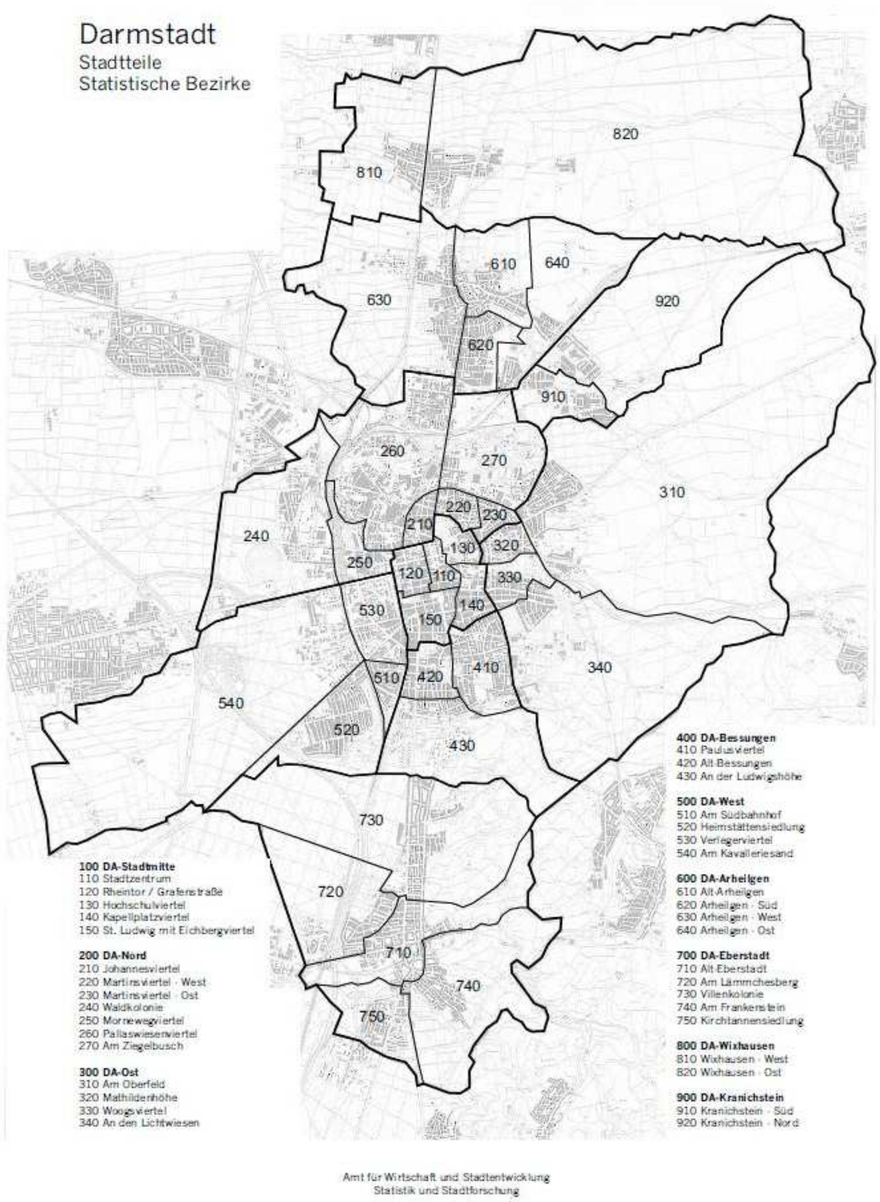
Mobile phone data from a Telekom subsidiary Motionlogic

As the first-place winner of bitkom's Digital City competition in June 2017, Darmstadt was awarded free access to mobile phone data from the Telekom subsidiary Motionlogic. The data was supplied to Darmstadt's independent statistical office in two instalments, in January 2019 and in an improved version in June 2019. This section

[16] It is striking that – as opposed to the mornings – no linear correlation between traffic levels and measurements of particulate matter could be found in the afternoons (west wind).

discusses the data and analyses of the second, significantly improved delivery only since Motionlogic put a great deal of effort into optimising the evaluation of their mobile phone data. Prior to that, the author of this article conducted a critical analysis of the data delivered by Motionlogic in January 2019 and pointed out a number of inconsistencies.

The data supplied by Motionlogic had an extremely high spatial and temporal resolution, giving the city of Darmstadt new possibilities for conducting a mobility analysis. The data is based exclusively on the point of departure and arrival of the SIM card and does not convey information about the route. As a matter of course, Motionlogic aggregated the data to guarantee that no conclusions could be drawn about individual mobility behaviour and to ensure the anonymity of the users. The Federal Commissioner for Data Protection approved the delivery in accordance with the specified standards.

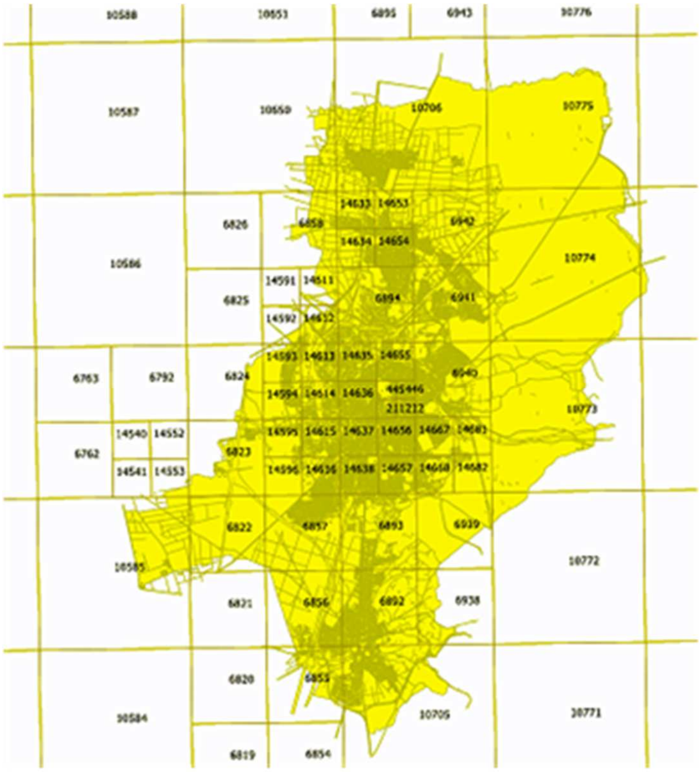


Statistical districts
in Darmstadt

The data Motionlogic delivered was structured as follows:

Traffic analysis zones: The data was provided as a CSV file. In addition, Motionlogic's traffic analysis zones were also delivered as a shapefile. It is important to note that Motionlogic's traffic analysis zones do not correspond with the Telekom cell towers but rather are aggregated on a higher level. The traffic analysis zones are much larger in rural areas, for example the Darmstadt-Dieburg administrative district, than in Darmstadt city centre. The number of traffic analysis zones for the city of Darmstadt is 49 and thus higher than the number of statistical districts, which are otherwise the smallest unit (37 statistical districts).

For Darmstadt, the traffic analysis zones were produced via shapefile and analysed using QGIS software before being compared to the borders of the statistical districts. The following diagram shows the municipal area with the Motionlogic traffic analysis zones and developed areas shown in grey. For further analysis, the borders of the Darmstadt-Dieburg administrative district and other local authorities were combined with the Motionlogic traffic analysis zones in QGIS using shapefiles from the Federal Agency for Cartography and Geodesy.[17] This usually allowed traffic analysis zones to be clearly allocated to the regional and local authorities.



Motionlogic traffic analysis zones with Darmstadt and surrounding areas; built-up areas are in grey

For the time being, Darmstadt's statistical districts are not compatible with the Motionlogic traffic analysis zones. The locations of large companies, however, are clearly identifiable in the traffic analysis zones. In addition, the information required for checking the plausibility of employee data at company sites can be acquired by consulting with the companies and evaluating business reports or via the "traditional" company register provided by the Hessen State Statistical Office each year. It was thus possible to drastically improve

[17] Federal Agency for Cartography and Geodesy, regional maps, at https://www.bkg.bund.de/DE/Produkte-und-Services/Shop-und-Downloads/Landkarten/Karten-Downloads/Regionalkarten/regionalkarten.html

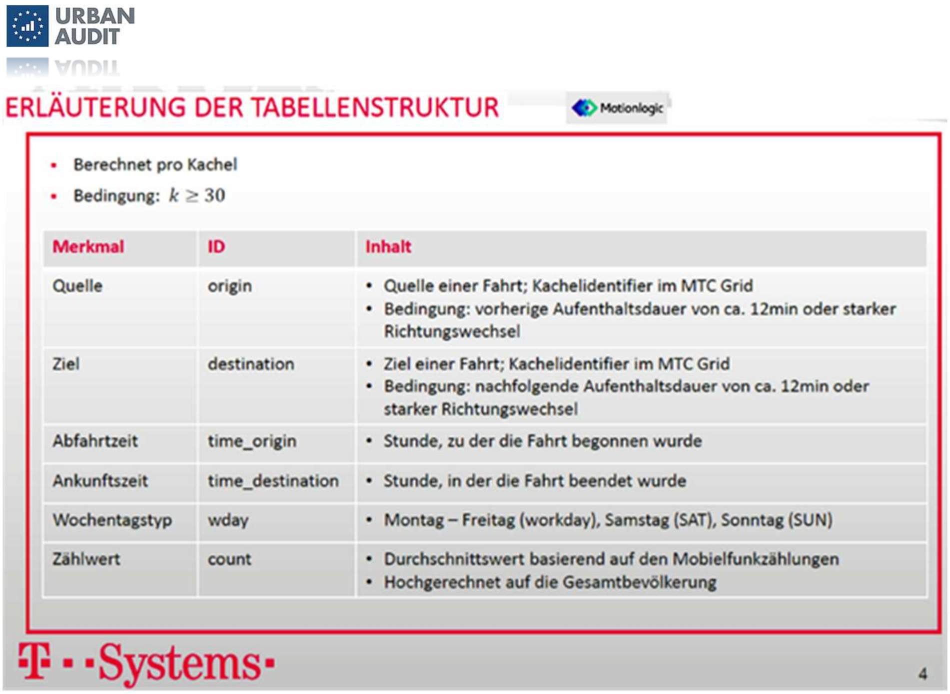
the official statistics using new, volatile mobile phone data for traffic analysis, something that was previously inconceivable.

However, not all of the traffic analysis zones of a municipality or a city can be clearly classified, making a precise analysis of overlapping areas necessary. At a working group meeting in Wiesbaden, Patrick Vollmer from the Hessen State Statistical Office therefore recommended agreeing on valid classification criteria, if possible, on a national basis (e.g. centroid analysis). The approach taken by Sandra Hadam from the Federal Statistical Office could be an interesting method for German cities: using the small area estimation method, she was able to take mobile phone data as auxiliary data to estimate the unemployment rate for other, statistically relevant spatial units and provide the corresponding parameters for the accuracy of these rates (Hadam 2019: lecture during the 2019 Statistical Week in Trier).

CSV file with traffic data: In addition to the shapefiles, the mobile phone data was also saved in the CSV file odm_darmstadt_mtc_hour.csv. It quickly became apparent that this file – with 146,282 data sets and six entries per data set – would pose a “big data challenge” for the analysis. The two graphs on the next page show the structure of the data and an example of how the data is to be analysed.

In general, any statistical software can be used for analysing data, e.g. SPSS or R.; the Java programming language was used to evaluate the data for Darmstadt. In addition to enabling CSV files to be easily imported for processing, Java has the advantage of making it possible to very quickly produce numerous variants of the data analysis, which can then be saved as CSV files and evaluated. However, we recommend other cities that also receive this mobile phone data use “traditional” statistical software with algorithms that are described here.

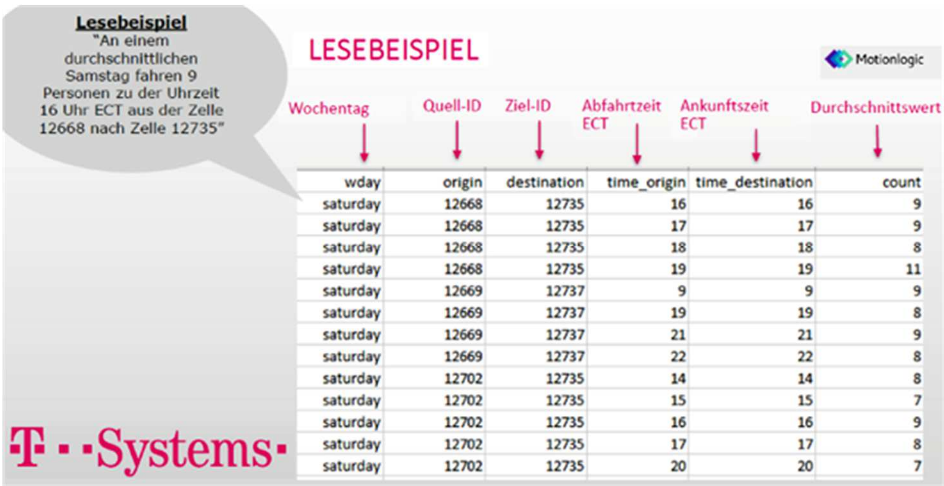
Explanation of the table structure for the data provided by Motionlogic



- Berechnet pro Kachel
- Bedingung: $k \geq 30$

Merkmal	ID	Inhalt
Quelle	origin	• Quelle einer Fahrt; Kachelidentifier im MTC Grid • Bedingung: vorherige Aufenthaltsdauer von ca. 12min oder starker Richtungswechsel
Ziel	destination	• Ziel einer Fahrt; Kachelidentifier im MTC Grid • Bedingung: nachfolgende Aufenthaltsdauer von ca. 12min oder starker Richtungswechsel
Abfahrtzeit	time_origin	• Stunde, zu der die Fahrt begonnen wurde
Ankunftszeit	time_destination	• Stunde, in der die Fahrt beendet wurde
Wochentagstyp	wday	• Montag – Freitag (workday), Samstag (SAT), Sonntag (SUN)
Zählwert	count	• Durchschnittswert basierend auf den Mobielfunkzählungen • Hochgerechnet auf die Gesamtbevölkerung

Sample interpretation of the CSV file of the data provided by Motionlogic



wday	origin	destination	time_origin	time_destination	count
saturday	12668	12735	16	16	9
saturday	12668	12735	17	17	9
saturday	12668	12735	18	18	8
saturday	12668	12735	19	19	11
saturday	12669	12737	9	9	9
saturday	12669	12737	19	19	8
saturday	12669	12737	21	21	9
saturday	12669	12737	22	22	8
saturday	12702	12735	14	14	8
saturday	12702	12735	15	15	7
saturday	12702	12735	16	16	9
saturday	12702	12735	17	17	8
saturday	12702	12735	20	20	7

Evaluation of mobile phone data for traffic analysis

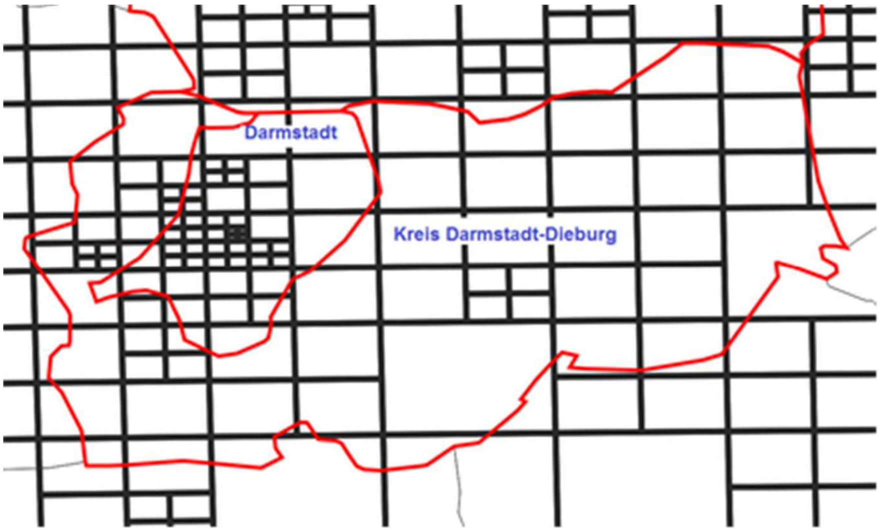
When evaluating mobile phone data for traffic analysis, it is essential to first define the objectives: what insights should be achieved, what data should be evaluated. Considering the great variety of data and evaluation options, it is essential to have clear objectives in order to be able to use the data for a meaningful traffic analysis.

The main objectives of the study carried out in Darmstadt were as follows:

- Analyse the mobility behaviour of commuters from specific surrounding municipalities and cities into small-scale areas in Darmstadt using high spatial and temporal resolution.

- Analyse the mobility behaviour of commuters within and into the city centre from surrounding municipalities and cities at important company and university locations in Darmstadt using high spatial and temporal resolution.
- Analyse the mobility behaviour of visitors and tourists to Mathildenhöhe within the context of the State of Hesse applying to have the Jugendstil buildings known as Mathildenhöhe recognised as a World Cultural Heritage Site.

The motivation for analysing commuter flows in the Darmstadt region was to support traffic planning by supplying it with meaningful data on important small-scale locations with destinations that cause heavy traffic. Although sufficient data on commuters to Darmstadt is currently available in the form of statistics from the Federal Employment Agency on employees subject to social security contributions, these statistics only cover about 70 percent of work-related commuters (see the city of Darmstadt's municipal publications) and, since they are only available on an annual basis, they are of limited use for analysing small-scale traffic zones with high spatial and temporal resolution.[18]



Motionlogic traffic analysis zones for the municipal area of Darmstadt and the surrounding administrative district of Darmstadt-Dieburg (red boundary lines)

An analysis of commuters from municipalities to the east of Darmstadt, especially from the municipalities Roßdorf and Groß-Zimmern could contribute important data for the debate on the construction of a tram in these municipalities. Data of this kind, which has been very incomplete until now, would also lead to important insights into the flow of traffic into the city.

[18] Cf. the following publications:
Magistrat der Wissenschaftsstadt Darmstadt, Darmstadts Ein- und Auspendler, Statistische Berichte 2. Halbjahr 2017, Darmstadt 2017.
Magistrat der Wissenschaftsstadt Darmstadt, Sozialversicherungspflichtig Beschäftigte in Darmstadt, Statistische Berichte 1. Halbjahr 2018, Darmstadt 2018.

Basic data and algorithms

The data supplied by Motionlogic – including the shapefiles of the traffic analysis zones – makes it possible to combine traffic analysis zones and GIS data and is based on the ODM matrix as shown in the table above.

The algorithms used to examine this particular problem will be described based on the analysis of commuters from the neighbouring municipalities of Roßdorf and Groß-Zimmern to the small-scale traffic analysis zones, primarily, for example, to company sites and educational institutions.

The following steps are required to analyse the ODM matrix using the Java tool:

- Open the CSV file.
- Enter the data on working days (“workday” as type of weekday).
- Define the traffic analysis zones in the municipal area of Darmstadt that are of interest (“destination”).
- Define the traffic analysis zones of the commuting locations under analysis (“origin”).
- Define the arrival time at the destination (“time-destination”).
- Add the number of mobile phone users (“count”) in the destination traffic analysis zone during the allotted time frame.
- Record the results in a CSV file.

In addition to the results described in the next section, the commuters from all of Darmstadt’s traffic analysis zones to company sites were also analysed; this analysis took commuters to the city centre into consideration or e.g. analysed them separately.

Results of the commuter analysis using mobile phone data

Basic principles

For an analysis of commuter data, it is helpful to have other statistical data for calibrating and checking the plausibility of the findings. In general, the mobile phone data provided did not differentiate between employees subject to social insurance contributions, students and pupils, self-employed commuters, civil servants, and shoppers or tourists commuting to the city. Furthermore, delivery traffic to company sites was also included, whether from within or outside the city. These desirable differentiations cannot currently be charted for an analysis of traffic within the city. Nevertheless, the mobile phone data yielded significant improvements, resulting in a deeper understanding of the traffic in the selected traffic analysis zones. The results of the analysis of mobile phone data will be presented using the following example.

The commuter flows to the municipalities Roßdorf and Groß-Zimmern in the Darmstadt-Dieburg administrative district to the east of the city needed to be analysed for the planned construction of a tram line. A highly differentiated analysis in terms of spatial and temporal resolution was required. The focus was on determining how many commuters from the two neighbouring towns travel to which small-scale traffic analysis zones in Darmstadt on working days, determining which companies are destinations, and developing a model of commuter data on working days.

Thus, the basic data for the query was known:

Origin: the towns of Roßdorf and Groß-Zimmern, traffic analysis zones 10836, 10893, 10956

Destination: all traffic analysis zones in Darmstadt; the sites of the company Merck (pharmaceutical and chemical company with approximately 9,000 employees) and the Lichtwiese campus of TU Darmstadt were of particular interest. The relevant traffic analysis zones included all of the traffic analysis zones in Darmstadt, especially the zones 6894 Merck and 10773 An den Lichtwiesen

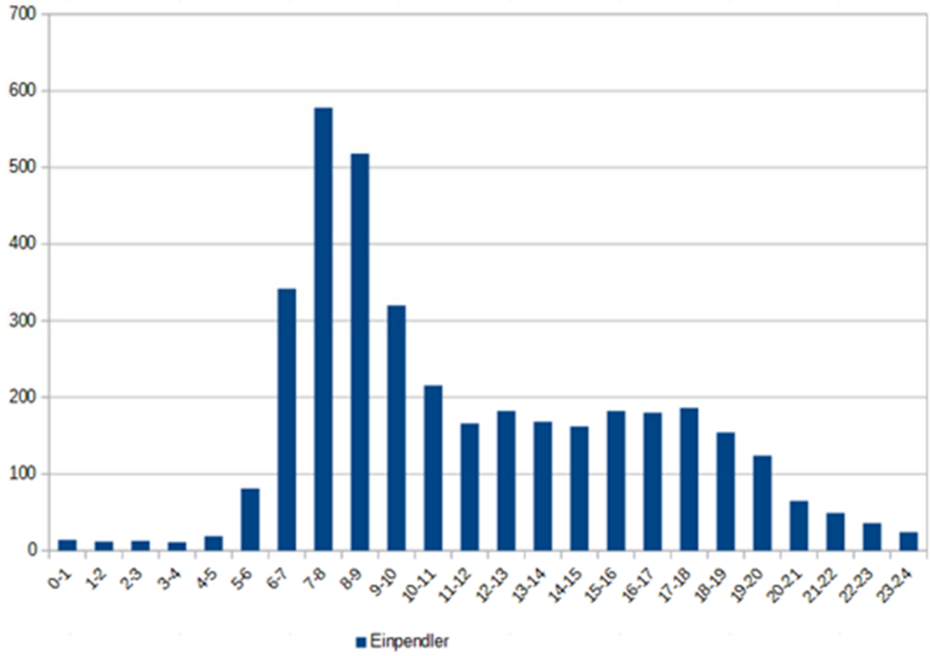
Arrival time: from midnight to midnight

Total: Number of commuters to the city, sorted according to arrival time

Days: working days

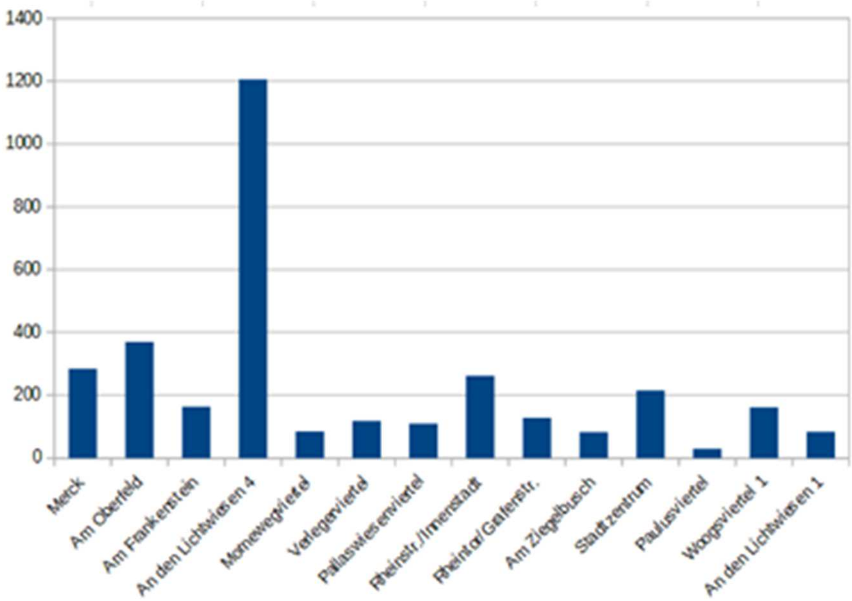
The following graph shows the hourly distribution from midnight to midnight of the total number of commuters to the city of Darmstadt from the two municipalities Roßdorf and Groß-Zimmern. In total, 3,801 people commuted to the city during this time period, reaching a peak with 578 people between 7 and 8 am. The number of commuters decreased significantly after 10 am.

Overall commuter flows
on a working day from the eastern district (Roßdorf and Groß-Zimmern) to all traffic analysis zones in Darmstadt (midnight to midnight)

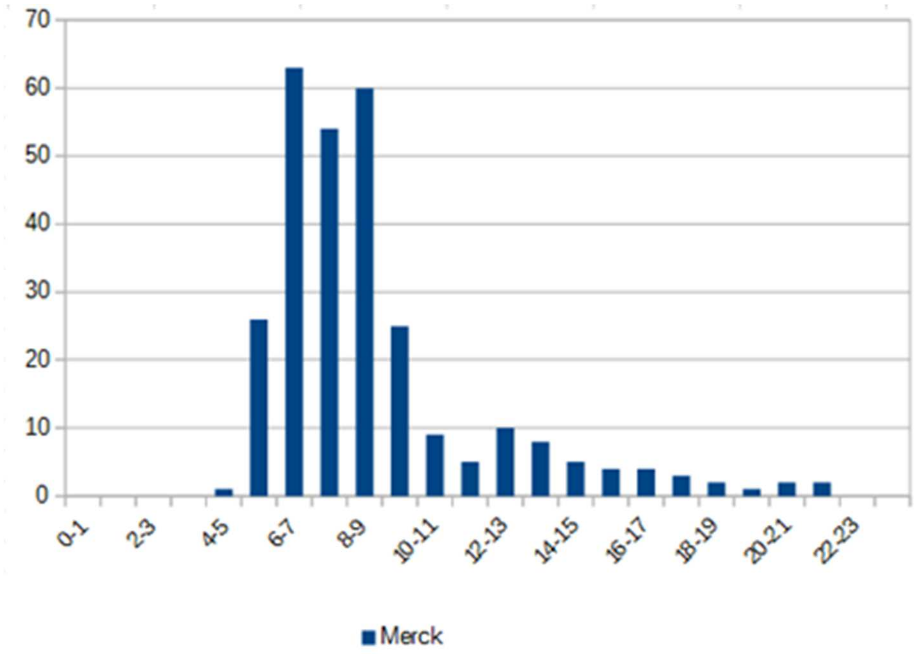


In the graph above, which shows the overall commuter flows from the two towns to various traffic analysis zones in Darmstadt, the TU campus Lichtwiese is most striking, followed by Oberfeld, the company Merck, the Rheinstrasse/city centre, and the urban centre. Here the limits of using mobile phone data to analyse commuter flows become apparent, as the traffic analysis zone Oberfeld only indicated the morning traffic jam of vehicles headed into the city when they were stopped on the access road (B26) for a longer period of time. The other commuter data, however, is quite plausible.

Commuters from Roßdorf and Groß-Zimmern
in particularly highly-frequented traffic analysis zones

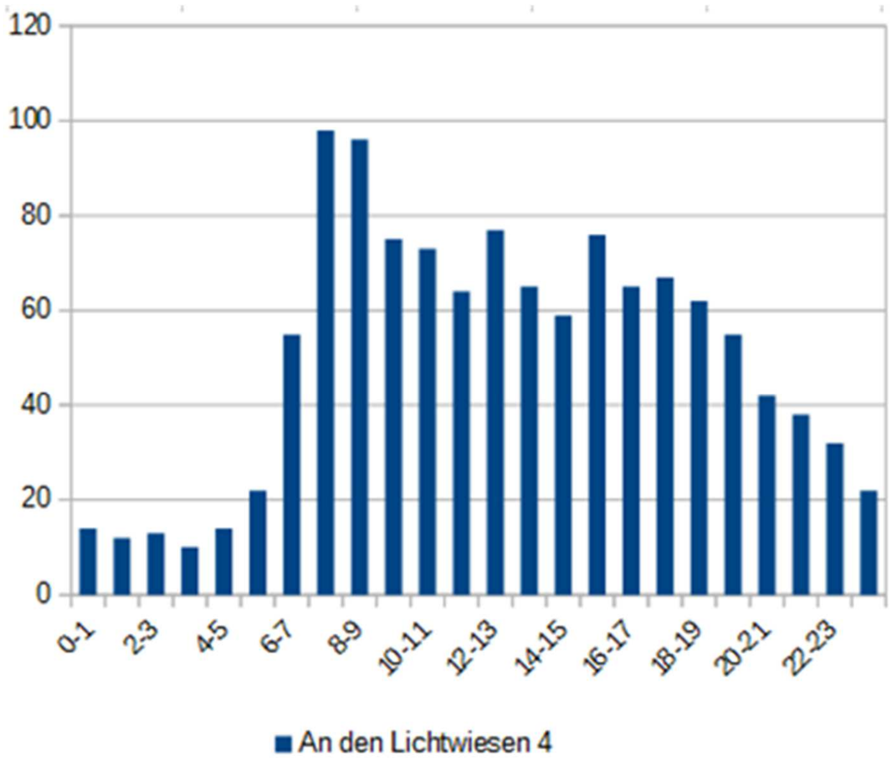


Working day commuters to the company Merck are well charted in the following graph; the peak hours between 6 and 10 am clearly reflect the employees driving to their workplace.



Commuters from Roßdorf and Groß-Zimmern to the traffic analysis zone in which the company Merck is located

The data for the TU campus Lichtwiese has a completely different profile, as demonstrated by the following graph.



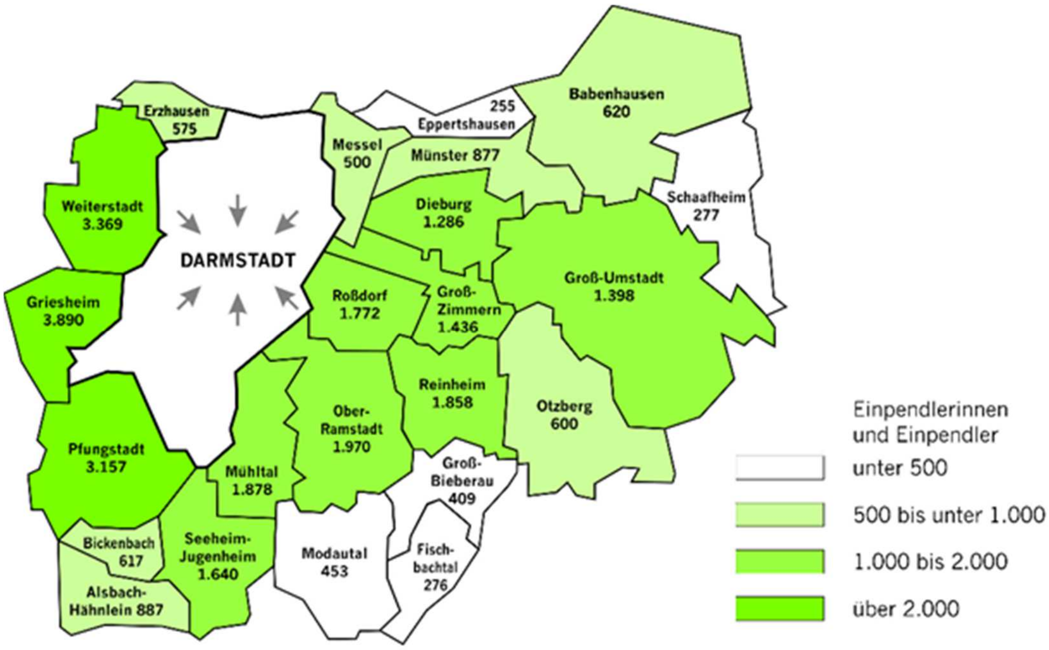
Commuters from Roßdorf and Groß-Zimmern to the TU Lichtwiese campus

The large number of students who are known to live in these two communities went to university at different times than employees went to work, e.g. at Merck. The peak commuting time for students was also between 7 and 10 am, but because university courses start at different times, the number of commuters did not decrease after 10 am to the same extent as it did at other locations.

These examples demonstrate that it is possible to represent the number of commuters from the eastern district (Roßdorf and Groß-Zimmern) to Darmstadt in an hourly temporal resolution across the various small-scale traffic analysis zones.

In order to check the plausibility of the results, these numbers should be compared to figures for employed commuters. The number of employees subject to social insurance contributions who commuted to Darmstadt from the two municipalities comprised 3,208 people (see the following graph). The analysis described above with the Motionlogic data yielded 3,801 commuters to the city.

Employees subject to social insurance contributions who commute
to Darmstadt from the surrounding municipalities



As mentioned above, the number of commuters to the city only included the figures for employees subject to social insurance contributions recorded by the Federal Employment Agency and did not include students, self-employed commuters, and civil servants, nor did it include pupils or shoppers. Consequently, the slightly higher numbers from the Motionlogic analysis were a closer approximation to actual commuter flows even though they were not, of course, an exact model. It is striking that the companies in Darmstadt to which commuters drove are well charted.

Using mobile phone data to analyse commuter flows offers new possibilities for Darmstadt:

An improved quality of life via:

- Reduction of particulate matter and nitrogen oxide pollution through better traffic control.
- Decrease in noise levels in urban areas.
- Concepts for better and "smarter" transport to and within the city thanks to new data.
- Possible improvements to public transport, particularly by extending existing tram lines and/or increasing the frequency of trams during peak commuting hours.
- New data for the planned construction of the new "Lichtwiesen" tram line (connection from the central station – university campus Lichtwiese).
- New basis for planned improvements to the tram and train services in the Darmstadt-Dieburg administrative district, perhaps including a considerable reduction of motorised private transport for commuting.

For the first time, commuter flows to small-scale areas and traffic analysis zones in Darmstadt were charted using mobile phone data. The new data made it possible to evaluate points of departure and arrival on a small scale and in hourly intervals.

Methodical approach and error analysis

This example shows the possibilities that using mobile phone data offers for analysing commuter flows in German cities. However, the challenge continues to lie in the precise analysis of the mobile phone data – for example, in a few specific traffic analysis zones, commuters on the Autobahn or the major road leading into the city from the east were also included in the data. Misinterpretations, e.g. an inaccurate, excessive total number of commuters, etc., can be avoided only when there is a good knowledge of the local situation and the traffic analysis zones are wisely chosen. For the time being, only incomplete data is available on commuter flows as only one data provider is currently willing to share its data. In addition, the extrapolation to mobile customers, which is carried out by the provider, cannot be independently verified. At the present time, it is only possible to verify whether the data is representative and selective when mobile phone data is analysed in combination with, for example the municipal traffic model in order to calibrate and check the plausibility of the data.

Conclusion

An important goal for Darmstadt is to improve the quality of life by reducing particulate matter and nitrogen oxide pollution, which is primarily produced by motorised private transport. Additional goals, such as decreasing noise levels in urban areas, can only be achieved by ensuring better and "smarter" transport to and within the city. The mobile phone data provided by the company Motionlogic enables new kinds of analyses of commuters and thus make it possible to map commuter flows to and within the city. However, this poses significant challenges for urban development and statistics because it requires the analysis of big data. In general, new mobile phone data on commuter flows can help improve the official statistics thanks to new, volatile data that can support urban development, urban planning, and traffic planning and improve our understanding of traffic flows.

This article has presented one example of an evaluation of the mobile phone data from Motionlogic. Additional analyses of traffic flows within the city centre, commuter flows to and from Wiesbaden and Frankfurt am Main, and the corresponding plausibility checks are advisable.

Further methodical and analytical analyses are needed to better understand the mobile phone data and its ability to provide useful information for the statistics departments in other cities and research institutes. For the Frankfurt/Rhine-Main Metropolitan Region, a joint project in collaboration with Darmstadt, other statistics offices, the Hessen and Rhineland-Palatinate State Statistics Offices and the Federal Statistics Office to analyse the commuter flows in the Rhine-Main region could result in a significant improvement in the available data for analysing commuter flows in the Frankfurt/Rhine-Main Metropolitan Region and thus for improved traffic infrastructure and modern public transport. These findings generally apply to German metropolitan areas. For "ideas can only be of use if they start living in many minds". – Alexander von Humboldt.

Günther Bachmann was head of the department of statistics and urban research for Darmstadt, the City of Science

6. Mannheim, the university city: Using crowd data for examining the urban climate

By Christopher Barron

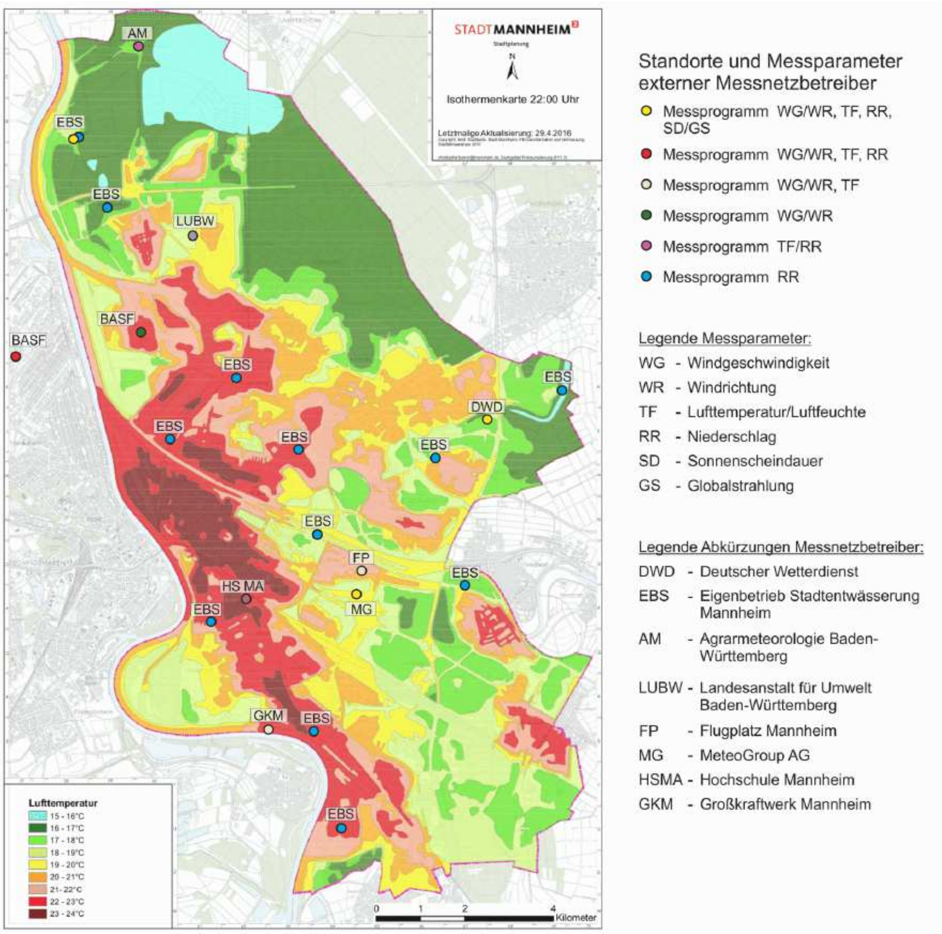
Crowd data

The city of Mannheim now looks back on a 40-year-old tradition of collecting and supplying data on climate ecology, thereby rightfully earning its place among Germany's "urban climate pioneers". For example, in collaboration with Heidelberg University, Mannheim's first isothermal map was produced by the urban planning department as early as 1975. This was the first city-wide image of temperature conditions in Mannheim.

Based on this, hundreds of additional data sets of the urban climate in Mannheim were produced on both a city-wide and district level. When collecting this data, researchers always made an effort to incorporate technological developments such as IR thermography, smoke cartridge experiments (cf. the illustration below) or weather balloons to resolve issues related to climate ecology.

Cold air flow, marked by smoke
https://www.staedtebauliche-klimafibel.de/?p=34&p2=4.1.3

The increasing availability of high-quality specialised geodata from the city of Mannheim (e.g. airborne laser scanning, specific surface sealing data, urban green volumes) is decisive for calculating Mannheim's 2020 urban climate analysis using the mesoscale model FI-NAH 3D. The measurements are validated in two different ways: on the one hand, by means of an accompanying temperature measurement within the municipal area; on the other, via long-term measurement series carried out by the German weather service (DWD) in the northeast green corridor. As the illustration on the next page shows, due to the requirements of the DWD, the latter is located outside of the urban heat island and thus has a much higher ability to produce cold air. There are no certified measurement stations in Mannheim's urban heat island.

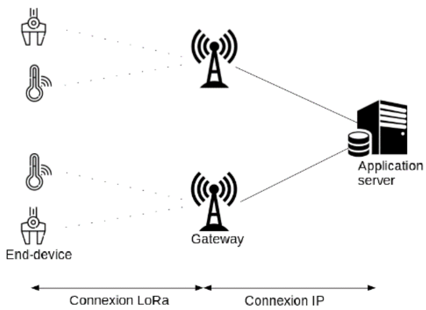


Locations and measurement parameters of external measurement network operators in Mannheim
against the backdrop of the isothermal map

Climate sensors or crowd data could be one way to close this gap. A variety of systems are feasible in municipalities:

- Standard citizen science projects, e.g. luftdaten.info (cf. illustration below).
- Sensor networks incl. infrastructure, data management, and support. The illustration on the next page shows a schematic representation using LoRaWAN, a signal transmission technology for integrating battery-operated devices and sensors into the Internet of Things (IoT).
- Systems for calculating immission in case of damaging events, similar to those frequently used by the fire brigade.

Low-cost sensor
from the luftdaten-info project https://luftdaten.info.



Long Range Wide Area Network (LoRaWAN)

Source: https://de.wikipedia.org/wiki/Long_Range_Wide_Area_Network#/media/Datei:Architecture_lorawan.png

The decisive factors for choosing a system are the intended use and resulting general conditions: What data should be recorded? Temperature, humidity, heavy rainfall, etc. each demand different requirements in terms of sensory functions and location. What quality of data is expected? Spatial and temporal resolution, regionwide measurements vs types of urban structure, or the number of measurement intervals are also relevant. Does sensor data need to be comparable with existing measurement data?

This, in turn, poses challenges that must be thoroughly considered beforehand:

- Funding (acquisition and running costs).
- Who is responsible (environment agency, IT department, climate protection control centre, urban planning department, etc.)?
- Integration into the cityscape; protection against vandalism.
- Is electricity/an internet connection necessary?
- Open source solution vs proprietary systems.

Christopher Barron
works for the open space planning department of the city of Mannheim (christopher.bar-ron@mannheim.de).

Following an initial analysis, the city of Mannheim commissioned an expert evaluation to identify suitable locations for a measurement network to record data on weather, climate, and air hygiene. Furthermore, depending on the locations, recommendations were made regarding measurement technology and the density of measurement networks to ensure new devices can be integrated into existing networks. The mid-term goal is to collect sensor-based urban climate measurements within the urban heat island in order to better resolve planning issues surrounding urban climate and adaptation to climate change.

II Urban Audit – data use made easy

The data collected and processed for the Urban Audit is available to all interested users on the internet. There are different ways to access the data depending on the intended use. KOSIS Association Urban Audit includes an **information portal** and a **dynamic report** (Urban Audit Structural Data Atlas) for all Urban Audit territorial units as well as an additional dynamic report that includes the results from the survey on the Quality of Life in European cities. **Eurostat**[19], the statistical office of the European Union, provides a database for accessing this data.

Chapter overview

The Urban Audit Structural Data Atlas

Structural data atlas

The **Structural Data Atlas** [20] at www.urbanaudit.de allows users to access this data via the menu option "Data and Evaluations". As a dynamic reporting supplement to the information portal, it enables the interactive generation of customised data tables, diagrams, and maps on selected basic data and the interactive generation of indicators for different German Urban Audit territorial levels (municipal level, functional urban areas (FUAs) and sub-city district level - SCDs) and reporting years. Please refer to the brochure "The German Urban Audit"[21] and the online user documentation "Structural Data Atlas - user manual"[22] for more information on how to use the Structural Data Atlas.

[19] ec.europa.eu/eurostat/de/web/cities/data/database.
[20] Direct link: apps.mannheim.de/statistikatlas/ua/strukturdatenatlas/
[21] KOSIS Association Urban Audit (2013) (ed.): *The German Urban Audit – Comparison of cities in the European Statistical System* (www.staedtestatistik.de/fileadmin/urban-audit/UA_Broschuere_2013_final_EN.pdf).
[22] apps.mannheim.de/statistikatlas/ua/strukturdatenatlas/pdf/Anwendungshilfe%20zum%20Urban%20Audit%20Strukturdatenatlas.pdf.

1. The Urban Audit information portal

By Ricarda Buff

The DUVA-based Urban Audit information portal[23] contains all of the data collected in Germany for the Urban Audit in recent years. The Urban Audit database currently consists of 127 German cities. In addition to the city data itself, data on the functional urban areas (FUAs) of German Urban Audit cities and data on city districts, or sub-city districts (SCDs), is also available to the public on the information portal. This data is constantly updated and continuously incorporates new information.

The information portal can be found on the www.urbanaudit.de website via the menu option "Data and Evaluations". The portal allows users to set individual filters to select any of the available data according to different territorial units, years, variable characteristics, or characteristic groups. In addition, the selected data can be downloaded free of charge.

Supplementary indicators as well as basic data are available for many characteristics. This service is complemented by a cartographic display using the DUVA map tool and the possibility to directly access the evaluation and display options of the Structural Data Atlas.

Since 2017, the DUVA evaluation assistant has been increasingly used for providing data in tables and diagrams. The newest feature enables the creation of dynamic graphs that users can interactively adapt to their needs.

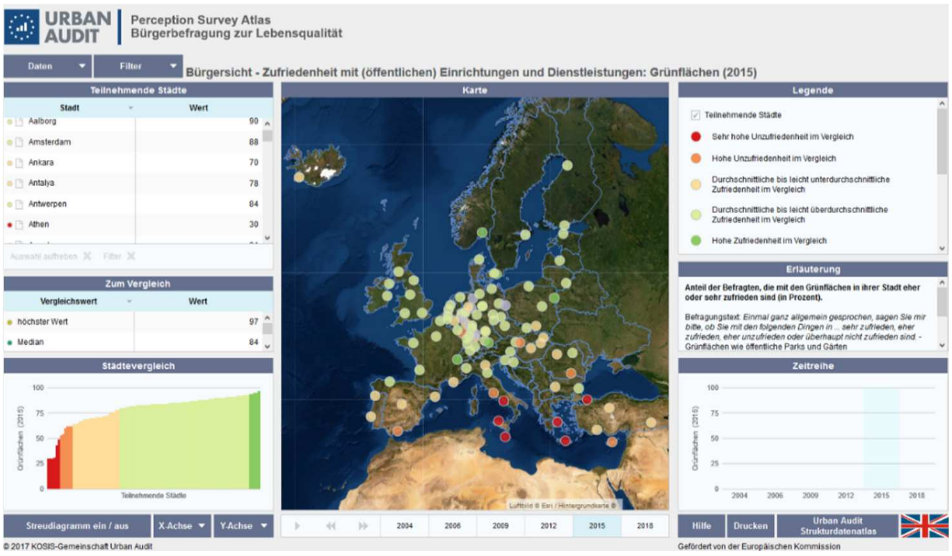
[23] Further information on DUVA is available at www.duva.de.

2. The Urban Audit Perception Survey Atlas

By Ricarda Buff

The Urban Audit Perception Survey Atlas provides a graphic depiction of the results of the Quality of Life in Cities survey. The interactive report contains data on the subjective quality of life for residents in each of the cities over a period of time. In addition to the cities covered by the central European survey, 24 additional German cities recently joined the survey via the parallel survey on the quality of life coordinated by the VDSt working group on surveys. The 31 participating German cities can be compared to one another and to other European cities in the Perception Survey Atlas.

The link to the Perception Survey Atlas can be found on the www.urbanaudit.de website via the menu option "Data and Evaluations".



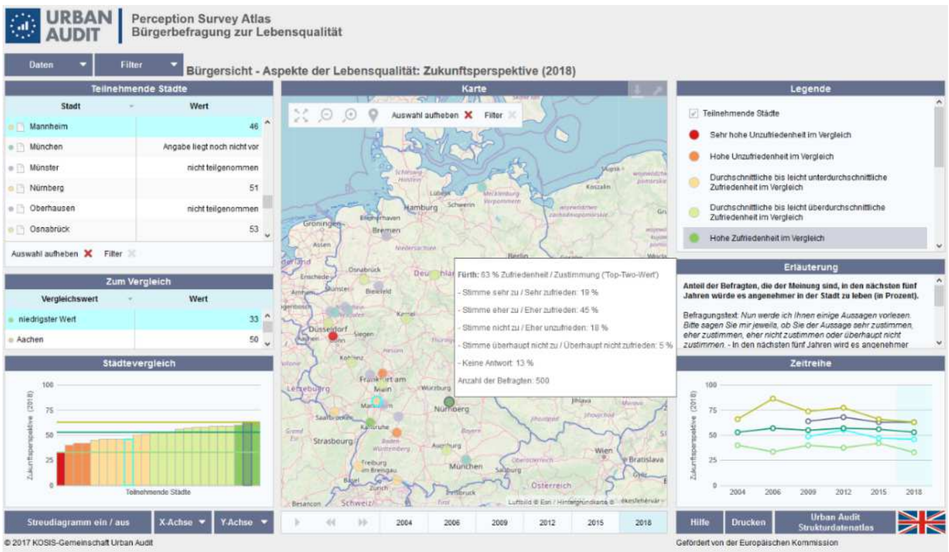
The start page of the Perception Survey Atlas

Users can quickly switch to the Structural Data Atlas, the second InstantAtlas product from the Urban Audit community, by clicking on the "Urban Audit Structural Data Atlas" button at the bottom right-hand corner of the screen. Both atlases are available in English. Users can switch languages by clicking on the corresponding flag.

By clicking on the "Topic" button, users can select numerous different topics from the Perception Survey. The topics range from satisfaction with public facilities such as schools or sports facilities, the subjective perception of noise, cleanliness, and air quality in the city, to the personal sense of safety in the city and neighbourhood, and an individual appraisal of the future development of each city. The current topic is displayed as the heading of the map. The precise question is visible in the explanation box on the right-hand side of the screen.

The legend allows users to switch between an aerial view and an OpenStreetMap background map in addition to providing an overview of the colour code for each item.

The value for the participating cities, which is used for the city comparison, corresponds to the proportion of participants who agreed with the statement or were satisfied with an aspect. It comprises the top two assessments, namely the categories “fully agree” and “mostly agree”, and, analogously, the categories “very satisfied” and “mostly satisfied”.



Perception Survey Atlas with OpenStreetMap map

By scrolling over one of the circles on the map, an information box with detailed information appears with the answers for the selected question from the city’s residents. In addition to the breakdown of the degrees of agreement or disagreement, an interesting aspect is the information on the number of respondents to the corresponding survey.

The particular advantage of providing access to the survey data in the Perception Survey Atlas is that individual values can easily be put in relation to one another via dynamic adjustments.

Using pre-defined filters, comparisons can be limited to cities from a certain country, with a specified population, or certain city types. This enables specific comparisons with other cities from the same category. It is also possible to create customised groups of cities, for example to put figures from one's own city in relation to neighbouring cities in a regional context. The individual filters can be selected by choosing cities in the "Participating Cities" menu or by clicking on the corresponding cities on the map. The selected cities are highlighted in blue. It is also possible to select the highest and lowest value for comparison as well as the median for the chosen question.

The data set also enables an examination of the development of the subjective perception of the quality of life in a city over the course of time, in some cases since 2004. The time series provide a graph that allows users to quickly recognise how, for example, satisfaction with public transport has developed over the past years. Here, too, the development of one city can be compared to the average development of all participating cities.

A selection field is located beneath the bar chart showing the city comparison, which opens up a scatter diagram. Scatter diagrams make it possible to chart two questions in relation to one another and can thus offer initial insights into correlations.

All of the functions described here and other useful information are explained in more detail in the "Help" section. Even if you don't need tips for getting around the website, this section is worth a read.

Contacts and responsibilities

KOSIS Association Urban Audit

www.urbanaudit.de

STADTMANNHEIM²

In Germany, the KOSIS Association Urban Audit acts as the project partner for data collection to support the European urban comparison. In 2018, the city of Mannheim was elected as the managing office for another year. The project is supervised by the municipal statistical office of Mannheim. The managing office is responsible for business management, represents the association within its mandate, heads the steering group, carries out bookkeeping, and manages the funds of the association.

KOSIS-Gemeinschaft Urban Audit
c/o Stadt Mannheim, Kommunale Statistikstelle
Postfach 101832
68018 Mannheim
Email: urbanaudit@mannheim.de

The director of the Municipal Statistics Office of the city of Mannheim, Dr Ellen Schneider, is responsible for the managing office.

Dr. Ellen Schneider
Tel.: +49 (0) 621 / 293 7486
Fax: +49 (0) 621 / 293 7750
Email: urbanaudit@mannheim.de

Ms Ricarda Buff is the contact person for the KOSIS Association Urban Audit in all matters relating to the collection of structural data.

Ricarda Buff
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Email: urbanaudit@mannheim.de

NUAC

In the European nations participating in Urban Audit, the project is coordinated on the national level by the respective national Urban Audit coordinator (NUAC). In Germany, this coordinator is appointed by the KOSIS Association Urban Audit.

Tobias Link
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The Federal Statistical Office is the project coordinator for the structural database and therefore the point of contact for Eurostat for all legal and financial matters. The contact person at DESTATIS is Dr. Hanna Brenzel.

Statistisches Bundesamt

Statistisches Bundesamt
Referat B204
Dr. Hanna Brenzel
Gustav-Stresemann-Ring 11
65189 Wiesbaden
Tel.: + 49 (0) 611/752014
Email: hanna.brenzel@destatis.de

www.destatis.de

Eurostat Directorate E, Sectoral and Regional Statistics, has overall responsibility for the project. The contact person is Teodora Brandmüller in Sectoral and Regional Statistics and Geographical Information.

Eurostat

Eurostat
Directorate E4 – Regionalstatistik und geographische Informationen
Teodora Brandmüller
11, rue Alphonse Weicker
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Tel.: +352 (0) 4301 / 1 (zentrale Telefonnummer)
Email: ESTAT-Urban-Audit@ec.europa.eu

https://ec.europa.eu/eurostat/

The German survey, carried out parallel to the European survey on the quality of life from a citizen's perspective, is coordinated by the VDSt (Association of German Municipal Statisticians) Survey Working Group (VDSt AG Umfragen).

VDSt AG Umfragen

Survey officer
Daniela Schüller
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Publications

Free print copies of all publications of the KOSIS Association Urban Audit can be requested by sending an email to urbanaudit@mannheim.de. The PDF versions are available for download in the download section on the website www.urbanaudit.de – where you can also find many other national and international publications on the topic of Urban Audit.

Urban Audit Brochure 2013

Comparison of Cities in the European Statistical System (2013): The compact brochure provides interesting information on the project background, organisation, and use of data for the German Urban Audit. Also available in English.

Urban Audit Brochure 2015

Data – indicators – information (2015): The focus of this brochure is on the utilisation of comparative urban data. Let these national and international examples inspire you! Also available in English.

Regionalisation of the micro-census

Regionalisierung des Mikrozensus für den europäischen Städtevergleich (Regionalisation of the micro-census for a comparison of European cities) (2016): This brochure documents the small estimation method which enables the utilisation of results from the regular micro-census survey and the registered statistics from the Federal Employment Agency for showing small, regionalised, socio-economic reference features.

Urban Audit Brochure 2017

Quality of Life in the City and Suburban Areas (2017): The main focus of the Urban Audit brochure 2017 is the exploration of existing data for cities and their suburban areas and the testing of open geodata as an alternative data source. Overall, the brochure takes into account the growing importance of the urban dimension, not only at European level. Also available in English.

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