

Using Data to Shape our Future Cities

Digital sovereign cities – sustainable investments
in data infrastructure



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Preface

Cities have always been places where people meet and connect with each other. They are changing constantly, they are living labs. During the COVID-19 pandemic, the evolution of cities becomes even more visible. It made us reflect upon some big questions: How will we live and work in the future? In which way will we use our public spaces and strengthen social cohesion? Digitalisation can provide new answers to these questions because data will be the foundation of future cities.

Using and linking extensive databases allows for a more effective management of mobility, social planning and crisis management issues. Data handling is also a question of municipal self-determination and independence in the digital space. In November 2020, the main committee of the Association of German Cities met and discussed these topics. The result is the discussion paper “Strengthening the digital sovereignty of municipalities”.

Francesca Bria is the former Chief Digital Technology and Innovation Officer for Barcelona and contributed significantly to shaping the digital path of the city. Her message to cities is: “Take your data back!” She says: “The cities that do not have a system for managing this data infrastructure and that do not know what to do with it, are putting what is perhaps the greatest collective treasure of a society in the digital age into the hands of private organisations [...]. Those cities are slowly losing their know-how and their ability to control and shape their societies in a way they think is best. Instead, the tech companies will be in charge.”

Data is not a side issue, but extremely important for political and strategic control – that is, a task for the leaders of the cities. Municipal data management is a complex undertaking. You need the right infrastructure, trained administrative staff, a powerful organisation and a forward-thinking legal framework.

Therefore, in a joint project of the Association of German Cities and Partnerschaft Deutschland, we discussed the question: How can data be used to shape the cities of the future?

I would like to thank the Sounding Board with experts from our member cities for their involvement in this project and my thanks also go to PD – Berater der öffentlichen Hand GmbH for preparing this study. These are practical insights, which showcase the challenges of municipal data management, but, more importantly, they also demonstrate concrete solutions and give actionable recommendations.

I hope the study gives you some food for thought for designing our future cities.

Happy reading!



Helmut Dedy
Executive Director, Association of German Cities

Using Data to Shape our Future Cities

Digital sovereign cities – sustainable investments in data infrastructure

1. Introduction

1.1 On the way to sovereign data handling

The **digital transformation of society** is changing our cities. The sovereign handling of the data generated in urban areas is essential so that the cities can play a sustainable and proactive role, both today and in the future.

This study shows how cities can approach the topic of data sovereignty in strategic, organisational and infrastructural terms. This should not be considered as a linear process with a specific end, but rather as a circular one. As digitalisation continues to develop in a dynamic way, cities will have to redefine their concepts of data sovereignty repeatedly, with every new technological development and solutions provider. New data usage options, new aspects of the city's vision and other requirements for data infrastructure will emerge continuously, as is illustrated by the figure below. It summarises the most important elements of the data sovereignty cycle.

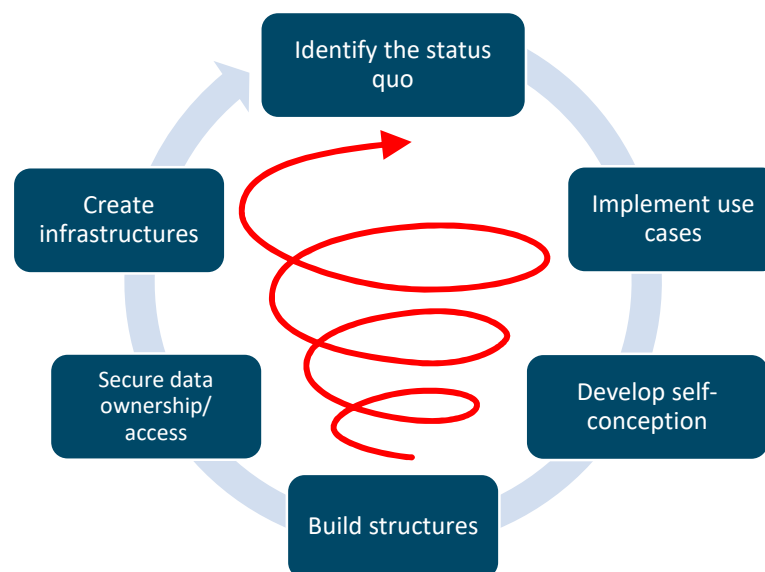


Figure 1: The cycle of strategic urban data handling

Identifying the status quo (Sections 2.2 and 3.1.2)

Cities started to use data to control and manage their services of general interest even before the concept of smart cities evolved. All city administrations use data to do their work effectively across different departments. Some departments traditionally deal with data at a superordinate level, e.g. the statistical offices or the geoinformation departments. Therefore, before approaching the topic of data more strategically, it is essential to **comprehensively identify the status quo**.

This includes the following aspects:

- ➔ **Stakeholders:** Who uses urban data within the city administration, in the “Konzern Stadt”¹ and in the city as a whole? What kind of networks already exist?
- ➔ **Use cases:** How is data currently being used? Is data only used within individual departments? Or are there use cases of any cross-sectional use of data? What are the positive and negative experiences of such use cases?
- ➔ **Strategic framework:** Which documents (e.g. Smart City Strategy, council resolutions) provide information on the use of data? Which strategic documents can provide information on the goals of using such data and their intended impacts?
- ➔ **Data quality and data ownership:** How is data currently available? To what extent is the data that might be needed for improving control still based on paper records or on other forms that are not machine-readable? To what extent does the city own the data collected from private businesses in the smart city context?
- ➔ **Infrastructure:** Where is data currently stored and how is it stored? Who has access to it? Which higher-level systems or platforms (e.g. GIS, open data platforms, etc.) are already in place – both in the city administration and in the “Konzern Stadt”? Are there interfaces between these systems and platforms?

Implementing use cases (Chapter 2)

The discussions with the Sounding Board clearly showed that the sovereign handling of data does not have to begin with a comprehensive strategy concept. It makes much more sense to **approach the topic by starting to use the data**. That means it is possible to begin with small attempts, experiment, make real-time mistakes and start all over again. The city will iteratively develop an understanding of what it wants to do with data, how it will use the data and who should use it. Every data use case that was implemented successfully can also be used for communication purposes to promote increased cooperation, both internally and externally. However, when implementing the data use cases, the cities do not have to come up with new, innovative ideas each time. Rather, the use cases of other cities (see e.g. Section 2.2) can serve as inspiration.

Developing a vision for the city (Section 3.1)

Based on the identified status quo and the first use cases, the city should develop a vision of how it wants to deal with data. This **vision has a superordinate, strategic character**, which means that the top administrative level must get involved and communicate this strategy both internally and externally. Data is not a technical, but a strategic issue.

The vision clarifies which role the city would like to play when dealing with data, both in relation to the private sector and also for the urban society as a whole. It defines how the use of data should contribute to reaching the strategic goals of the city and which outcomes and impacts are to be achieved for the different target groups. It also specifies an ethical framework as well as overarching technical aspects at a strategic level.

Establishing structures (Section 3.2)

Based on the municipal vision, the city should develop structures that enable a sovereign handling of data. There is no such thing as a blueprint that can serve all cities, however, it is important that all **essential roles** will be covered. It is also important that the strategic roles are not defined as having

¹ The term „Konzern Stadt“ reflects the relationship between the city’s („Stadt“) bureaucratic administration and municipally owned companies. It emphasises the concept of a central management as known in private business groups („Konzern“).

an operational character only. Always keep in mind that data is of utmost priority. This means that the highest administrative level must be responsible for managing and advancing this issue. A major challenge here is that urban data has so far often been used within specific departments only. However, data can only be used strategically when those silos are broken down. It's of fundamental importance to include the staff as a whole and to provide targeted training to key personnel.

The structures in the town hall are not the only ones that should be considered. Data is generated, processed, and used by a wide variety of stakeholders in the city. The **municipal companies** are particularly important in this respect. When it comes to using data, especially the municipal utilities, including local public transport, are often much more advanced than the city administration itself. For them, data is a business model. Consequently, they are usually not too enthusiastic about sharing their data within the "Konzern Stadt". Therefore, city leaders and politicians must ensure that the municipal companies are not pursuing their own data agenda. In the worst case, their agenda will even be contrary to the city's overall strategic goals. There are possibilities to do so, according to the accompanying legal assessment by the Lorenz von Stein Institute of Administrative Sciences.²

Securing data ownership and data access

The private sector has understood for years just how valuable data is. The cities, however, are only at the beginning of this process. This is particularly evident in **the restrictive clauses for using data** that are common practice in smart city contracts.³ Cities must ensure that they can use the data according to their visions. This also includes legal aspects: Standard data use clauses and general terms and conditions are essential. Standard clauses or standard terms and conditions are still lacking. It is not very efficient that every city has its own regulations.

Sven Hense, Head of IT Applications and Digitalisation of the City of Bonn, even goes one step further and suggests to solve the problem at a completely different level: "It would be best to add the aspect of data ownership to the EVB-IT [Supplementary Contractual Conditions for the Procurement of IT Services]." However, as this would be a very complex undertaking, the City of Bonn and the City of Münster jointly developed wordings for specifications for awarding procedures that define how data is to be handled. These can be found in the appendix. They can be used as a source of inspiration, but they have not undergone comprehensive legal review yet.

"It would also be very desirable to include the topic of data sovereignty as a condition in smart city funding programmes. Maybe it would even be possible to agree on the same data use clauses for all federal levels and to develop them further," said Hense.

At the same time, it must be ensured that these data use clauses are applied throughout the whole city (administration and participations). However, this will of course also entail **organisational and structural aspects** and will only work when the top level of the city administration is involved.

Additionally, there are also various community aspects, as citizens are increasingly becoming data producers. In order to be able to use this data in compliance with data protection regulations, a common understanding, and, again, adequate legal bases are needed.

² Lorenz von Stein Institute of Administrative Sciences (November 27, 2020): Wissenschaftliches Gutachten zu rechtlichen Fragestellungen bei kommunalen Datenplattformen im Kontext von Smart City anhand der Freien und Hansestadt Hamburg und der Stadt Wolfsburg. Please contact PD to get access to this report. You will find the contact details at the end of the study.

³ Schlüter, K.; Herth, M.; Schmitz, E. (PD – Berater der öffentlichen Hand GmbH) (2020). Data Sovereignty in Smart Cities (Datensouveränität in der Smart City), https://www.pd-g.de/assets/Presse/Fachpresse/200213_PD-Impulse_Datensouveraenitaet_Smart_City.pdf, pp. 14, accessed on January 14, 2021.

At the same time, the **private sector produces a large part of the data** in urban areas. Mobility providers for car sharing or map services, for example, generate massive amounts of data that could also be used to manage urban mobility. The same holds true for platforms such as Airbnb. The crux is that the cities usually do not have any contractual relationships with these private companies. However, there are some international examples, e.g. in Barcelona and Amsterdam, that demonstrate that cities are very well able to negotiate successfully with private providers. This works particularly well when several cities join forces.

Creating infrastructures (see Chapter 4)

When cities want to use data from different specialist areas and perhaps also together with urban companies and other users, they need new data infrastructures. **Urban data platforms** are the basic infrastructure for the sovereign handling of data. Municipal practice clearly points in the direction of a system of systems: data remain in their silos, but are linked to each another through interfaces and in such a way that joint access and use of this data is possible in accordance with the data usage rights.

Depending on the initial situation, competencies and resources, data infrastructures can be set up by the city itself (see the Hamburg case study) or by external partner companies (see the Darmstadt case study). In this respect, there is no right or wrong. What is important is that the infrastructures are working in accordance with the data handling specifications that were developed for the respective city's self-concept. By doing so, urban agglomerations and centres should not only think about data infrastructures within the city limits: Inter-municipal cooperation is beneficial for all parties (e.g. mobility across city limits).

And then?

Dealing with the topic of data sovereignty will not have an end. Once the cycle has been completed, you will have to start all over again. As new forms of data use, new players and new technical infrastructure solutions will continue to evolve, **data sovereignty must be negotiated and actively shaped again and again**. However, once you went through the cycle once, you have laid the foundations. Every time the cycle starts again, you can build on what you have already developed. As a result, cities will actively shape the digitalisation of services of general interest in the interests of their citizens and have an essential basis for dealing with new challenges – such as the climate crisis, refugee movements, a pandemic or a city-wide blackout.

1.2 Methodology and participants

This study is mainly based on the expertise of the **Sounding Board** (see below for a list of members). The Sounding Board was established at the invitation of the **Association of German Cities**. In particular, cities with extensive experience in the digitalisation of services of general interest were invited to participate in the Sounding Board. Another aspect the selection considered was to represent cities of different sizes and different regions.

During the project, the members were actively involved in various formats (see Figure 2). The project results were prepared between May and December 2020. Consultancy **PD – Berater der öffentlichen Hand GmbH** (PD) was responsible for the content development (in close exchange with the Association of German Cities).

Legal experts from the **Lorenz von Stein Institute of Administrative Sciences** provided specialist support and clarified fundamental legal issues relating to urban data platforms. The questions were

developed during a workshop with the Sounding Board. This was based on the two case studies from Hamburg and Wolfsburg.⁴ The results of the legal investigation were incorporated into the study as well.⁵

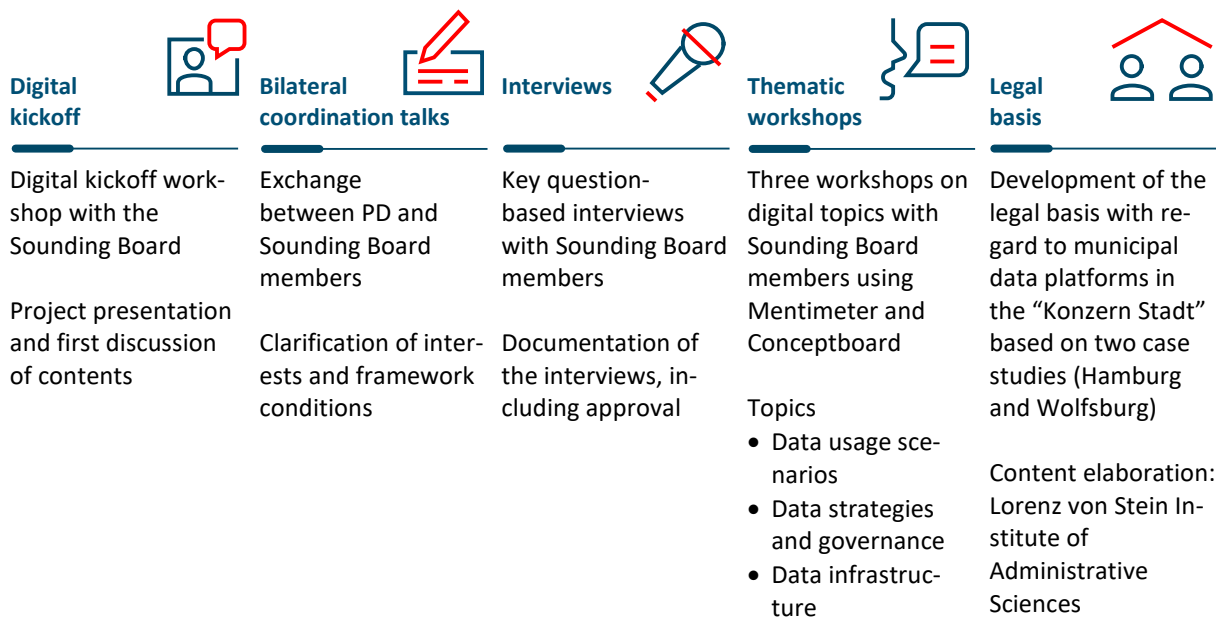


Figure 2: Working methods of the Sounding Board

The open and constructive exchange with the Sounding Board was a decisive factor for the success of this project. The Association of German Cities and PD greatly appreciate the time the members invested.

The cities represented on the Sounding Board are deliberately not a representation of all German municipalities. Instead, most of them are **pioneers in the field of digitalisation**. Consequently, the purpose of this study was not to deliver a representative survey of the current situation, but rather to present the experiences made using best practice examples.

⁴The analysis focuses on questions of public law. Contract law issues were not included.

⁵Please contact PD to get access to this report. You will find the contact details at the end of the study.

The members of the Sounding Board were:

Table 1: Members of the Sounding Board

City	Member	Position
Berlin	Dr Frank Nägele	State Secretary for Administrative and Infrastructure Modernisation
Bonn	Sven Hense	Head of IT Applications and Digitalisation
Cottbus	Dr Gustav Lebhart	CIO
Darmstadt	José David da Torre Suárez	Managing Director Digitalstadt Darmstadt
Dortmund	Dr Fritz Rettberg	CIO
Emden	Bernd van Ellen	CDO
Hamburg	Thomas Eichhorn Sascha Tegtmeyer	CDO Agency for Geoinformation and Surveying Head of Urban Data Hub
Heidelberg	Manfred Leutz	Head of the Department for Digital and Information Processing
Cologne	Sabine Möwes	Head of the Digitalisation Unit
Leipzig	Dr Beate Ginzl	Head of the Digital City Department
Munich	Thomas Bönig	CIO/CDO
Nuremberg	Dagmar Messingschla-ger Dr Martin Haller	IT Department
Ulm	Sabine Meigel	Head of Digital Agenda Office
Wolfsburg	Dr Sascha Hemmen	Head of the Digitalisation and Economy Department

1.3 Regulatory framework

When moving towards increasing data sovereignty, cities are acting in a **complex regulatory environment** that is also **changing dynamically**. This complexity and the dynamic development are major challenges for the cities. The following table should give a rough overview of the most important regulations at the various levels. Please note: This list is not exhaustive.

Table 2: Legal foundations

Law/Directive	Level	Key aspects
PSI Directive ((EU) 2019/1024)	EU	Basic obligation of the public sector to pass on non-personal data. Scope covers all public organisations and companies. The updated directive is currently being particularised (e.g. with a definition of high-value datasets). Further development of the PSI Directive 2013/37/EU (what is new is, amongst others, that the scope also includes municipal companies). National implementation required (see IWG).
General Data Protection Regulation (GDPR) ((EU) 2016/679)	EU	Strengthens the protection of personal data. Public organisations may only use personal data for a specific purpose and only make it publicly available in anonymised form.
INSPIRE (2007/2/EU)	EU	The aim is to create a uniform geographic data infrastructure and an adequate EU data portal. High level of commitment on the Member States in terms of metadata and interoperability. Much of the data collected in the smart city context falls within the scope of this regulation.
Data Governance Act (draft of November 25, 2020)	EU	Creation of harmonised European standards for the reuse of protected data that is owned by public authorities (extended PSI Directive). Registration rules and provisions for data intermediaries.
Act on the Reuse of Information (Informationsweiterverwendungsgesetz, IWG)	Nation-wide	National implementation of the then valid PSI Directive 2013/37/EU. The new legislative process for the IWG also takes into account the new PSI Directive (EU) 2019/1024. The IWG specifies <i>how</i> data is to be published (e.g. as machine-readable data). The Freedom of Information Acts regulate <i>whether</i> data is to be published. The situation in the individual federal states is very heterogeneous (see below). ^{6 7}
Freedom of Information Act (Informationsfreiheitsgesetz, IFG)	Nation-wide	Only applies to federal authorities. Unconditional right to access official information, but no proactive obligation to provide data.

⁶See Schlüter, K.; Herth, M.; Schmitz, E. (PD – Berater der öffentlichen Hand GmbH) (2020): Data Sovereignty in Smart Cities (Datensouveränität in der Smart City), https://www.pd-g.de/assets/Presse/Fachpresse/200213_PD-Impulse_Datensouveraenitaet_Smart_City.pdf, p. 10, accessed on January 14, 2021.

⁷When this study was completed in January 2020, a draft law to amend the E-Government Act and to introduce the law on the use of public sector data was presented. The latter should transpose the PSI Directive into national law and replace the IWG. The draft law could not be considered for this study.

Law/Directive	Level	Key aspects
IFG at federal state level	Federal states	The following states currently have their own IFG based on the model of the federal law, i.e. without a proactive obligation to provide data: Baden-Württemberg, Berlin, Brandenburg, Hesse, Mecklenburg-Western Pomerania, North Rhine-Westphalia, Saarland, Saxony-Anhalt, Schleswig-Holstein, Thuringia.
IFG and transparency laws at federal state level	Federal states	The following states currently have their own IFG or transparency laws that go beyond the regulations of the federal government and the above-mentioned states and oblige the independent (“proactive”) publication of essential data: Bremen, Hamburg, Rhineland-Palatinate.
States without an IFG or similar regulations	Federal states	The following states do currently not have any legal regulations for the provision of public data: Saxony, Lower Saxony, Bavaria.
Special regulations at municipal level	Municipalities	Municipalities can go beyond their respective state-level regulations by passing municipal freedom of information by-laws, in which they commit themselves to establish access to public data.

2. Use of municipal data as a starting point

Regardless of whether it is online daycare registration, parking sensors or mobility apps: municipalities are increasingly using digital technologies while providing services of general interest. Numerous data records are already being generated and this will increase in the future. The **secure and efficient management of data** on the one hand and its **productive and impact-oriented use** on the other are future tasks for all cities.

What is the status quo of municipal data management in Germany currently? How can cities collect data, use it and interconnect it in a meaningful way? Which kinds of added value can be generated from smart data management, for civil society, the local economy and their own administration?

These questions will be answered in the following sections.

2.1 Added values of municipal data

In a first step, the strategic use of municipal data primarily serves the administration itself: It can improve **municipal services so that they become more impact-oriented, efficient and better**. According to Dr Gustav Lebhart, CIO of the City of Cottbus: “The success of a public administration essentially depends on the organisational units in the administration making the right decisions at the right time. Reliable and timely prepared information is fundamental for this.”

In addition to the administration itself, data also is of great value for the various stakeholders. Which users are there? The following figure provides an initial overview:

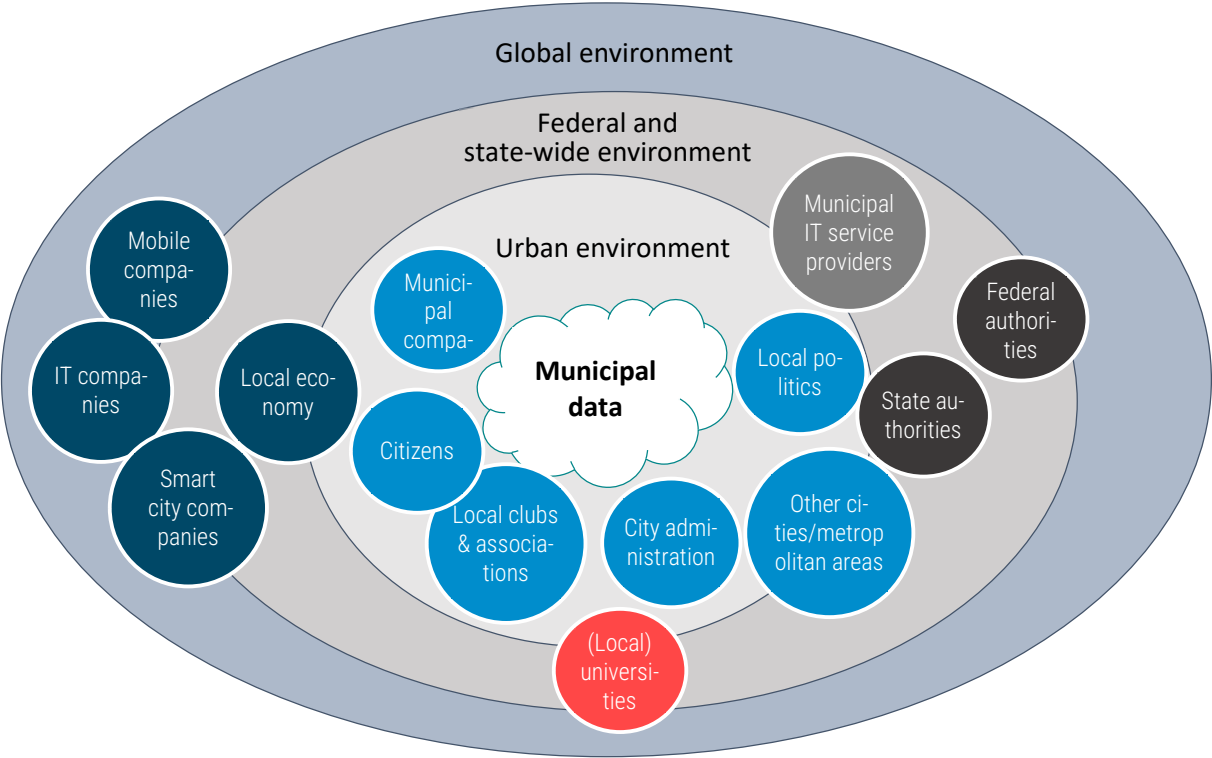


Figure 3: Stakeholders in the field of urban data use

And what are the different stakeholders **interested in**? The following table provides an overview:

Table 3: Interests of the various municipal data stakeholder groups

Stakeholders	Benefits and added value
Citizens	<ul style="list-style-type: none"> ➔ Indirect benefits from improved city services ➔ Better foundation for voting decisions
City administration	<ul style="list-style-type: none"> ➔ Optimisation of own services ➔ Optimisation of internal processes ➔ Development of new services ➔ Development of well-founded decision templates for politics and administration ➔ Strategic management of investments ➔ Reduction of bad investments
Municipal companies	<ul style="list-style-type: none"> ➔ Optimisation of own services ➔ Optimisation of internal processes ➔ Development of new services and business models
Local politics	<ul style="list-style-type: none"> ➔ Decision-making based on statistics
Local clubs and associations	<ul style="list-style-type: none"> ➔ Indirect benefits from improved city services ➔ Use of municipal data for own purposes, where appropriate
Other cities/metropolitan areas	<ul style="list-style-type: none"> ➔ Development of well-founded decision templates for political and administrative stakeholders in the inter-municipal network ➔ Strategic management of investments
Municipal IT service providers	<ul style="list-style-type: none"> ➔ Development of new services ➔ Adaptation of the infrastructure for municipal data management
Federal authorities	<ul style="list-style-type: none"> ➔ Analysis of municipal developments ➔ Well-founded decision template for political activities at nationwide level ➔ Department-specific generation of information (e.g. 5G expansion, climate monitoring, etc.)
State authorities	<ul style="list-style-type: none"> ➔ Analysis of municipal developments ➔ Well-founded decision template for political activities at state level

- Department-specific generation of information (e.g. traffic development, educational offers, etc.)

Local universities

- Data as an essential basis for research

Local economy

- Development of new business models
- Optimisation of advertising and marketing activities
- Optimisation of work processes

IT, mobile and smart city companies

- Development of new business models
- Optimisation of advertising and marketing activities
- Selling collected data to the city (especially real-time data)

2.2 Status quo and use cases

Of course, cities have not only started using data to control their services ever since sensors and apps were introduced. In some areas, mostly concerning **GIS and urban statistics**, data has always been the focus of activity. However, with both new technologies and data digitalisation, completely **new potentials for municipal data use** are emerging, particularly when it comes to interconnecting data from different sources – both within the administration and beyond. In this area, the cities still have a lot of work to do.

Bernd van Ellen, CDO of the City of Emden, summed it up: “We currently have data in many different pots and they are all simmering side by side. The task is to make *one* dish out of them.” Dr Fritz Rettberg, CIO of the City of Dortmund, added: “Individual departments and subsidiaries often lack the resources to deal with the topic of how to use data in innovative ways. Sometimes there is also a lack of imagination as to what could be done with data.”

As a result, German cities hardly exploit the potential a strategic and comprehensive data management would be offering. **Innovative forms of data processing** – the use of artificial intelligence (AI) or algorithms – that the private sector has been using extensively and for quite some time now, still is uncharted territory for most cities or is only⁸ being applied in pilot projects.

Therefore, in order to communicate the **added value** of a city-wide data use and therefore to promote **the breaking down of data silos**, we should look at municipal use cases.

The ways in which urban data can be used innovatively are just as diverse as the municipal services of general interest themselves. On the one hand, the use cases of the Sounding Board cities, which will be presented in the following, should help to identify use scenarios for your city. On the other, they

⁸ See Houy, Constantin et al. (2020): Potenziale künstlicher Intelligenz zur Unterstützung von Sachbearbeitungsprozessen im Sozialwesen, in: Nationales E-Government Kompetenzzentrum (Hrsg.): Berichte des NEGZ, Nr. 8, Berlin, <https://negz.org/berichte-des-negz-2020-potentiale-kuenstlicher-intelligenz-zur-unterstuetzung-von-sachbearbeitungsprozessen-im-sozialwesen/>, accessed on January 14, 2021.

See Polyteia (2020): Gute Daten. Gute Verwaltung, https://polyteia.cdn.prismic.io/polyteia/4d2ff821-b2a5-4983-8da8-a9affc32839a_Studie+Polyteia+%26+Hertie+School+%22Gute+Daten.+Gute+Verwaltung.%22.pdf, p. 11, accessed on January 14, 2021.

should illustrate that modern, city-wide data management is worthwhile for all stakeholders involved and for the cities as a whole. This list is not exhaustive, however, the examples also show that inter-connecting data from different content areas tends to be the exception rather than the rule.

Table 4: Selected use cases of the Sounding Board members

City	Name of the project (status)	Short description	Data sources used
Berlin (see also below)	SEMA project (implemented)	Development of a data-based and plan sewer inspection and renovation strategies in order to stop the progressive aging of water and sewage systems.	Environmental data, geographic data, data on the condition of the sewers
Bonn	Tracking refrigerators in ambulances (planned)	Permanent monitoring of refrigerator temperatures in ambulances and emergency doctor vehicles via LoRaWAN to fulfil the health department's documentation obligations for the professional storage of medicines.	Temperature data from LoRaWAN sensors in the refrigerators
Cottbus	Energy monitoring (planned)	Web-based energy control room for the central visualisation and automated monitoring of individual objects using standardised software with convenient documentation, analysis and reporting functions as well as system control functions. Detailed energy controlling should help to optimise the operation of buildings.	Original energy data
Darmstadt	Environmental sensor network (planned)	Combination of air pollution data and traffic data for speed limitation or traffic diversion to clarify whether the latter has an effect. This should enable to carry out environmentally and health-friendly traffic planning.	Air pollution data, traffic data
Dortmund	Digital guidance system for disabled parking spaces (in implementation)	Recording of the occupancy of disabled parking spaces and display in a digital city map or app.	LoRaWAN sensors, geographic data, OpenStreetMap

City	Name of the project (status)	Short description	Data sources used
Emden	Integrated social planning (implemented)	Creation of social space analyses on the basis of an interdisciplinary exchange of geographic and social data in order to develop the neighbourhoods for the benefit of the citizens.	Social data, geographic data
Hamburg (see also below)	Cockpit Social Infrastructure (implemented)	Cross-departmental digital planning and participation platform for the analysis and planning of urban infrastructure based on social space aspects in order to carry out community-based and social district development.	Collected population data, city's own social statistics as well as data from offers on leisure and sport, child and youth welfare, green areas, daycare centres, schools, senior citizens, health
Heidelberg	MAsH project/ smart winter service (planned)	Collection and combination of weather and environmental authority data with the data from the specialist application software of the winter service to optimise winter service planning.	Environmental and weather data
Cologne	Smart construction site management (in implementation)	Use of data from traffic cones of construction sites to visualise the status of construction sites and to pass it on to third parties (e.g. rescue vehicles or delivery traffic) in order to optimise traffic routes.	Data from IoT sensors ⁹ in the traffic cones of construction sites
Leipzig (see also below)	COVID-19 data dashboard (implemented)	Digital data dashboard to visualise the free capacities of hospital beds and those infected with COVID-19 for the decision-making level in order to have an up-to-date and fact-based basis for decision-making.	Data from health authorities and hospitals

⁹ IoT: Internet of Things.

City	Name of the project (status)	Short description	Data sources used
Munich	Smart construction site and event management (in implementation)	Merging of data from the city and the municipal utilities to optimise construction site management and to coordinate related events and processes, such as approvals for events, tree maintenance work, etc.	Technical data with reference to space and time (previously in different kinds of specialist application software), geo-data pool, property and building index
Nuremberg	Central geodata management (implemented, expansion ongoing)	Central provision of basic geographic data and diverse geodata on a common, central platform in the intranet (WebGIS) and use in various types of specialist application softwares. The focus is on using this data internally and tapping synergies. Integration of geodata in other specialist application software (e.g. SAP for maintenance applications, daycare portal Nuremberg, etc.).	Geospatial data from agencies and municipal companies; external sources: Bavarian Agency for Digitisation, High-Speed Internet and Surveying, external companies with high-resolution aerial photographs or orthophotos and state authorities (State Office for Monument Protection, State Office for the Environment)
Ulm	Smart e-scooter parking (implemented)	The city provides geodata on where scooters can be parked to the scooter companies. It is not possible to park scooters in locations that have not been designated for this purpose. In return, the city also receives data from the scooter providers, in order to optimise mobility offers and scooter locations. Complies with the Mobility Data Specification (MDS).	Geospatial data and data from a third party
Wolfsburg	Smart Water (planned)	Use of sensors to measure the water quality of urban water bodies (ponds, lakes, etc.) in real time in order to become aware of negative developments at an early stage and thus protect life.	Data from sensors that will be integrated into the water bodies

The table shows that the Sounding Board cities make extensive use of their data. However, many of the projects use data from, content silos; **to interconnect data from different departments tends to be the exception.**

With the aforementioned background, the projects in Berlin, Hamburg and Leipzig are particularly interesting. We will therefore present them in more detail below:

Use case Leipzig: COVID-19 data dashboard

Goal



Value proposition



Developed solution



Involved parties



Development of a data dashboard that visualises important data for COVID-19 crisis management

→ Data visualisation will improve control

→ Summarising and easily understandable visualisation of the development of the COVID-19 pandemic and the available hospital beds

→ Data dashboard

Department for Geoinformation and Land Management, Health Department

Group of users

COVID-19 crisis team

Implementers



Department for Geoinformation and Land Management

Data sources



Success factors



This is what project managers say



Data from the Health Department and the hospitals as well as spatial data of the city districts

→ Technical implementation in the Department for Geoinformation and Land Management was effective

→ It is important to have good access to all data sets

“It was important to use a current, political tool to build trust for the topic of data use. In particular, the mayors have become more aware of just how important data is.”

Advantages



- Accelerates the visualisation of the course of the COVID-19 pandemic
- Improves the foundation for decision making to effectively combat the COVID-19 pandemic

Use case Hamburg: Social infrastructure cockpit

Goal



Value proposition



Developed solution



Involved parties



Development of a cross-departmental digital planning and participation platform for the analysis and planning of urban infrastructures based on a social space approach

- Targeted development of neighbourhoods, close to the citizens
- Reduction of bad investments
- Well-founded basis for political decisions in urban planning
- Department-specific urban planning

- Map-based planning and visualisation software (open-source model)
- Software: Master-portal
- Processing: Urban Data Platform

District administration (in charge), departments of urban and social space planning

Group of users

City administration employees involved in urban planning processes

Implementers



CityScienceLab at HafenCity University Hamburg, Agency for Geoinformation and Surveying

Data sources



Success factors



This is what project managers say



Population data, construction management data, geographic data, local supply data, school and daycare data

- Large amounts of data and existing data streams
- The project was handled in an agile manner, which paid off. → The project was implemented faster and more cost-effectively than planned.





“The idea for developing the tool came from the user group itself, i.e. the social space managers, which increased acceptance.”

Advantages



- Simplifies urban planning processes
- Tool offers a mix of data visualisation and data analysis

Use Case Berlin: Planning of sewer inspection and renovation strategies (SEMA)

Goal 	Value proposition 	Developed solution 	Involved parties 
Development of a data-based approach to support and plan sewer inspection and renovation strategies	<ul style="list-style-type: none"> → The progressive aging of the water and sewage systems will be stopped → High-quality forecasts will allow for an impact-oriented planning of renovation measures → Strategic investment management 	<ul style="list-style-type: none"> → Digital, data-supported model → Mathematical model for calculating the current and future condition of the sewer infrastructure → A simulator combines technical and environmentally relevant data with the help of artificial intelligence 	Berliner Wasserbetriebe, The Berlin Centre of Competence for Water, ¹⁰ Senate Department for Economics, Energy and Public Enterprises, Senate Department for the Environment, Transport and Climate Protection and The Technology Foundation Berlin ¹¹

Group of users

Employees of the Berliner Wasserbetriebe and The Berlin Centre of Competence for Water

Implementers

Berliner Wasserbetriebe, The Berlin Centre of Competence for Water.¹²

Data sources

Environmental, geo and traffic data, data on the constitution of sewers

Success factors

- Several statistical model approaches were tested
- Test and training data were used to calibrate and validate the models

This is what project managers say

“SEMA forecasts the condition of the sewer network and shows us where renovation is needed the most. The insights gained from using the strategy simulator have already made us a lot smarter. Now, we are more precisely aware of the options to make adjustments in order to operate sustainably for generations to come.”

Advantages

- Impact-oriented planning of renovation works
- Avoidance of costly sewer inspection trips

¹⁰ Kompetenzzentrum Wasser Berlin

¹¹ Technologiestiftung Berlin

¹² The Centre of Competence is financed by the Berlin Senate Department for Economics, Energy and Public Enterprises.

2.3 Challenges cities face when using data

The use cases show that cities use data intensively, but that the combination of data from different technical silos tends to be the exception rather than the rule. Bearing in mind that the Sounding Board cities are among the pioneers in terms of digitalisation and data use, the following question arises: Why do cities not increase their use of the data that results from the digitalisation of providing their services of general interest? After analysing all the information and insight gained in the workshops, the interviews, and the more general research, we were able to identify **eight major challenges for urban data use** (see Table 5). Based on these challenges, the following paragraphs will provide information on how cities can increase their confidence in urban data handling.

Table 5: Overview of data use challenges

No. Challenges	
1	Lack of awareness among administrative and political leaders
2	Lack of skills and awareness among employees
3	Inadequate data sharing culture
4	Insufficient data infrastructure and poor data quality
5	Lack of experience and rigid structures
6	Lack of cooperation in the “Konzern Stadt”
7	Insufficient data sovereignty in the smart city context
8	Lack of trust among the citizens when it comes to the public sector handling data

2.3.1. Administrative and political leaders lack awareness

In many cities, **data is not (yet) considered to be a strategic but rather a technical topic**. Consequently, the IT departments or the specialist departments are responsible for this matter. The local politicians also have difficulties to understand the strategic importance of the issue. For example, Sebastian Askar, Head of Digitalisation, ICT Industry, Digital Infrastructure and Open Data in the Berlin Senate Department for Economics, Energy and Public Enterprises said: “For political stakeholders, data as a topic is too abstract and not (yet) particularly interesting, which is why many are reluctant to invest in this area. Political support is of fundamental importance for establishing a system of strategic data handling.”

The PD study “Data Sovereignty in Smart Cities” from February 2020 has already demonstrated the **lack of expertise and insufficient awareness** among top administrators and politicians. In a survey among local government representatives, almost 50 % of the respondents thought that the data sovereignty knowledge of those responsible for smart city matters was poor or very poor. Around two thirds of the respondents thought that local politicians had a poor awareness of the topic or none at all.¹³

¹³ See Schlüter, K.; Herth, M.; Schmitz, E. (PD – Berater der öffentlichen Hand GmbH) (2020): Data Sovereignty in Smart Cities (Datensouveränität in der Smart City), https://www.pd-g.de/assets/Presse/Fachpresse/200213_PD-Impulse_Datensouveraenitaet_Smart_City.pdf, p. 27, accessed on January 14, 2021.

As with all topics of strategic importance, a lack of awareness of the responsible persons in administration and politics has very negative consequences: Silos can only be broken down, harmonised rules for data handling can only be developed and implemented and financial resources for adequate infrastructure can only be made available with the support of the city leaders. The same holds true, even though in a different role, for local politics.

In this respect, the topic of data sovereignty, along with the topics of digitalisation and smart cities, must be put on the **agenda of top administrators and City Council**. Dr Sascha Hemmen, Head of the Department for Digitalisation and Economy of the City of Wolfsburg, said: “The Administrative Board must be involved when it comes to defining the data use goals the city wants to pursue. The positioning of this group and the support that comes along with it is an essential success factor for the further work and the implementation.” The process of developing a data strategy can contribute significantly to this common understanding of goals.

2.3.2. Employees lack skills and awareness

The digitalisation of services of general interest is a comparatively young topic and the cities generate very large quantities of data that is of different quality (e.g. real-time data). Therefore, it comes as no surprise that **many employees are inexperienced in handling this data**. They need data analysis competencies and corresponding qualifications and further training, but it is also of particular importance to raise a general awareness for the potential (added) value of data among the employees.¹⁴ The knowledge that data from the own area of responsibility can be of relevance to other areas as well is the foundation for combining data and the willingness to share it.

Since departments often have a great deal of autonomy, a common understanding of how data is handled and especially of the issue of data sovereignty is essential.

2.3.3. Inadequate data sharing culture

One of the biggest obstacles to establish strategic data handling is the **silos mentality** of the city departments – almost all Sounding Board members emphasised this point. Sabine Meigel, Head of Digital Agenda Office of the City of Ulm, spoke for many others when she said: “The main challenge is to break down the silo mentality within the administration. For example, different divisions of the administration are used to be led by a level of higher hierarchy, which has all the information. In our case, this is different: A lot of information is available in digital form and there is no monopoly of information. Consequently, municipal data use is a major cultural change as well!”

One problem here is that individual departments consider themselves to be the owners of “their” data and that the other departments abide by this: “Our goal is to increasingly use data from the various departments in other administrative sectors as well. But the departments own the data, which is a major challenge,” said Thomas Bönig, CIO and CDO of the City of Munich.

In this respect, the lack of awareness amongst the employees, as discussed in the second challenge above, also plays a central role. Furthermore, the people involved sometimes also have very practical concerns that hinder them from releasing the data. José David da Torre Suárez, Managing Director Digitalstadt Darmstadt, said: “Anyone who shares data gives up their monopoly of information and may have to face critical questions and discussions about their own work. This is one of the reasons why we are often facing an initial reluctance when it comes to breaking up the data silos.” Sabine

¹⁴ See Polyteia (2020): Gute Daten. Gute Verwaltung, https://polyteia.cdn.prismic.io/polyteia/4d2ff821-b2a5-4983-8da8-a9affc32839a_Studie+Polyteia+%26+Hertie+School+%22Gute+Daten.+Gute+Verwaltung.%22.pdf, p. 20, accessed on January 14, 2021.

Meigel, Head of Digital Agenda Office of the City of Ulm, added another aspect: “People are concerned they will embarrass themselves, e.g. because there are data errors or the quality is poor. This is another reason why data is sometimes not shared with great enthusiasm.”

It is apparent that further instructions by higher hierarchical levels are just as important as proactive explanations, further training and not leaving the employees behind. **Data does not belong to individual departments, but to the city as a whole.** However, any Digitalisation Department will have a hard time enforcing this without being backed by the city leaders. A common vision can help as well.

2.3.4 Insufficient data infrastructure and poor data quality

Apart from the silo mentality, an **insufficient data infrastructure** is another factor impeding the exchange of data with other organisational units. In many cases, without personal contacts, employees in various departments do not even find out about the existence of data in the first place. The result is that the same data is collected multiple times and both the quality and the efficiency of providing services of general interest remain below their potential. So far, open data has been a workaround in some places: Current studies show that the main users of open data are the administrations themselves.¹⁵

However, there are further problems. So far, **data is often not available in digital form.** Thomas Bönig, CIO and CDO of the City of Munich, said: “According to estimations, 80 % of the data in the administration is only available on paper. Before we can use it, we have to digitise it.” The unusable formats include paper files and files that are hardly machine-readable or not machine-readable at all, e.g. PDF documents.

Additionally, **data from many types of specialist application software** cannot be made available for other purposes, even with the ones involved willing and a central data infrastructure in place. What is needed in these cases are interfaces and, in particular, data standards.¹⁶ Bernd van Ellen, CDO of the City of Emden, said: “The biggest problem for exchanging data within the city administration are the different IT solutions of the different types of specialist application software, which make the data incompatible.”

Another point is that even machine-readable and centrally located data can be unusable for other departments – because of the **poor data quality.** For example, when the standardised metadata fields are not filled out or contain errors, the data cannot be used by other people or institutions. Furthermore, data is not always kept up-to-date. Sven Hense, Head of IT Applications and Digitalisation of the City of Bonn, gives an example for this: “For many years, we had numerous and inconsistent street directories. Different administrative departments were responsible for the tables. The information was inconsistent and not always updated on a daily basis. As a consequence, the quality of the individual directories varied significantly.”

The exciting thing about Bonn case is that a solution was found thanks to the coordination and provision of data through the open data portal: “The open data portal now has a quality-assured street

¹⁵ See Bertelsmann Stiftung (2020): Open Data in Kommunen, https://repository.difu.de/jspui/bitstream/difu/578514/1/AK_OpenData%20inK_4_2020.pdf, p. 6, accessed on January 14, 2021.

See. BMWI (2020): Open Public Data in Deutschland, https://www.digitale-technologie.de/DT/Redaktion/DE/Downloads/Publikation/SSW/2020/SSW_Open_Public_Data_in_Deutschland.pdf?blob=publicationFile&v=11, p. 45, accessed on January 14, 2021.

Vgl. Hans-Böckler-Stiftung (2020): Open Government Data, http://www.iaw.edu/tl_files/dokumente/p_study_hbs_442.pdf, p. 70, accessed on January 14, 2021.

¹⁶See Polyteia (2020): Gute Daten. Gute Verwaltung, https://polyteia.cdn.prismic.io/polyteia/4d2ff821-b2a5-4983-8da8-a9affc32839a_Studie+Polyteia+%26+Hertie+School+%22Gute+Daten.+Gute+Verwaltung.%22.pdf, p. 23, accessed on January 14, 2021.

directory that is updated daily – which is also used by the city administration's departments themselves.”

In this case, **open data may be an (interim) solution**. In many other cases, however, administrative data cannot be published due to data protection. Nevertheless, they should be made available to the entire administration.

2.3.5 Lack of experience and rigid structures

Since the use of data still is a young topic, **the municipalities are lacking the experience**. Some cities first have to deal with the smart city concept and develop data sources, for example through sensors. Other cities are already using smart city applications, but are not yet interconnecting data or are not using them beyond specific applications. And when it comes to using artificial intelligence, the municipalities still are at the very beginning.

This is a real challenge for the municipalities: Usually, the hierarchical administrations organised in content-related silos obstruct **creative, experimental and open-ended approaches**. At the same time, the rigid structures and salary options in administrations tend to deter creative IT talent. Without internal know-how, willingness to experiment and creativity, the cities will hardly be able to become active players in the digital transformation of urban societies.

2.3.6 Lack of cooperation in the “Konzern Stadt”

Regardless of whether it is mobility, health or energy: **Municipal companies** are essential participants in practically all fields of services of general interest – and thus also in their digitalisation. Accordingly, a lot of data – just think of the mobility apps of the public transport companies – is not generated by the administration itself, but by the “Konzern Stadt”.

When it comes to data, however, the administration and the municipal companies are usually operating in separate spheres. While many public utilities and other municipal companies are developing modern data infrastructure because they want to use data as a business model, the cities are obviously lagging behind. Wherever there is exchange, the users hardly have equal rights. In fact, there are legal requirements (the GDPR and the PSI Directive) that must be complied with whenever data is shared in the “Konzern Stadt”. Nevertheless, there are possibilities to do so – and these should be utilised.

2.3.7 Insufficient data sovereignty in the smart city context

While cities are only slowly systematically tapping into the topic of data, the private sector has been developing adequate **data business models** for years. In smart cities, this means that private companies secure data sovereignty for themselves and, for example, do not grant the assigning cities any access to raw data. Examples of typical **restrictive contract clauses** can be found in the PD study “Data Sovereignty in Smart Cities”.¹⁷

In the current project, Dr Sascha Hemmen, Head of the Digitalisation and Economy Department, uses an example to illustrate the problem: “Some time ago, the City of Wolfsburg wanted to introduce an app that was meant to make biking in the city easier, and also to improve the integration and the motivation to use the bike. We wanted to immediately use the data on the cycling citizens that was

¹⁷ See Schlüter, K.; Herth, M.; Schmitz, E. (PD – Berater der öffentlichen Hand GmbH) (2020): Datensouveränität in der Smart City, https://www.pd-g.de/assets/Presse/Fachpresse/200213_PD-Impulse_Datensouveraenitaet_Smart_City.pdf, pp. 14, accessed on January 14, 2021.

collected in the app. But the project failed because the private partner did not want to share the data with us in the form we wanted them to.”

In a report that was prepared as part of this study, the Lorenz von Stein Institute of Administrative Sciences also describes that cities can practically only get access to such data by contractual means.¹⁸ If the contract does not include any regulations that explicitly describe the transfer of data to the municipality, the municipality will depend on the goodwill of the provider. Non-binding declarations of intent are not sufficient in the event of a dispute.

The **lacking data sovereignty** is a major obstacle for the autonomous handling of data. Cities that receive the data from private providers only in an aggregated form and prepared for a specific application, are legally not allowed to use the data for other purposes.

2.3.8 Citizens lack trust when it comes to the public sector handling data

In the digital city, citizens are increasingly becoming data producers themselves. For example, anyone who moves through the city with the help of a public transport app generates a wealth of data of immense value, which is highly relevant for cities, even when it is non-personal data. Time and again, however, it shows that citizens are **very critical when the public sector wants to use this data**.

This is a major challenge for the public sector. Unlike the private sector, it will neither be able nor willing to hide its data use clauses in incomprehensible contracts. Cities must therefore seek trust from their citizens. This will only be possible with **great transparency and extensive dialogue**. Sabine Möwes, Head of the Digitalisation Unit of the City of Cologne, said: “In order to counter the fear of the ‘transparent citizen’, it is incredibly important to enter into a dialogue with everyone involved.” Various Sounding Board cities are therefore starting such a dialogue and, for example, develop data ethics concepts or found committees on this matter.

¹⁸ See report of Lorenz von Stein Institute of Administrative Sciences, pp. 54.

3. The foundation for smart data use: strategy and organisation

In many cities, there are stakeholders who are well-versed in handling data and who in some cases also have the power and scope to promote the use of data, to raise awareness for the topic and to spark enthusiasm for it. However, these stakeholders are not yet strong enough to reach all the different administrative levels, especially when it comes to use the same data in different departments and for different purposes or for jointly using the data in an interconnected way.

In the previous section, we have discussed the challenges of municipal data use. Many of these challenges relate to issues for which a **common understanding** must be reached and **structures and ways of thinking** must be changed. A common understanding of how data is to be used is an essential part of a strategic data framework. Changing the structures and mindsets – the governance – of an organisation is a cultural change that municipalities should embrace.

This chapter will discuss these two strands of action – the strategic and structural frameworks, the governance –, describe the status quo, identify the need for action and make recommendations.

3.1 Strategic framework for urban data use

3.1.1 Why do we need a strategy?

The challenges are obvious. But will yet another concept paper help to increase the use of data? The answer is: yes and no. A concept paper can disappear in a drawer without having any significant effect. But the **process of creating the concept** can be important and helpful in itself. Key internal and external stakeholders that deal with data as a topic in a systematic way struggle for reaching a common understanding. This approach will enable the cities to unleash the enormous potential of their data – for the benefit of all.

A data strategy refers to the **overall city-wide strategic goals** and explains how the systematic use of data will help to reach them. It defines **roles and framework conditions**, such as the relationship between the municipality and municipal and private companies. It also helps to implement **standardisation**, both in terms of processes and technology. This is how José David da Torre Suárez, Managing Director Digitalstadt Darmstadt puts it: “The use of data supports the control and the strategic development at city level as a whole. For this purpose, the use of data must be linked to the goals of the city, for example by developing use cases that serve the goal of reducing CO₂ emissions.”

The starting point is the assumption that the value of data is often created or increased **by merging data from different departments**. Helge Braun, Head of the German Chancellery, also emphasised this point during the hearing on the Federal Data Strategy: “There is no culture of aggregating and processing data because this is not necessary to fulfil sovereign tasks.” Then, according to Braun, the public sector should say: “We are still processing the data because there are still some useful things that we could do with it.”¹⁹ Very often, however, the **silos mentality** hampers such aggregation or merging activities, as was discussed above when presenting the third major challenge.

The silo mentality of administrators comes as no surprise, as this is one of the principles defining a good administration, i.e. it is a hierarchical organisation. Silo mentality becomes an obstacle, however, when different organisational units do not know what wealth of data the others have or are

¹⁹ See Transkript zur Expertenanhörung zur Datenstrategie (January 23, 2020), <https://www.bundesregierung.de/resource/blob/975226/1726084/f84b0fb9049daaed50f782c1070ca71a/2020-02-27-transkript-anhoerung-datenstrategie-data.pdf?download=1>, p. 31, accessed on January 14, 2021.

even unwilling to share them. There are several reasons for this. Two of them were already mentioned above: Employees are concerned to get critical questions about their work and worry about being embarrassed by poor data quality. Therefore, solutions should be sought within the departments. Staff must be trained and fear must be reduced through open and positive communication. And finally, the departments need the necessary resources and support services to adequately prepare the data.

At this point it also makes sense to discuss the topic of open data. Great hopes were and still are associated with **open data** – both in terms of transparency and the participation of citizens in their cities and in terms of strengthening the local, data-based economy.

The recent Deutsches Institut für Urbanistik (German Institute of Urban Affairs, Difu) study “Open Data in Municipalities” gives a good overview of the background, challenges and the current implementation status.²⁰ First of all, it is important to note that **sovereign data handling goes well beyond the topic of open data**. Because both in administration and beyond administration, there is highly relevant data that cannot be made available as open data for various reasons (e.g. personal reference or security issues). It is therefore important to distinguish between open and closed data.

Furthermore, sovereign data handling does not mean to use a maximum of open data. Every city should decide how many human and financial resources it would like to invest for providing open data. A sovereign way of doing so can also mean to initially focus on closed data. The exciting thing is that open data does not only have external effects. The city administration itself – this is also shown in the Difu study – makes intensive use of the data that is published as open data.²¹ The external transparency also has an internal effect and, as a result, the departments will receive the necessary knowledge about existing data and access to this data.

Additionally, **legal developments such as the PSI Directive act as a stimulus for the data issue as a whole**. Discussions about open data are always also discussions about data as a whole. The City of Hamburg has made this experience as well, i.e. with its Transparency Act. Sascha Tegtmeier, Head of Urban Data Hub of the City of Hamburg, explained: “With the Transparency Act, attention to the subject of data has increased significantly. Due to political pressure, infrastructure could be built and strengthened, and as a result, apart from the publication, added value was generated for the administration itself.”

Cities must also realise that they are by no means the only, and certainly not the strongest, stakeholders in the field of urban data. Internet companies have been building data-based business models for many years. As a result, citizens in most cities tend to use private offers such as Google Maps to navigate through the city – no matter whether they travel by car or by public transport.

This, however, goes hand in hand with **great control of the private sector**: Do the routes lead through traffic-calmed zones? What will be prioritised – the subway or a private transport service such as bike sharing? Cities must define their position in this matter. They must consider whether they should make their data available to Google and other private companies. The aim is that the information of the companies is correct and that the city can exercise control in a positive way. Sascha Tegtmeier, Head of Urban Data Hub of the City of Hamburg, said: “The use of data by Google can be of interest to a city if the better information situation means that more citizens switch to using public transport, which protects the environment and the climate.”

²⁰ See Bertelsmann Stiftung (2020): Open Data in Kommunen, https://repository.difu.de/jspui/bitstream/difu/578514/1/AK_OpenData%20inK_4_2020.pdf, accessed on January 14, 2021.

²¹ Ibid., pp. 7 and 8.

Dr Frank Nägele, State Secretary for Administrative and Infrastructure Modernisation of the City of Berlin, makes another point: “It is wrong that Google uses the traffic data we provide for free for its own services, while we do not receive their data for our applications or have to purchase it for a lot of money.”

The fundamental issues presented here show that there is a great need to clarify these and other questions. The use of data must be based on clear values and strategies. Data strategy frameworks **function as guardrails and provide orientation** to all stakeholders.

3.1.2 Developing a strategic framework

What is the status quo in the municipalities when it comes to developing strategic frameworks and which content do they prioritise? When we were preparing this report, none of the cities represented in the Sounding Board had developed an explicit data strategy. At the same time, other strategy documents (smart city strategy, digitalisation strategy) include **references to the strategic handling of data** or approaches that can be transferred to the handling of data. The members of the Sounding Board also shared their ideas and work statuses on data strategy considerations. Below, we will outline the most important points that have already been incorporated into a strategy or that are currently being prepared.

Ethical framework and vision

An essential element of data strategies is a **definition of the ethical framework** and the **city's vision** for data handling. This comprises various dimensions. Against the background of the powerful interests of the private sector, the relationship between private stakeholders and the state is of particular importance. Does the city want full control, for example of the data collected in the smart city context? Or does it lack capacities to do so and is therefore more likely to outsource certain aspects to the private sector? As the study “Data Sovereignty in Smart Cities” has shown, both approaches are legitimate. However, the decision for any of them should be made deliberately and the respective approach should be evaluated regularly.²²

However, the vision on how to use data does not only affect the relationship between the state and the private sector or households, but the **entire ecosystem of data use** with its diverse stakeholders (see 2.1).

In this respect, it is essential that the city, in line with its commitment to the common good of its citizens, steers the stakeholders in this specific direction. Ethical guidelines should be used as a framework, as they also create trust among the citizens. The values on which digitalisation projects are based are fundamental here. What is the understanding of people and democracy that underlies digitalisation? Which ethical questions should the municipality discuss?

The digitalisation concept of the City of Dortmund can be used as an example here: “Both for the implementation of digital technical systems in cities and, in particular, the associated data collection and use, it must be checked in this context that everything complies with human, personal and employee rights, does not undermine democracy and democratic structures, treats all people equally

²² See Schlüter, K.; Herth, M.; Schmitz, E. (PD – Berater der öffentlichen Hand GmbH) (2020): Data Sovereignty in Smart Cities (Datensouveränität in der Smart City), https://www.pd-g.de/assets/Presse/Fachpresse/200213_PD-Impulse_Datensouveraenitaet_Smart_City.pdf, pp. 21, accessed on January 14, 2021.

and do not discriminate, [...] follows ethical principles and codes of conduct for handling data in the city [...].”²³

Ulm, for example, attaches so much importance to the question of ethical principles that it has developed its own **data ethics concept**, which defines “ethical guidelines for the conception, programming and operation as well as for the use of data, applications and IT systems by the City of Ulm”. These guidelines define issues such as the safeguarding of privacy, democratic control and transparency through algorithms, oblige the actors to the concept of common good and enshrine values such as sustainability and social responsibility.²⁴

Strategic goals and impact

Just like digitalisation, the use of data is not an end in itself. Consequently, a data strategy should answer the question of how the use of data contributes to **the strategic goals of the city** and which **impacts** are to be made with it. Urban strategy documents are the starting point to this. The City of Leipzig uses its data in accordance with the integrated urban development concept Leipzig 2030. Dr Beate Ginzler, Head of the Digital City Department, said: “The use of data serves the goals of our integrated urban development concept. In doing so, data takes on the role of a digital cross-sectional infrastructure. I am convinced: Nothing serves the urban development concept (INSEK) more than efficient data use.”

The City of Leipzig has also put this understanding into writing. For example, the “Urban Data Platform Leipzig – Agreement of the Core Working Group” states that the use of data aims at “increasing the quality of life and the growth opportunities of regional companies, gaining knowledge as well as improving policy making and the review of goals [...]”²⁵.

Additionally, the strategic data framework shows which **fields of action the city prioritises when it comes to using data**. Hamburg, for example, puts it this way: “Intelligently used and shared data become part of digital services of general interest, are a driver of innovation and are of ever greater importance for the city's ability to control and adapt.”²⁶ This means that, in the context of services of general interest, data should contribute to the well-being of the urban society – in various policy and administrative areas. In line with this requirement, data use questions are also enshrined in sub-strategies, e.g. the strategy for intelligent transport systems in Hamburg.²⁷ Furthermore, data should be made available as an innovation factor and especially to private companies. And finally, data should be used internally to optimise the control system.

To identify how exactly the use of data should contribute to achieving the city's strategic goals is **complex and should not be underestimated**. This is an enormous task, because “the use of data relates to all areas of municipal activities”, as one participant of a workshop of the Sounding Board put

²³ See Ratsvorlage Leitbild Digitalisierung Dortmund, Drucksache Nr.: 16691-20, <https://blog.do-foss.de/kol-umne/leitbild-zur-digitalisierung-der-stadt-dortmund/>, pp. 2, accessed on January 14, 2021.

²⁴ See Datenethikkonzept Ulm, <https://www.zukunftsstadt-ulm.de/sites/default/files/downloads/ulm-201008-txt-datenethikkonzept-stadt-ulm-final.pdf>, p. 1, accessed on January 14, 2021.

²⁵ See Stadt Leipzig (2020): Urbane Datenplattform Leipzig – Verständnispapier der Kernarbeitsgruppe. Internal, unpublished document by the City of Leipzig, pp. 2.

²⁶ See Digitalstrategie Hamburg, <https://www.hamburg.de/contentblob/13508768/703cff94b7cc86a2a12815e52835accf/data/download-digitalstrategie-2020.pdf>, p. 6, accessed on January 14, 2021.

²⁷ See ITS-Strategie für Hamburg (2016), <https://www.hamburg.de/contentblob/5934418/2afc89cd64f950803e25689ad3e5db87/data/its-strategie-fuer-hamburg.pdf>, pp. 18, accessed on January 14, 2021.

it in a nutshell. Data strategies that only focus on operational issues, will waste their potential to illustrate the **value of data**, to bring together **challenges and solutions** and thus **to use data to solve city-wide problems**.

Strategic data frameworks that do so successfully, can also unfold a **power-political dimension**. When justifying resources, strategic consistency is a valuable argument. When the stakeholders succeed in demonstrating in what way data use contributes to achieving overarching strategic goals, politicians and top administrators are more willing to provide resources such as money, personnel or non-material support: “We must make clear to what extent the use of data supports the politically defined goals, because this helps us to gain understanding from the political stakeholders, which then puts us in a position to make resource requirements more transparent and also justify them in a better way,” said Sascha Tegtmeyer, Head of Urban Data Hub Hamburg.

Target groups of data use

The formulation of the impact or the reference to the overarching city strategy results in a **prioritisation of target groups**. The city should define which are the groups in the city that should benefit most from using data. These can be citizens, but also the local economy, organised clubs and associations, the science community or the media (see also 2.1). Of course, the administration itself or the “Konzern Stadt” as a whole can also be defined to be the main target group to benefit from the added value the use of data generates.

In this context, it must also be specified in which **constellations of users and networks** the data should be used and how the city plans to encourage this. Darmstadt, for example, organises hackathons and tests innovative forms of cooperation, as José David da Torre Suárez, Managing Director Digitalstadt Darmstadt, explained: “In our hackathons, innovative solutions are developed, but we also find out which data is relevant for which users. We also identify existing needs and what structures and formats the data should have. Users from business, science, culture, education, the society and the city administration come together in a city lab, where they jointly develop ideas.” This also includes the question of how the city involves its citizens.

Technical aspects

A strategic data framework can be used to regulate technical aspects at a higher level. This includes in particular the **basic requirements for the data platform as the technical infrastructure** (see Chapter 4). The requirements for the concept for a system of systems, as described below, can be derived from the approach that you want to aggregate the data available in the departments into a central infrastructure.

Technical standards as well as agreements on service levels and availability are needed in this respect. Additionally, the strategy also describes central specifications for release conditions and the rights to the data. Data standards and clear regulations for connecting specialist application software ensure interoperability. Such a strategic data framework will describe the task of data management in the municipality.

The fourth challenge – the **challenge of poor data quality** – can also be tackled in this framework. Dr Gustav Lebhart, CIO of the City of Cottbus, emphasised: “A consistent data strategy, clear responsibilities and documented processes and the right technology can significantly improve the quality and usability of data. In this way, measurable results can be achieved that also have a direct positive impact on the effectiveness of the administration.” According to this understanding, a data strategy also has the purpose to define **quality standards**, e.g. by defining targets for the electronic collection of data and support options.

Advice on how to develop such a strategy

But how exactly should the municipality proceed to create a strategic data framework? Which steps are to be taken and which actors are to be involved? As explained above, the process of developing this strategy is of paramount importance. The **development of a data strategy is the central measure** that is available to a municipality to communicate how valuable data is, but also to increase acceptance and reduce reservations. In this respect, the process alone will already contribute to mastering the first and second challenges as mentioned above as well as to raise awareness among politicians, administrative leaders and employees.

Furthermore, the process can help to reduce fears and worries among the actors in the specialist departments. To coordinate the whole ecosystem, citizens, initiatives, companies and other external groups can already be involved at this point of development. This will not only ensure acceptance, but also enable the municipality to include the demands of these groups at an early stage.

At the beginning of developing a strategic data framework, **responsibilities must be defined**. Within the administration, an appropriate department (see Section 3.2 for further information on this) should be assigned to push the process of strategy development. The head of the city should be the one assigning this task.

For developing the strategic framework, various actors and units of the administration should be involved, especially those who already have expertise in using data. These include those responsible **for geographic information systems, statistics or open data**. Other representatives and committees, and especially the **staff council**, should be consulted and invited to collaborate as well.

In the next step, the responsible body should identify **the status quo** for the entire “Konzern Stadt”, i.e. the administration and the municipal companies. Which data is already available and can be used? Which data is already being used across organisations? Are there already needs to use data across departments? Which infrastructure, e.g. geographic information systems, already exists and how is it used?

The **data use ecosystem should also be analysed**. Which networks are already being used to organise the use of data? Which stakeholders are particularly interested in the topic? How can citizens, local businesses, the scientific community and other groups be involved right from the start, in order to prepare for future cooperation?

What follows after this is the **strategy development in the narrower sense**. Which values and which vision are foundation for the use of data? Which strategic goals of the city should be particularly supported by the use of data? Which effects should be achieved by this? For which target groups should the use of data primarily generate added value?

The strategy then enters **the implementation stage** by defining measures and responsibilities. Which data should be aggregated and published? How should this be done? Which use cases should be implemented by whom? Which form of network should be set up and how?

Using data in the municipality can only be successful when **added value is made visible at an early stage already**. To this end, when developing the strategic framework, a focus should be on smaller projects that can be realised quickly (quick wins). Their implementation will provide presentable examples and increase the acceptance in the departments, which will then continue to participate.

In addition to the local conditions in the municipality, **developments at state and federal levels** must also be taken into account, i.e. the data strategies of the respective governments, but also of individual ministries. For the months and years to come, technical data strategies can be expected to be developed at federal and state level. These will be integrated into the respective overarching data strategies and can to some extent also have an impact on the municipalities. For example, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety has announced its own data strategy²⁸ and, at the same time, defined the goal of supporting digital solutions to advance the traffic transition in municipalities.²⁹ Municipalities should observe and shape these developments at federal and state level and link to them to their own work in the departments and offices.

3.2 Governance structures

3.2.1 Governance in administration

Now, with the strategic considerations on how to use data in place, how can they be implemented and **enshrined in the organisation of the municipal administration**? This is the key question for the following considerations. In municipalities, three basic types of tasks have to be performed in order to establish the use of data in the sense of the strategic goals:

- ➔ **Support the collection of data:** A central unit should support the departments and the municipal companies in collecting and processing data in order to ensure standardisation and to achieve high data quality. This also includes the training of all employees in order to create a basic knowledge of urban data (data literacy). Today, it comes natural to administration employees to apply administrative law; in the future, they must be able to collect, evaluate and interpret data. This is a competence that will be important everywhere, not only in IT and organisational departments.
- ➔ **Provide data:** The municipality must ensure that everybody who can and wants to work with the available data knows about them. For this purpose, technical infrastructure must be provided and existing data must be handled in a transparent way.
- ➔ **Manage the network of actors/ecosystem:** In order to implement the actual use of the existing and known of data, the municipality must activate and motivate institutions and people inside and outside the administration, establish links and encourage the development of use cases.

Roles and structures

The municipality should establish roles for these tasks and define how to integrate these roles into the organisational structure. This section provides information on how this can be done. It makes sense to discuss the design of this governance structure in connection with the considerations for creating a strategic framework. In this way, the strategic decisions can directly be incorporated into governance. However, there is no need to wait for the strategic framework to be defined and then start creating the roles; some of the tasks can be executed simultaneously so that successes will be achieved more quickly and the added value of data use can be demonstrated.

²⁸ See Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (2020): *Umweltpolitische Digitalagenda*, https://www.bmu.de/fileadmin/Daten_BMU/Pool/Broschueren/broschuere_digitalagenda_bf.pdf, p. 73, accessed on January 14, 2021.

²⁹ *Ibid.*, p. 49.

But what do **practical ways of organising the use of data** look like? The examples of the Sounding Board members show that there are many options. Two very different examples are the ones from the cities of Darmstadt and Leipzig:

- In **Darmstadt**, the responsibility for data issues has been outsourced to Digitalstadt Darmstadt GmbH, while the control is carried out directly by the senior mayor. Advisory boards ensure that civil society remains involved. So-called area leads from different policy areas ensure the involvement of the city administration and the municipal economy.

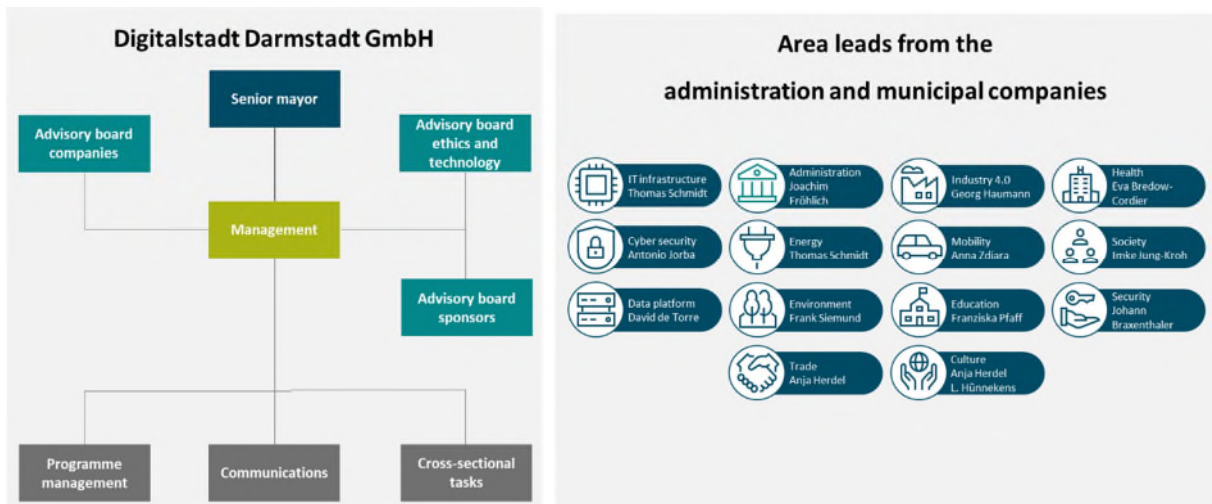


Figure 4: Organisational chart of Digitalstadt Darmstadt GmbH and organisation of the areas

- In **Leipzig**, the interdisciplinary coordination of the urban data platform is carried out by the administration itself, i.e. by the department “Digitale Stadt Leipzig”. The connection to political control takes place through line organisation and also through the specific committee model that is in place in Leipzig. The latter also ensures the integration of the specialist departments and the municipal subsidiaries.

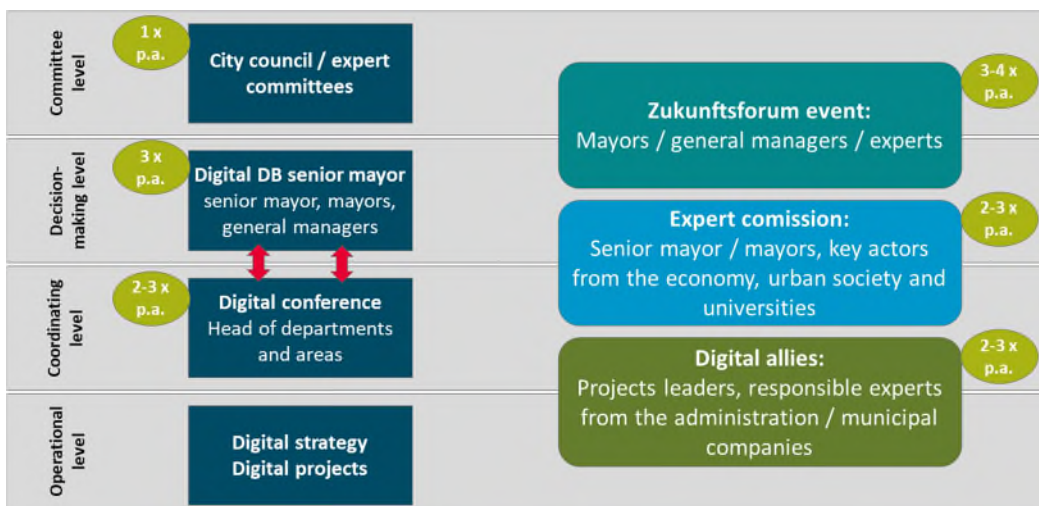


Figure 5: Committee model of the City of Leipzig

Despite the significant differences, both organisational options can certainly be considered to be very good examples. This also shows that **there is no universal scheme for municipalities that want to organise their data use**. Is it better to outsource so that expertise on the subject of data is bundled

and the new organisation can create a network inside and outside of the administration? Or is it better to assign the office that uses the data as designated by the administrative hierarchy and then integrate it into the other areas from the administration and municipal companies with the help of a sophisticated committee model? The municipalities must answer these questions in light of their individual situation and then develop the structures that fit them best.

But how do municipalities find out which structure is the right one for them? The following figure **lists possible roles that should be fulfilled within the framework of communal data governance**. However, this list is only a suggestion and by no means should every role be translated into a specific position. Rather, the roles entail bundles of tasks of varying scope. One person can also have several roles.

Table 6: Roles of municipal data use

Role	Level	Description
Data strategist	Senior/CDO	<ul style="list-style-type: none"> ➔ Overall responsibility for the topic of data use ➔ Moderation of internal administrative coordination ➔ Bring about strategic decisions
Group data manager	Senior/CDO	<ul style="list-style-type: none"> ➔ Control of the municipal subsidiaries and holdings in the area of data use ➔ Moderation of coordination processes for the implementation of data use cases ➔ Coordination with the Coordination with the managing body to control or instruct the municipal companies in the areas of data use
Consultant for the implementation of use cases	Senior/CDO	<ul style="list-style-type: none"> ➔ Networkers who bring together the knowledge of the data that is available in the “Konzern Stadt”, in the economy and the civil society as well as possible use cases and possibilities for collecting further data. They furthermore motivate, accompany and actively support the different actors (e.g. also through network events, working groups and committees).
Data quality assurance	Supportive role	<ul style="list-style-type: none"> ➔ Supports the departments or municipal companies in the collection and processing of data in order to combine them at city-wide level.
Stakeholder manager	Supportive role	<ul style="list-style-type: none"> ➔ Ensures the support of external actors, especially of the organised civil society, the scientific community and (local) companies, to enhance the collaboration for using data in the sense of the strategic goals (e.g. also by organising hackathons or activating potentials of known local actors).
Communication manager	Supportive role	<ul style="list-style-type: none"> ➔ Informs the general public, in particular the citizens, about data issues and plans and implements participations that involve the citizens.
Ethical ombudsperson	Supportive role	<ul style="list-style-type: none"> ➔ Can be contacted when ethical issues arise in connection with data use (see the example from Dortmund)³⁰ and can be accompanied by an ethics and technology advisory board (see the example from Darmstadt).
IT	Supportive role	<ul style="list-style-type: none"> ➔ Supports and enables data infrastructure by using the existing IT system.

³⁰ See news portal of the City of Dortmund, https://www.dortmund.de/de/leben_in_dortmund/nachrichtenportal/alle_nachrichten/nachricht.jsp?nid=553099, accessed on October 21, 2020. As of December 2020, this news item was no longer available. The ombudsperson is also mentioned here: <https://www.eco.de/news/eco-expertenrunde-das-macht-die-smart-city-dortmund-lebenswerter/>, accessed on December 8, 2020.

Role	Level	Description
Disseminator	Departments/ participations	<ul style="list-style-type: none"> ➔ Spreads information about the added value the use of data generates. ➔ Organises an exchange by the employees of the departments who are familiar with the technical challenges and the possibilities of using data.
Data owner	Departments/ participations	➔ Ensures the integrity and provisioning of the data and that it is up-to-date.
All employees	Departments/ participations	➔ Support the data owner and the creative development of use cases to simplify administrative procedures or to solve urban challenges.

But how should the municipalities **organise all these roles**? Where exactly should they be incorporated in the **organisational chart**? Ultimately, these questions must be answered individually and based on the municipal circumstances, because these matters strongly depend on the organisational structure for digitalisation and the smart city, respectively. Do we have a CDO or a digitalisation department? Has an office been assigned with these tasks?

No matter how individual the choices will be, there is one thing all Sounding Board members agreed on: Data as a topic must be handled by the top administrative level. The administrative leaders should forward the issue of data use, regardless of the organisational form. This directs the necessary attention to the topic and, at the same time, improves the implementation of overarching regulations in the overall administration.

The intervention of administrative leaders is especially important when departments think that their data is their property – which is pretty common, as this study has revealed. And the report of the Lorenz von Stein Institute of Administrative Sciences shows that the main administrative officer may instruct departments to hand out their data. However, such an instruction would usually only happen in individual cases. If the aim is to regulate the sharing of data in general, the Lorenz von Stein Institute of Administrative Sciences recommends statutes or administrative regulations. Less binding solutions are political resolutions, target agreements and declarations of intent.³¹

Enabling agility

So, if we want to enshrine the use of data in our organisational structure, is it enough **to incorporate the roles**? There are good reasons to assume that it is not. As briefly discussed above, the legalistic, hierarchical and task-sharing organisation of administrations is a decisive foundation of silo mentality. This is very well-founded and simply abolishing it would be short-sighted. With this kind of structure, however, it will hardly be possible to start the cultural change that is necessary for implementing the use of data. Because in order to combine data and implement use cases, stakeholders and users must have the courage to try out new things – while accepting that mistakes might happen. This calls for **agile, flexible ways of working that allow for a quick, collaborative and interdisciplinary creation of unfinished prototypes**. With such working methods, the municipality can also succeed in bringing experts into the administration, where there is also an urgent need for specialists.

³¹ See report of Lorenz von Stein Institute of Administrative Sciences, pp. 71.

In recent years, many cities have started to design such innovative spaces. A good example is the **City Lab Berlin**, which is also a special case: As an institution of The Technology Foundation Berlin TSB, it is not a municipal, but a privately organised institution; however, it takes on the role of a digital innovation laboratory for the administration. The connection to the Berlin Senate is ensured by an advisory board with prominent members.

The City Lab Berlin has the task of initiating innovative projects and making them tangible through prototypes. This way of working is revolutionary for public administrations, as it produces intermediate results that can be unfinished and flawed. The advantages, however, are obvious: Prototypes make the desired result tangible, accelerate coordination processes and enable feedback and an agile, further development.³²

Such experimental spaces are good options for larger cities in particular. They can also be used to organise the exchange with the network of actors or the ecosystem by inviting external parties, e.g. civil society, business, scientific or other representatives, to participate in the experimental spaces.

3.2.2 Governance in the “Konzern Stadt”

Sensors in urban rubbish bins are the responsibility of waste management, while smart applications in the energy sector are implemented by municipal utilities. As this exemplary list shows, a sovereign handling of urban data in the interests of the common good can only be achieved in close cooperation with the municipal companies.

As described above in the sixth challenge, **data use cooperation in the “Konzern Stadt”** is not trivial. Ambiguities regarding the legal framework prevent municipal companies and the administration from exchanging their data. Further reasons for the currently low level of cooperation are the cultural issues (as mentioned above) and the fact that there is no awareness of how valuable the own data can be for other actors.

Legal aspects³³

Legal hurdles that are usually mentioned when it comes to sharing data across administration departments are the European **PSI Directive and the Act on the Reuse of Information (Informationsweiterverwendungsgesetz, IWG)**, which transposes the directive into German law. The aim of the directive and the law is to improve the making available of public data of the (European) economy. Put simply, information – i.e. data – that has been reused by a public body should also be able to be reused by private individuals. The public body is then obliged to release this data to the private individuals. Administrations and municipal companies are concerned that the sharing of data in the “Konzern Stadt” already creates this obligation to disclose such data to private individuals.

However, according to the report of The Lorenz von Stein Institute of Administrative Sciences, this is not the case. As both municipal companies and administrations perform public tasks, the Act on the Reuse of Information does not apply. It would only require the disclosure to private individuals, for example through an open data portal, if the data had already been released commercially to third

³² See Seibel, B. and Boeck, V. (September 8, 2020): How a prototype can save your digital project from derailing, in: Apolitical, https://apolitical.co/en/solution_article/prototype-digital-project-derailing, accessed on January 14, 2021.

³³ This paragraph is based on the report of the Lorenz von Stein Institute of Administrative Sciences. This was carefully prepared and reviewed. However, it is the legal conception of a legal institute. In order to increase legal certainty even more, cities should carry out further legal investigations in individual cases, where appropriate. With the implementation of the PSI Directive, the Data Usage Act (DNG) should replace the current IWG (see p. 8). The current draft bill could not be considered in the legal investigation.

parties. Therefore, **the Act on the Reuse of Information is not a hurdle for exchanging data in the “Konzern Stadt”**.³⁴

But **what if the company refuses this?** What options does a city have to oblige its companies to open up their data silos? There are several possibilities with different binding characters. Assuming that the subsidiary is a GmbH (a company with limited liability), the city can amend the articles of association and define the rules for data disclosure there. However, it can also issue instructions to the managers through the general meeting. The management can also be controlled through labour law measures, e.g. target agreements for the release of data. Additionally, public-law contracts or declarations of intent can also include provisions for the disclosure of data. This option requires mutual consent, but this may as well increase acceptance and compliance with the agreement. In the case of an AG (joint-stock company), it is not possible to instruct the managers.³⁵

And the other way round? Does a **municipal subsidiary have the right to view and use internal data of the city administration?** According to the Lorenz von Stein Institute of Administrative Sciences, state-specific legal regulations or regulations of the municipality itself might restrict this way of sharing data. If no such restrictions are in place, data can be shared with the municipal companies. However, the Lorenz von Stein Institute of Administrative Sciences recommends to restrict this access to the fields of activities for which the respective companies were founded.³⁶

These considerations relate explicitly to **non-personal data** and do therefore not take into account the issue of data protection. However, data in the smart city context usually does not need a personal reference in order to develop use cases that will generate added value. However, this data is often user-generated, i.e. created through the behaviour of persons. How can the municipality ensure the necessary anonymisation in this respect? This must already take place when the data is collected, as subsequent anonymisation or pseudonymisation could be reversed.

Dr Sascha Hemmen from Wolfsburg gave an example of how to anonymise data while collecting it: “We want to measure how many people are walking or cycling through the pedestrian zone and at what time. Today, only limited data is available to us, so that it is difficult to make political decisions, for example, on whether or when to open the pedestrian zone for bikes. We now plan to use cameras with very low resolution. With those, it is technically impossible to identify people, but we can still tell whether someone is walking or riding a bike.”

Cultural/organisational aspects

The legal way can only be one way of improving the cooperation on data issues within the “Konzern Stadt”. What are other options for the municipalities to influence the culture and the organisation?

Municipal companies should also be **involved in the governance as described above**. Wherever data is held by these companies, the stakeholders should be involved as data owners, for example. Appointing disseminators and qualifying also the employees of the municipal companies will increase the comprehensive understanding of how important it is to use data and, in particular, improve the cooperation within the “Konzern Stadt”. The two examples from Leipzig and Darmstadt, which were discussed above, are also characterised by the fact that their governance was kept in mind and incorporated into the “Konzern Stadt” right from the start.

³⁴ See report of Lorenz von Stein Institute of Administrative Sciences, pp. 15.

³⁵ See report of Lorenz von Stein Institute of Administrative Sciences, pp. 35 and pp. 79. The report also indicates that access rights can be established through general laws (p. 42, pp. 88). As this goes beyond municipal responsibilities, it will not be discussed any further at this point.

³⁶ See report of Lorenz von Stein Institute for Administrative Sciences, pp. 49 and pp. 93.

In Leipzig, for example, the committee model ensures a regular exchange on data use issues between the administration and participations. What is special is that the exchange does not only take place at top levels, but **at all levels of hierarchy**.

Darmstadt, as discussed, even founded a municipal company for digitalisation, which thus is responsible. However, administration and the company are equally involved. The stakeholders are working as area leads in the individual fields of digitalisation and jointly discuss the use cases.

However, this requires the common understanding that the data of the municipal companies can also generate considerable added value for digital services of general interest. This means that commercialisation interests must be cut back. In the “Konzern Stadt”, data should be used to reach the strategic goals – it is far too valuable to be sold. A current publication by the Fraunhofer Institute put it this way: “When we talk about ‘creating value from data’ and the development of digital business models in the municipal economy, this does not mean that municipal companies should sell digital customer or city data to the highest bidders on platforms, e.g. for targeting and advertising purposes. Instead, it means, firstly, to use digital technologies and data to create added value at appropriate points in the value creation process, secondly, to develop from a product provider into a value-added service provider that gears its activities towards the common good, and, thirdly, to use the specific potential of utility companies.”³⁷

One thing must be said for the sake of completeness: If the city restricts the business options of its participations, this can of course lead to reduced distributions or, if necessary, higher subsidies, which should be kept in mind as well. Again, meaningful deliberations on the topic can only take place when there is a fundamental understanding of how valuable data is for the city as a whole – at the level of city leaders, city treasurers and city councillors.

3.2.3 Barcelona: pioneer on the way to data sovereignty

Since most German cities are only gradually moving towards urban data sovereignty, it is worth taking a look at other European countries, i.e. at the **City of Barcelona**, which is an international pioneer in this respect. In the context of this study, we will pay special attention to:

- ➔ the **data strategy** “Responsible and Ethical Use of Data Strategy: Data Commons”
- ➔ the **data governance structures** with the Municipal Data Office (Oficina Municipal de Dades, OMD)
- ➔ the **procurement guidelines** to ensure data sovereignty.

Data strategy: handling data responsibly

The City of Barcelona published its data strategy in 2018.³⁸ The then CDO Francesca Bria was responsible for the strategy, which specifies, amongst others, **fundamental and ethical values** for the handling of data, creates governance structures (see below) and lays the foundations for data infrastructure. One thing is made very clear: Data has a high strategic value for the control of the entire city and are “a source of prosperity” for all citizens.

³⁷ See Fraunhofer IAO (2020): Umbruch, Aufbruch, Durchbruch: Wie die Kommunalwirtschaft die digitale Welt gestaltet, http://publica.fraunhofer.de/eprints/urn_nbn_de_0011-n-6024159.pdf, accessed on January 14, 2021.

³⁸ See City of Barcelona (2018): Barcelona City Council Digital Plan – Government measure concerning ethical management and accountable data: Barcelona Data Commons, https://www.barcelona.cat/digitalstandards/en/data-management/0.1/attachments/barcelona_data_management_0.1.en.pdf, accessed on January 14, 2021.

The data strategy **challenges large private corporations**: The data strategy challenges large private corporations: It says that the public and private perception of data as being a private asset that creates administrative advantages was wrong.³⁹ Francesca Bria explained this understanding of data in an interview: “Data is a public infrastructure, just like water, roads and the air we breathe. Therefore, it should be treated in the same way. Data belongs to the citizens of Barcelona.”⁴⁰

The strategy also defines high ethical standards for the use of the data. For example, “automated decisions must be fair and appropriate” and “non-discriminatory”.⁴¹ This statement goes in the direction of algorithms that are increasingly being used by the public sector as well.

Municipal Data Office (Oficina Municipal de Dades)

The strategic positioning of the data topic in the urban organisational structure as well as adequate resources are fundamental prerequisites for sovereign data handling. The City of Barcelona did this by setting up its **Municipal Data Office (Oficina Municipal de Dades)**.

The Chief Data Officer (here CDO) is the leader of the Municipal Data Office, which is responsible for “the management, quality, governance and use” of data from the city administration and all municipal companies.⁴² In order to be able to fulfil this strategic task, it was not connected to the IT department, but directly to the senior mayor. Departments that have previously dealt with the topic of data, in particular the statistics department, were also integrated into the Municipal Data Office, which has a total of around 40 employees from different disciplines.

³⁹ See City of Barcelona (2018): Barcelona City Council Digital Plan – Government measure concerning ethical management and accountable data: Barcelona Data Commons, https://www.barcelona.cat/digitalstandards/en/data-management/0.1/attachments/barcelona_data_management_0.1.en.pdf, p. 7, accessed on January 14, 2021.

⁴⁰ See Barcelona’s Robin Hood of Data: Francesca Bria (November 16, 2018), in: Sifted, <https://sifted.eu/articles/barcelonas-robin-hood-of-data-francesca-bria/>, accessed on January 14, 2021.

⁴¹ See City of Barcelona (2018): Barcelona City Council Digital Plan – Government measure concerning ethical management and accountable data: Barcelona Data Commons, https://www.barcelona.cat/digitalstandards/en/data-management/0.1/attachments/barcelona_data_management_0.1.en.pdf, p. 16, accessed on January 14, 2021.

⁴² Ibid., p. 20.

Procurement guidelines

Just like many German cities, Barcelona is facing the challenge that **many smart city contracts restrict data sovereignty**. In response to this, the City of Barcelona is currently developing procurement guidelines on the subject of data sovereignty.⁴³ All contracts of the city administration and – this will certainly be interesting from the German perspective – also of all city participations (majority-owned) will in future contain clauses that transfer data sovereignty to the city (to the greatest extent possible). Additionally, interfaces should be used to automatically integrate this private data into the urban data platform (“Data Lake”).

Extensive training should be carried out for project managers so that the clauses will actually always be included in tenders and contracts. Simultaneously, the urban data infrastructure is being expanded in such a way that it will be able to process data from the private sector in the first place. Even before the procurement guidelines were finalised, they had been tested in pilot projects. One example is the bike-sharing provider Bicing: Data that users generate through the Bicing app is fed into the overarching data platform, where it is used to optimise urban traffic – in compliance with Barcelona's ethical guidelines.⁴⁴

⁴³ The information in this paragraph is based on the presentation “Data Sovereignty” by Malcom Bain, legal advisor to the City of Barcelona, as part of the Smart City dialogue platform.

⁴⁴ See Barcelona Digital City: Bicing, <https://ajuntament.barcelona.cat/digital/en/digital-transformation/urban-technology/bicing>, accessed on January 14, 2021.

4. Urban data platforms as central infrastructure solutions

4.1 Initial situation and definition of terms

As explained in Section 2.3, the **lack of data infrastructure** is a major challenge for the sovereign handling of urban data. A particular problem is that data from the various departments cannot be combined. In most cases, there is also a lack of knowledge as to which data is collected by other departments or units.

While connecting the data within the administration is an essential first step, a sovereign data use entails more: The **connection of data with municipal companies and possibly even beyond**, with actors from private and civil society, would be desirable as well. The baseline study “Urban Data Spaces – Possibilities of Data Exchange and Collaboration in Urban Space” by Fraunhofer FOKUS describes this vision as well: “We define an urban data space as such a data space that contains all types of data that could be relevant for the municipal social, economic and political space.”⁴⁵

The reality in the municipalities, however, looks completely different. As shown in 2.2 Status quo and use cases, most use cases are still happening in their respective data silos – even in the Sounding Board cities, which are pioneers in this field. Data from different areas are only combined to a very limited extent. In terms of infrastructure, this is reflected in the fact that the existing data platforms generally have **limited thematic focus** (e.g. mobility platforms) or only serve a specific purpose (e.g. open data portals).

Geographic information systems go further, but are often not integrated into developments in the smart city context. Thomas Eichhorn, CDO in the Agency for Geoinformation and Surveying of the City of Hamburg, works in both spheres and said: “The new Smart City staff units or CDOs are often not aware of the geoinformation platforms that have been developed for many years. Furthermore, they do not know that data with spatial reference are subject to regulatory principles such as the INSPIRE Directive – which is also relevant for Smart City data. An integration is urgently recommended in this respect.”

Additionally, the quantity and quality of the data is changing significantly: Especially due to IoT sensors, more and more real-time data is being fed into the municipalities' networks. With those, the continuity of control can be improved considerably. However, even in the most progressive cases, such **data platforms remain limited to individual topics**, e.g. mobility or energy platforms. Linking real-time data from various specialist departments entails completely new requirements for data infrastructures.

With regard to higher-level **urban data platforms (UDPs)**, the current understanding is rather heterogeneous. At the same time, there is uncertainty, but also urgency. Benjamin Seibel, Director of the Berlin CityLAB, summed it up: “For many cities, data platforms are a mystery. Nobody knows what they are and what you need them for, but everybody wants one.” This situation may also be due to the fact that the topic is very complex and the municipalities are only at the beginning of discussing it in a strategic and conceptual way.

Often, the IT department is considered to be responsible for this matter. However, this department usually treats data in a technical way and not so much in strategic or organisational terms – but this

⁴⁵ See Fraunhofer FOKUS, Fraunhofer IAIS, Fraunhofer IML (2018): Urbane Datenräume – Möglichkeiten von Datenaustausch und Zusammenarbeit im urbanen Raum, https://cdn0.scrvt.com/fokus/774af17bdc0a18cd/69f7a401c168/UDR_Studie_062018.pdf, p. 30, accessed on January 14, 2021.

is by far not enough when tackling the challenges as described above. Furthermore, **legal questions** arise when setting up and operating a UDP: Do we have to create a specific legal basis for the UDP? For example, by providing data through the open data area of a UDP, are companies possibly entitled to an availability of data or may they even make claims for damages if a data set was incorrect?

The Lorenz von Stein Institute of Administrative Sciences recommends to pass **suitable regulations** for developing UDPs in order to promote legal certainty and acceptance, but “not only within the city administration, but also in the relationships with wholly-owned and majority-owned subsidiaries of the respective municipality and towards private parties.”⁴⁶ In particular, if the operation of a UDP involves interfering with the rights of third parties, the municipality needs a law passed by the respective state parliament in order to implement the UDP accordingly. Statutes or administrative regulations and maybe also public law contracts can be used to regulate specific questions about data platforms in the municipality. This means that the municipalities are quite free in regulating the legal framework.⁴⁷

But to what extent can **third parties make claims** in cases where the data provided is no longer available or incorrect? The Lorenz von Stein Institute of Administrative Sciences differentiates here: If, for example, a company suffers damage due to a technical error in the data platform, it cannot make any claims against the municipality, as there is no liability (which requires human action). The only possible exception would be that the municipality and the company closed a contract, in which the municipality assumes liability, for example in the form of a guarantee. Therefore, the Lorenz von Stein Institute of Administrative Sciences advises not to enter such agreements.⁴⁸

If the company suffers damage because, for example, an employee forgets to update a data record, the situation must be assessed differently. If there is a contract that promises to provide the data, the municipality is liable. However, the Lorenz von Stein Institute of Administrative Sciences points out the possibility to include liability limitations in the event of negligence into contracts.⁴⁹

If no contract has been concluded, the municipality could be liable due to a breach of official duty. However, this official duty can only result from a law (e.g. a transparency law) or, depending on the individual case, from an appropriate statute. If such a law has been passed in the state or such a statute has been passed by the municipality, the municipality might be liable.⁵⁰ What is important here, however, is which claims and rights to correctness and completeness result from the law or the articles of association and which do not.⁵¹

Despite these limitations and uncertainties, it was possible to derive central aspects of a common understanding after analysing the interviews and workshops with the Sounding Board. It is clear that a UDP is superordinate, both in thematic and functional terms, and that it should connect several singular platforms, databases and portals. Linking different data sources and **breaking down silos** should create a foundation for new applications and evaluations.

On the IT side, the UDP, as the central infrastructure, should be used to reduce the complexity of the architecture by connecting each urban system to the central UDP only. This will significantly decrease the development and maintenance demands of the interfaces required for the entire city-wide data exchange. The dominant understanding is that data is not stored directly on the UDP, but that the

⁴⁶ See report of Lorenz von Stein Institute of Administrative Sciences, p. 5.

⁴⁷ Ibid., pp. 22, pp. 71.

⁴⁸ Ibid., p. 57, p. 63.

⁴⁹ Ibid., pp. 57.

⁵⁰ Ibid., pp. 59.

⁵¹ Ibid., p. 110.

UDP accesses the various data sources on the basis of defined use cases, like a **system of systems** or a **data hub**.

Accordingly, a **UDP can be defined as an urban infrastructure** that enables different urban data sources and services to be brought together and therefore create added value for various user groups. These include, for example, urban decision-makers, the administration, citizens and stakeholders from the economic domain. According to this understanding, open data portals or IoT platforms are no UDPs in the narrower sense. However, open data portals or IoT platforms will be integrated into a UDP as sub-components or systems. An overall architecture should always be kept in mind and right from the beginning.

Many cities consider the City of Hamburg with its UDP (see 4.3.3) to be a reference point. Therefore, the definition of terms that is used there is of overriding relevance. A (internal) concept paper that was made available as part of the project said: “The new thing about this approach [is] the generation of knowledge from existing data, which comes from various sources. But only the combination, analysis and provision of functions on the basis of standardised services turns an approach into a smart approach. In addition to the transparency portal,⁵² which focuses on providing the data, the Urban Data Platform should be able to answer questions, react to events and be based on a wealth of digital knowledge. This will grow steadily in the future once other specialist application software, which is so far still characterised by its monolithic structure, starts to follow this transactional approach and if we succeed in establishing recognised standards for interoperable services, also beyond the boundaries of the administration. At the same time, the level of knowledge will constantly grow thanks to data from third parties.”

4.2 Reference architecture and data standards

Even though there is a lot of uncertainty about data platforms among the municipalities, important foundations were already laid in 2017. **DIN SPEC 91357** “Reference architecture model Open Urban Platform (OUP)”⁵³ introduced a specific design proposal and a standardised framework for urban data platforms, respectively. It is aimed at municipal administrations and political decision-makers, planners and manufacturers, but explicitly also addresses smaller cities and regions. The reference architecture was designed with the participation of German and Dutch actors and stakeholders from various sectors, also from German cities.⁵⁴

The OUP described in DIN SPEC 91357 aims at freeing data from sectoral silos and thus is perfectly in line with the spirit of this study. To ensure data sovereignty, it stipulates **open-source principles** and therefore suggests open interfaces, which enables data to be exchanged between different systems (and also between cities). Open interfaces prevent vendor lock-in, i.e. that a municipality becomes dependent on a single solution provider. This also ensures that technical components from different manufacturers can be connected.

⁵² The transparency portal is the Hamburg Open Data Portal.

⁵³ See Deutsches Institut für Normung e. V. (DIN) (2017): DIN SPEC 91357. Reference architecture model Offene Urbane Plattform (OUP), <https://www.beuth.de/de/technische-regel/din-spec-91357/281077528>, accessed on January 14, 2021.

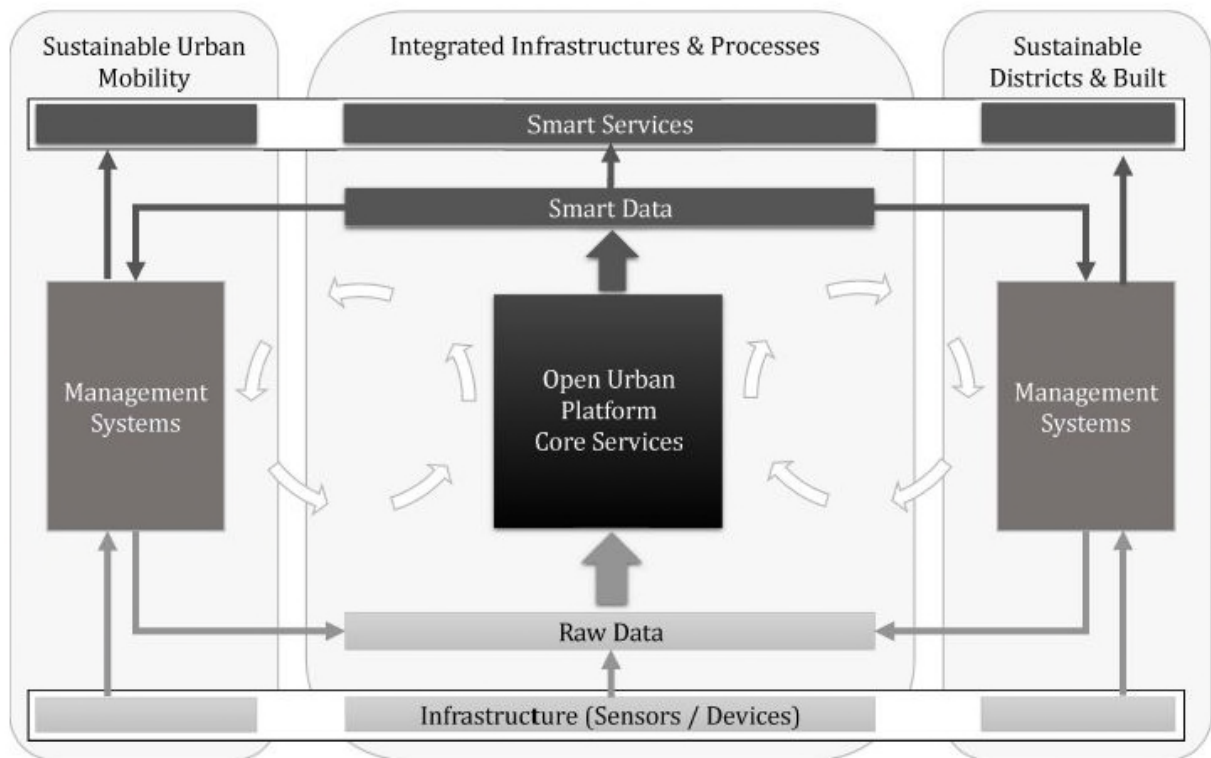
⁵⁴ Amongst others, scientific institutions (Fraunhofer FOKUS), cities (Cologne, Berlin, Munich), energy supply companies, providers of smart city solutions as well as telecommunications and technology companies participated in the development.

At this point it should be pointed out that apart from open, standardised interfaces, uniform names for resources (URIs⁵⁵) and standardised data formats are also necessary for exchanging data successfully. Even domain-specific data, such as environmental data, can have significant deviations in their structure and therefore always require syntactic and semantic standardisation so that they can be exchanged. This is particularly true for the communication and the data exchange between two cities, between companies and the city or within the individual administrative departments: The systems must be able to communicate with each other. This requires harmonised data and a consistent translation.

The (standardised) data are brought together in a UDP, which DIN SPEC 91357 specifies as follows: “An urban platform is a system that enables the use and monitoring of urban data and also supports the control of urban infrastructures and relevant elements. In addition, it enables new and improved service offerings, both for the public and for (private) organisations. Most of them are no 'off-the-shelf' solutions. Rather, the urban platform is understood as a 'platform of platforms', which is fed from existing elements, but can be developed constantly.”

- What is the relationship between singular systems, such as an open data portal or an IoT platform, and the UDP? A UDP is an independent system and functions as a central data exchange platform for all other systems. An open data portal is connected to the UDP as a data-receiving system and enables the publication of selected data. An IoT platform, on the other hand, controls and monitors sensors and actuators in urban areas and, as the UDP data source, ensures that the live data from the sensors is directly available for further processing in the UDP (the IoT platform temporarily stores the sensor data). Depending on the structure, both systems – open data portal and IoT platform – can also have their own visualisation layer, which is also connected to the UDP (see DIN SPEC architecture).
- What is the difference between an Open Urban Platform (OUP) and an urban data platform (UDP)? DIN SPEC 91357 uses the term OUP for the reference architecture it describes. The attribute “open” refers to the open-source principles of the software that is used. Open source always implies open interfaces. The collective term “urban data platform” generally means any central data platform that integrates various urban data, regardless of whether proprietary software and proprietary interfaces are mainly used as technology or not. In this study, unless specified otherwise, we are using the overarching term “urban data platform” (UDP).

⁵⁵ URI: Uniform Resource Identifier.



The Open Urban Platform is at the core of the DIN SPEC reference architecture. It collects and analyses data from as many urban systems as possible and in a central location. A system could, for example, be a specialised application software in the administration, e.g. for reporting or urban planning (see management systems, left and right), but also an IoT platform from which data from a sensor network (IoT data) (level below) is fed into the OUP.

Figure 6: Schematic illustration of the Open Urban Platform design according to DIN SPEC 91375⁵⁶

The data that were collected and connected in the OUP, i.e. the smart data, are then enriched and once again made available to the connected systems so that they can work more intelligently because they now have more information to fall back on. The technical advantage of a central system is that all systems in the city must only be connected to the central system in order to exchange data with all the other ones. Based on the networked data layer, additional new smart services (top level) can be created for the stakeholders (citizens, companies, administration).

4.3. The market is confusing, implementation has just begun

The planning and implementation of a UDP are great challenges for municipalities. In the following, we will examine the **market perspective** in more detail. For doing so, we will discuss the constellations of the manufacturers, the differentiation of services and current developments as well as

⁵⁶ See Deutsches Institut für Normung e. V. (DIN) (2017): DIN SPEC 91357. Reference architecture model Offene Urbane Plattform (OUP), <https://www.beuth.de/de/technische-regel/din-spec-91357/281077528>, accessed on January 14, 2021.

typical municipal forms of UDP implementation. Necessary preliminary considerations with regard to operations, development and the level of in-house production will be described as well.

4.3.1. The market for UDPs

Status quo: fragmented supply situation

Private or public providers of data-related services and products do usually not offer an “off-the-shelf” UDP, because the structure of a UDP has so far still required the **use of different products from different manufacturers**. Rather, it is mostly several companies that support a municipality with their services and help setting up the UDP step by step, to ultimately to create a complex data ecosystem by connecting many other systems. It is then up to the municipality to put the individual pieces of the mosaic together to an efficient and coherent whole. It must control the process in a goal-oriented manner and requires considerable know-how to set up and operate very complex IT architectures in a multi-stakeholder scenario.

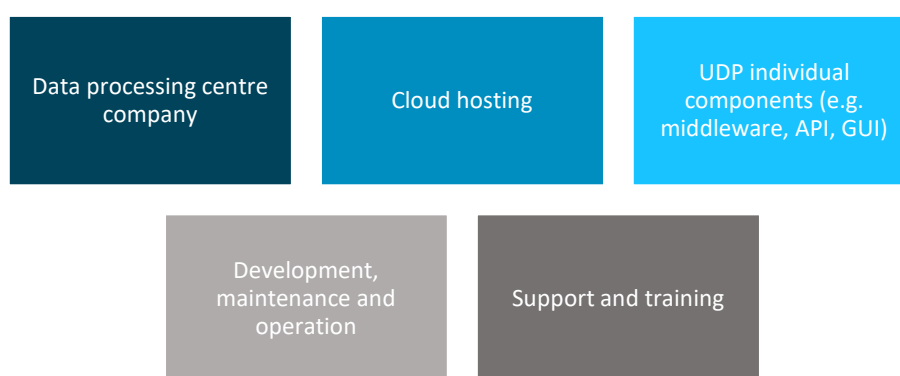


Figure 7: Typical range of data services and products

A powerful, **secure and stable data centre** is required to operate a UDP. Data centre services can be provided by the city's own IT department, a municipal IT service company, but also by a private company or a cloud services provider. In addition to the data centre services, the municipalities cooperate with software companies that could provide the UDP or continuously implement the connectors or interfaces for connecting the various systems to the UDP. They also provide further system integration services. Depending on the design of the platform architecture and the range of functions, it is common that the municipalities assigns several companies.

Furthermore, the **development, maintenance and customising of the actual platform solution** are offered as services on the market. This is supplemented by companies that take on the development and maintenance of **special components**. This includes components for the use of artificial intelligence or business information systems with dashboard functions. The provision of technical support and of training courses are also among the services that are frequently offered on the market.

Consortia as a way to bundle offers

From the municipal point of view, it is a positive development that the fragmented supply side is increasingly offering standardised, integrated service bundles, for example in the form of **consortia**. This also includes the establishment of **community approaches** for the exchange of experiences and as a basis for development communities (on the side of the municipalities).

Additionally, more and more open-source solutions complying with DIN standards are emerging. Those do not require great development efforts by the municipalities and therefore also enable smaller cities to set up their UPDs. Such market offers reduce the complexity of decision-making for the municipalities and make it easier to compare different providers.

There are two types of consortia. Firstly, there are **individual consortia that are founded on the basis of individual municipal tenders** for the development and operation of a UDP. These consortia have a dedicated consortium lead, usually a municipal IT service company that, as a general contractor, manages the coordination of the other parties involved and is responsible for the system integration and thus the creation of a functioning overall system.

However, only few (usually very large) cities have internal IT departments that are capable to take on the role of general contractor themselves, e.g. Hamburg and Vienna (see 4.3.3). Still, this model is difficult to apply even for very large cities, because it requires very sophisticated IT control and expanded skills for the design of such complex systems.

Secondly, **there is a trend for the foundation of fixed consortia**, which jointly realise many projects, which results in good economies of scale and the release of synergy potentials. An example of this from the German-speaking area is the DKSR (short for “Daten-Kompetenzzentrum für Städte und Regionen”, English: Data Competence Centre for Cities and Regions), which was founded in November 2020. According to its own information, DKSR is committed to the open-source principle as well as the topic of data sovereignty.

Municipal IT service providers develop their first solutions

Municipal IT service providers and special-purpose associations are also expanding their portfolio by offering data-related products and services. Ekom21, for example, a special-purpose IT association from Hessen, is currently focusing on platform offers for the administrative core team and also uses artificial intelligence for them. As a public organisation, the IT association manages the following UPD services:

- ➔ Data centre services
- ➔ Providing or procuring cloud capacities
- ➔ Offering software solutions

A major advantage of the cooperation between cities and special-purpose IT associations is the proximity of the local actors. Special-purpose IT associations know the local needs and typical use cases. As public contracting parties, they are usually trusted by the relevant stakeholders. Furthermore, they make the procurement of products and services easier for the member municipalities, which do no longer have to procure them from private providers.

4.3.2 Status quo of urban UDP implementation

Even most of the Sounding Board cities, which are digital pioneers, have not set up any data infrastructures that comprehensively connect all urban data systems. Many cities have established **individual data solutions** (e.g. databases or platforms with a limited range of application) that are not interconnected at all or only to a limited extent, which basically means that the cities' data remain in silos. The generation of added value by connecting and extracting data is not yet implemented in adequate ways. The local differences of the implemented data platforms are not only due to the various technical architecture and infrastructure, but especially to the constellation of the project implementers.

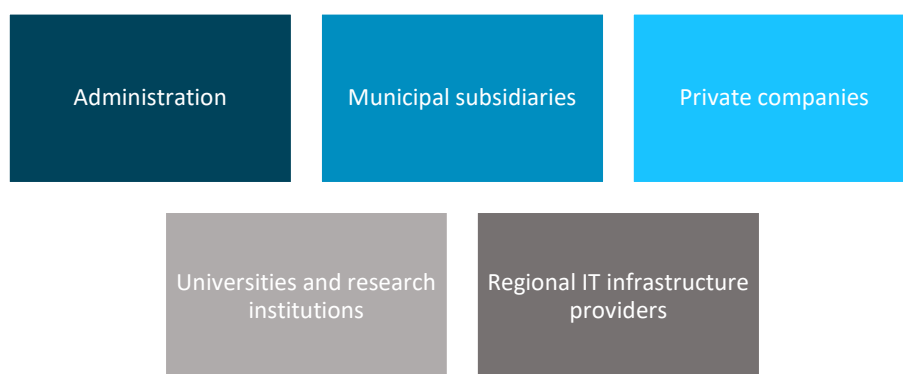


Figure 8: Key actors in UDP projects

The following were identified to be the **key stakeholders** for the implementation of UDP projects:

- ➔ Administration (different organisational units)
- ➔ Municipal subsidiaries (especially public utilities)
- ➔ Private companies (often full-service providers, software development companies, data centres)
- ➔ Regional IT infrastructure providers (multi-service)
- ➔ Universities and research institutions

The administration's **own resources** (e.g. financial or human resources) also play an important role for the implementation and design of the data infrastructure. Implementation and design do of course also depend on the size of a municipality (with funding competition winners being the exceptions).

City-specific skills and resources play an important role for the **procurement of data infrastructure**. They determine which services can and must be procured on the market. In the course of platform implementation, the individual UDP components must be integrated into the system, which is a very challenging task, especially for smaller cities.

Larger cities such as Hamburg or Vienna, on the contrary, usually have the necessary know-how and capacities to find companies they can cooperate with by themselves as well as to enforce the necessary standards and then to act as system integrators that combine all these partial services into a functioning whole, which is then developed further continuously.

A well-founded decision as to which services should be realised inhouse and which should be procured can only be made after coming up with the necessary preliminary considerations (see Chapters 2 and 3) and honestly assessing the own capacities. This **process of identifying the right components and making decisions** is of high relevance for a target-oriented awarding procedure, but even if a municipality has done everything it could in this respect – the current market situation is anything but clear and requires in-depth analysis. This is because UDPs cannot be bought “off the shelf” without further ado. Also, it is a complex undertaking to formulate the tender documents: “You need really good computer scientists to formulate a tender for data platforms. Use several tenders from other cities as a point of reference, this will certainly make it easier. When we became active in the end of 2018, we entered unknown territory,” said Sabine Meigel, Head of Digital Agenda Office of the City of Ulm, about her experience with the tender for an IoT platform that can be expanded in the future.

The municipalities are using various **types of implementation** for their UDPs. The individual platform projects vary by the extent of in-house efforts and the constellation of actors, amongst others. Below, we will briefly describe the predominant types.

Table 7: Common types of UDP implementation

Type of implementation	Characteristics
In-house development with open-source components	<ul style="list-style-type: none"> ➔ High level of in-house activities ➔ Extensive use of urban resources ➔ Integration of open-source components for support
Purchase of modular solutions	<ul style="list-style-type: none"> ➔ Medium level of in-house activities ➔ Integration of components that were developed internally and by third parties ➔ Allows for a flexible combination of several solutions and the adjustment to municipal needs
Purchase of a comprehensive solution by one provider	<ul style="list-style-type: none"> ➔ Low level of in-house activities ➔ Dependency on one provider ➔ Enables the city to use a UDP without providing great internal know-how and personal resources

The City of Leipzig has decided against purchasing a complete package and opted for **developing a modular solution** based on its own components that are developed by the city itself. “The background to this approach is that we, as a city, wanted to remain flexible in terms of structure and possible adjustments. Furthermore, we wanted to improve our own competencies and thus the technology sovereignty of the city,” explained Dr Beate Ginzler, Head of the Digital City Department.

Even though UDPs cannot be purchased with all the necessary architectural elements, there are definitely larger, more comprehensive “complete packages” on the market that cover a wide range of UDP components or data services and thus offer municipalities their own data ecosystem. For municipalities, it is important to ensure that there is no vendor lock-in, because then they would be very dependent on the provider and they would have problems to come out of this difficult situation.

The City of Cottbus had **negative experiences with large providers** and market leaders: “The behaviour of some of the big market leaders is very dirigiste. Sometimes they understand the role of the administrations as digital service providers only to a limited extent,” said Dr Gustav Lebhart, CIO of the City of Cottbus.

Another common way of setting up your own data infrastructures is the **tendering of (partial) services and the implementation with local providers**. One example is the City of Ulm. After the City went through a data strategy process, in which it clarified the framework conditions for data handling, it started a tender procedure. The two local providers eXXcellent solutions (development) and SWU Telenet (operations) were awarded the contract for the technical implementation.

Before that, it was also considered to make use of a state solution. However, this was rejected in favour of the implementation as outlined above: “Originally, we had planned a very large solution in the sense of a uniform urban data platform. But in the course of the process, we changed our mind. Now, we are building an IoT platform first, which can be expanded in the future. We have been developing the platform in an agile manner since February 2020, with the support of Fraunhofer IESE.”

Inter-municipal cooperation is another type of UDP implementation strategy more and more municipalities are using. Larger cities, such as Munich or Hamburg, grant UPD access also to the surrounding municipalities, which increases the effectiveness of their data projects. This is a win-win situation for the urban centres, said Thomas Bönig, CIO and CDO of the City of Munich: “While the City of Munich contributes resources, we cannot manage data from our surrounding municipalities in a meaningful way without the help of the local base. Regardless of whether we talk about traffic, the environment or major events – all these topics go well beyond the city's limits.”

This approach also works **across state borders**, as a model project funded by the Cities of Leipzig, Hamburg and Munich demonstrates. The Cities are jointly driving, of course, as an open-source project, the development of a digital twin, so that other municipalities will be able to adopt and reuse the urban data platform models that were developed.

GAIA-X – the European cloud

The GAIA-X project, a **European cloud alliance**, was launched in October 2019. The project aims at strengthening a European digital economy, as part of which the foundations for the development of an interconnected, open data infrastructure that is based on European values are being developed. It is the goal to build “a digital ecosystem in Europe that will produce innovations and new data-driven services and applications”.⁵⁷ In this way, Europe's dependency on international providers should be reduced in order to maintain its capacity to act strategically.

The EU Commission, European governments, companies, research institutions and associations support this major European project. The GAIA-X Foundation manages the operational cooperation of the many partner institutions, by organising the network and strengthening international cooperation. The development is running on the basis of 40 European use cases. The first interim results were presented in summer 2020, while the first ready-to-operate solutions should be available on the market in early 2021. This should create a European alternative to American or Chinese cloud computing providers for storage, software and computing services.

The **federal level also invests significantly in this project**. While €40 million have already been included in the budget for 2020, this should increase to a three-digit figure in 2021. This amount includes funds for setting up the GAIA-X data infrastructure, for an innovation competition and for promoting the “Industry 4.0” platform, which will be connected to GAIA-X.⁵⁸

⁵⁷ See Federal Ministry for Economic Affairs and Energy (2019): GAIA-X: Das europäische Projekt startet in die nächste Phase, https://www.bmwi.de/Redaktion/DE/Publikationen/Digitale-Welt/gaia-x-das-europaeische-projekt-startet-in-die-naechste-phase.pdf?__blob=publicationFile&v=18, accessed on January 14, 2021.

⁵⁸ See Tagesspiegel Background (November 27, 2020): Haushalt 2021: Digitale Weichen sind gestellt, <https://background.tagesspiegel.de/digitalisierung/haushalt-2021-digitale-weichen-sind-gestellt>, accessed on January 14, 2021.

It is currently difficult to assess **how significant GAIA-X could become for the municipalities** in the future. Benjamin Seibel, Head of the Berlin CityLAB, tweeted in mid-September: “Last night I dealt with GAIA-X in more detail but I still have no idea whether it will be good thing or a total flop.” There are too many buzzwords and too few concrete propositions, criticises Seibel. He said to be very curious about the prototype that is announced for the end of 2020. The Sounding Board has criticised a lack of information. Municipal companies, on the contrary, see specific points of contact for themselves, according to VKU, an association of municipal companies.⁵⁹ GAIA-X and an exchange of data through cloud services could help companies to become active across industries, e.g. the energy and transport industries.

The **Association of German Cities is also proactively involved in developments regarding GAIA-X**. To this end, the Association of German Cities cooperates with the German Association of Towns and Municipalities, the German County Association, Bitkom e. V. and Fraunhofer IESE. Together, they formulate recommendations on how to use GAIA-X, point out which added value will be generated and discuss practical examples from German municipalities. In this way, they want to accompany and guide municipalities to make them aware of the possibilities and the limits of GAIA-X.

4.3.3 Case Studies: examples from three pioneering cities

Urban Data Platform: Hamburg's data hub

Ever since Hamburg published its Transparency Act in 2012, the City has been a German pioneer in terms of data policies, which was most recently confirmed in the digital strategy, which was updated in 2020. In 2017, when individual portals, e.g. the Transparency Portal in Hamburg, had already been up and running for many years, the Hamburg Senate assigned the Agency for Geoinformation and Surveying (LGV) and the CityScienceLab at HafenCity University to jointly develop the platform. Organised as **Urban Data HUB Hamburg**, the two players are now developing new services and consulting offers and also provide scientific support. The platform is defined as follows: “The Urban Data Platform Hamburg is a conceptual approach that aims at connecting existing and future IT systems and IT services so that they know about each other’s existence and can exchange their data, but also at using their logical and analytical skills in interactive processes to provide information, prepare decisions, assist or make decisions.”⁶⁰

Hamburg's platform is not an application, but a **data hub**, a “shared data zone”, whose task is to break up data silos. Which considerations play a role for this? An overarching goal indicates the right direction: The platform should create added value for the urban society – especially as an instrument for economic development – and not only serve the internal administration. In this way, it is a (silent) give and take: Over 40 types of specialist application software are connected to the data hub through adaptors. Administrative departments that might otherwise now work together at all benefit from this, as do citizens who are provided with new applications. The platform is implemented as a strict open-source approach: All components are configured as open-source components and could therefore also be used by other municipalities. Hamburg shares development components with other

See Tagesspiegel Background (September 30, 2020): Wie die ersten Gaia-X-Clouds aussehen sollen, <https://background.tagesspiegel.de/digitalisierung/wie-die-ersten-gaia-x-clouds-aussehen-sollen>, accessed on January 14, 2021.

⁵⁹ See Verband kommunaler Unternehmen e. V. (2020): Kommunale Unternehmen unterstützen GAIA-X: Chance für Energiewende und Smart Cities, <https://www.vku.de/presse/pressemitteilungen/archiv-2020-pressemitteilungen/kommunale-unternehmen-unterstuetzen-gaia-x-chance-fuer-energiewende-und-smart-cities/>, accessed on January 14, 2021.

⁶⁰ See Eichhorn, T. (2019): Hamburg – Urban Platform. Urban Data Hub, <https://www.interreg-nordsee.de/Resources/Persistent/89235f3cc56fc84b77ae286769bc868cde8cbbc7/Thomas-Eichhorn---Urban-Plattform--Urban-Data-HUB.pdf>, accessed on January 14, 2021.

cities, also within the framework of the project “CUT-Connected Urban Twins” (digital twins; together with the Cities of Leipzig and Munich), which is funded by the BMI. Other cities can already copy these system sections and configure them in their systems.

The **open-source approach also supports the sovereign handling of the data**: “The platform is operated by the City only. We also use the Fraunhofer FROST Sever solution, which is an open-source solution as well,” explained Thomas Eichhorn, CDO of the Agency for Geoinformation and Surveying. So, as everything is open-source – does that mean that everything else is a walk in the park? No, said Thomas Eichhorn: “The whole undertaking is a very complex system, but it works very well. However, not everything functioned right from the start and it does not make sense to copy our system without any customisation to any other municipality.” It is important to develop demand-oriented solutions, also because such a project needs great and strong resources for participating in and overseeing the individual divisions. “Around 80 people are employed in the urban data and geographic data infrastructure division, 50 people for operational project processing and coordination, 25 in the development division and we also have further employees, e.g. for web design,” explained Thomas Eichhorn.

At present, a real-time data infrastructure is being set up as part of the Urban Data Platform. The focus for the further development of the platform is currently on further, specific application options, which are also being developed together with stakeholders.

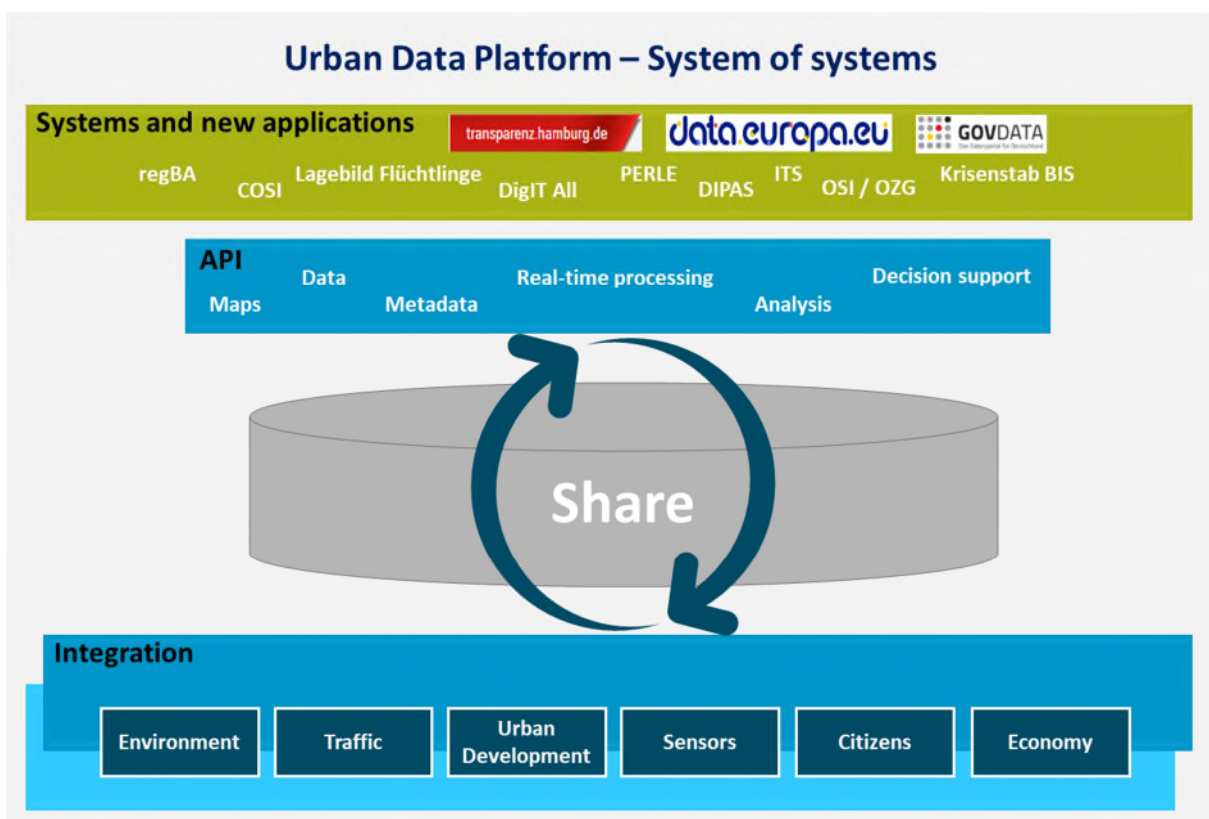


Figure 9: Architecture of Hamburg's Urban Data Platform

Darmstadt's data platform: developed by the municipality, operated by private players

The City of Darmstadt is also developing an urban data platform as a data hub. It is scheduled to start operations in early 2021. While Hamburg initially focused on administrative data, Darmstadt has

been aiming at **connecting other stakeholders** right from the start. Darmstadt formulates its platform vision accordingly: “The central data platform should serve as the basis for a large number of projects from the digital city's project portfolio and facilitate the networking of the involved actors. It simplifies the communication between the citizens and the city and offers data security and confidentiality through strong encryption.”

José David da Torre Suárez, Managing Director Digitalstadt Darmstadt, said: “In terms of conceptually and architecture, the platform is very similar to Hamburg's approach.” Furthermore, Darmstadt's platform is not a data pool, but enables various stakeholders to access different data through interfaces, according to José David da Torre Suárez. The focus of the platform is on interconnecting and visualising the IoT sensors installed in Darmstadt. The data comes from the environmental sensor network, mobility sensors and other data from clients such as the Darmstadt Zoo. Technically, this is made possible by using the Microsoft Azure cloud computing platform.

After an award procedure, the City of Darmstadt assigned a consortium consisting of the special-purpose IT association ekom21 – KGRZ Hessen (municipal data centre), Urban Software Institute GmbH – [ui!] and DARZ GmbH, a private company that offers data services and has an own data centre in Darmstadt. When it comes to integrating external companies, Darmstadt also attaches great importance to acting in a sovereign way: “When developing the tender, we paid special attention as to not become dependent on one provider and we did so right from the start. For example, we specified the metadata model and the interfaces,” explained José David da Torre Suarez. On the part of the City, Digitalstadt Darmstadt, which is a wholly-owned subsidiary, is responsible for the platform.

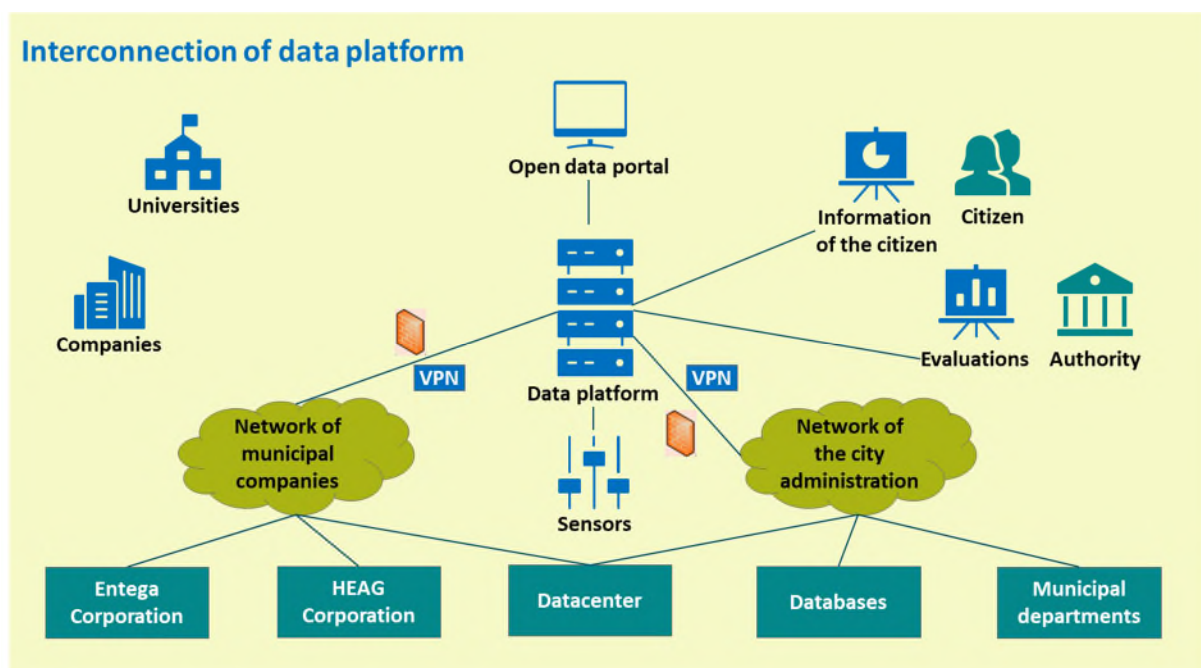


Figure 10: Network of Darmstadt's data platform

Vienna's Urban Data Plattform: the European lighthouse project

The strategic use of urban data is of great value for the cities: “In the future, an urban data infrastructure will be just as relevant as public lighting, the streets and any other infrastructure,” said

Stephan Hartmann, “Smarter Together” project manager.⁶¹ That is why targeted investments are made available for adequate data infrastructure. For the realisation of its own UDP, Vienna does not only use its own funds but also the funding from the “Smart Together” programme, a funding line of the EU research and innovation programme “Horizon 2020”.

The following **goals** are formulated for the UDP:

- ➔ Continuously increase **the number of available data records**.
- ➔ Increase the **use and application** of the data (e.g. through new applications or the optimisation of services) and develop an understanding of how the infrastructure is used.
- ➔ Create an **ecosystem**, in which authorised parties can exchange all types of open and restricted data.
- ➔ Facilitate **monitoring** and enable automated data transfer between project partners.
- ➔ Identify yet undiscovered **dependencies** to become aware of problems more quickly (e.g. energy generation and consumption are not known in advance).

Through the UDP (see Figure 11), many different smart city data, for example from the “Smarter Together” projects, are brought together in a single infrastructure⁶², which complements and integrates existing data infrastructures and individual platforms such as the Open Data Platform.⁶³ The UDP enables the exchange of existing data for different use cases through an urban infrastructure and thus frees this data from the previously existing data silos. The use of a security layer and components for authentication should ensure that only authorised persons have access to the data.

The data platform is based on the FIWARE platform by the FIWARE Foundation, but is operated by the City of Vienna. The platform is hosted on-premise in the City's data centre and FIWARE serves as middleware. It contains the **data from various databases and data sets, in line with the data warehouse approach**. The content of the data is prepared, analysed and graphically displayed in the platform.

From a technical point of view, the FIWARE framework consists of a set of different open-source platform components to combine the data. The open-source approach is a key point for Vienna: “We wanted to design a platform that we can also make available to other cities. It should therefore continue to be an open-source platform, because the fact that 98 % of the components in Vienna are open-source components is part of our strategy,” said Gerhard Hartmann, Magistrate of the City of Vienna.

The data provided in the UDP are diverse, but primarily include data from the “Smarter Together” project and therefore mainly building data, energy data (e.g. on water consumption, electricity and heat), car sharing data and also, to some limited extent, real-time data. They will be available as **open and sometimes as closed data**. This should also promote the local economy and the start-up ecosystem: “We prefer to make our data openly available so that local start-ups can use them as well. Unlike Google, they would not be able to purchase data and they are very grateful for this fact,” explained Gerhard Hartmann.

⁶¹ See Städtische Daten: Zu wichtig, um sie Google zu überlassen (March 2, 2020), in: Wiener Zeitung, <https://www.wienerzeitung.at/verlagsbeilagen/digitale-republik/2052768-Staedtische-Daten-Zu-wichtig-um-sie-Google-zu-ueberlassen.html>, accessed on January 14, 2021.

⁶² See Hartmann, G. (2017): Datenplattform Smarter Together, https://www.corp.at/archive/CORP2017_4.pdf, accessed on January 14, 2021.

⁶³ See Stadt Wien: Open Government Wien, <https://digitales.wien.gv.at/site/open-data/>, accessed on January 14, 2021.

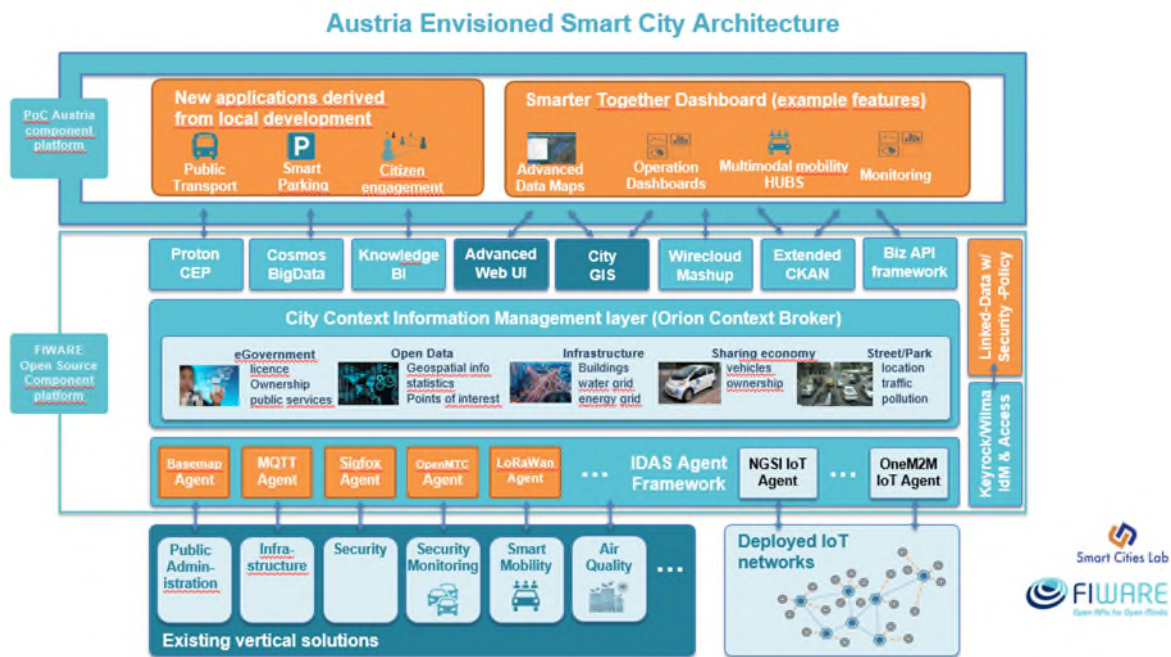


Figure 11: Vienna's Urban Data Plattform⁶⁴

4.4 Recommendations for action

Sovereign data handling may sound like a simple and clear objective, but it is actually a complex undertaking – and this holds especially true for the planning of data infrastructure. As demonstrated in Chapters 2 and 3, the municipalities must start an in-depth strategic discussion to be able to define what their individual UDPs should look like. Municipalities should be aware of this when they start tendering at the latest, so that they can specify the right requirements for their UDP and formulate this adequately for the awarding procedure. The tenders from other cities are a helpful source for this.

It is also worth taking a look at **existing standards**, especially with a focus on DIN SPEC 91375, as discussed above. They do not only provide important guidance, but can also be used to formulate the tender itself where the specifications become binding requirement for private bidders. But what additional advice did the interviewees and the Sounding Board give and what generalisable aspects can be derived from it? The central recommendations for action for planning and implementing data infrastructures can be summarised as follows:

- ➔ **Maintaining data sovereignty** should be top priority when planning and implementing data infrastructure. During the tender process and especially in the case of contractual agreements with private providers, municipalities must pay close attention to the clauses and the wording, as these also set the course for how data will be exchanged, accessed and processed. This does not only hold true for the administrative core team, but also for the cooperation with other urban actors. These principles should also be emphasised when dealing with organisations from the “Konzern Stadt” (e.g. municipal utilities). For this, the actors must be proactively involved, otherwise the implementation will be inconsistent and, in the worst case, bad contracts will be concluded. Such a situation can become a risk for the sovereign data handling of a municipality.

⁶⁴ Provided by the City of Vienna.

- **Established standards** should be used, observed and further developed in order to make systems and products compatible. Existing standards are very valuable for the process of platform development, because there is no need to reinvent the wheel when it can be so much easier. A UPD should be considered to be a part of a larger whole, a network. It does not have to be a local product only. To enable the future networking of municipalities, structures and standards must be established now to prevent the emerging of parallel, isolated solutions. Therefore, frequently used standards are the basis for a catalogue of requirements for data infrastructure solutions.

Consequently, the development of framework conditions, such as laws and ordinances, must be continued in order to create a common framework for action: “Legal foundations for collecting important data are lacking and so are nationwide registers the municipalities could get their data from, e.g. building registers. The legal, organisational and technical framework conditions for this must be discussed and designed in a continuous process between the federal levels,” demanded Dr Gustav Lebhart, CIO of the City of Cottbus.

- The application and use of **open-source components** ensure the sovereignty of the data platform architecture and accelerate innovations. The free or inexpensive use of existing modules is just one advantage of an open-source approach. More importantly, the quality of developments increases as well, and the exchange between many participants promotes innovations, since adjustments are possible at any time and without restrictions, unlike when using proprietary solutions. Of course, this does not mean that external providers cannot be assigned with assisting with integrating or “customising” a solution.
- **Start with use cases instead of procuring a complete solution:** Urban data platforms are complex systems. What is the point of a sophisticated platform infrastructure when there are no usage scenarios at the service level? The Sounding Board came up with a motto for this: “It is better to think big and start small”. Looking at a concrete use case should make it much easier for municipalities to start linking data in intelligent ways.

What data do we have, for example to enable integrated social planning? Which departments do we have to involve in order to connect data pools? Which specialist application software must be integrated? Thomas Eichhorn, CDO of the Agency for Geoinformation and Surveying, suggested to start a close dialogue with stakeholders: “We regularly organise data demand workshops or hackathons.” Such bottom-up approaches are geared towards the needs of the different stakeholders and their purpose is not only to practice the first steps of the “mechanics of the data platform”, but to also initiate other useful ideas.

- **Develop your own attitude and values:** Introducing a UDP should not just be the result of an idea that accidentally crossed someone's mind. This project needs thorough thinking. Internal discussions across departments are just as much a part of this process as is the definition of terms – and the municipalities should take sufficient time for this, both before the tender and during development. It is not just about architecture, it is also about the philosophy behind the platform. In Hamburg, for example, a working group developed an overarching, internal document that formulates basic considerations on the structure, the understanding and the city's demands on its UDP.

As data is a contentious issue, such a document will not only have a positive effect on knowledge transfer, but also on political debates and reliable system development.

- **Use existing networks:** Networks, e.g. working groups of the municipal umbrella organisations or the Fraunhofer “Morgenstadt Initiative” are perfect for exchanging experiences. This will help you

with the first steps, but also with technical discussions, the comparison of components and questions regarding applications. They are a good point of contact for the communities. In the end, they can also be vehicles for the overall project in order to improve (data) networking across borders. City networks, associations or communities of private providers also contribute to the transfer of knowledge.

- ➔ **Critical evaluation of the resources in the tender process:** A municipality needs great specialist knowledge for the tender. The process requires dedicated specialist knowledge that your own IT department might as well not be able to provide. If there are obvious knowledge gaps, external expertise is essential to avoid numerous errors that will become very expensive in the long term. However, when you just need a little inspiration or a boost, we recommend to consult examples from other municipalities, which can be used as blueprints. In this way, municipalities can avoid a lot of work. However, they should also reflect critically and not just copy.

The central questions raised are: What do we want to develop? Which resources do we need for this? The in-house IT capacity and the performance of the partnering municipal IT service provider are important parameters for possible types of implementation and should also be evaluated for a tender.

It remains to be seen whether comparing providers will help for deciding on how to implement: “In early 2019, we had the impression that the providers were exploring new territory as well. This was also reflected in enormous price ranges – there was no such thing as a stabilised level of offers,” said Sabine Meigel, Head of Digital Agenda Office of the City of Ulm.

5. Outlook and conclusion

The study has shown: Cities must **set the course for enhancing their data sovereignty**. Large parts of urban services of general interest are already based on digital technologies. This will increase significantly in the years to come. With growing data volumes and more and more real-time data, controlling the cities will also increasingly be based on data.

Cities must not leave the data-based control of urban resources, such as roads, to the private sector – otherwise Google will continue to decide whether traffic is directed through traffic-calming zones and which modes of transport are prioritised. Cities must negotiate in a much more proactive and sovereign way – and, ideally, not as individual municipalities but in groups.

Some cities are currently testing the use of algorithms and artificial intelligence and it will not be long before relatively new types of data use become part of our everyday life. This is a challenge for cities: The rapidly developing technological possibilities in the private sector run contrary to the traditional administrative processes – the cities need to establish **a spirit of innovation and create space for creativity**.

In order to remain sovereign, cities must be able to understand, use and adapt the new technologies themselves. This, in turn, requires highly qualified specialists, for example from the context of big data analytics, for whom cities have not been attractive employers so far – neither in financial nor in cultural terms. Nevertheless, designing a city in the interests of the common good can also be an interesting task for many specialists. The cities should strengthen their brand as employers and enable more flexible and innovative processes within the administration.

Additionally, the cities will be confronted with **new ethical questions** time and again. No city leader in Germany would want to introduce a social credit system such as the one in China, even if the necessary data was available for this. The ethical questions are often somewhat smaller: For example, how do you deal with data from social networks? Can they be used to control the city? The German cities are generally very cautious about this. In this respect, it is even more interesting that the City of Barcelona, as a pioneer in the field of data ethics, is feeding data from social networks into its “data lakes”. As this comparatively simple example shows, cities will be confronted with a multitude of ethical issues in the next few years. The sooner the cities create frameworks for such discourse, the better.

It is good news that the topic of data sovereignty is now being discussed intensively at various levels. For example, the second phase of the “**National Smart Cities Dialogue Platform**” focused on the topic of data governance.⁶⁵

Data strategies are currently being developed both at federal government level and at the level of many federal states. And at EU level, the **GAIA-X** project aims at creating an adequate infrastructural framework to improve data sovereignty in Europe. On their way, the cities will be able to rely on ever increasing resources, which is very important and very positive.

In the end, however, the city leaders, together with their administration, the municipal companies, the citizens, political and many other local actors will shape data sovereignty in their local context –

⁶⁵ See Federal Ministry of the Interior, Building and Community (November 29, 2019): Auftakt für die Zweite Phase der Nationalen Dialogplattform Smart Cities, <https://www.smart-city-dialog.de/aktuelles/baustaatssekretaerin-bohle-kuenstliche-intelligenz-und-staedtische-daten-governance-chancen-und-risiken-besser-verstehen>, accessed on January 14, 2021.

because the sovereign handling of data will grow in importance and become an essential basis of local self-administration.

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7.3 List of abbreviations

AG	Working group (Arbeitsgruppe)
AGB	General terms and conditions (Allgemeine Geschäftsbedingungen)
API	Application Programming Interface
BI	Business intelligence
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
CDO	Chief Digital Officer
CEP	Complex event processing
CIO	Chief Information Officer
CO₂	Carbon dioxide
CUT	Connected Urban Twins
DIFU	German Institute of Urban Affairs (Deutsches Institut für Urbanistik)
DIN	German Institute for Standardisation (Deutsches Institut für Normung)
DKSR	Data Competence Center for Cities and Regions (Daten-Kompetenzzentrum für Städte und Regionen)
GDPR	Regulation (EU) 2016/679 from 27 April 2016 of the European Parliament and of the Council on the protection of individuals with regard to the processing of personal data, on the free movement of such data and repealing Directive 95/46/EC (General Data Protection Regulation)
EDP	Electronic data processing
EU	European Union
GIS	Geographic information system
GmbH	Limited liability company (GmbH)
GUI	Graphical User Interface
IFG	Freedom of Information Act (Informationsfreiheitsgesetz)
ICT	Information and communications technology
INSEK	Integrated urban development concept (integriertes Stadtentwicklungskonzept)
INSPIRE Directive	Infrastructure for Spatial Information in the European Community
IoT	Internet of things
IT	Information technology
IWG	Act on the Reuse of Information (Informationsweiterverwendungsgesetz)
AI	Artificial intelligence

LGV	Agency for Geoinformation and Surveying (Landesbetrieb für Geoinformation und Vermessung)
LoRaWAN	Long Range Wide Area Network
MQTT	Message Queuing Telemetry Transport
M2M	machine to machine
OB/OBM	Senior mayor
OMD	Oficina Municipal de Dades
ÖPNV	Public transportation (öffentlicher Personennahverkehr)
OUP	Open Urban Platform
PDF	Portable Document Format
PoC	Proof of concept
PSI	Public sector information
RZ	Data centre (Rechenzentrum)
UDP	Urban Data Platform
UI	User interface
URI	Uniform Resource Identifier
WebGIS	Web-based geographic information system (see GIS)
VKU	Association of municipal companies (Verband kommunaler Unternehmen e. V.)
VPN	Virtual Private Network

Appendix

Data use clauses of the Cities of Bonn and Münster

The Cities of Bonn and Münster have developed the following sample specification. This is the draft version 0.4:

Sample specifications for municipal data sovereignty

Draft by the Cities of Bonn and Münster for a “sample specification for municipal data sovereignty” as a component for service specifications for procurement and awarding procedures for the coordination, regulation and securing of municipal data sovereignty.

1. Data rights

→ Purpose: Determination of the copyright holder -> especially for cloud services or common database rights for externally hosted processes

1.1 The copyright of the generated and processed data lies exclusively and indefinitely with the City of Bonn/Münster.

→ Purpose: Clarification of copyright and right of use -> Right of use only may not be enough, as rights can be withdrawn or expire when contracts are temporary.

1.2 The copyright includes the unrestricted and unlimited right of use of the City of Bonn to the data generated and processed. The right of use also includes the right to open data publication under a data license the City of Bonn/Münster may select freely, as well as any right to any further processing by the City of Bonn/Münster.

→ Purpose: Specification of order data processing and data outflow/subsequent use without the knowledge of the client

1.3 Use of the data generated and processed by the contractor must be agreed upon separately and in writing.

2. Technical data access

→ Purpose: To ensure that automated access to the data processed in the application is possible, e.g. for the connection of a data platform.

2.1 The technical data access (API) generally happens through an IT interface provided by the contractor. This interface must be usable in a productive way and for complete data access in machine-readable format. A format is machine-readable when the data it contains can be processed further in an automated manner. The data output should be provided with metadata.

2.2 The API follows a common standard (such as REST or SOAP) and can be used without additional, fee-based development systems.

2.3 Technically established and productively usable API standards (e.g. XÖV) are to be used with priority.

2.4 Detailed API documentation with an explanation of the functions is included in the offer price.

2.5 If an API cannot be offered, at least one machine-readable export option for the entire generated and processed data is to be implemented by the contractor.

→ Purpose: Software with an explicit open data interface promotes uniform data formats and simplifies the provision of open data. This strengthens the establishment and acceptance of open data in all specialist departments.

2.6 In addition to points 2.1 to 2.3, it is optional to implement an externally usable API or at least one data export with data protection-compliant and automated output of the content in machine-readable formats (external open data publication).

→ Purpose: Safeguarding a data migration: Raw data (complete database) as a safeguard, if the API is not sufficient for a complete data migration. The keyword here is to secure the data access when using cloud service providers/external hosting services.

2.7 Access or alternative provision of the raw data by the contractor is technically possible and included in the offer price.

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Further suggestions

- The requirements above should help to formulate sample specifications, which must be included in the contract to be closed.
- Large parts of sample specifications are tables and formulated in a way that makes it easy to assess an offer (yes/no or "fulfilled to XX percent"). In this way, different offers can be compared easily.
- Currently, the only API standards mentioned are general ones (SOAP, REST). A municipality that already uses a specific data platform that supports certain standards, can mention these explicitly, as the City of Hamburg did: https://geoportal-hamburg.de/urbandataplattform/HH_UDP-Schnittstellen.pdf

Justification

Why is that important?

A) Quotes from the PD study (<https://www.pd-g.de/ueber-uns/unternehmen/die-pd-als-impulsgeber/pd-impulse-datensouveraenitaet/>)

- **3.1.2.3** - Check the effects of IWG and PSI: Municipalities or municipal companies that enter into smart city contracts with the private sector, they are facing the challenge that they might violate regulations of the PSI Directive that must be transposed into national law by 2021.
- **3.1.2.4** - Include data sovereignty in tender documents. As municipalities are subject to strict procurement regulations, smart city services must usually be tendered. In the context of data sovereignty, this represents an opportunity: Those who formulate precise requirements for data sovereignty in the tender documents avoid legal uncertainty and possibly difficult renegotiations

(also in terms of public procurement law).

- ➔ **3.1.2.5** - Develop sample formulations and ensure internal use. The digitalisation of services of general interest in the smart city context is a topic that affects all areas of a municipality. Various departments use digitalisation in accordance with their specialist strategies and municipal holdings conclude contracts with smart city providers.

B) Quotes from Fraunhofer Urbane Datenräume 07/2018

(https://www.fokus.fraunhofer.de/de/fokus/presse/urbaneDatenraeume-Studie-Datenmanagement_2018_06)

- ➔ “Transfer of the existing municipal technical infrastructure into a standards-based infrastructure with open interfaces and formats according to a general ICT reference architecture”
- ➔ “Municipalities should actively promote the technical and organisational development of their urban data space. This should enable them to use their data sustainably for a variety of innovative services and to establish data sovereignty.”
- ➔ “Raising awareness for possible dependency problems (vendor lock-ins) and counteract such tendencies early on: Municipalities that rely on the technologies of a single manufacturer or operator when designing their technical ICT infrastructure, can create a dependency that will cost a lot of money and effort in the long term. Therefore, municipalities should take into account the aspect of openness when closing contracts for purchasing systems and products or when outsourcing services. They must be aware of the effects of vendor lock-ins.”
- ➔ “Minimising the data dependency on one provider”

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