

Connected Urban Twins

Clear plans for neighborhoods

Data and analyses on Munich's districts converge in a Digital Twin – opening new paths to climate neutrality.

Simulations at the desk

The 3D Project Planner makes construction projects in Hamburg tangible earlier on – along with their impact on the city. How does this change planning practice?

Better participation

Digital tools enable more citizens to contribute their perspectives to planning. Leipzig shows that this is a win-win situation for everyone.

Quick start for municipalities

All applications and tools at a glance
(from p. 48)



Three cities, one project

Urban Digital Twins are transforming urban development in Hamburg, Leipzig, and Munich. Other municipalities can also benefit from the experiences gained through CUT in the future.

Innovative tools for urban development



There's an image that has accompanied us through five years of Connected Urban Twins (also known as CUT): a printed city map with colored hatchings and notes in bright fineliner, a small handwritten legend at the bottom. For a long time, this was the reality of urban planning, where plans moved from desk to desk and only gradually took shape at the very end of a long process.

Urban Digital Twins are changing everything here. They revolutionize how cities plan their living spaces and how they can respond to citizens' needs. Printed maps are replaced by virtual city models that not only show the status quo but also enable "what if" scenarios. Instead of passing plans around, professionals now work asynchronously and agilely on a shared data foundation – a groundbreaking cultural shift in public administration.

Cities must find ways to cope with heavy rainfall and heatwaves. They must manage growth and densification without losing sight of preserving neighborhoods and valuable archi-

tectural heritage. Energy networks are being put to the test, and mobility, the economy, and work are changing. Administrations and authorities must make more decisions faster, and with fewer staff due to a shortage of skilled workers.

Urban Digital Twins can become a key technology here: for sustainable, liveable cities with diverse urban societies. It has been a tremendous privilege for Hamburg, Leipzig, and Munich to work together on these developments, put projects into practice over five years, and share our experiences. CUT started as the largest of the German Smart City Model Projects. The three cities will benefit from the results and new networks in the long term. But they are not the only ones: the knowledge, experience, and tools gained can also be used by many other municipalities in the future. This report intends to help make that happen.

Dr. Nora Reinecke Overall Project Lead
and Hamburg Project Lead

Mirko Mühlport Leipzig Project Lead

Felix Hörmann Munich Project Lead

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What are Urban Digital Twins?

How many daycare places are lacking in a growing neighborhood? What's the most effective way to cool hot spots in the city? Are important routes barrier-free – and where does the information about this come from? These are just some of the questions Urban Digital Twins can answer.

What is a Digital Twin?

Digital Twins bundle data about physical reality and use algorithms for analysis and simulation. In industrial applications, the goal is often to describe products completely virtually – to then optimize products and processes with the help of simulations, for example.

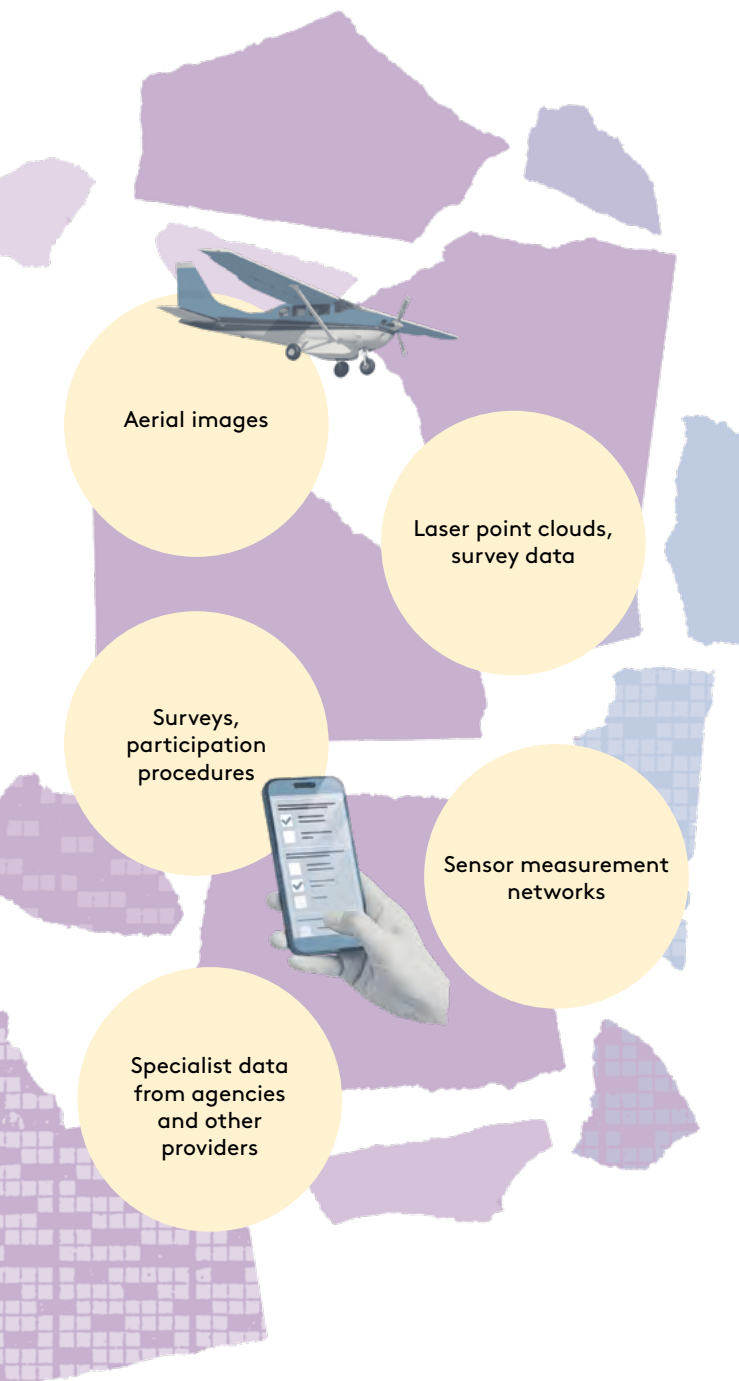
How do Urban Digital Twins differ?

A living city is too complex to capture entirely virtually. Depending on the application, an Urban Digital Twin shows a specific section of reality. It bundles digital resources – data, applications, or algorithms for analyses and simulations – to address urban development questions and enable better decision-making.

What criteria should a twin meet?

Urban Digital Twins are intelligent, realistic models of the city. They are trustworthy, reliable, and can be used to evaluate and simulate urban processes. Their goal is to foster the sustainable transformation of cities, making them more livable, resilient, and future proof. Responsibility usually lies with the municipality, which is also responsible for data protection and information security. Urban Digital Twins are designed to be accessible and understandable for their target audiences. Open modules allow them to be transferred to other topics and locations.

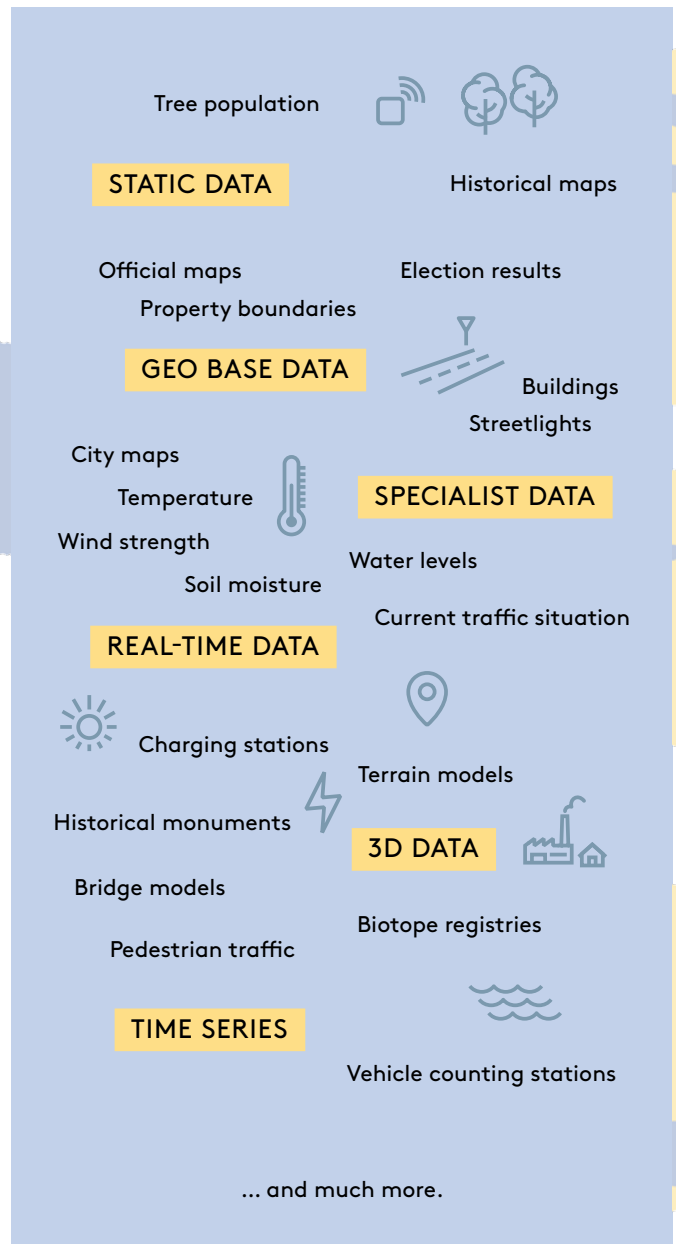
How Urban Digital Twins work



Collecting data

From address registers to 3D city models, from street trees to glass recycling containers, from biotope boundaries to charging stations: municipalities maintain a wide range of information about the city.

URBAN DATA PLATFORM



Publishing data

Structuring this treasure trove of data and making it available in a standardized way is the task of Urban Data Platforms. These platforms can extend existing geodata infrastructure, for example by integrating real-time data. They also define interfaces and metadata, as well as the legal framework for use.

URBAN DIGITAL TWINS

Example: Hamburg

Coordinating major events more easily

In the digital twin of a major event, planning is done collaboratively: Building Information Modeling (BIM) enables participants to exchange information directly on the object. Information and comments on individual trades can be discussed and different planning scenarios compared.



Christine, a firefighter, checks evacuation routes in the virtual model.

Fairground operator Joscha provides information on the space requirements and noise emissions of his ride.



Example: Leipzig

Creating daycare places close to home

The digital twin brings together data on population trends, daycare capacities, and construction planning – as a dashboard and as a basis for forecasts.

Youth welfare officer Carlo forecasts next year's daycare occupancy.

Mara, a planning officer, simulates the daycare demand in a new residential district.

Example: Munich

Planning energy-efficient neighborhood development

Climate protection begins in the neighborhood. A neighborhood development tool brings together all the important information – such as heating infrastructure and green space provision, monument protection, and subsidized housing.



Urban planner Seynep visualizes scenarios for green roofs.

Harnessing data

Urban Digital Twins bundle digital resources along a specific use case. With the help of analysis tools, they make data usable for various users and generate added value for the city.

Feedback

Data from the Urban Digital Twins flow back into the Urban Data Platform. It will be available for further applications in the future. For example, if various scenarios for heavy rainfall events are simulated in a digital twin, the results can then be used both for planning evacuation routes in urban areas and for new construction projects.

What is CUT?

Connected Urban Twins (CUT) is a nationwide unique smart city lighthouse project of the cities Hamburg, Leipzig, and Munich. Experts from administration, municipal enterprises, and research institutions jointly developed Urban Data Platforms and Digital Twins over five years. With a project volume of €32.4 million, CUT is Germany's largest Smart City Model Project.

The project focuses on the further development of the digital infrastructures and competencies of cities and municipalities in dealing with Digital Twins and, in connection with this, strengthening their technology and data sovereignty. To this end, research projects and innovative use cases as well as formats for communication and knowledge transfer were developed and implemented – with the aim of sustainable integrated urban development and better citizen participation.

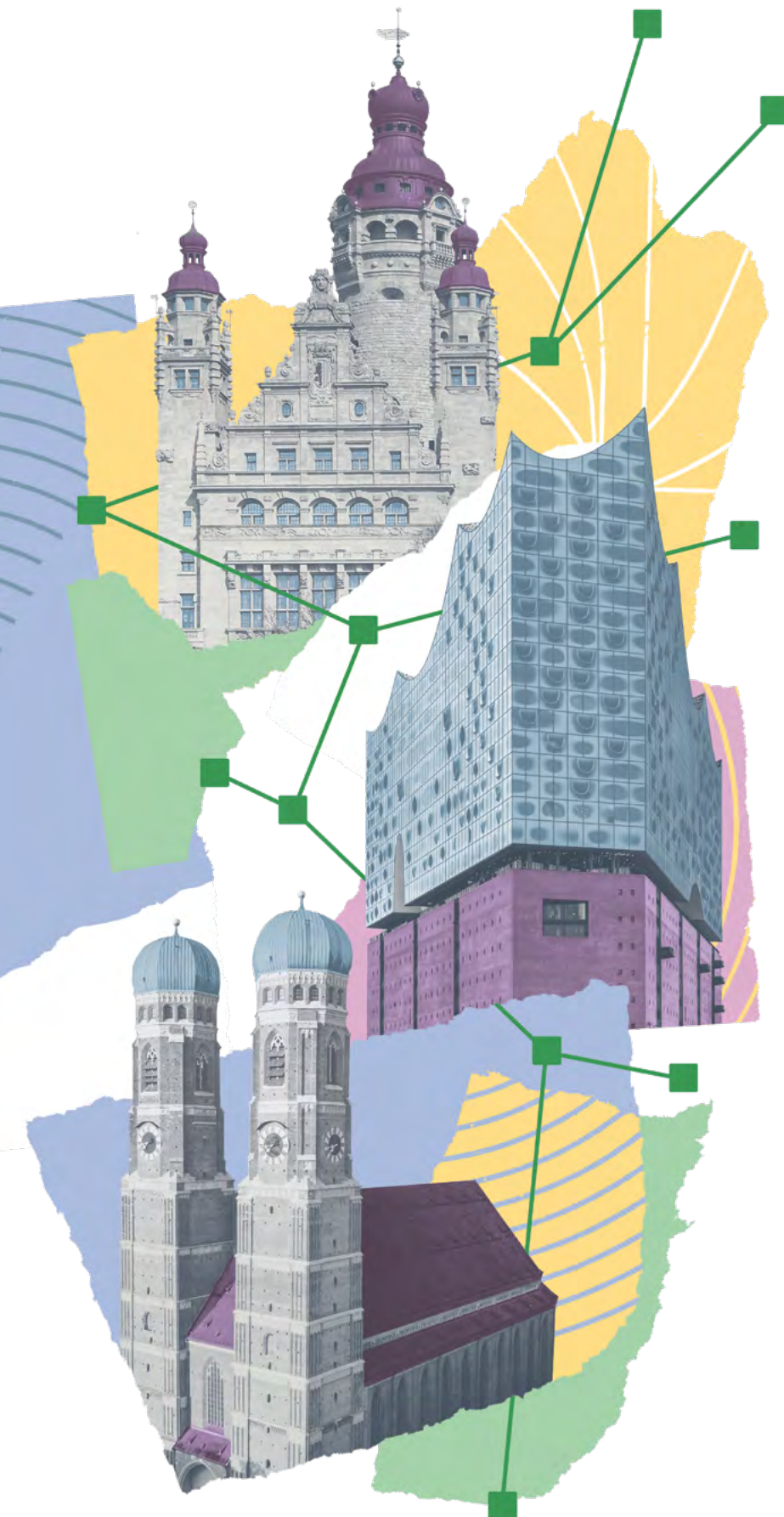
Standards and Open Source technology

The exchange of experience and knowledge across cities has resulted in a number of solutions that can serve as models for the future. These include a nationwide standard for Digital Twins in cities and municipalities: DIN SPEC 91607 provides a comprehensive basis for effectively implementing Digital Twins while drawing on existing foundations and best practices (p. 17). In addition, the project has developed a series of technical components for data platforms and Urban Digital Twins, which will be published as Open Source solutions.

Quick start for municipalities

How can cities build the necessary data infrastructure? Which framework conditions must be clarified in advance? The project addressed these questions in various knowledge transfer formats. The findings are documented in videos and presentations as well as various handouts and publications – a quick start for cities and municipalities that are new to the topic (p. 48).





Urban Data Platforms and Digital Twins

Further development and operational use of replicable Urban Data Platforms and Digital Twins.

Innovative applications in urban development

Testing of Urban Data Platforms and Digital Twins in current use cases in urban development.

Participation of urban society

Co-creative development and use of innovative digital participation formats, instruments, and procedures.

Transformative experi- mental urban research

Linking technology research with social science research on Urban Digital Twins.

Replication and knowledge transfer

Internal project knowledge management, supra-regional knowledge transfer, and exemplary replication of project results.



INTERVIEW

Working together for future cities

Europe's cities are reinventing themselves as sustainable, safe, and livable metropolises. In the CUT project, Hamburg, Leipzig, and Munich are exploring how Urban Digital Twins can contribute to this transformation. A conversation with the project leads Dr. Nora Reinecke, Mirko Mühlport, and Felix Hörmann.

ABOUT THE PEOPLE

Dr. Nora Reinecke

has a PhD in Geography and is a project manager with over 15 years of professional experience. She currently works at the Office for IT and Digitalization in Hamburg's Senate Chancellery, serving as CUT's overall project lead as well as the Hamburg project lead.

Felix Hörmann

is a geographer and has been responsible for smart city and digitalization issues in the Department of Urban Planning and Building Regulations of the City of Munich since 2018.

Mirko Mühlport

is an industrial electronics technician, economist, and administrative scientist with more than 15 years of experience in transformation projects. He heads the Urban Data and Digital Infrastructures department in the Digital City Department in Leipzig and coordinates the city-wide Digital Twin program.

Cities are growing worldwide – including Hamburg, Leipzig, and Munich. How is this changing urban development?

Felix Hörmann Urban space is scarce. We already must accommodate more and more planning requirements in the same areas. Climate change makes this even more urgent – with heavy rainfall, heatwaves, as well as the demand for recreation and high-quality public spaces.

Mirko Mühlport We're all observing the necessity of multiple uses of land. That brings great complexity into administration, because many different departments often lay claim to the same areas. This slows processes and makes decisions even more complicated. We need to escape the "complexity trap".

What role do Urban Digital Twins play in this?

Nora Reinecke They improve decision-making capabilities. Urban Data Platforms and Digital Twins take data out of silos, layer it, connect it, make it accessible for visualization and analysis. Suddenly, different departments see the same picture for the first time. And on this basis, they can work together.

Mirko Mühlport In practical terms, this means moving from a text-based discussion of a topic to a level of visualization and simulation. Topics become more tangible, more accessible – and that helps to avoid mistakes and conflicts. These large, illuminated planning tables are our new campfires (laughs).

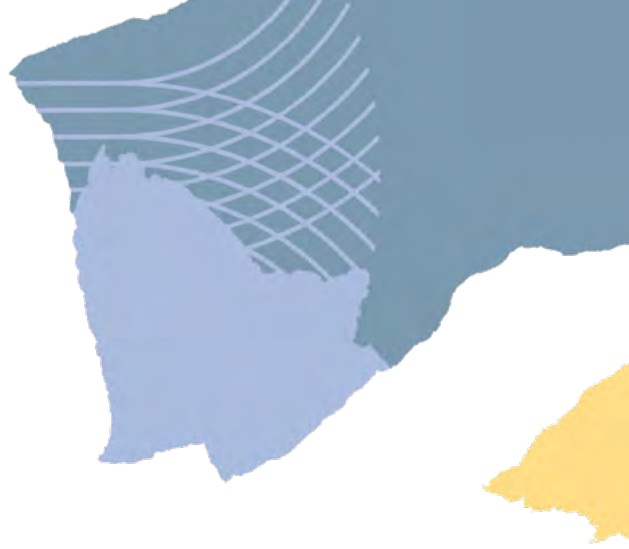
Felix Hörmann Simulations are a crucial topic. Twins make it possible to try things out in the virtual city. How does the climate in a neighborhood change when we alter the vegetation? How does a new building affect noise, wind, or shading? For a long time, evaluations on these topics were circulated in print form within the administration. Today, all planners can use Open Source infrastructure to perform climate simulations for their neighborhoods, make adjustments in the 3D city model, and calculate the effects. That's sensational.

Nora Reinecke With the help of twins, we can think in scenarios in a completely different way, and not just speculatively, but based on evidence – in some cases with real-time data. To put it bluntly, we simulate virtually instead of pouring assumptions into concrete. I see a lot of potential for development here.

Looking back, how does CUT differ from other Smart City Projects?

Nora Reinecke We benefit enormously from having developed a modular system together in which we can share data, analysis, and simulation tools. We started out as Germany's largest Smart City Project, and I can say that what has been created here not only helps our own cities but will also be effective in many other cities and municipalities. Starting with the standards, through the [multitude of use cases](#), to the [publications and Open Source solutions](#) (p. 48). >

“This exchange advances us as cities, but also the topic as a whole. It is clear to us that we must continue this path. And that the end of the project period is only the beginning of the development.” **Felix Hörmann**



Mirko Mühlport We started the project with a great deal of freedom, thanks in part to the trust placed in us by the funding agencies. The fact that experiments were possible here, across city and disciplinary boundaries, and with our scientific partners, ultimately led to us becoming a true development community. We cooperate on fundamental issues such as standards and strategies – but also very specifically in use cases, technical development, research, and knowledge transfer.

Felix Hörmann In practical terms, if I have a question, I call a colleague – and sometimes only realize in the second step that she's not even based in Munich (laughs). This exchange advances us as cities, but also the topic as a whole. It's clear to us that we must continue this path. And that the end of the project period is only the beginning of the development.

Where can municipalities start if they want to adopt Urban Digital Twins themselves?

Mirko Mühlport I mean this quite seriously: send us an email, give us a call, talk to us at an event, or watch the tutorials in our CUT Academy (p. 45). The most important questions to ask at the outset are: What shared infrastructure can I draw on? And where can I find partners for knowledge and technology?

Felix Hörmann In some smaller towns and municipalities, there is a feeling that this is too big a task for us. Or that we don't need it here. My response to that is: if you don't act yourself, the issue will catch up with you at some point. For example, with municipal

heat planning or EU requirements for building and housing registers. We need nationwide standards here, because these are challenges that no one can tackle without digital infrastructure.

Nora Reinecke I'd say: just do it (laughs). Seriously! Whether it's a small municipality or a big city, it always starts with the question of what I need. What is my problem, what is the specific use case? To put it simply: if I live on a river that floods, flood scenarios are particularly relevant to me. For this, I need geodata provided by the state agencies and simulation models that are also available as Open Source. There is a lot of empirical data available here, and you can quickly arrive at a practical solution without having to develop new infrastructure yourself.

You've been working on Urban Digital Twins together for five years now. What added value do you see in your cities and administrations?

Mirko Mühlport Let me give you a concrete example: In the past, two offices in Leipzig used Excel spreadsheets to plan the utilization and expansion of daycare centers. This is now done in a Digital Twin. When you overlay the data, you realize that we will need some capacity in other areas in the future. Urban Digital Twins will save millions in the future because there will be fewer planning errors.

Nora Reinecke In the offices, applications like the [3D Project Planner](#) (p. 19) speed up planning. Previously, plans were printed, annotated, scanned, and then



printed again by the next department. Those days are over – saving time and money. Planning also becomes more efficient because many departments can work on a draft simultaneously.

Felix Hörmann As the work efficiency of individual planners increases, the job becomes more attractive because it is more holistic. As a planner, I now work in neighborhood development in an agile team. I have tools at my disposal that I can use to develop and simulate climate and energy scenarios. This is associated with a cultural change that amounts to a minor revolution. But it also follows a bitter necessity. More apartments are to be built nationwide – but skilled workers for cities and building authorities don't just fall from the sky. In the future, we will have to make more decisions with fewer people. To ensure that this can be done with the same quality, we need digitalization and, in particular, Urban Digital Twins. >

“We started the project with a great deal of freedom, thanks in part to the trust placed in us by the funding agencies. The fact that experiments were possible here, across city and disciplinary boundaries, ultimately led to us becoming a true development community.” **Mirko Mühlport**

“Urban Digital Twins help make better decisions – and at the same time show why certain decisions were made.” **Nora Reinecke**

Where do citizens and urban society experience the possibilities of Digital Twins?

Mirko Mühlport Our goal is to involve citizens as active experts in the development of the city. The first step is to lower the threshold for participation. In other words, we don't just want to reach the professionals who are confident enough to speak into the microphone at an event. We also want to reach those who may be thinking about issues at home and then write a comment online. In the competition for the [redesign of Matthäikirchhof](#) (p. 34), for example, we had many more perspectives in the process – by combining events here at the Smart City Lab Leipzig with digital tools for participation, such as a VR application. This is a win for citizens, architects, and for the administration.

Felix Hörmann Our experience is that simulations and visualizations can make processes much more objective – for example, when it comes to climate protection or the planning of roads and bike paths. It becomes easier because content becomes tangible and easier to communicate.

Nora Reinecke Urban Digital Twins help us make better decisions – and at the same time, they make it clear why certain decisions were made and not others. I am convinced that this transparency strengthens our democracy. Because when the reasons behind urban planning decisions become more transparent, everyone involved benefits – even if the outcome does not meet their own expectations.

What comes next in your cities – what are you taking from CUT and what's on your current agenda?

Felix Hörmann We will definitely continue to work on the neighborhood development tool mentioned above. We have received various requests to integrate topics such as waste management and urban drainage. This is part of the development toward a new data culture characterized by give and take. In addition, we will digitize further urban development processes on a case-by-case basis, based on our Digital Twin action program established by CUT.

Mirko Mühlport In Leipzig, we have also introduced a twin program, which various specialist departments and disciplines are continuing to work on. The role of application manager, which was created in the CUT project, has become firmly established in the development of Digital Twins. It is important to continuously develop the underlying data infrastructures and secure the necessary resources. We are now continuing to work on this solid foundation in specific use cases, in neighborhood and economic development, climate protection and adaptation, the heat transition, mobility, and participation – right through to the Council Information GPT and Digital Twins in application processes. I still see huge potential here, and we will stay on the ball.

Nora Reinecke In Hamburg, the project gave us the opportunity to redevelop Digital Twins, explore new areas, and gain valuable experience – and we have gone far beyond the original project goals. In Hamburg, this will form the basis for a twin ecosystem that will link the multitude of current and future activities even more closely together – across disciplinary boundaries and authorities and in close cooperation between the administration, politicians, and urban society. The partnership-based exchange with Munich and Leipzig was a real catalyst for this: we inspire each other, develop transferable solutions, and show what strong inter-municipal cooperation can look like. We are determined to continue this special form of cooperation. We are ready for CUT 2.0.

Shaping urban transformation with Digital Twins

Connected Urban Twins shows how cities can work together to develop data-based solutions. The steering group of the three project partners, together with the funding body, the Federal Ministry of Housing, Urban Development, and Construction (BMWSB), provided strategic support for the project and provided key impetus. Here, the representatives explain the role that Digital Twins play in climate-resilient, participatory, and modern urban development.

Renate Mitterhuber, Head of the Smart Cities Division,
Federal Ministry for Housing, Urban Development and Building

"Connected Urban Twins shows how strategic urban development succeeds in a modern digital administration: through networked thinking, open data spaces, and inter-municipal cooperation. CUT, one of our flagship projects in the Smart Cities funding program, has not only created digital tools but set benchmarks – for innovative, forward-looking, and public-good-oriented urban development."



Christian Pfromm, Chief Digital Officer of the Free and Hanseatic City of Hamburg

"In the CUT project, we developed new digital tools for Hamburg's administration and urban development – and in the collaboration learned how Digital Twins support administrative modernization: data-based, interoperable, scalable. Their potential unfolds above all when cities learn from one another and develop together."

Dr. Beate Ginzel, Head of the Digital City Department, Leipzig

"Digital Twins are key to public welfare-oriented and sustainable urban development in Leipzig. The applications developed in the CUT project help us to manage infrastructure restructuring, simulate scenarios, and set data-based climate targets. In this way, we create planning foundations that are transparent and resilient."



Dr. Laura Dornheim, Chief Digital Officer of the City of Munich

"With CUT, we have used innovative participation processes and new applications to test how the Munich Digital Twin makes urban development more understandable and accessible – especially in a large city like Munich with complex structures. When citizens can contribute their ideas and help shape the process, digital urban development becomes more equitable and effective. Inter-municipal cooperation was a key driver of innovation in this process."

Data and standards



Whether from surveys or sensors, from precise street measurements or climate simulations – standardized data provide the foundation for Urban Digital Twins. Through the CUT project, a core infrastructure has been developed to unlock valuable city data – and to establish a standard for Digital Twins.



Learn more:
connectedurbantwins.de/en/data



One standard, many applications: Leipzig's digital street space model in web view (above) and automated quality assessment of bike paths in Hamburg.



Describing street space logically – with semantic 3D City Models

It's all about lanes and directions of travel, modes of transport and intersections, traffic lights and much more: the CityGML standard from the internationally recognized Open Geospatial Consortium (OGC) enables three-dimensional road spaces to be described precisely. The new version 3.0 was developed in collaboration with CUT-compatible semantic city models were implemented for Munich and Leipzig as part of this process. These can be used, for example, to calculate routes or model planning scenarios – such as how converting a car lane into a bike lane would affect traffic flow.

Citizens contribute data – enabling municipalities to use it securely and in the long term

On the online platform “beteilige.me,” citizens report sealed surfaces, and in the FairCare Verkehr project, parents or caregivers document their everyday mobility. In this way, local experts create valuable georeferenced qualitative data – also at events such as sensor walks in Leipzig. Based on these experiences, a CUT working group is developing recommendations for local authorities on how the findings can be integrated into Urban Digital Twins in the long term – and how local authorities can process data securely and anonymously.

DIN SPEC 91607: a nationwide standard for Urban Digital Twins

Two years of work for a common standard: On the initiative of the CUT team, more than 40 experts from administration, associations, science, and industry have developed a comprehensive basis for the implementation of Urban Digital Twins. Important core elements are the architecture graphic and a description of the technical capabilities of the components. In addition, around 100 usage scenarios have been compiled from the participating municipalities, which the working group has translated into use cases. These facilitate the entry into the development of Digital Twins.



Urban planning

Text — Nicholas Brautlecht
Photos — Michael Kohls

made



Hamburg

With its innovative 3D Project Planner, Hamburg is breaking new ground in how construction projects and ideas are visualized. Using simple 3D models and simulations, urban planners can coordinate across departments – and citizens can also have a greater say.

easy



G Good ideas often arise when different perspectives come together: Two urban planners in Hamburg strike up a conversation about a tool that would make their daily work easier. How practical would it be if, in the future, not only technical drafters but everyone in the administration could visualize structural changes much earlier on?

A few weeks later, in fall 2022, this wish takes shape: initial concepts for the 3D project planner are developed, made possible by the Connected Urban Twins project. The goal: to sketch construction projects and initial urban development ideas in 3D and enable simple what-if scenarios – based on geodata, without great effort or special technical expertise.

The challenges in urban development are significant: housing shortages, conflicts of use, the climate crisis, and new consumption habits. In a dense, historic city like Hamburg, such issues often must be solved on a local scale – with a view to individual neighborhoods, streets, and buildings, and the people who live in them.

▲
Making changes tangible: What used to be possible only with a wooden model of Hamburg (above) can now be achieved with 3D Project Planning software.

Hamburg is home to 1.9 million people – with just as many perspectives on the city,” says Helen Winter, project manager for the 3D project planner at the Ministry of Urban Development and Housing (BSW). “Our job is to shape this into a livable whole.”

Visitors to the ministry pass a huge wooden model of Hamburg in the entrance hall. The 1:500 scale model was built by model makers and carpenters and has been updated repeatedly since then – because until recently it was one of the few ways of making changes to the built city tangible. Today, computer-aided design (CAD) allows for more flexibility in planning. However, this requires expensive and hardware-intensive computer programs as well as experts to operate them.

One link, one click, one beginning

This is exactly where the 3D project planner comes in, which went live in its first version less than twelve months after the planners’ initial meeting: as a new toolbox for working in 3D, it is integrated into the open geoportal for municipalities initiated by Hamburg – the

Masterportal. The goal: to break old routines and overcome departmental boundaries. Access: a simple link. No expensive software, no training required. “Anyone who is reasonably digitally savvy can get started right away,” says Winter, who focused on urban development and digitalization during her studies in economic geography at RWTH Aachen University. “The perspective is somewhat reminiscent of well-known map apps – only enriched with specialist data and based on sophisticated urban infrastructure.”

Within minutes, any district employee can sketch roof structures at their workplace or import architectural designs as 3D data. Buildings can be demolished virtually, shadows and sightlines can be checked, and spatial contexts can be played through and evaluated. With a click, you can switch from a bird’s-eye view to a pedestrian’s perspective. “No one has to kneel in front of a wooden model anymore,” says Winter.

Soon, the tool will also simulate noise – for example, to find the optimal placement for a new school building that does not amplify traffic noise for neighboring allotments compared to the original construction. “Our colleagues have experience, but with this tool, they can substantiate their assumptions,” says Winter. It does not replace an expert opinion – but it does provide a sound basis for evaluation at an early stage.

Short path to prototypes

This also helps professionals, as Winter reports – she talks about an early planning meeting for the new Diebsteich long-distance train station. It’s about the basics – how do the designs look in the surroundings, is the height right, does it create a harmonious picture? For an initial assessment, the draughtsman responsible simply loaded the 3D data from three designs into the application, took screenshots with the surroundings – done. Again, this is no substitute for professional software, but it does make things much easier in the early stages.

The 3D project planner is designed to bring greater speed and flexibility to administrative processes, facilitate coordination, and save costs. Initially, these ambitious goals were met with a modest start-up budget: with around €80,000, the core team led by

Winter and her BSW colleague Mateusz Lendzinski developed the prototype with the support of two developers from IT service provider Dataport. It was important to quickly create “something clickable,” says Winter, in order to gather feedback and clarify requirements more easily. After the test round, the project continued with a larger budget and the Landesbetrieb Geoinformation und Vermessung (LGV), Hamburg’s central geodata service provider, on board, with a new front end, more flexible geometries, and usage-related 3D data.

“The cool thing in Hamburg: all geo-data applications run on the same technical base,” says Winter. So the planner can be easily integrated into other applications via the Masterportal – with no new software costs. “That creates incredible synergies.” >

Urban Model Platform makes simulation models accessible

Simulations can determine how green roofs improve the urban climate or how smart traffic lights affect traffic. The Urban Model Platform (UMP), developed by the Hamburg State Office for Geoinformation and Surveying and the City Science Lab at HafenCity University Hamburg, taps into the potential of models stored in data silos at public authorities, universities, and companies. A wide variety of model servers are connected to the UMP, whose algorithms can be accessed via standardized interfaces and integrated into applications such as the 3D Project Planner. The UMP has been in operational use in Hamburg since 2025 – as the basis for integrated what-if scenarios.

► Just a click away: the application runs on every laptop in the public authorities.





▲ Virtual and in reality: the building of the Ministry of Urban Development and Housing in Hamburg Wilhelmsburg.



Turning data into tangible images

One example of how this concept has been applied is the Inner city specialist portal. Based on telecommunications data, this portal shows, among other things, how many people stroll through the city center. “This gives us a better understanding of the downtown area and allows us to develop targeted measures,” says product owner Daniel Kulus. Thanks to the 3D Project Planner, it is now possible to see how people flows and building usage interact. “The photorealistic representation of the digital city model helps citizens to find their way around the city center more easily. The ability to view building uses such as residential, shopping, or services in the 3D model is also a real bonus,” he says.

How can city centers remain vibrant and diverse? This is the question addressed by the “Hidden Potential” project, which is funded by the federal government and co-financed by the city of Hamburg. The goal is to broaden the often-technical dialogue on urban development. The 3D Project Planner is also helpful in this regard. At the monthly “After-work Apéro” in the Raum zum Stadtfinden (Space to Find the City) – the project’s central contact point – experts meet citizens and use the tools in the specialist portal Innenstadt to

translate figures and technical language into tangible images.

What began as an informal conversation between two practitioners is now a tool that strengthens the creative possibilities of urban planning in Hamburg. And Helen Winter is certain that there is even more potential. A noise simulation is already in the planning stage, and wind simulations are also set to be incorporated into the city’s Urban Model Platform, which means they could also become available for the 3D Project Planner. This is not a finished product, but a growing tool. Its strength lies in its current application – and in what is still possible. *Seine Stärke liegt in der Anwendung heute – und in dem, was noch möglich ist.*



Learn more:
connectedurbantwins.de/en/3dprojectplanner

Simulations for the city

Why is public data a strategic advantage – and what Hamburg plans to do with them. A look at the potential of simulations in city-wide use.



Helen Winter is responsible for innovative urban development use cases within CUT in Hamburg.

1 – Why does it help planners to be able to create their own simulations?

Our intuition and professional expertise are a good start. But only through simulations and visualizations does feeling turn into understanding. Then we can validate or disprove assumptions with real data – and make informed decisions.

2 – How can the shared use of simulation models work in practice?

The Urban Data Platform is Hamburg's data hub. It is connected to the Urban Model Platform, which will also make simulation models available for various applications in the future. An example: our noise models, previously intended for building construction projects, are also of interest to the environmental authority – for strategic noise mapping in the annual noise action plan. That's the key point: sharing models and even integrating commercial models into our own applications via our infrastructure – without having to purchase external software. This makes Hamburg a pioneer nationwide.

3 – Why is it important that data remain publicly owned?

Commercial data are often only available temporarily and bound by license terms. Data we as a municipality collect and own are under our control. Many of them we also provide as open data, enabling reuse – under the motto: Open Data – Open Government. This way, they can benefit many fields of urban development, not just one narrow application.

FOCUS

Technology and innovation



Artificial intelligence, smart building models, and virtual worlds: in Urban Digital Twins, future technologies are put into practical use. Three examples of how data collection and visualization are changing – and how better collaboration in the city becomes possible.



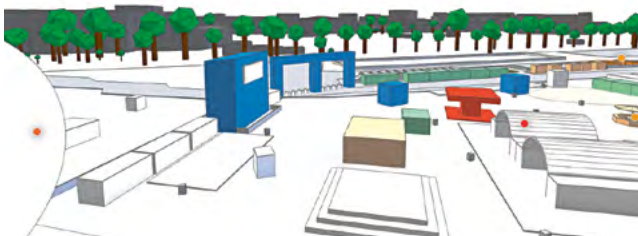
Learn more:
connectedurbantwins.de/en/technology

Experiencing urban space virtually: From VR prototype to visualization platform

Whether bridges, streets, or buildings: virtual reality simulations can make construction projects more tangible for both professionals and laypeople. In the CUT project, Hamburg Port Authority (HPA) developed an extensive VR prototype – the basis for replication in Leipzig, where users can, for example, walk through the historic and current old town. Real-time environmental and mobility data can also be integrated. The next step: a multi-user VR visualization platform for the entire city, developed by the State Office for Geoinformation and Surveying Hamburg with support from the City of Leipzig.



Where does the stage fit in here?
3D view from the planning tool.



Better with BIM: planning large events using Building Information Modeling

Big cities are great places to celebrate. This means that many authorities and companies are involved in the planning and approval of fan zones, concerts, and public festivals. The BIM-based coordination platform developed in the CUT project visualizes the planning status live in a 3D view – supplemented by all important information. Integration into the City of Hamburg's Digital Participation System (DIPAS) also allows participants to collaborate online.

Beautiful shadows: Hamburg's
Elbe bridges in VR – and at
different times of day.

City model: AI support for planning and administrative knowledge

How many parking spots are in a street? How many floors do the buildings have? In older cities, such basic data are often missing and must be gathered manually. AI could take over in the future. CUT research partner ScaDS.AI Leipzig developed two prototypes: one that semi-automatically counts building floors from geolocated photos, and one that analyzes parking. A third AI prototype searches Leipzig's council information system and reveals thematic connections between resolutions and submissions.



Tomorrow's neighbor- hood

Text — Sandra Will

Photos — Julian Baumann

develop- ments



Munich

Anyone planning sustainable neighborhoods needs reliable data. As part of the CUT project, the city of Munich has implemented a neighborhood development tool that bundles information for specialist planners, making their work easier. A visit to the pilot neighborhood.

The three large backyards in southwest Munich are reminiscent of an urban Garden of Eden: tall pine trees and old apple trees cast shadows on the green lawns, birds chirp around the playgrounds, and roses, tomatoes, and sunflowers planted by residents grow next to some of the house entrances. The neighborhood on Hinterbärenbadstraße would be a prime example of urban living in green surroundings – if it weren’t for all the challenges that come with a housing estate from the 1960s: lack of accessibility, car-centric infrastructure, and poor energy efficiency due to gas stoves.

Those responsible at the municipal housing association Münchner Wohnen, which maintains most of the buildings in the seven-hectare estate, also realized that something had to change – and contacted the Department of Urban Planning and Building Regulations. “The buildings are in dire need of renovation, so it was clear that action was needed,” says Robin Zöllig, who is the project manager responsible for Hinterbärenbadstraße. “But before we draw up a concept, it is important to know the framework conditions.” To do this, the exact area must be defined and an inventory taken.

Urban but green:
the Hinterbärenbad-
straße neighborhood
in southwest Munich.



Livable, climate-neutral, and resilient neighborhoods

“For a well-founded initial assessment of neighborhoods, we need a lot of data from the various departments of the City of Munich – for example, on energy consumption, urban climate, mobility options, owner and population structure, and other planning law basics,” explains deputy project manager Verena Menzinger, who, like her colleague Robin Zöllig, is responsible for climate-neutral urban development planning. “So in the past, we had to make individual inquiries to different departments.” This can lead to time-consuming research when it is unclear whether and where specialist data is available. “In smaller communities, the number of employees may be manageable, but with around 45,000 employees in Munich, you can’t just knock on someone’s door and ask,” says Verena Menzinger. Once they have the information, some of the data sets are not up to date or are only available in different file formats.

The fact that so much different data is needed is also linked to Munich’s goal of becoming climate neutral by 2035 – ten years earlier than the whole of Germany. The integrated neighborhood approach for climate-neutral, climate-resilient, and livable



▲ With a sustainable plan: Project Manager Robin Zöllig onsite.



▲ Healthy neighborhood garden: Citizens' wishes are also incorporated into the planning.

neighborhoods is intended to contribute to this goal alongside city-wide measures. “In the integrated neighborhood approach, we consider more than just one specialist topic – that is, we don’t just want to modernize or renovate the building stock, but also promote climate-friendly mobility and create green, high-quality open spaces that are necessary due to climate change,” explains Katja Drüssler from the Geodata Service of the Municipal Department, who is responsible for Urban Data Platforms and Digital Twins as part of the CUT project. “The idea behind the CUT project was to develop Digital Twins of the city of Munich not on the basis of technology, but on the basis of use cases. The first case was based on the requirements of the Department of Urban Planning and Building Regulations – and so we started in 2022 with a Digital Twin for climate-neutral neighborhood development,” says Katja Drüssler. The system builds on the city’s existing geodata infrastructure, which makes data centrally available to all departments and processes and analyzes it in interaction. “Our initial goal was to make complex relationships easier to understand with the help of dynamic maps, profiles, and interactive dashboards. The various visualization tools can now be used to address different stakeholders, such as

decision-makers at the planning or political level,” explains Katja Drüssler, who became the product owner of the so-called Neighborhood Development Tool (Quartiersentwicklungstool, QET) during the development phase, with Verena Menzinger as the technical contact.

Making data accessible

With the help of the QET, Robin Zöllig can now see with just a few clicks that the population in Hinterbärenbadstraße tends to be older and the income tends to be low. The apartments, with an average size of 40 to 45 square meters, are also small and in very poor condition in terms of energy efficiency.

But before the tool could be used for the first time, it was a long process, as Katja Drüssler explains: “We had to consult with the data owners on many data sets and clarify who would have access and whether the data could be imported into the geodata infrastructure.” A great deal of communication was necessary to establish a culture of data sharing – and to clarify how data could be made available in a meaningful way. >

Building reeager as the basis for integrated urban development

Interoperable, comprehensive, and up-to-date building data is an essential basis for interdisciplinary, integrated urban development. Through its digital building register, the state capital of Munich has created a uniform database of buildings in recent years. This has established an essential prerequisite for, for example, the planning of climate-neutral neighborhoods or urban development monitoring.

“QET brings the benefits of digitalization closer to specialist departments. It simplifies processes, improves data exchange, and streamlines coordination.” **Andreas Schlagbauer**

Andreas Schlagbauer from the Department of Urban Planning and Building Regulations also had to learn this. He is responsible for developing use cases in the CUT project and took over the role of product owner from Katja Drüssler during the course of the project. He says: “QET brings the advantages of digitalization closer to the specialist departments. It simplifies processes, improves data exchange, and streamlines coordination.” The tool evaluates data – for example, from the central building register that was created within CUT – in a subject-specific manner and puts it into context so that it is also available to specialist planners at a low threshold, without in-depth software knowledge. “Specialist planners don’t need raw data, they need results. They want to draw in an area and immediately know how many residential units and how many residents there are,” explains Andreas Schlagbauer. In the future, monitoring will also make it possible to evaluate implemented measures beyond the analysis – this increases transparency for the city council, the departments, and the public. “This allows us to show how much CO2 a neighborhood has saved and that it is worthwhile to implement a concept,” explains Andreas Schlagbauer.

Exemplary development project

In the neighborhood around Hinterbärenbadstraße, Robin Zöllig and his team have already identified several other construction sites in addition to the existing buildings, such as the four-lane road in front of the local shops, which forms the center of the neighborhood but is not exactly inviting to linger.

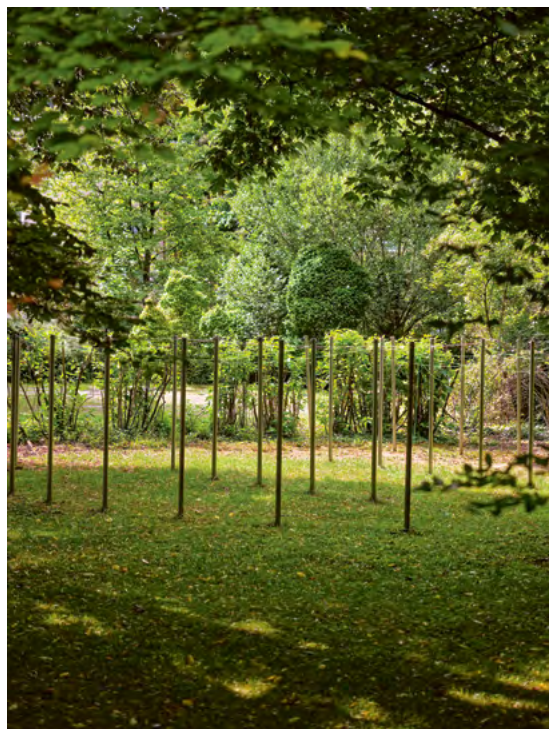


Green with a big impact: Shady parks and squares help make neighborhoods more climate-resilient – and so does this courtyard in the Hinterbärenbadstraße neighborhood.

Creating living space is also a major issue for the municipal housing association. “With the QET, we can see whether there is a development plan or other specifications for floor heights. However, if we add additional stories, we also want to involve the older residents who have lived there for a long time so that we don’t take them by surprise with changes,” says Robin Zöllig. Thanks to QET, he also knows that amenities for families are rather scarce and that there are no bike paths to the neighboring school. Seeing these connections is important for planning decisions, as Zöllig explains. The concept for the neighborhood should be finalized by next year at the latest. It would then be the first to have been developed from the outset in a data-based and interdisciplinary manner thanks to the tool. For Munich, this is an important step toward integrated, climate-friendly urban development – not only in Hinterbärenbadstraße, but also in other neighborhoods.



Learn more:
connectedurbantwins.de/en/qet



Sustainable neighborhoods

Integrated neighborhood concepts are an important tool on the path to a climate-neutral city. Where the neighborhood development tool helps in their creation – and how it can also benefit other municipalities.



Andreas Schlagbauer is responsible for the development of use cases in urban development at CUT in Munich.

1 – How does the neighborhood development tool specifically support planners?

The QET brings data, most of which is already available, closer to the reality of planning. Various data sets can be integrated and prepared for specialist planning so that they are then readily available. This saves time and coordination with other departments. In addition, it is important for the integrated neighborhood approach to consider not only energy use and renovation needs, but also specialist topics such as biodiversity and socio-spatial challenges.

2 – Why is transparency so important in neighborhood development?

The QET helps with cooperation between departments because it streamlines processes and creates a common data basis. When decisions are made now, they are based on traceable data and can also be communicated more easily thanks to the QET. In the future, monitoring will not only make it possible to see the current status, but also to track measures and monitor progress.

3 – Is the QET also transferable to other cities and municipalities?

The tool could also help other municipalities to store data centrally and make neighborhood development transparent. How difficult or easy this will be depended on the existing infrastructure of the respective city. We provide the FME Workbenches – a visual editor – so that municipalities can build their own tools on this basis. One of the biggest challenges for us was to find out whether the necessary data exists and where it is located – and to raise awareness that shared data benefits everyone.

Climate and energy



Hamburg, Leipzig, and Munich are working toward climate neutrality: both to contribute to combating global warming and to remain resilient and livable. Three examples show how cities collect reliable climate data, integrate environmental impacts into planning, and use tools to support the transformation toward climate-neutral cities.



Learn more:
connectedurbantwins.de/en/climate-energy



Noise and wind at the click of a button: simulations as every-day tools for planners

Where is the street noisy, where does the wind whistle? Urban planners in Hamburg will soon be able to carry out simulations more easily – and thus assess the environmental impact of buildings before commissioning costly expert reports. In the Connected Urban Simulations project, several models are being linked to the Urban Model Platform (p. 21) developed in the CUT project. In the future, they will be available to planners from any workplace via the Open Source geoportal. For the first time, an external service is also being integrated in the form of an AI wind simulation.

Crystal clear: overview of photovoltaic systems in the Energy Atlas.



Tools for sustainable transformation: Energy Atlas and Energy Transition Dashboard

Energy supply is an important factor on the path to climate neutrality. As part of CUT, Leipzig has developed the Energy Atlas, which bundles georeferenced information on the expansion status and potential of renewable energies. It brings together information on photovoltaic systems and charging stations, monument protection, and green roof subsidies, among other things. The Energy Transition Dashboard evaluates daily location and performance data from energy generation and consumption facilities, visualizing the progress of the energy transition at a glance.

Making real-time data available: Blueprint for better sensor data infrastructure

Sensors can measure how wet the ground is, how many bicycles are on the road, or how high the water level of a river is. To use real-time data effectively in Urban Digital Twins, it should be available via standardized interfaces. In Leipzig and Munich, a sensor data infrastructure was set up as an extension of the Urban Data Platform, new sensors were procured, tested, and integrated into the FROST server developed by the Fraunhofer Institute IOSB. With support from Munich, this was expanded to include multi-client capability. This allows real-time data to be made available via an OGC standard and for different user groups.



The future

Text — Carolin Wilms

in inter- action



Leipzig

In collaboration with industry and the urban community, the city of Leipzig is implementing complex planning processes. The city administration uses digital tools to orchestrate data, stakeholders, and strategies. This is leading to new solutions for neighborhoods – and for major issues such as the energy transition. An insight with a view.



A neighborhood opens up: Citizens were also able to explore the newly created urban space in virtual reality.



Crowds gather in front of the virtual world. Two women get in each other's way. Who gets to view the display first? "This kind of opportunity is still rare," recalls Heike Gebhardt, who works as a project manager for Connected Urban Twins in Leipzig. For two weeks, citizens of the city can view nine designs for the new Matthäikirchhof as 3D models online or move around them on site via touch display and change their perspective. And they can comment on their impressions using a small chat window.

Matthäikirchhof is a historic site in Leipzig. It has been everything: a castle complex, the historic nucleus of the city, then a monastery, later the Stasi headquarters and the scene of the Peaceful Revolution. It was also a disco for a while – and today it is the last largely unused area in the inner city ring. The federal government wants to build the central archive for the Saxon Stasi files here. An open



Art in construction: The striking bar of the former SED administration building will be retained in the new design.

urban planning competition is to determine the future design of the site.

Integrating technical planning and public relations

"To date, the city administration has not carried out a participation process of comparable complexity – especially not in connection with an urban planning competition in which the public and specialist planners work so closely together," says Stefani Komm, head of the urban development department, about the process, which has been running for more than three years. What makes it even more special is that 3D models and a virtual reality application developed as part of the CUT project are used to support communication at events. Citizens can also participate online – feedback on the planning drafts is collated in DIPAS, an Open Source software developed in Hamburg that was adapted and further developed in Leipzig as part of the CUT

“This analysis and mediation service is the decisive factor for Digital Twins in making decisions in a polyphonic environment.” Heike Gebhardt

project. The feedback is then passed on to the participating architectural firms.

In the first phase of the competition, 66 designs were submitted. A jury will decide on the proposals. Experts, city councilors, and a citizen representative selected by lottery are part of the jury. In the end, nine designs will go on to the second round of the competition – and be brought to life virtually.

Experiencing and co-planning urban development

A citizen moves from the corner of the Wagner monument up to Matthäikirchhof via a touch display. Where a wall previously blocked the way, she can now float past the buildings into the city center. Users can read the accompanying information at their own pace – and comment on their observations. In two weeks, around 1,500 digital contributions are created. Pascal Schaefer, who works as a science manager, is one of two citizen representatives in the urban planning competition and ensures that the contributions from the participation process are included. He sees the added value primarily in the visual presentation of the designs: “This makes it accessible and easier to grasp for those who otherwise would not be able to imagine it so well.”

Better communicating the complex interrelationships of urban development is one of the reasons why Urban Digital Twins play a role not only in participation processes, but also in the planning of climate-adapted neighborhoods, the mobility and heating transition, and other city-wide urban development issues. “This analysis and communication service is the decisive factor for Digital Twins in making decisions in a multi-voiced environment,” says Heike Gebhardt, referring specifically to complex tasks such as the energy transition.

Orchestrating the energy transition with planning and consulting tools

A wide variety of stakeholders, from historic preservation authorities to investors and municipal utilities, must work together if the energy transition is to succeed. This is precisely why the [Leipzig Energy Twin](#) was developed (p. 33). It bundles data on buildings, networks, potential areas, and ownership structures, thus creating a common digital foundation for planning, consulting, and decision-making for the first time.

The Energy Twin is already being used in municipal heat planning and in the development of energy concepts for neighborhoods. Over the next few years, it will be expanded to include energy consumption data and findings from digital road surveys, for example, so that detailed analyses of listed buildings will also be possible.

At the same time, a public version of the Energy Twin is being created for citizen participation, which will make neighborhood-specific information available for the first time, for example on the potential of geothermal energy or best practice examples. This will enable owners and companies to receive targeted advice.

The added value of Digital Twins: investments are facilitated, approval processes are accelerated, and renewable energies are promoted. Above all, however, the energy twin achieves one thing: it makes the complexity of the energy transition manageable – for administration, politics, business, and citizens alike.

Jointly developed: the DIPAS participation software

The Digital Participation System (DIPAS) developed in Hamburg has also been used in Leipzig and Munich in the context of CUT. The transfer enabled the testing and adaptation of technical, structural, and practical components. Successful participation processes in all three cities demonstrate the flexibility of the system, which is also available as Open Source software for reuse by other municipalities.

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▲
Roofs make sense: Digital Twins also help with the planning of photovoltaic systems and green roofs.

Reconciling conflicting positions through participation

“Leipzig’s city center is becoming greener and more interesting. The design shows me a good possible option,” reads an online comment in the participation process for Matthäikirchhof – which also goes directly to architect Maximilian Köth. The proposal by his Stuttgart-based architectural firm Riehle Koeth, developed in collaboration with landscape architect Levin Monsigny, ultimately convinced the jury. “My impression was that we further developed our design, which was already based on a mediating approach, with the help of the feedback,” says Maximilian Köth today. “We wanted to show the complexity of the Matthäikirchhof’s long history and reconcile the contradictions of the place.” The collaborative process helped to hear different opinions and bring them into alignment.

Leipzig shapes the future through collaboration

A good year after the competition decision, project managers Heike Gebhardt and Christoph Schubert are standing in the Smart City Lab, the City of Leipzig’s innovation laboratory for digital and sustainable urban development. This is also where the next development steps and applications of Digital Twins are being tested: How can simulations help to make different planning scenarios even more

“My impression was that we developed our design the most with the help of feedback.” Maximilian Köth

tangible? What interfaces do Digital Twins enable between specialist departments and citizens, and how can they be linked together?

It is clear that no single actor, no company, and no administration can manage the transformation alone. Rather, it is the interaction between urban society, business, research, and administration that ensures success. The city administration plays a central coordinating role with digital tools. It uses digital tools to control processes, connect actors, and make the complex inter-relationships of urban reality manageable.



Learn more:
connectedurbantwins.de/en/matthaikirchhof

Digital-supported participation

Digital tools can help communicate complex interrelationships – and change the perspective of planning. Experiences from digitally supported participation processes in Leipzig.



Heike Gebhardt is a CUT project manager in Leipzig.

1 – Why is it worthwhile for planners and project developers to support participation processes with digital tools?

Spontaneous answer: It can help improve dialogue between planners and urban society, enabling them to shape the city together. Visualizing complex contexts, for example in 3D models, makes the planning perspective more comprehensible. Feedback from urban society can be meaningfully incorporated into further planning. Or it can provide an initial indication of the mood regarding potential changes to the cityscape.

2 – How does this change the experience for citizens, business and scientific actors?

Various factors come into play here. Different actors can actively participate and make their concerns visible. Science can support us, for example, with modeling for pedestrian flows, wind, and noise. This brings together perceived reality and data models with simulation possibilities: How loud is it at the location in terms of residential, work, and recreational areas? Does the use of space make sense in terms of purchasing power and inner-city development? Are there enough shaded areas to improve the quality of stay?

3 – How do you deal with the experiences of the three actors described above – and what are the future application possibilities?

Through application management in the Digital City department, we have learned a lot about the needs of the specialist departments, the economy, and urban society, and how we can support them in the use of digital tools. We are already working in the areas of commercial area development, feel-good places for children and young people, and many others. In the future, I see potential in scrollytelling to communicate complex data topics to different target groups. The same applies to the use of AI to better recognize the “patterns of a city.”

FOCUS

Planning cities for everyone



Cities should serve everyone who lives in them. Urban Digital Twins make it possible to integrate more perspectives into planning – for example through VR simulators or real-life experiments. They can also simplify key processes, such as planning for daycare networks. Three examples from digital public services.



Learn more:
connectedurbantwins.de/en/urban-society

Testing bike paths before they are built – in the VR simulator at the Technical University of Munich.



Experiencing urban development with VR mobility simulators

This bike ride doesn't feel safe: a narrow lane next to parked cars, the risk that someone might suddenly pull out. Luckily, the scenario is only visible on the screens of the VR glasses – in the bicycle simulator at the Technical University of Munich. A moving platform and artificial wind complete the immersive experience. The goal: to bring urban planning to life at an early stage. For example, to test different variants of a bike path in a 3D environment. Virtual rides on e-scooters and accessibility tests in a wheelchair simulator are also possible.

All data in one place: Digital Twin simplifies daycare planning

Parents in Leipzig are looking for daycare places: this is where the puzzle begins for planners. Which neighborhoods have how many children? How is the population developing? Which buildings need renovation or new construction? The Urban Digital Twin Daycare Network Planning tool brings together this data from various specialist departments and technical systems. The tool enables better monitoring of daycare capacity utilization, reliable forecasts for each district, and automated controlling – saving the daycare network planning team around two weeks of work per month.

FairCare transport: how real-life experiments broaden urban perspectives

Many cities are built for commuters – but unpaid care workers such as parents and caregivers also travel daily to perform important tasks. To better integrate their mobility perspectives into urban planning, the Hamburg City Science Lab has conducted several real-world experiments to record everyday journeys and barriers, such as a city walk organized by an initiative of family caregivers. The Urban Data Collector web application helps to document the input. The Urban Data Narrator can be used to create data-based stories to illustrate social issues.



Barrier-free through the city:
Data collection on a city walk

CUT in dialogue

Exchange and networking are key drivers of innovation. We present Connected Urban Twins at events and discuss them with experts from the field. We also create spaces for dialogue and joint development with our own formats.



Innovative solutions from the CUT project were presented at the Market of Opportunities.

Urban Digital Twin Days 2025: three days of experiencing the city of the future

From April 1 to 3, 2025, everything in Hamburg revolved around Urban Digital Twins. The potential of Digital Twins, concrete applications, and their roles in sustainable urban transformation were discussed in front of an international audience of experts. A practical day presented tools from the CUT project, followed by a two-day scientific conference with insights from research and urban planning.

Smart country convention: CUT in dialogue with federal policy and practice

Every year at the Smart Country Convention, CUT demonstrated how Digital Twins make cities smarter. At the booth, in workshops, and in panels, research met administration. In 2022, Klara Geywitz, then Federal Minister for Housing, Urban Development, and Building, visited the CUT stand to learn about concrete use cases.



Overall project lead Dr. Nora Reinecke (left) and Klara Geywitz (right) at the presentation at the CUT booth.



Hamburg's first twin day: administration in dialogue on the city of tomorrow

The successful kick-off on September 12, 2024, focused on direct exchange between administration, project team, and city stakeholders. The discussion centered on opportunities, challenges, and specific areas of application for Digital Twins in Hamburg.

Data Week Leipzig: networking around urban data

Data Week Leipzig brought together administration, research, and business for the fourth time in June 2025. The Leipzig CUT team helped launch the event. It provides insights into working with Urban Data Platforms and Digital Twins and brings them to life in hackathons, sensor walks, and Lego workshops.



Guests at the New Town Hall: Visitors to Data Week 2025 in Leipzig.

International Forum on Urban Digital Twins: Twins in a research context

On September 12, 2023, the City of Munich, together with the TU Munich, hosted the International Forum on Urban Digital Twins as part of the 18th 3D GeoInfo Conference. Experts from around the world took part.

Intercity exchange
in Munich: Mathias
Boedecker and Jana
Dietrich from the City of
Leipzig's geodata service.



Plenary workshops: exchange and inspiration in Hamburg, Leipzig, and Munich

The big team meeting: Once a year, between 50 and 60 project participants met in one of the three partner cities. The workshops provided direct insight into the work of the partners and offered new ideas. In addition to plenary formats, there was room for small groups to discuss challenges, tools, and use cases.



What's next? CUT team members at the workshop in Hamburg in May 2025.

Data-based discussion:
The digital city model shows how digitalization is changing urban planning.



Digitalization – how smart is the city?

On January 28, 2025, the new urban development plan was presented in a digital and dynamic format as part of the “München hat Plan” exhibition. On this evening, interested members of the public were able to discuss the opportunities and risks of digitalization with experts and try out digital tools for planning and participation.

MPSC congresses: three cities network together

The three CUT cities of Hamburg, Leipzig, and Munich each hosted a congress of the Smart Cities Model Projects (MPSC). The focus was on transferable solutions, inter-municipal exchange, and joint learning. The events strengthen cooperation between the 73 model projects nationwide. CUT is the largest MPSC.



Interactive planning tables make it easier to explore the complex dynamics of urban life – within the CUT team as well as in conversations with the wider public.



strg+c[ut]: The digital discussion format on Urban Digital Twins

Four times a year, the CUT team discusses current developments in the context of Urban Data Platforms and Digital Twins. Together with guests from administration, research, and practice, new perspectives emerge. strg+c[ut] is open to questions, exchange, and critical input. The format invites participants to think ahead together about digital urban development.



Learn more:
connectedurbantwins.de/strg-cut (German Site)

CUT Academy: Sharing knowledge for the city of tomorrow

The CUT Academy shares project knowledge. Webinars, lectures, and videos show how Urban Data Platforms and Digital Twins are changing cities. The offering is aimed at administration, research, and anyone who wants to rethink their city. All content is freely accessible.



Discover More:
connectedurbantwins.de/en/knowledge-transfer/welcome-to-the-cut-academy

Two awards for Connected Urban Twins and the digitalization of urban development

CUT 2025 was awarded the Public Leadership Award by the Future Congress State & Administration for outstanding management of public innovation projects. In 2022, the DVW e.V. – Society for Geodesy, Geo-information and Land Management had already awarded CUT the DVW Future Prize for its supra-regional role model function in digital urban redevelopment.

CUT use cases for innovation and practical relevance honored

Several CUT applications have won awards. For example, the 3D Project Planner 2025 was honored with the Geospatial World Excellence Award for its innovative use of geodata-based solutions. The BIM Champion Award 2025 for outstanding achievements in digital planning and construction was awarded to the automated BIM application based on data from the Hamburg Geospatial Twin. In 2025, the DIPAS user community was awarded the “Proven in the Field” seal for successful and practical municipal implementation.



Lara Stappenbeck and Ahmed Salem, Hamburg State Office for Geo-information and Surveying, at the BIM Champion Award 2025 ceremony.

FOCUS

Living together

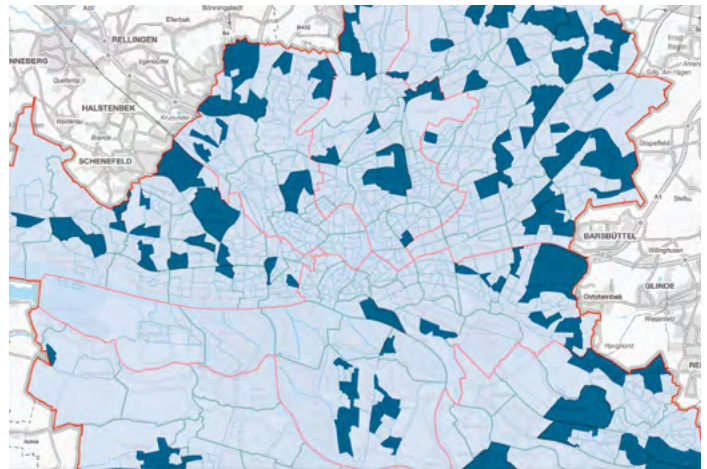


Many people, little space: those who live in cities have to make compromises. Urban Digital Twins can facilitate negotiation processes in urban development – for example, by making them more tangible, inviting participation, or creating a database as a basis for discussion. Three examples.



Learn more:
connectedurbantwins.de/en/urban-society

Where do many households with children live?
Map from the DSM dashboard.



Online participation and data stories: Shaping cities together

Rethinking the city center – easily from home: In the broad-based participation process on the future of Munich’s city center, the public was able to contribute via DIPAS for the first time. In addition, the DIPAS_stories component was tested in Munich. The STEP Story enables experts and the public to explore the first digital urban development plan via a data story – the combination of urban data and practical examples helps to make the plan tangible.



Over 14,000 visitors were able to experience the STEP story in the “Munich has a plan” exhibition.



Avoiding displacement – with digital urban development monitoring

When many apartments in a neighborhood are extensively modernized, converted into condominiums, or sold for speculative purposes, tenants often can no longer afford to live there. Digital urban monitoring (DSM) exists to identify these processes in a timely manner. It provides the knowledge base for initiating targeted countermeasures in accordance with the Building Code. In the CUT project in Hamburg, the necessary data and analysis tools on population, social structure, and rent development were brought together in an Urban Digital Twin – and can be accessed quickly and easily via a web application.

Customizable dashboard: Housing market at a glance

Munich regularly publishes data on the housing market to create a neutral basis for planners, politicians, and citizens. The housing market observation dashboard bundles specialist data from various sources that were previously published in brochures. This means that they are available immediately after publication, and users can customize the web interface to suit their needs. The project was implemented based on the Open Source software Grafana, which makes it easier for other municipalities to reuse.

Quick start for municipalities

TECHNICAL DEVELOPMENTS AND APPLICATIONS

Practical knowledge: A wide range of digital tools and use cases have been developed and tested in the CUT project. Much of the experience and results have been published and can be reused. An overview.

Application	Description
3D Project Planner	The 3D Project Planner is a digital web application based on the Master-portal. It enables planners in public administration to analyze construction projects within the 3D city model using geospatial data and to quickly and easily sketch their own ideas for urban development.
Address Twin Leipzig	Address Twin transfers all Leipzig addresses into a spatial register and models dependencies on buildings and small-scale structures. The data will be integrated into address-using processes as a municipal standard in the long term.
AI floor detection	AI-supported floor detection fills a data gap within the city. Several data sources were combined to record the number of floors for each building and assign this information to a specific building so that it could be entered into a database.
AI parking space analysis	Parking space detection with AI: Using object-based image recognition, the system automatically detects occupied and vacant parking spaces. This provides cities and public authorities with a reliable data basis for developing parking concepts, such as resident parking in heavily used neighborhoods.
ALLRIS-GPT	ALLRIS stands for "General Council Information System" – the LLM prototype ALLRIS-GPT, developed by ScaDS.AI, analyzes decisions and proposals from the Leipzig Council Information System and reveals thematic connections between council proposals.
beteilige.me – platform for engagement	With beteilige.me, civil society organizations can implement their own participation processes. Citizens' opinions, knowledge, and wishes can be recorded as georeferenced text contributions and photos.

Application	Description
BIM-based coordination platform for large-scale events	A shared digital environment enables cities and event organizers to plan and coordinate large events more effectively. The use of Digital Twins and the BIM method make planning, communication, and implementation more efficient, transparent, and sustainable.
BIMFabrikHH	BIMFabrikHH is a web-based Open Source tool for creating basic BIM models from open geodata for Hamburg. After selecting an area and entering project data, a standard-compliant IFC file is generated. The process enables direct reuse in planning processes – as well as in the specially developed BIM Viewer integrated into the Masterportal.
Building and housing database with spatial reference (GeWoRa) Leipzig	GeWoRa bundles address- and building-related data from the city of Leipzig and forms the basis of the municipal building twin. The database links information across disciplines, thus supporting efficient planning – for example, in heat planning, neighborhood development, or blackout prevention.
Building and housing register Munich	The Munich Building and Housing Register serves as an essential data source and comprises both basic building data and specialized building data, which are used in various applications for visualizations, analyses, and simulations. A key advantage is interoperability, which facilitates interdisciplinary data use.
Charging station dashboard	The dashboard displays charging infrastructure and parking spaces for electric vehicles in public spaces. It replaces complex tables with a visual planning aid and enables targeted control of locations for administration and urban planning.
City center specialist portal	The City center specialist portal is a digital tool based on the Masterportal for analyzing data relevant to inner cities. It supports administration, politics, and planning in Hamburg in the exchange and data-based decisions on city center development.
Connected Urban Simulations	Connected Urban Simulations makes noise and wind simulations usable for urban planning in order to assess environmental impacts at an early stage. The Urban Model Platform, OGC API processes, and tools such as 3D Modeller, Scenario Explorer, and Scenario Discovery Module create a flexible, future-proof solution.
Dashboard Housing Market Monitoring	Connected Urban Simulations makes noise and wind simulations usable for urban planning in order to assess environmental impacts at an early stage. The Urban Model Platform, OGC API processes, and tools such as 3D Modeller, Scenario Explorer, and Scenario Discovery Module create a flexible, future-proof solution.
Data Narrator	Data Narrator (DANA) is an add-on for the Masterportal that allows georeferenced data sets to be supplemented with text, photos, and images. This allows the mostly highly technical representations to be expanded with information and more vivid illustrations.

TECHNICAL DEVELOPMENTS AND APPLICATIONS

Application	Description
Daycare network planning	The Leipzig daycare network plan visualizes childcare needs and available places. It integrates data from several specialist departments, complies with legal requirements, and allows simulations of the impact of planning scenarios in the urban area.
Digital Twin for climate-neutral neighborhoods.	Climate-neutral and resource-efficient urban development ideally takes place at the neighborhood level in existing buildings. In the future, Munich will use a development tool that consolidates data on a neighborhood, enables automated analyses, and prepares the results in a tailored manner.
Digital Twin Lüderitz (Namibia)	An Open Source Digital Twin is being created for the city of Lüderitz (Namibia). It supports urban planning in the context of the planned expansion of renewable energies (green hydrogen) and transfers CUT's participatory approaches to promote citizen science.
Digital Urban Development Monitoring	Digital urban monitoring is a tool used by the Hamburg city administration to help identify displacement and gentrification processes in mixed-use neighborhoods. A map-based web application provides data on population, social structure, and rent trends.
Energy Atlas	A constant overview is needed for the targeted expansion of renewable energies: How far has the expansion of plants progressed? Where are potential areas located? What is the situation with regard to the charging infrastructure? The Energy Atlas can be used to identify current expansion statuses and potential and to plan strategic measures.
Energy-efficient neighborhood development in Leipzig	Energy-efficient neighborhood development uses digital models of urban neighborhoods to plan energy concepts more quickly and effectively. It supports specialist agencies, energy suppliers, and offices in analyzing, developing measures, implementing, and monitoring existing buildings.
Energy Transition Dashboard Leipzig	The Energy Transition Dashboard supports climate protection managers and urban planners in making decisions about the expansion of renewable energy. It draws on data from the Federal Network Agency's Market Master Data Register and is continuously further developed within a municipal development consortium.
Expansion of the sensor data infrastructure in Leipzig and Munich	Sensors that capture traffic, infrastructure, and environmental data in real time are essential for Urban Digital Twins. The CUT project expanded the sensor data infrastructure in Leipzig and Munich. Data was provided via OGC SensorThings API and integrated into 3D Tiles and CityGML 3.0.
Framework for 3D and VR visualizations	The Twin Framework for Unreal Engine facilitates the creation of 3D city visualizations on PCs and in VR. It supports common formats such as Datasmith, .obj, .fbx, glTF, CityGML, Cesium, and the REST API to enable the rapid integration of real geodata into modular, interactive environments.
Geo Base Twin	The concept of the geo base twin forms the binding basis for the spatial reference of all Urban Digital Twins. It comprises the intelligent networking of area-related geobasis information, considers methods for analyzing this data, and thus assumes a broker functionality.

DIPAS: Digital participation system for informal citizen participation

DIPAS is an advanced Open Source solution for citizen participation – both online and on-site. DIPAS seamlessly integrates geodata and can be integrated into existing urban IT ecosystems. This makes it a useful tool for cities and municipalities that want to effectively involve their citizens in planning processes. As part of the CUT project, the DIPAS frontend and admin backend were redesigned. In addition, the following innovations were developed and tested collaboratively:

DIPAS_navigator

The dashboard displays key figures on current and past participation processes fully automatically in real time, thus providing an introduction to each participation process.

DIPAS_stories

The tool presents urban planning content and geodata in an interactive storytelling format and supports dialogue with the public.

DIPAS_text

The tool enables participation in text content by allowing passages to be marked, commented on, evaluated, and jointly developed.

DIPAS_analytics

AI-supported, large amounts of feedback can be structured and evaluated – transparently, based on geodata, and to support technical decisions.

The DIPAS software was adapted and made configurable as part of the CUT project so that it can be easily transferred to other cities and municipalities. Individual customizations, such as your own appearance, can be implemented straightforwardly. The DIPAS software can either be set up and hosted independently in your own infrastructure or obtained and operated via the German Administration Cloud as a service from dataport.kommunal without a tender process.

Application	Description
Integration of the OGC WFS interface into Apache Superset	The Open Source visualization software Apache Superset was further developed in the CUT project to integrate geodata into dashboards via the OGC WFS interface. The aim is to support spatial filter functions. Leipzig, Bonn, and Mönchengladbach developed three new features for this purpose as part of a partnership.
Location search for digital infrastructure	The location search enables the drawing of search circles based on the geodata infrastructure, for example for antenna systems, and the targeted search and coordination of suitable urban areas for multiple use by telecommunications, science, and other stakeholders.
Masterportal	The Masterportal is an Open Source geoportal that was further developed as part of the CUT project. In addition to the BIM viewer, new features include a 3D project planner, a template function, a front end for simulations, and a storytelling tool.

TECHNICAL DEVELOPMENTS AND APPLICATIONS

Application	Description
Metadata catalogue	The metadata catalogue (MDK) of the City of Munich was implemented based on the CKAN standard and the SDDI concept of TUM. As part of the Urban Digital Twin, it automatically collects city-wide metadata and makes it available for further use via a clearly structured interface.
Neighborhood development tool	Climate-neutral and resource-efficient urban development ideally takes place at the neighborhood level in existing buildings. In the future, Munich will use a neighborhood development tool (Quartiersentwicklungstool, QET) that consolidates data on a neighborhood, enables automated analyses, and prepares the results in a tailored manner.
Open Data Portal Leipzig	The Leipzig Open Data Portal provides administrative data in an open, standardized, and machine-readable format. Interfaces enable automated data exchange between municipal data catalogues. Citizens and developers use the data for apps and visualizations, such as “Leipzig giesst” based on the tree register.
Pop-Up Platform Leipzig	The Pop-Up Platform is a flexible prototyping tool that supports the testing and implementation of technologies such as the Internet of Things (IoT), Urban Data Platforms, and Infrastructure-as-a-Service (IaaS). This allows concrete use cases to be tested, technical challenges to be identified, and suitable solutions to be developed.
Puls Leipzig	Puls Leipzig is a business-oriented trend analysis based on aggregated social media data. Using AI-supported filtering, relevant topics are identified and visualized in dashboards. The city’s economic development department and corridor management provide the specific questions that guide the analysis.
Road condition analysis	The automated road condition analysis detects cracks, potholes, and other damage using image and sensor data, even on different road surfaces. The spatially localized results provide a reliable data basis for maintenance, repair, and prioritization.
Scenario Explorer	The Scenario Explorer is an extension of the Masterportal. It allows users to access and execute shared models on the Urban Model Platform and view them as data layers. It also enables scenario comparisons and uncertainty analyses using model ensembles.
Semantic 3D street spatial modeling	The CityGML 3.0 standard enables structured 3D modeling of roadways, sidewalks, street furniture, and vegetation. It has been tested in Leipzig and Munich and expanded to include the Road2 CityGML3 guideline to support urban planning processes.
Smart District Data Infrastructure (SDDI) catalogue system	The SDDI catalogue system supports cities in establishing Urban Digital Twins. It connects data, tools, and applications, facilitates metadata maintenance, enables multi-client operation, and transparently displays technical dependencies.
Sumonity – interface between the SUMO traffic simulation engine and the Unity game engine	Sumonity is an interface that connects the microscopic traffic simulation engine SUMO (Simulation of Urban Mobility) with the game engine Unity. This enables unprecedented simulation accuracy and an improved user experience in traffic simulations.

Application	Description
Urban Data Platform Hamburg	The Urban Data Platform Hamburg is the city's central data hub. In the CUT project, Idproxy was introduced to create new data access points via OGC API features. The containerized data integration is Open Source, and the new customer portal is supported by data automation.
Urban Model Builder	The Urban Model Builder is an Open Source platform for collaborative modeling of urban systems. Models are based on current data via interfaces to Urban Data and Model Platform. Thanks to a low-code interface, they are also understandable and expandable for non-programmers.
Urban Model Platform	A key element of Digital Twins are what-if scenarios, for example relating to climate, traffic, or noise. They use simulation to show the effects of planned measures. The Urban Model Platform links various simulation models in a common system.
VR application from the Matthäikirchhof district	The winning design of the urban planning competition for Matthäikirchhof in Leipzig was implemented in virtual reality and integrated into the 3D city model of Leipzig. The project teams and planning offices worked together across cities to implement the project.
VR for mobility	Virtual reality (VR) enables early visualization of planned urban spaces from different perspectives. Digital Twins and simulators show usage scenarios with movement, wind, 360° audio, and sensors and cameras to record driving behavior, for example of bicycles and e-scooters.
VR prototype	The CUT VR prototype enables the immersive visualization of urban planning processes. Users can virtually walk through construction projects and compare variants in the real urban environment – including live data such as traffic flows. The aim is to make technical data more accessible and to facilitate participation and coordination.
VR visualization platform	With the help of virtual reality (VR), you can walk through your own city, fly over it, and immerse yourself in planned buildings. As an interactive visualization platform, VR provides new insights into urban development and urban data in the Digital Twin.

KNOWLEDGE PRODUCTS AND PUBLICATIONS

Mediation is one of CUT's core areas of activity – the formats and publications collected here help cities and municipalities get off to a quick start with Urban Digital Twins.

Product/Publication	Description
Baseline and endline assessments UDP/UDT	As part of baseline and endline assessments, the city-level Urban Data Platforms (UDP) and Urban Digital Twins in Hamburg, Leipzig, and Munich were analyzed at the beginning and end of the CUT project. The endline assessment also considered twin topics in accordance with DIN SPEC 91607.
CUT Academy	The CUT Academy is a digital training program offered by the CUT project. In short video formats, experts from the three project cities impart practical knowledge on the topics of urban data, Digital Twins, and digital urban development.
CUT study on models and simulations in urban management	The CUT study on models and simulations is aimed at city administrations and offers an introduction to the topic of Urban Digital Twins. At the same time, it records the current status of simulation models in use, thus creating a sound basis for further developments.
Digital participation tools in comparison	The board provides a digital overview of tools and methods that are suitable for use in informal (digital) participation processes and have been tested as part of the CUT project in Hamburg, Leipzig, and Munich.
DIN SPEC 91607 Digital Twins for Cities and Municipalities	The DIN specification (DIN SPEC) provides cities and municipalities with a basis for implementing Urban Digital Twins. The standard was developed with over 40 experts, including the CUT team, and is a milestone for the standardization of Digital Twins in Germany and Europe.
Glossary	The CUT glossary is a reference work on the project website. It explains key terms from the fields of urban data, Digital Twins, and digital urban development in an understandable way and is continuously expanded by the CUT partners.
Guide to data governance	The guidelines developed in the CUT project provide orientation in the complex field of data governance. They form the basis for a detailed examination of specific areas of action and are the starting point for formulating recommendations and documenting best practices.
Guide to Model Land: Ethical guidelines for simulations in urban development with Digital Twins	Guide to Model Land is a practical ethics guide for the use of digital simulation models in urban development. It helps local authorities to identify ethical issues at an early stage, weigh them up, and integrate them responsibly into planning processes.
Guidance for tenders in the context of Urban Digital Twins	The guidance for tenders in the context of Urban Digital Twins is based on the perspectives and experiences gained from tenders within the framework of the geodata infrastructure (GDI) and the Urban Data Platform (UDP).

Product/Publication	Description
Guidelines for handling citizen-generated data	Citizen-generated data reflects the reality of local life and provides insights for public welfare-oriented urban development. In order to make this data usable in the long term, it must be linked to other urban data. The aim of the guidelines is to highlight the potential of this data.
Questionnaire for collecting use cases	The questionnaire for identifying use cases helps cities to plan Smart City Projects in a targeted manner. In five modules, it guides users through key topics and provides specific guiding questions for discussions with experts in various fields – for the structured clarification of requirements and the development of a product vision.
Real-world laboratory Hamburg – space for transformative and experimental urban research	In the Hamburg real-world laboratory, prototype real-world experiments are being used to develop digital tools for citizen participation, process modeling, and scenario simulation. These tools promote sustainable urban development and are incorporated directly into the Hamburg Digital Twin.
Replication blueprint	The replication blueprint from Connected Urban Twins provides a structured overview of key project results and implementation steps. It supports other cities and municipalities in systematically planning their own projects in the field of Urban Data Platforms and Digital Twins.
SmartKlimaCity strategy	Leipzig's SmartKlimaCity (Smart Climate City) strategy shows where CO ₂ can be saved through digitalization. It combines measures from the climate protection program with projects from the Digital Agenda and new approaches from CUT and RDS (Real-World Laboratory for Digital Cities) – as a basis for Digital Twins.
Technical article on the modular system for Urban Digital Twins	The technical article "Urban Digital Twins as a Modular System: A Concept from the Connected Urban Twins (CUT) Project" in the Journal of Surveying (1/2023) presents the theoretical concept of Urban Digital Twins developed in the CUT project, as well as technical, legal, and organizational aspects and the necessary digital resources.
Useful information for municipalities	The information on the CUT website supports knowledge transfer with compact background knowledge, links, and reading tips. It shows the starting point and framework conditions of the CUT solutions and serves as a guide for municipalities, experts, and smart city managers.



For more information, contacts, and downloads, visit our website:
connectedurbantwins.de/en/toolbox



The download area of our website contains key project results, publications, and materials for download. It offers those interested in smart cities and municipal stakeholders direct access to knowledge that supports them in developing their own solutions:
connectedurbantwins.de/downloads (German Site)

COMMUNITIES

During the CUT project, a development community emerged – some of which extends far beyond the project partnership. Among other things, CUT was involved in the communities listed below, some of which are still active beyond the project.

Community	Beschreibung
DIN SPEC 91607 & 91377 – e Consortia	In addition to initiating DIN SPEC 91607 (see p. 17), the CUT team also contributed to DIN SPEC 91377 “Data Models and Protocols in Open Urban Platforms.” Moreover, CUT is involved in the Smart Cities Standards Committee (NA 043-02-03 AA) to help transform DIN SPEC 91357 “Reference Architecture Model Open Urban Platform” into an official standard.
DIPAS User Community	The Free and Hanseatic City of Hamburg has launched the “DIPAS User Community” to connect cities, municipalities, and institutions in the use of DIPAS in participation processes. The aim is to exchange experiences and jointly develop the platform.
Masterportal Community	The Implementation Partnership (IP) is an association of organizations from public administration that use the Masterportal. The aim of the Implementation Partnership is to further develop the Masterportal independently, sustainably, and stably.
Smart Cities model projects	The 73 Smart Cities model projects (MPSC) funded by the federal government are experimental sites for integrated urban development. The aim of the program is to enable municipalities in Germany to try out a variety of practical solutions and thus promote Smart City development nationwide.

Overview of project partners

Funding body

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Supported by

Coordination and Transfer Office for
Smart City Model Projects (KTS)



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Ministry of Urban
Development and Housing,
Stadtwerkstatt

Agency for Geoinformation
and Surveying

City Science Lab at HafenCity
University Hamburg

Hamburg Port Authority

Dataport



Leipzig

Digital City Department

Agency for Geoinformation
and Land Use Planning

Agency for Statistics
and Elections

Agency for City Planning

Lecos GmbH

L-Group

Center for Scalable
Data Analytics and Artificial
Intelligence (ScaDS.AI)



München

IT Department

Municipal Department,
Munich Geodata Service

Department of Urban Planning
and Building Regulations

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From A to Z: Our glossary explains
the most important terms related to
Urban Data and Digital Twins.

All applications, knowledge products,
and current information can be found at
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