FUTRHUB

Developing the Digital City Together

Pilot Projects of the Development Partnership

We are creating one of Europe's most ambitious smart city projects - on the grounds of the former inner-city airport Berlin-Tegel. Through the use of innovative and interlinked digital infrastructures, we will develop innovative ways of managing urban space and mobility, rethink space for work and everyday life in the district of Berlin TXL.

The first year of the Development Partnership saw the fundamental infrastrucutre of the FUTR HUB put in place. Furthermore, the first partners set up joint pilot projects testing the FUTR HUB data platform and showing the potential of urban data.

The Development Partnership allows for the joint development of urban infrastructure and associated services in order to leverage the potential of digital networking in the new district. To do so, specific and concrete projects must be defined. A diverse set of partners and stakeholders then comes together to implement each use case prototypically.

Initial concepts have been developed Six pilot projects have been defined in the first year of the Development Partnership concentrating on the important technical infrastructure of the early phase. They are showcased in this document and will be implemented as soon as possible.

These pilot projects are just the beginning: In the next few years many more projects shall be developed ultimately transforming Berlin TXL into Europe's smartest urban neighbourhood.

Smart rainwater management Berlin TXL

Sustainable rainwater use for districts

Water is one of the core elements for living and working. Treating water and bringing it to the places where it is needed ties down many resources. In Berlin TXL rainwater will be collected directly on site, treated and used for cleaning vehicles or flushing toilets, for example. To do this, an intelligent, open, robust, and efficient management system is developed for the rainwater installations in the district and the water is made usable directly on site for the people operating the facilities, residents, and business owners.

The objectives and aspirations for the project - categorization in the FUTR HUB value compass

What does that mean specifically?

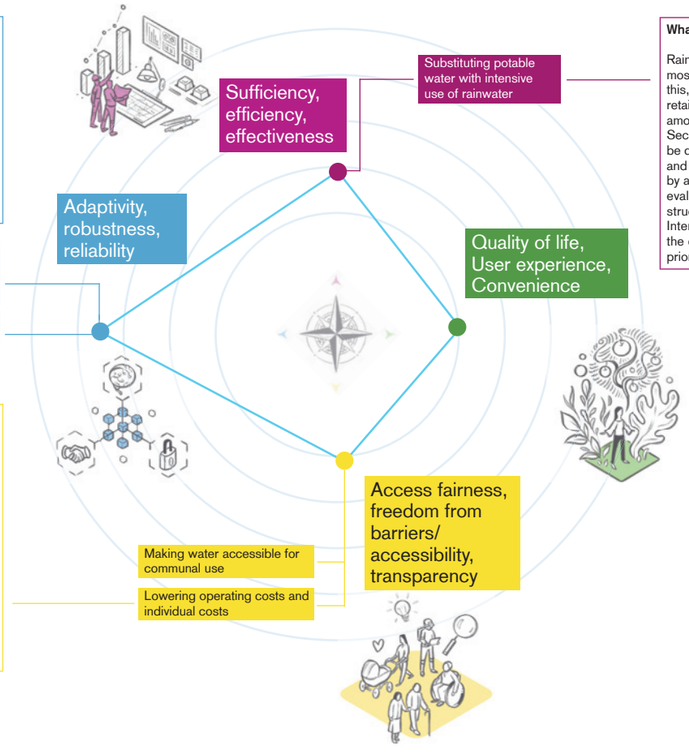
The efficient management system for the rainwater installations is scalable and transferable to many other districts. Due to its ability to adjust the rainwater distribution, the system can be set to reflect changes in the demand for process water (during vacation, for example) and also for any service volatility (say, when it rains heavily or if lengthy dry spells are expected). The people operating the facilities will probably control the system components through proprietary software.

The State of Berlin upon achieving the goal of increasing the number of districts using rainwater.

This contributes to reliable rainwater management.

What does that mean specifically?

The Berlin TXL site is home to residential, commercial, and nature zones that require water of different quality levels. To keep operating costs low and to make a contribution to sustainable development, the demand should be covered by process water and only in places where it is absolutely necessary. To this end, Berlin TXL's smart rainwater management will ensure a large and permanent supply of purified rainwater for irrigating park facilities, as process water for buildings. or for commercial purposes. Tenants and people operating the facilities can then save on costs by doing without potable water to a large extent.

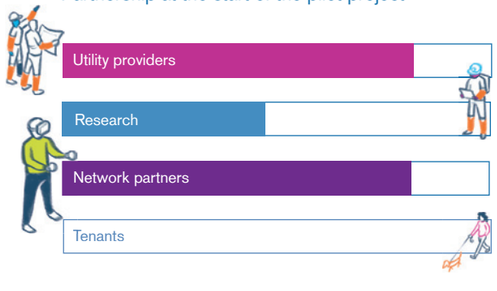


What does that mean specifically?

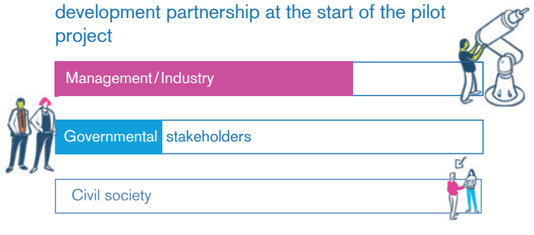
Rainwater should be used wherever it is most urgently needed on site. To achieve this, firstly the rainwater in Berlin TXL will be retained and purified in the greatest possible amounts without compromising flood safety. Secondly, the available purified rainwater will be delivered to consumers in computer-aided and prioritized order. This is made possible by a smart control system that collates and evaluates IoT data from local rainwater infra-structures, weather forecasting data from the Internet, and current consumer demands at the extraction points, and then prescribes a prioritized amount.

Stakeholders involved in the initialization phase*

Proportion of core partners in the Development Partnership at the start of the pilot project



Proportion of core partners (friends) in the development partnership at the start of the pilot project



*More details under "Developing the Digital City Together. Mission statement of the FUTR HUB Berlin TXL", in particular page 10: "The Development Partnership"

Resources needed for implementation of the project

Software
- Data platform ensures communication of supply and demand of purified rainwater on the Berlin TXL site
- System connects the rainwater IoT and Internet services
- Logics for setting priorities in the distribution of rainwater
- Specialist software for simulation and distribution of rainwater including interfaces for linkage to data platform and asset management

External hardware
- Where possible, a separate piping system for process water for buildings

Internal hardware Berlin TXL
- Sensors in the rainwater installations monitor the water level, the quality of the retained rainwater and the condition of the facilities
- Information and communication systems guarantee data transmission

Staffing resources needed when planning
- Specialist planner for rainwater installations
- Manager of rainwater installations
- Experts for rainwater use cases

Staffing resources needed in management
- Manager to run smart rainwater management
- Manager of rainwater installations

Clarifications needed at governance level
- Data sovereignty of the critical infrastructure
- Securing a human-machine interface
- Collecting data from building management and site infrastructures (rainwater installations, extraction points)
- Process water billing data

The pathway to smart rainwater management

Planning phase
- Clarify user requirements (by inquiring about water quality requirements, accessibility of the system...)
- Clarify demands made on the physical infrastructure (on sensors and/or other built-in technology...)
- Clarify demands made on the digital infrastructure (among systems (communication...)...)

1st Implementation step
- Implementing the necessary (digital) infrastructure (execution plans, tendering process...)

2nd Implementation step
- Systems launch (building the data connections between systems...)
- Systems launch and implementation of other applications (data connection between the systems, activation for consumers at rainwater extraction points)

3rd Implementation step
- Check for transferability
- and extend it to other
- uses (within the district and beyond)

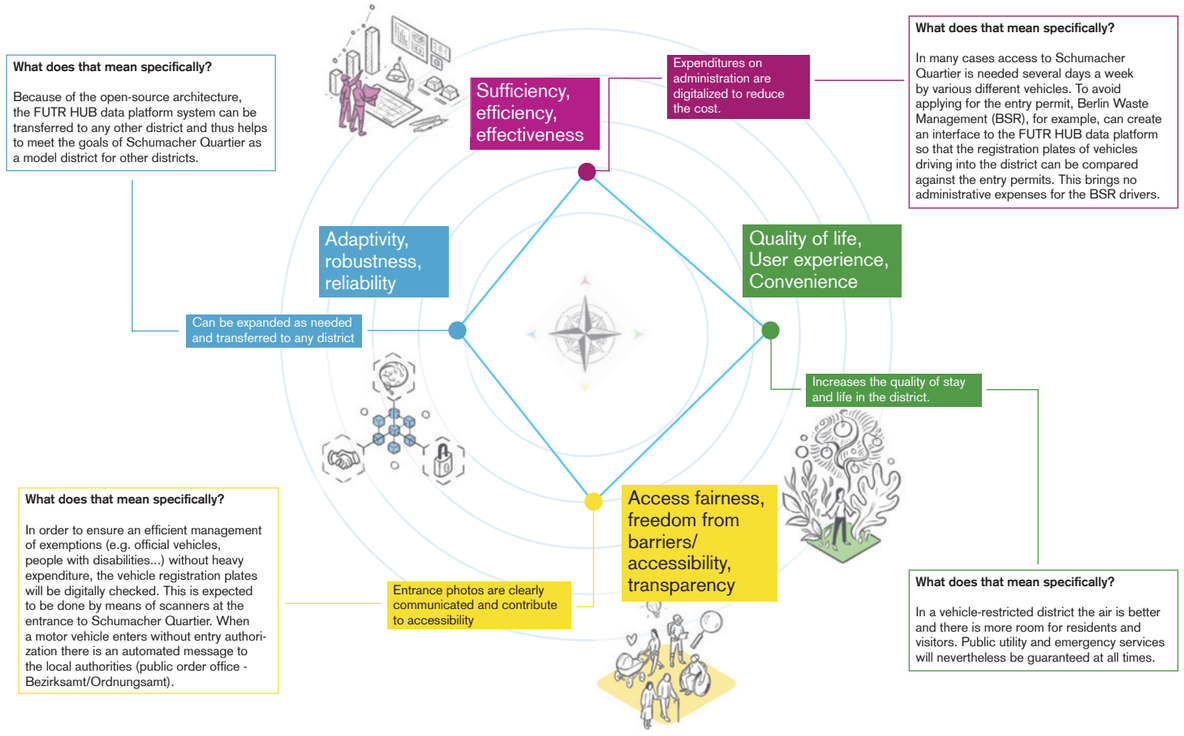
Linkages to other projects

- **Smart nature:** Rainwater for watering parks, cleaning paths
- **Heating-cooling network:** Loop lake / reservoir as a heating-cooling store as part of the rainwater installations
- **Platform for the district operators:** Cockpit for rainwater management with displaying water levels, consumption statistics, and warnings against bottlenecks (e.g. in periods of drought)
- **Market for the use of rainwater**: Data market on platform

Digital access control - Schumacher Quartier

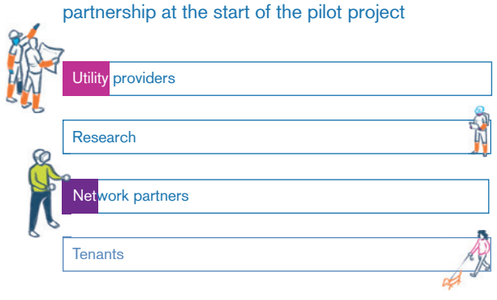
Schumacher Quartier is designed to be a vehicle-restricted district. Traffic can be kept out of the vehicle-restricted district by integrating the district garages upstream with the mobility hubs. The mobility of residents and visitors is nonetheless guaranteed - because of sharing services offered at the mobility hubs and good local public transport connections. A digital entry control (requiring no gates) will be developed to enable reliable control of entry to the district for any private vehicles needed in exceptional circumstances.

The objectives and aspirations for the project - categorization in the FUTR HUB value compass



Stakeholders involved in the initialization phase*

Proportion of core partners in the development partnership at the start of the pilot project



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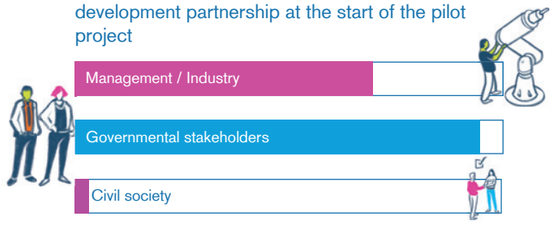


*More details under "Developing the Digital City Together. Mission statement of the FUTR HUB Berlin TXL", in particular page 10: "The Development Partnership"

Resources needed for implementation of the project

Software
- Software that
  - can compare vehicle registration plates against access permits
  - makes it possible to have an interface on the data platform to external data banks (vehicle registration plates)
  - forwards error messages automatically to the local authorities (Ordnungsamt)
  - allows a connection to computer-aided facility management

External hardware
- Physical components such as sensors or masts
- Scanners

Internal hardware Berlin TXL
- Information and communication systems that provide data transmission and allow interfaces with data banks (for example with lists of vehicle license plates approved for entry)

Staffing resources needed when planning
- Local authorities (Ordnungsamt) or district operators as contact partners for interested parties
- Programmers to implement the entry app (booking and use)

Staffing resources needed in management
- None (explanation on the implementation of the use of digital entry would be incorporated into the tenancy agreements with the tenants via the developers and residential construction companies)

Clarifications needed at governance level
- Check before handover of the system to road construction agencies whether operation of the infrastructure is desired
- Interface to the local authorities (Ordnungsamt)
- Interface to the external data banks

The pathway to smart access control

Planning phase (Feasibility study):
- Check technical and legal feasibility
- Check data protection provisions
- Hold conversations with providers
- Develop models for the operations
- Coordination with the operators of the mobility hubs

1st Implementation step
- Designating responsibilities at Tegel Projekt GmbH
- Buying, renting, or leasing hardware / software

2nd Implementation step
- Creating interfaces in the data platform
- Include information about the General Data Protection Regulation in the description of the district

3rd Implementation step
- Starting the test phase during the construction phase

4th Implementation step
- Consolidating the test phase and expanding the area if appropriate

Linkages to other projects

- **Platform for whoever operates the district:** personalized cockpit for digital entry with display of entry permits

Plant monitoring in the landscape zone

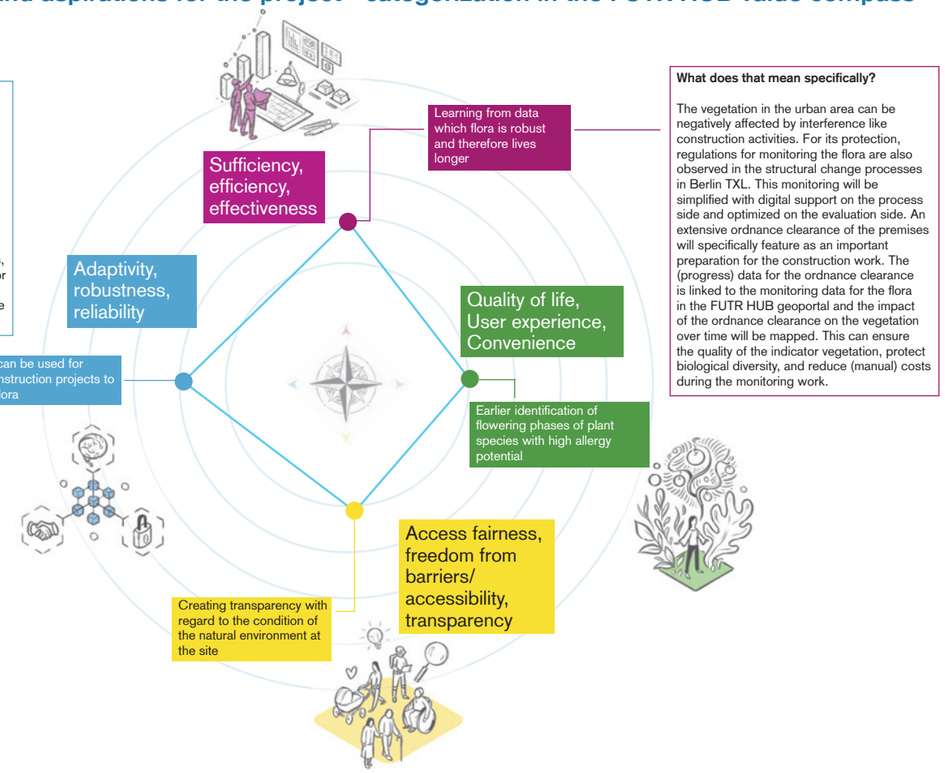
Drone-assisted monitoring of the natural environment

Nature in the urban landscape and its protection are always a very important part of development strategies for resilient cities. For even closer tracking of the factors that impact upon nature, the landscape zone of Berlin TXL will be further monitored by drone images during the construction work at the site. Using a digital combination of photographic, project, and experimental data from test sites should enable impacts on nature from ordnance clearances and other construction activities, including the corresponding measures for restoration of the natural environment, to be evaluated inexpensively.

The objectives and aspirations for the project - categorization in the FUTR HUB value compass

What does that mean specifically?

The objective of the use case is also to visualize what effects the ordnance clearance has on the vegetation. Not only does the data collected and combined from ordnance clearance and monitoring of the flora assist with the construction process, it also enables well-founded statements to be made on whether ordnance clearances have an effect on nature. This then gives rise to evidence-based data that should aid research institutes, nature conservation, and those responsible for future construction to minimize the negative effects of ordnance clearances or comparable interference in nature in their projects.

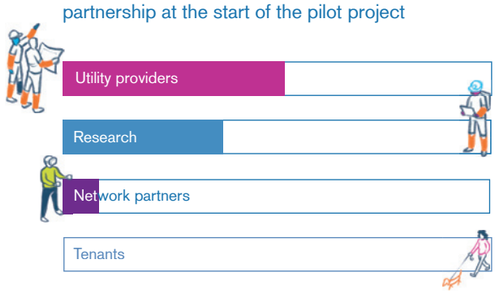


What does that mean specifically?

The vegetation in the urban area can be negatively affected by interference like construction activities. For its protection, regulations for monitoring the flora are also observed in the structural change processes in Berlin TXL. This monitoring will be simplified with digital support on the process side and optimized on the evaluation side. An extensive ordnance clearance of the premises will specifically feature as an important preparation for the construction work. The (progress) data for the ordnance clearance is linked to the monitoring data for the flora in the FUTR HUB geoportal and the impact of the ordnance clearance on the vegetation over time will be mapped. This can ensure the quality of the indicator vegetation, protect biological diversity, and reduce (manual) costs during the monitoring work.

Stakeholders involved in the initialization phase*

Proportion of core partners in the development partnership at the start of the pilot project



Proportion of core partners (friends) in the development partnership at the start of the pilot project

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Resources needed for implementation of the project

Software	• The FUTR HUB geoportal combines drone images and qualitative data from the ordnance clearance • Simple import and reference processes for drone images and data from the ordnance clearance
External hardware	• Drones with high-resolution optical sensors • Photo camera • Infrared camera
Internal hardware Berlin TXL	• None
Staffing resources needed when planning	• Willingness of the service providers involved to work digitally
Staffing resources needed in management	• Specialists to upload the drone images to the FUTR HUB portal
Clarifications needed at governance level	• Successful data release in the ordnance clearance and flora monitoring segments • Check the ordnance clearance and flora monitoring data for possible releases • Check the possibility of autonomous drone flights over adjoining German armed forces site

The pathway to flora monitoring

Planning phase
(Collating requirements):
- Check regulatory requirements of the State of Berlin
- Identify requirements from the TU Berlin monitoring plan
- Check requirements from other Berlin TXL use cases

1st Implementation step
- Check possibilities for implementation
- Consult (future) operators
- Determine technical options

2nd Implementation step
- Hardware procurement
- Acquiring drone systems

3rd Implementation step
- Preparation of the software systems
- Preparation of interfaces and import paths for the geoportal
- Preparation of processing possibilities for qualitative data

4th Implementation step
- Software design
- Technical testing of a combination of drone images and qualitative data on ordnance clearance

5th Implementation step
- Automation of the processes
- Interfaces and autonomous scanning flight over the premises
- Automated upload of the drone images
- Automation in the data processing

Linkages to other projects

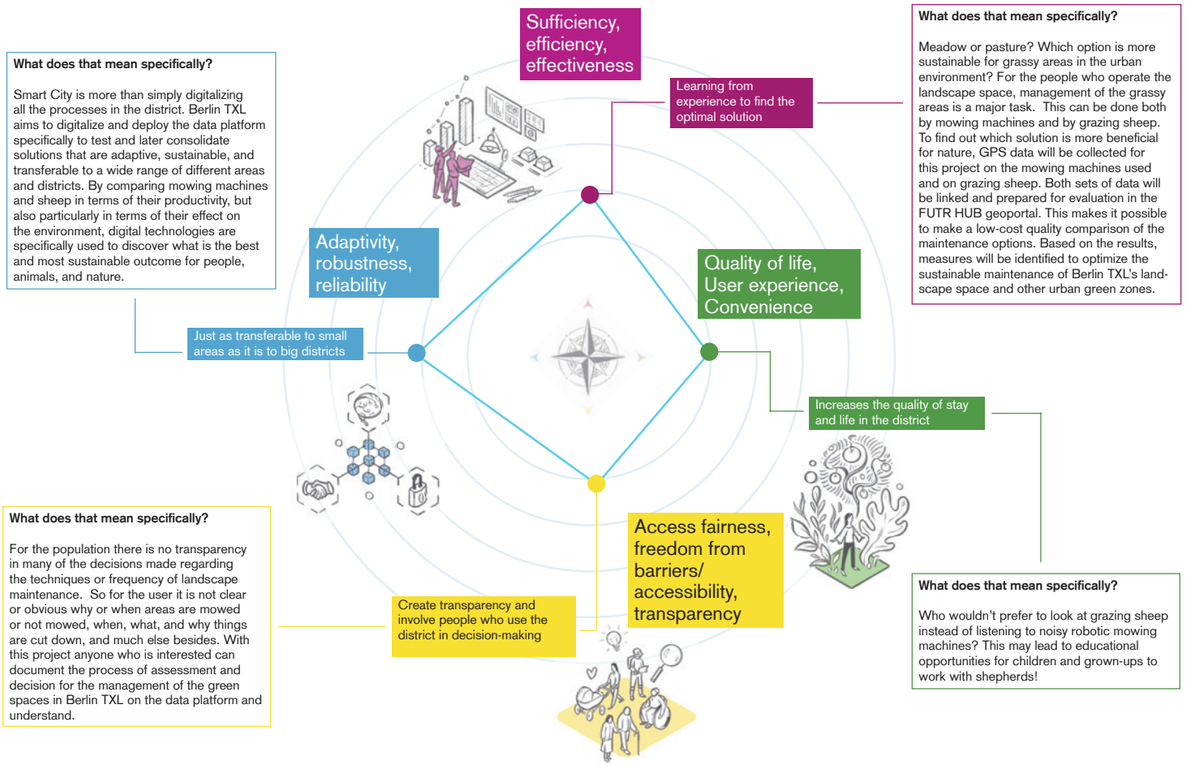
- **Data from weather stations:** Integration of weather data into the flora monitoring time-series data to incorporate into the evaluations the influences of heat and precipitation
- **Drone traffic management:** Initiation of a "UAV Traffic Management" for the Berlin TXL site

Comparison of grazing and machine maintenance in the urban space

Sheep versus machines

To make the management of green areas in Berlin TXL as sustainable as possible, this project will test which is the better solution for a natural environment for maintaining grassy areas in the landscape zone: grazing with sheep or using mowing machines. To do this, the use of machines and sheep will be tracked through GPS data and the maintenance quality will be digitally monitored regularly by means of plant monitoring (see Project Profile "Plant monitoring in the landscape zone - Drone-assisted monitoring of the natural environment").

The objectives and aspirations for the project - categorization in the FUTR HUB value compass



What does that mean specifically?

Smart City is more than simply digitalizing all the processes in the district. Berlin TXL aims to digitalize and deploy the data platform specifically to test and later consolidate solutions that are adaptive, sustainable, and transferable to a wide range of different areas and districts. By comparing mowing machines and sheep in terms of their productivity, but also particularly in terms of their effect on the environment, digital technologies are specifically used to discover what is the best and most sustainable outcome for people, animals, and nature.

What does that mean specifically?

Meadow or pasture? Which option is more sustainable for grassy areas in the urban environment? For the people who operate the landscape space, management of the grassy areas is a major task. This can be done both by mowing machines and by grazing sheep. To find out which solution is more beneficial for nature, GPS data will be collected for this project on the mowing machines used and on grazing sheep. Both sets of data will be linked and prepared for evaluation in the FUTR HUB geoportal. This makes it possible to make a low-cost quality comparison of the maintenance options. Based on the results, measures will be identified to optimize the sustainable maintenance of Berlin TXL's landscape space and other urban green zones.

What does that mean specifically?

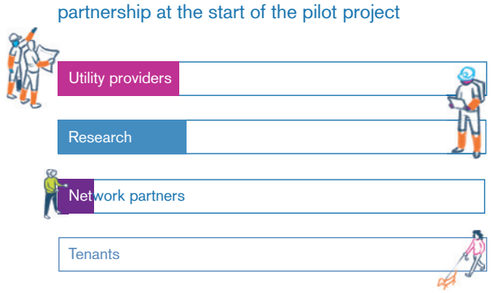
For the population there is no transparency in many of the decisions made regarding the techniques or frequency of landscape maintenance. So for the user it is not clear or obvious why or when areas are mowed or not mowed, when, what, and why things are cut down, and much else besides. With this project anyone who is interested can document the process of assessment and decision for the management of the green spaces in Berlin TXL on the data platform and understand.

What does that mean specifically?

Who wouldn't prefer to look at grazing sheep instead of listening to noisy robotic mowing machines? This may lead to educational opportunities for children and grown-ups to work with shepherds!

Stakeholders involved in the initialization phase*

Proportion of core partners in the development partnership at the start of the pilot project



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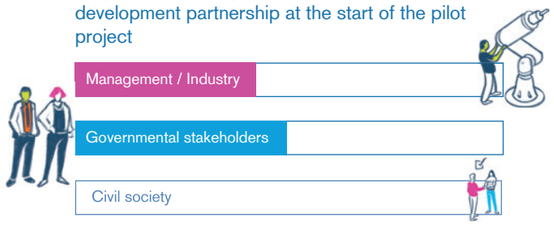


*More details under "Developing the Digital City Together. Mission statement of the FUTR HUB Berlin TXL", in particular page 10: "The Development Partnership"

Resources needed for implementation of the project

Software
- The FUTR HUB geoportal, which can display geo-referenced drone images and GPS data from mowing machines and sheep, as well as quality data for the flora.
- Simple import and referencing processes for drone images, GPS, and flora quality data.

External hardware
- GPS tracker for mowing machines

Internal hardware Berlin TXL
- Drones with high-resolution optical sensors (photo camera)
- GPS tracker for sheep

Staffing resources needed when planning
- Experts on grazing of urban green spaces

Staffing resources needed in management
- Shepherds
- Experts on air analysis
- Specialists to analyze and maintain the data

Clarifications needed at governance level
- Tracking of mowing machines
- Labor law (GDPR)

The pathway to a comparison of methods for landscape conservation

Planning phase
- Procuring the grazing sheep
- Procuring the mowing machines

1st Implementation step
- Equipping sheep and machines with GPS transmitters
- Preparing the areas (ordnance clearance, fencing in of areas)

2nd Implementation step
- Importing (live) GPS data to the geoportal (sheep, machines)
- Importing and georeferencing drone images and quality data for flora

3rd Implementation step
- Interlink GPS data, quality data, and drone images and visualize in the geoportal

4th Implementation step
- Data evaluation (automating)
- Deriving measures to be recommended

Linkages to other projects

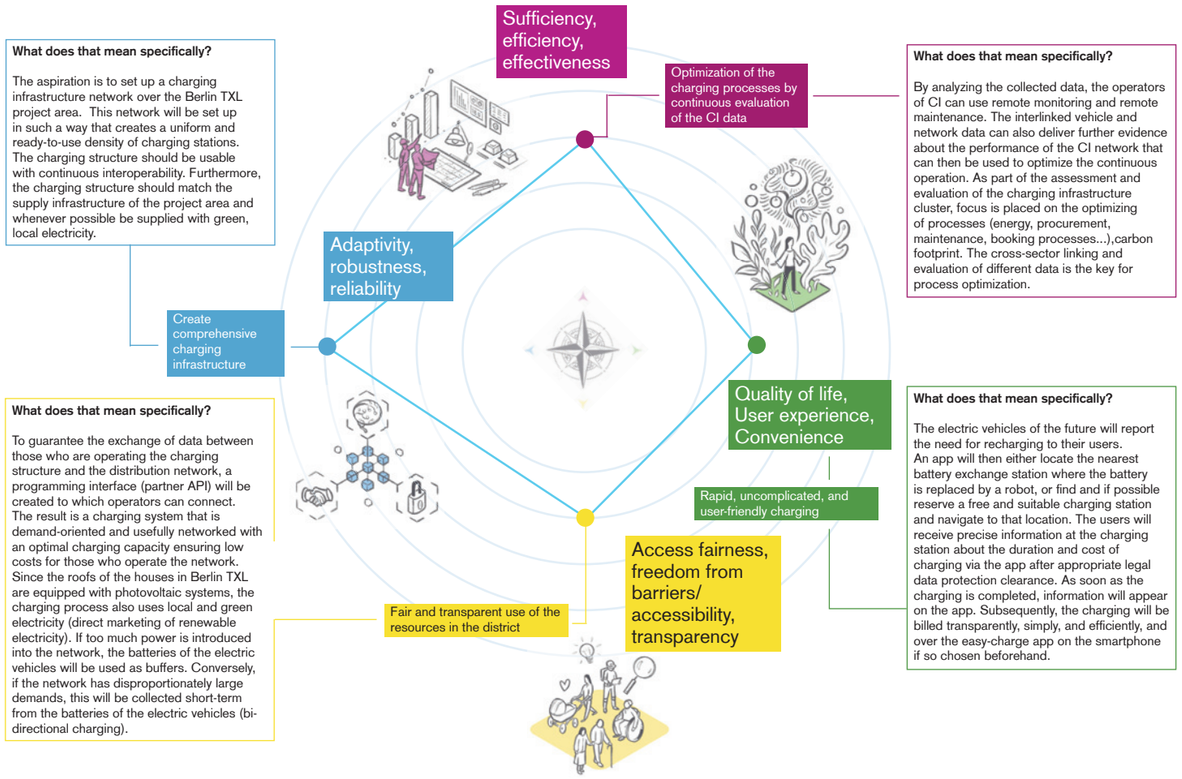
- **Flora monitoring in the landscape space** (see profile)
- **Data from weather stations:** Integration of weather data into the (flora) monitoring time-series data to incorporate the influences of heat and precipitation into the evaluations
- **Drone traffic management:** Initiation of a "UAV Traffic Management" for the Berlin TXL site

Exemplary and sustainable district supply in Berlin TXL

Charging infrastructure (CI)

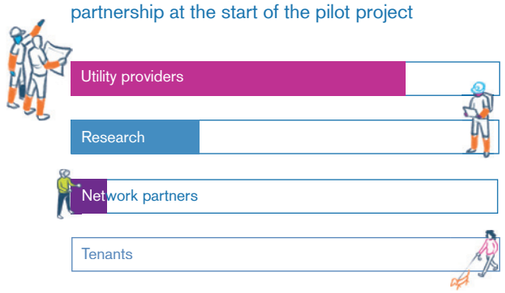
A charging infrastructure will be created in Berlin TXL pointing the way to the future for other urban districts and cities. The charging infrastructure will be integrated into multifunctional masts (MuFuMa) on the streets, for example. Within the framework of the development partnership criteria and processes are defined that make it possible to compare the performance of the charging infrastructure. Factors to be adduced for this here are: Planning, construction, supply, and use. Prospectively five mobility hubs of varying sizes will be set up in the Urban Tech Republic. In the vehicle-restricted Schumacher Quartier these hubs are operated as district garages in which the smart charging infrastructure is used.

The objectives and aspirations for the project - categorization in the FUTR HUB value compass



Stakeholders involved in the initialization phase*

Proportion of core partners in the development partnership at the start of the pilot project



Proportion of core partners (friends) in the development partnership at the start of the pilot project

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Resources needed for implementation of the project

Software
- Mode 3 charging
- OCPP 1.6 and OCPI for billing and backend communication
- ISO 15118 as leading standard for plug and charge
- Charging stations will be manageable via cluster or master-slave in cooperation
- Applications for the use of charging stations
- API interface for connectivity of third parties

External hardware
- Charging stations

Internal hardware Berlin TXL
- Charging stations for AC charging with type 2 plug
- Charging stations for DC charging with CCS plug

Staffing resources needed when planning
- Operators of CI clusters
- Technology manufacturers

Staffing resources needed in management
- Inspector for regular maintenance of the charging equipment
- Staff to implement data security and the protection of personal data
- Allow spontaneous and open-system charging, including the corresponding possibility of paying immediately at the charging station with reliable and secure authentication by using, say, a telephone hotline, cash payment, money or RFID card, NFC device (pursuant to VDE-AR-E 2532-100), cellphone SMS, smartphone app, Internet, plug and charge (pursuant to ISO 15118)
- Staff for billing the charging processes
- Experts who maintain the appropriate interfaces between the charging stations and the backend

Clarifications needed at governance level
- Data protection regulations for purchasing (CPO), the operators of the charging stations and the owners of the vehicles (data exchange)

The pathway to smart charging infrastructure

Planning phase
- Developing a pilot CI for security team by the middle of 2023
- Clearance of data protection provisions
- First exchange of data from charging stations and vehicles

Pilot CI at the multi-functional mast
- Determining a suitable model for operation
- Technology development, hardware / software
- Testing of control systems for the cluster at pilot status

1st Implementation step
- Construction phase in the project up until 2026
- First use with construction-site traffic
- Transferring the control pilot into a production system

2nd Implementation step
- First construction phase, Urban Tech Republic: Mobility Hub 1 and multifunctional masts
- First construction phase, Schumacher Quartier Mobility Hub 1
- Expanding the control functions, e.g. with forecasting functions

3rd Implementation step
- Second construction phase, Urban Tech Republic Mobility Hub 2, 3, 4
- Second construction phase, Schumacher Quartier Mobility Hub 2, 3
- Inclusion of more clusters (except Berlin TXL) at digital level

Linkages to other projects

- **Power station:** Hydrogen system, electricity supply
- **Mobility Hubs:** Car-sharing services, fleet management of major tenants
- **Digital district management:** Digital services (virtual charging assistant to improve user experience)

Innovative street lighting in Berlin TXL.

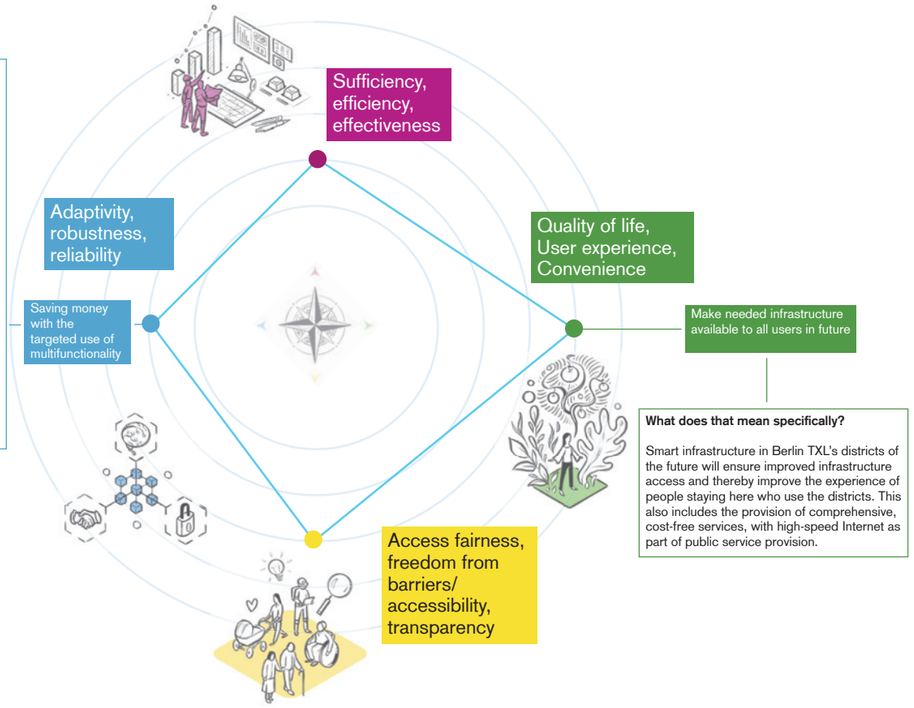
Multifunctional mast (MuFuMa)

In Berlin TXL the plan is to set up several hundred smart street lights, what are called multifunctional masts (MuFuMas), with various different additional features. Unlike a conventional street light these masts undertake a range of additional functions. Not only do they ensure the lighting for the public space by means of LED lights but they also implement an extensive charging infrastructure (minimum 2 x 22 kilowatts per mast). They also act as emergency call point accessible to the public and provide an extensive WLAN throughout the main areas of movement. In addition, they establish a small-cell network for 5G, allow for a modern management system for car parks, and set up sensors to collect various information on the surrounding area including environmental data and the number of passing vehicles.

The objectives and aspirations for the project - categorization in the FUTR HUB value compass

What does that mean specifically?

By using sensor technology and utilizing data for smart control of infrastructure, an urban area can be designed to become a smart city. The positioning of the components set up in an urban development should be discreet and efficient, so that technologies are not unsightly while the infrastructure remains available across the whole area to those using the cities. The use of multifunctional masts gives cities and district operators the opportunity to interconnect the technologies needed for a smart city and blending them gracefully into the city landscape with minimum space requirements. In any case, light masts needed are also fitted with extra components that can be operated and maintained conjointly and thereby save on costs. Likewise, controlling several components with one light mast is more efficient than installing individual components in an urban area. Operating from a single source also makes synergy effects possible thus saving on time, personnel, and financial resources.



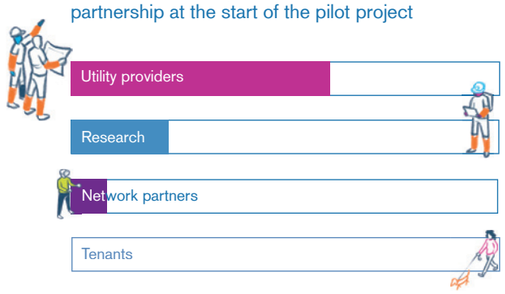
Make needed infrastructure available to all users in future

What does that mean specifically?

Smart infrastructure in Berlin TXL's districts of the future will ensure improved infrastructure access and thereby improve the experience of people staying here who use the districts. This also includes the provision of comprehensive, cost-free services, with high-speed Internet as part of public service provision.

Stakeholders involved in the initialization phase*

Proportion of core partners in the development partnership at the start of the pilot project



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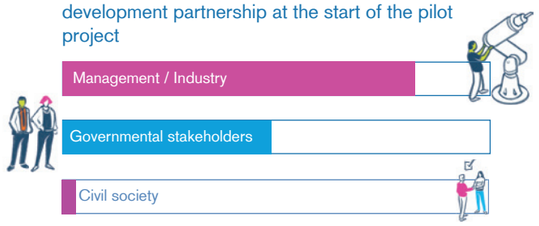

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Resources needed for implementation of the project

Software
- Embedded software for image data conversion
- Data interfaces (APIs) to the data platform
- Visualization of the data via dashboards
- Geoportal
- Control components for MuFuMa operation

External hardware
- Posts and lighting for series masts
- 5-G small-cell technology
- Charging infrastructure

Internal hardware Berlin TXL
- Physical components of the Internet of Things (IoT) such as LED lighting technology, environmental sensors, cameras for parking lot monitoring, communication modules, and WLAN access points
- Broadband access

Staffing resources needed when planning
- Light planners
- Steel constructors
- Specialists for IoT components
- Engineers for embedded software

Staffing resources needed in management
- Third-party providers, e.g. Berliner Stadtwerke

Clarifications needed at governance level
- Image-data management in conformity with the GDPR

The pathway to a multifunctional mast

Planning phase
- Determine requirements for the multifunctional mast from the needs of the district
- Design of the light post
- Select components on the mast
- Conclude construction planning for the mast

1st Implementation step
- Manufacture the light post
- Procure the components

2nd Implementation step
- Develop the software needed for the components on the mast
- Test the software in lab operations

3rd Implementation step
- Install the components in the light post
- Prototypical set-up and connection of the multifunctional mast (power and broadband)
- Commission the multifunctional mast

4th Implementation step
- Start test operation
- Connect the multifunctional masts to the data platform
- Visualize and evaluate the data

5th Implementation step
- Evaluate the test phase and optimize for mass production and live operation

Masthead

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