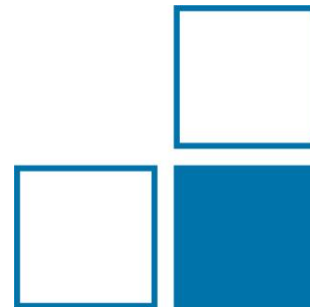




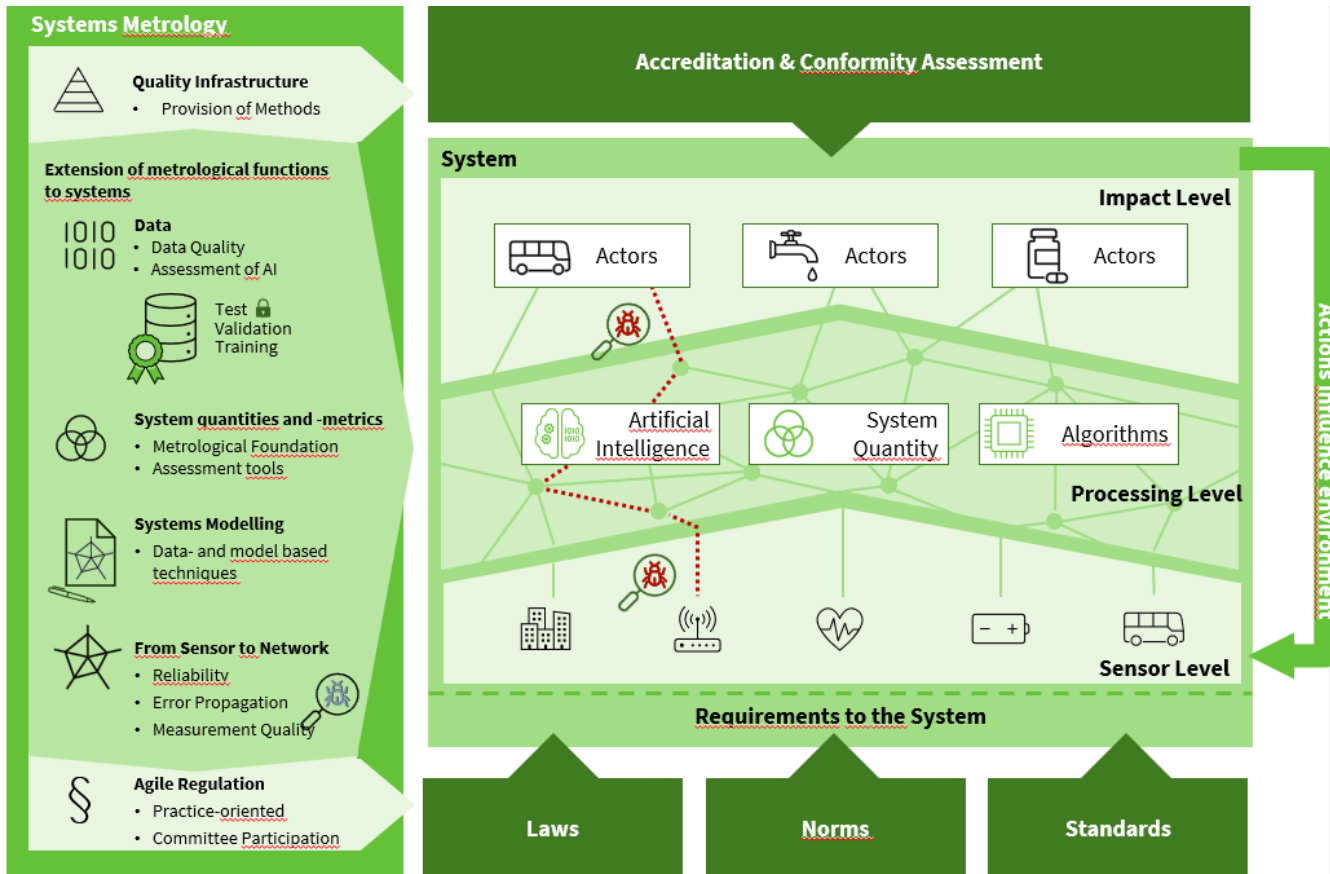
Sensor Networks in future cities

FORUM-MD Workshop on Metrology for
Complex Sensor Networks

Barbara Jung, PTB



Systems Metrology – Overview



Societal Interaction

- Communication of measuring data and their reliability
- Trust in data and decisions made upon them

Models and Metrics

- Measuring data based system models -> reliable predictions
- Metrics for assessment of complex systems

Data and Metadata

- Data infrastructures with built in metrological metadata
- Metrological data quality information -> reusability

Sensor Networks

- Uncertainty propagation
- Calibration approaches
- Automation and machine processability

Sensor networks in future cities - Examples

Smart Traffic Management:

- Traffic Light Control
- Parking Space Management

Air and Environmental Control:

- Central air quality control
- Noise monitoring

Waste Management:

- Waste bin filling level control

Energy Management:

- Smart Grids energy flows
- Public illumination



Source: Unsplash

Water Management:

- Leakage detection
- Waste water quality

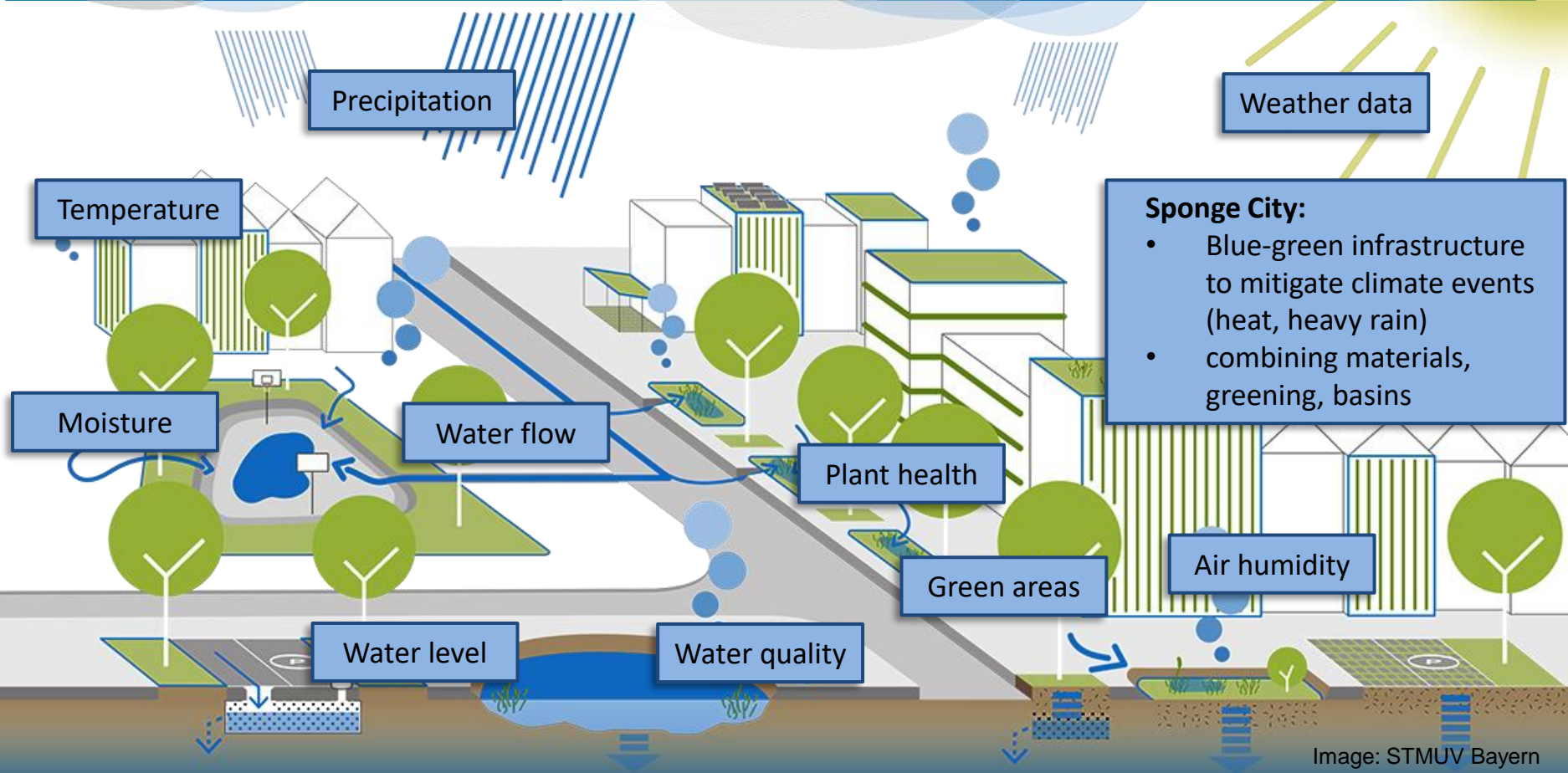
Smart Buildings/Infrastructure:

- Indoor climate monitoring
- structural monitoring

Safety and emergency:

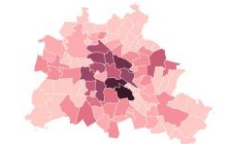
- Public space monitoring
- Early warning systems

City sensor networks - Example

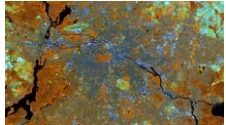




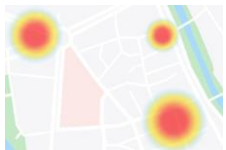
- Static data: Building infrastructures, street layouts



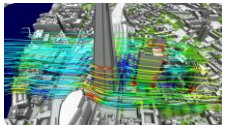
- Statistical data: historical data, population density



- External data sources: Satellite data, weather data

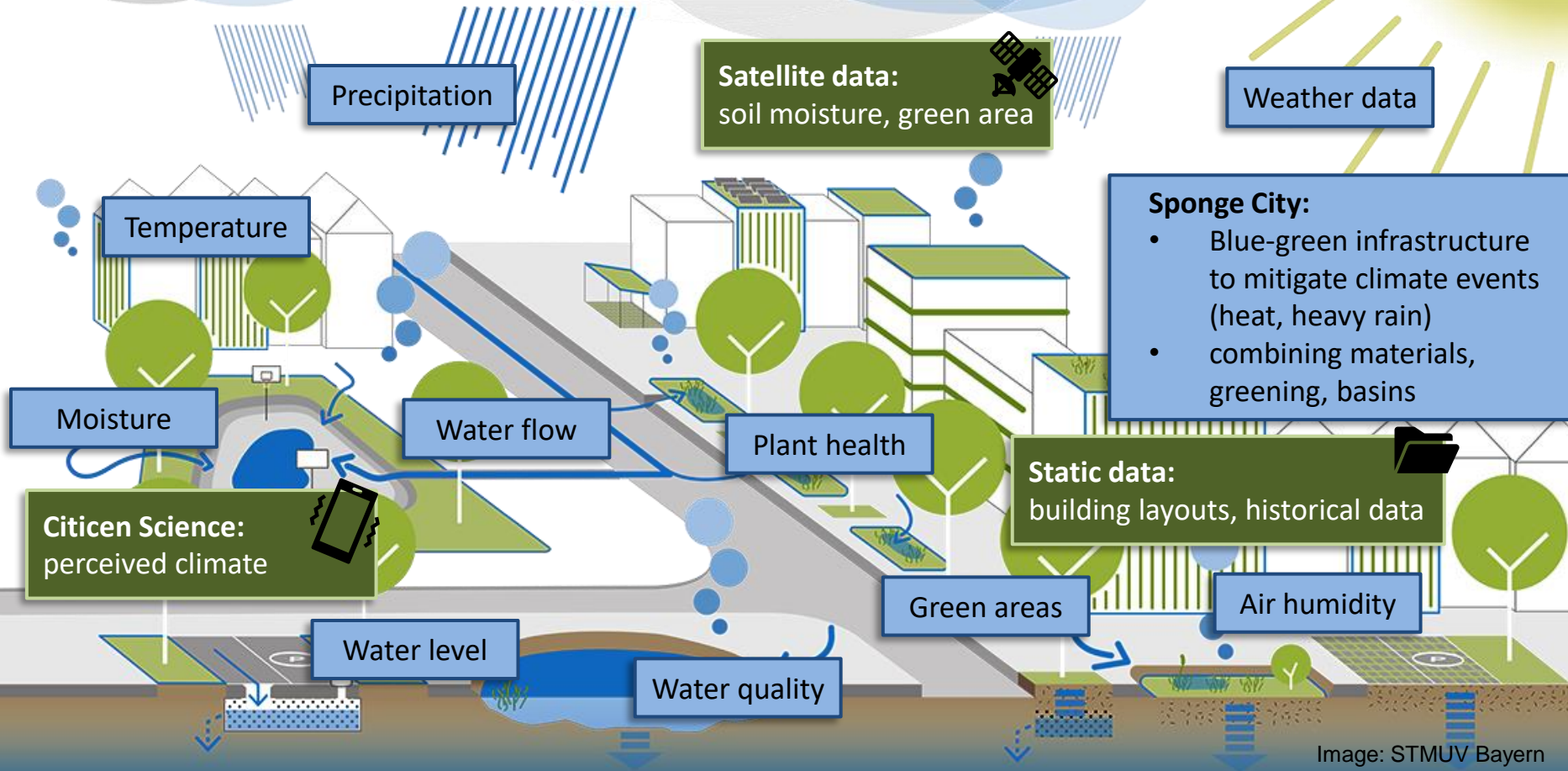


- Citizen science: Feedback, wearables, sensor stations



- Digital twins

City sensor networks: Example





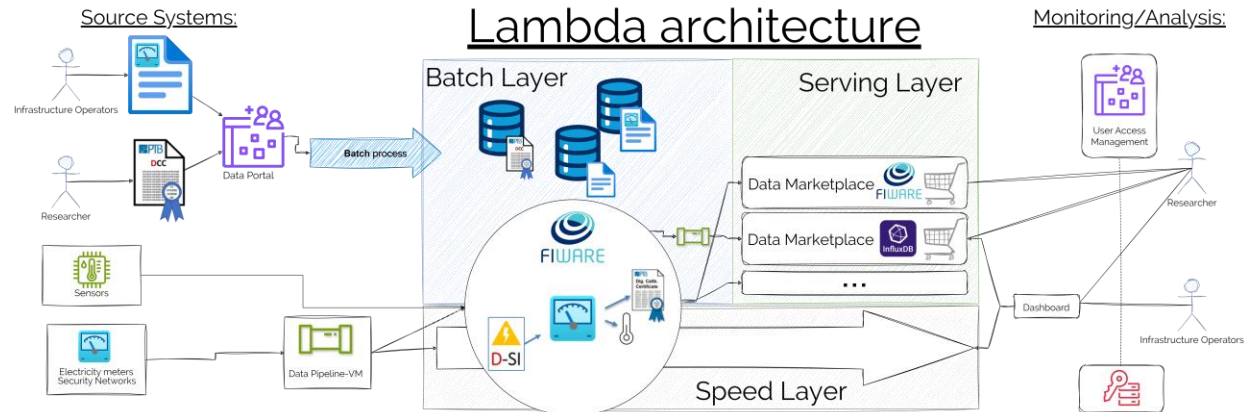
- Sensor networks in cities allow for more flexible and less stable (therefore cheaper) infrastructures.
- Sensor networks give a multifaceted image of cities.



- How can scalability and interoperability be ensured?
- What are high-level metrics that can be derived from sensor networks measurements?

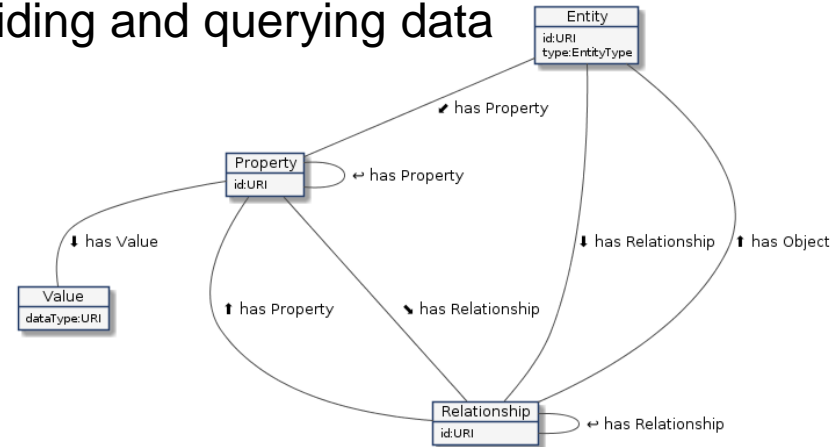
Data Infrastructures – Systems Engineering

- Systems engineering lifecycle for a data management architecture
- Taking into account stakeholder requirements as well as metrological metadata requirements for data reusability and FAIRness
- First Use Case energy data
- Testing field for smart city data infrastructures integrating metrology



Michael Ulbig:
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- Framework of Open Source Platform components, often recommended as interoperability solution for smart city data
- Used to implement smart city solutions and data infrastructures by several model smart city initiatives, such as Vienna, Living-in.eu, India Urban Data Exchange Platform, City Data Hub Platform South Korea, FZ Jülich
- Provides Smart Information Models for providing and querying data



DeviceWithDSI.jsonld 1.98 KiB Edit

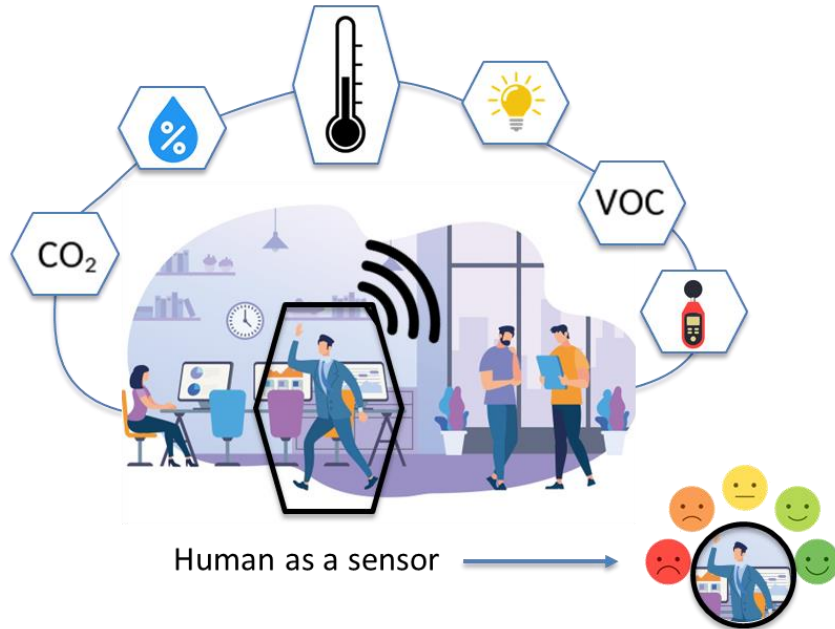
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Augmenting FIWARE Data Models by metrological metadata

expandedMU.jsonld 1.40 KiB

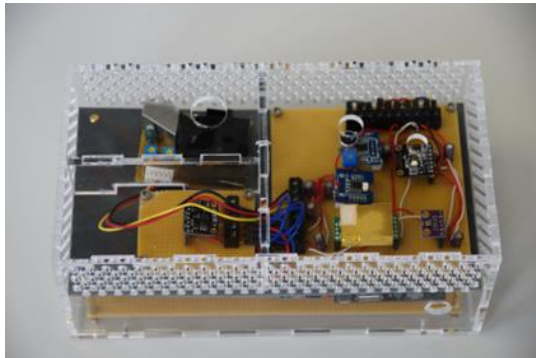
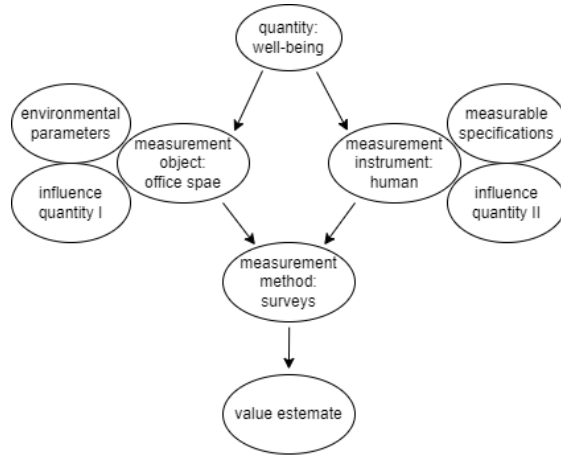
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Human as a Sensor – Measuring Well-Being



- Environmental sensor network information as characterization of office conditions
- Psycho-metric methods for assessing reliability of human feedback

Human as a Sensor – Measuring Well-Being



- Characterizing human as a sensor
- Measuring model for complex (high-level) quantity „perceived office climate“
- low cost setup – quality needs and metrological quality assessment

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