Using Digital Twins to Design More Sustainable Cities

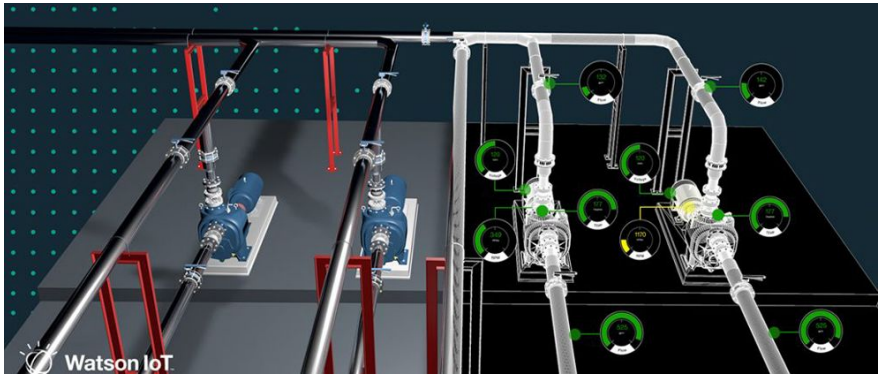
Joseph Picchi

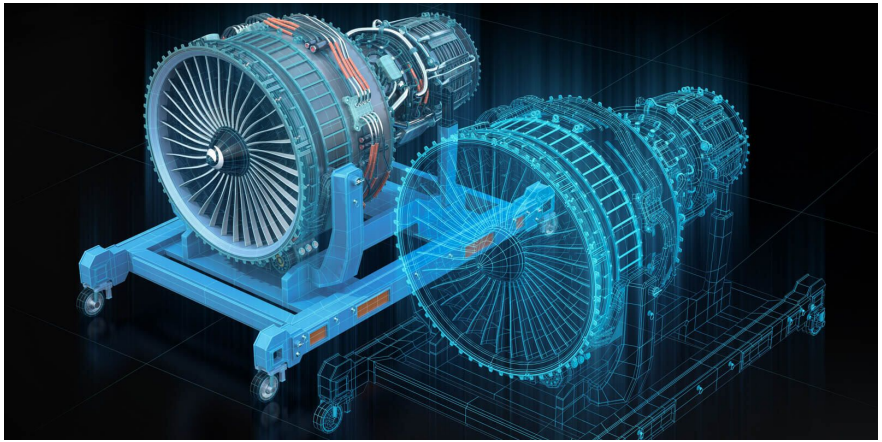
What's the Issue?

- Lack of civic participation
- Requires experts
- Multi-dimensional
- "Smart city" solutions are driven by private interests
- Not enough resources
- ICT companies

Digital Twins

- Virtual representations of material objects
- Simulates functions at a detailed level
- Apply this to an entire city!





Digital Twin of Herrenberg, Germany

1. 3D model of the cityscape
2. Street network model
3. Urban mobility simulation
4. Air flow simulation
5. Volunteered Geographic Information

1. 3D Model of Herrenberg

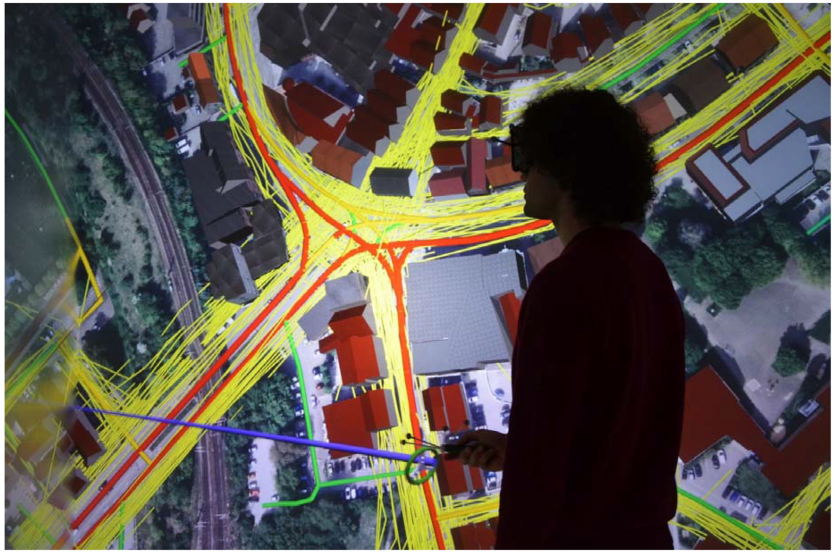
- Geographic data
- Digital elevation models
- Topological data
- Building information models (BIM)
- 3D laser scans

2. Street Network Model

- Space syntax for 2D layout
- Traffic census data
- Geographic information system (GIS) data
- Normal angular choice (NACH)
- Sensor network for emission data

3. Urban mobility simulation

- Simulation of urban mobility (SUMO)
- 3D cars, bikes, pedestrians, and public transport
- Simulates traffic and exhaust control

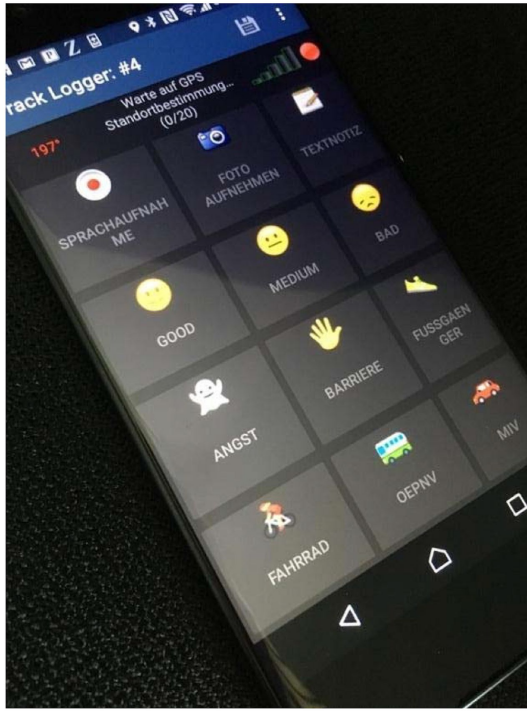


4. Air Flow Simulation

- OpenFOAM software
- Historical weather and climate data
- Model emissions production and distribution
- Model other weather-related phenomena

5. Volunteered Geographic Information

- Mobile app
- Track commute routes and transportation mediums
- Rate public spaces
- Register stationary activities
- Sound and image samples
- Emotional perceptions

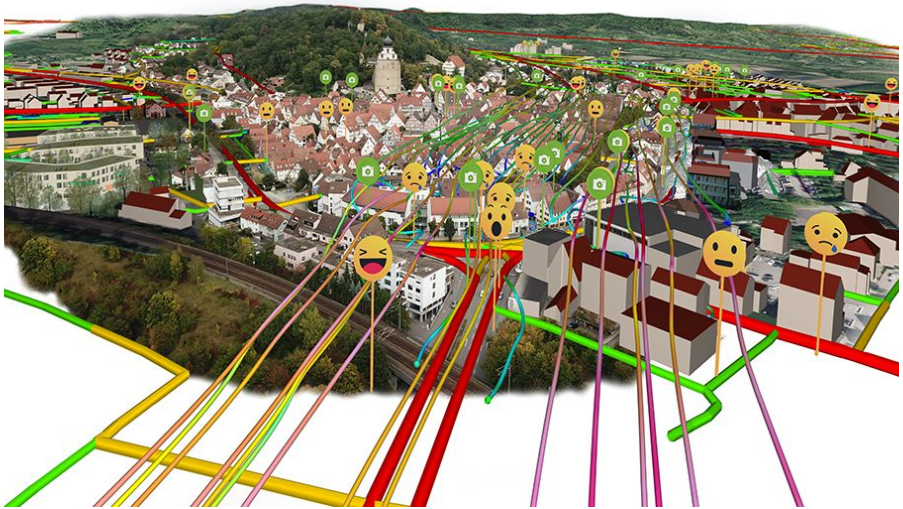


Digital City in Action

- High-Performance Computing (HPC)
- 3D visualization in virtual reality
- COVISE
- Visualized the Integrated Mobility Plan
- Simulated proposed developments

Conclusion

- Easy visualization of multidimensional developments
- Promotes civic engagement
- More representative of heterogeneous needs
- Democratizes urban data
- Coordinates “smart city” solutions
- Room for growth



Works Cited

Dembski, Fabian, et al. “Urban Digital Twins for Smart Cities and Citizens: The Case Study of Herrenberg, Germany.” *Sustainability*, vol. 12, no. 6, 2020, p. 2307., doi:10.3390/su12062307.

Gedenk, Eric. “Using Digital Twins to Design More Sustainable Cities.” *HLRS High Performance Computing Center*, www.hlrs.de/news/detail-view/2020-05-07/.

Korosec, Kirsten. “Xerox Built the Ultimate Transportation App for Los Angeles.” *Fortune*, Fortune, 28 Jan. 2016, fortune.com/2016/01/28/xerox-los-angeles-traffic/.

Mikell, Matthew. “Cheat Sheet: What Is Digital Twin? Internet of Things Blog.” *Business Operations*, 18 Feb. 2019, www.ibm.com/blogs/internet-of-things/iot-cheat-sheet-digital-twin/.