# Digital Twin & Official Statistics

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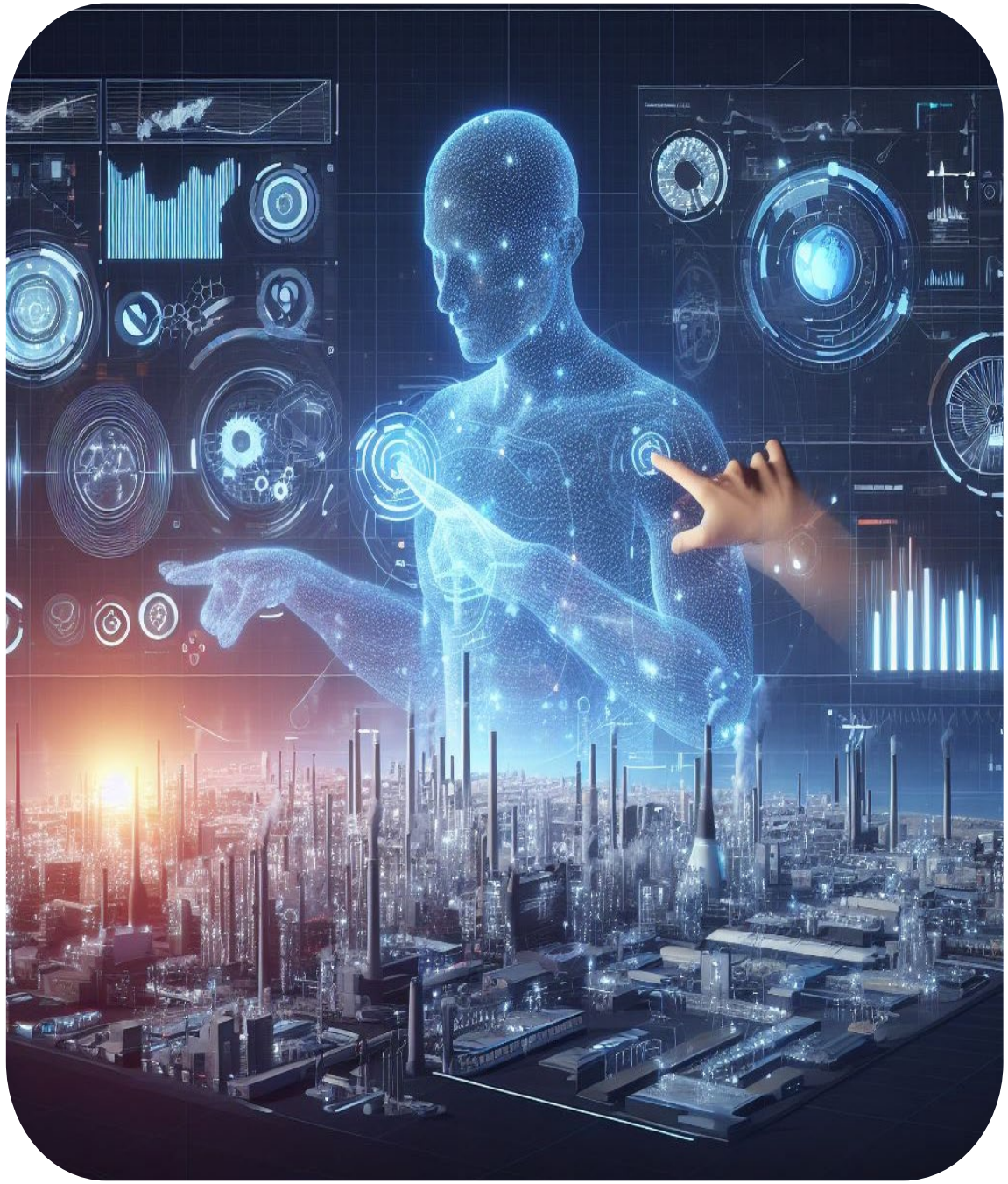
# Today’s talk

1. A brief description of Digital Twin
2. A brief overview of our research on Digital Twin
3. Opportunities and challenges for official statistics
4. Some case studies



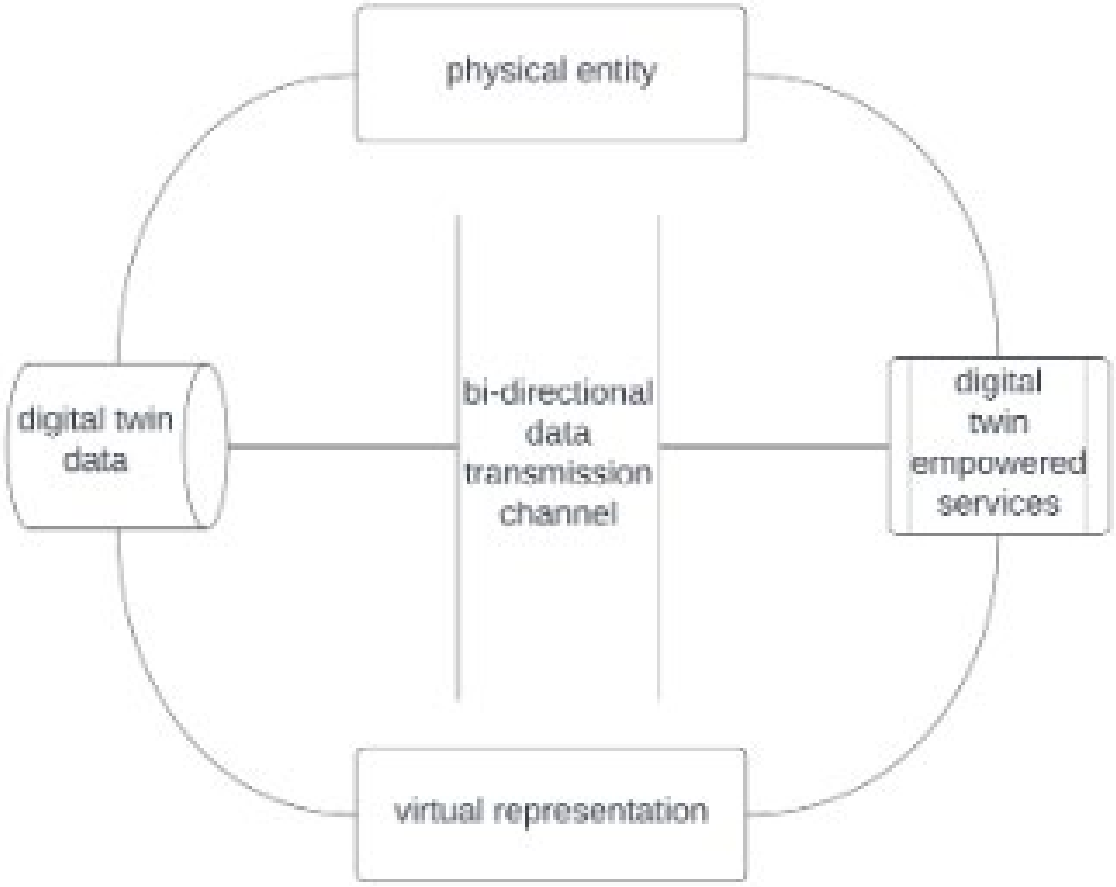
# What is digital twin?

‘an integrated multi-physics, multi-scale, probabilistic simulation of an as-built vehicle or system that uses the best available physical models, sensor updates, fleet history, etc., to mirror the life of its corresponding flying twin’

Glaessgen and Stargel (2012)

# Principal elements of digital twin

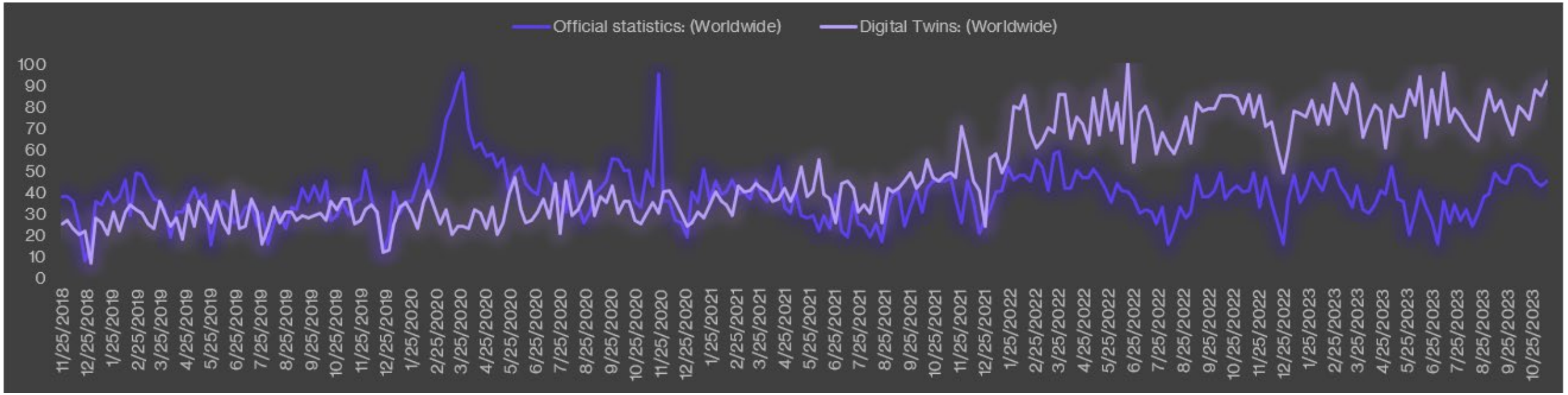
1. Physical product
2. Corresponding virtual representation
3. Bi-directional data transmission channel
4. Digital twin data
5. Digital twin services



# Why is digital twin important?

- ‘Digital Twin’ in Gartner top 10 strategic technology trends every year since 2017
- building block of the Metaverse (the post-reality universe, a perpetual and persistent multiuser environment merging physical reality with digital virtuality)
- Important pillar of industrial revolution 4.0
- To date, mainly used in manufacturing and product lifecycle management (PLM)

# Growing interest in Digital Twin




Source: Google Search November 2018 – October 2023

# Digital twin and the SDGs

*big data and cognitive computing*

MDPI

*Article*

## Enabling Digital Twins to Support the UN SDGs

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**Abstract:** Digitalisation has enjoyed rapid acceleration during the COVID-19 pandemic on top of the already fast-paced expansion impacting almost every aspect of daily life. Digital twin technology, which is considered a building block of Metaverse and an important pillar of Industrial revolution 4.0, has also received growing interest. Apart from its significant contribution to intelligent manufacturing, there has been considerable discussion on its implementation and the as yet undiscovered potential. This paper reviews the current trajectory of digital twin applications in supporting general sustainability, in the context of the 17 UN SDGs. Furthermore, it connects researchers and readers from different fields with the aim of achieving a better understanding of emerging digital twin technologies, the current values this technology has brought to support UN SDGs, and identify areas with potential for future research to better contribute to achieving the remaining tasks of Agenda 2030.

**Keywords:** digital twin; UN SDGs; sustainability

| key areas of digital twin applications | relevant UN SDGs |
|---|---|
| sustainable production, smart manufacturing, product lifecycle management, logistics and circular economy | 1, 8, 9, 12 |
| smart construction, building management and maintenance, prescriptive maintenance | 8, 9, 11, 12 |
| smart energy and resource management, urban planning and smart water infrastructure | 6, 7, 10, 11 |
| smart agriculture, livestock farming, fishery, the Earth and climate | 2, 13, 14, 15 |
| digital twining everything as healthcare service | 3, 10 |
| digital transformation of education and research | 4 |

# Digital Twin and Healthcare

*big data and cognitive computing*

MDPI

*Article*

## Impactful Digital Twin in the Healthcare Revolution

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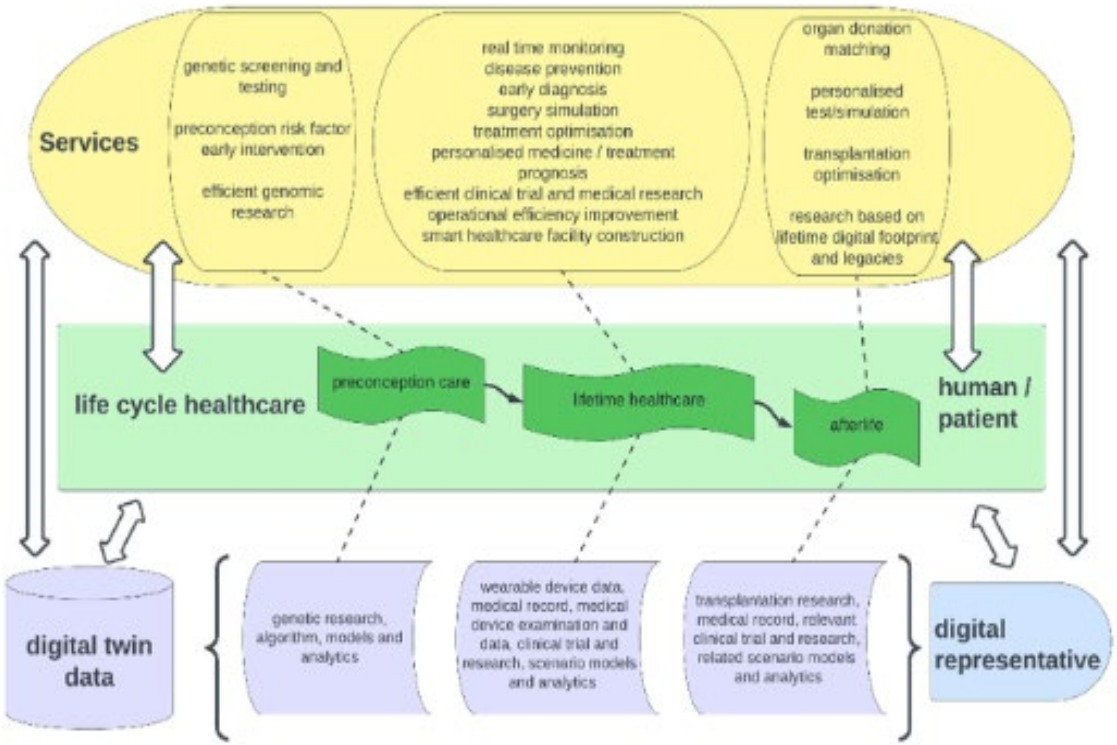
**Abstract:** Over the last few decades, our digitally expanding world has experienced another significant digitalization boost because of the COVID-19 pandemic. Digital transformations are changing every aspect of this world. New technological innovations are springing up continuously, attracting increasing attention and investments. Digital twin, one of the highest trending technologies of recent years, is now joining forces with the healthcare sector, which has been under the spotlight since the outbreak of COVID-19. This paper sets out to promote a better understanding of digital twin technology, clarify some common misconceptions, and review the current trajectory of digital twin applications in healthcare. Furthermore, the functionalities of the digital twin in different life stages are summarized in the context of a digital twin model in healthcare. Following the Internet of Things as a service concept and digital twining as a service model supporting Industry 4.0, we propose a paradigm of digital twinning everything as a healthcare service, and different groups of physical entities are also clarified for clear reference of digital twin architecture in healthcare. This research discusses the value of digital twin technology in healthcare, as well as current challenges and insights for future research.

**Keywords:** digital twin; healthcare; digital twin model; big data





# Opportunities from DT for Official Statistics

- Improved accuracy and real-time data analyses and analytics
- Enhanced predictive capabilities to support policy planning
- Cost efficiency in data collection and analyses
- Ability to simulate and assess impact of policies before implementation

# Challenges with DT for Official Statistics

- Technical Challenges: complexity in creation and maintenance. more complex physical entities will require more data and computational resources
- Data sharing: data protection, privacy, confidentiality and security
- Need for skilled personnel and technological infrastructure
- Integration with existing statistical methods and systems
- Digital divide – data divide

# Case study 1: Virtual Singapore

Singapore's digital twin – from science fiction to hi-tech reality


**Overview:**

1. Virtual Singapore is a dynamic three-dimensional (3D) city model and collaborative data platform, including the 3D maps of Singapore.
2. It was developed by the National Research Foundation of Singapore, in collaboration with various government agencies.

**Objective:**

1. To provide a comprehensive digital platform for modelling, visualization, and experimentation, aiding urban planning, policymaking, and improving citizen services.

**Integration of Data:**

1. Virtual Singapore integrates geospatial and real-time dynamic data, including demographics, movement, climate, and more.
2. It incorporates data from sensors and IoT devices across the city, providing updated and precise information.


# Case study 1: Virtual Singapore

**Applications:**

- **Urban Planning and Development:** City planners use the platform to simulate the impact of architectural and infrastructural changes.
- **Environmental Analysis:** Assessing environmental impacts of projects, like how a new building might affect airflow and heat in its surroundings.
- **Emergency Response:** Emergency services use it to conduct simulations for scenarios like floods or fires, enhancing preparedness and response strategies.
- **Public Services:** It aids in optimizing routes for public transport and managing public utilities more efficiently.

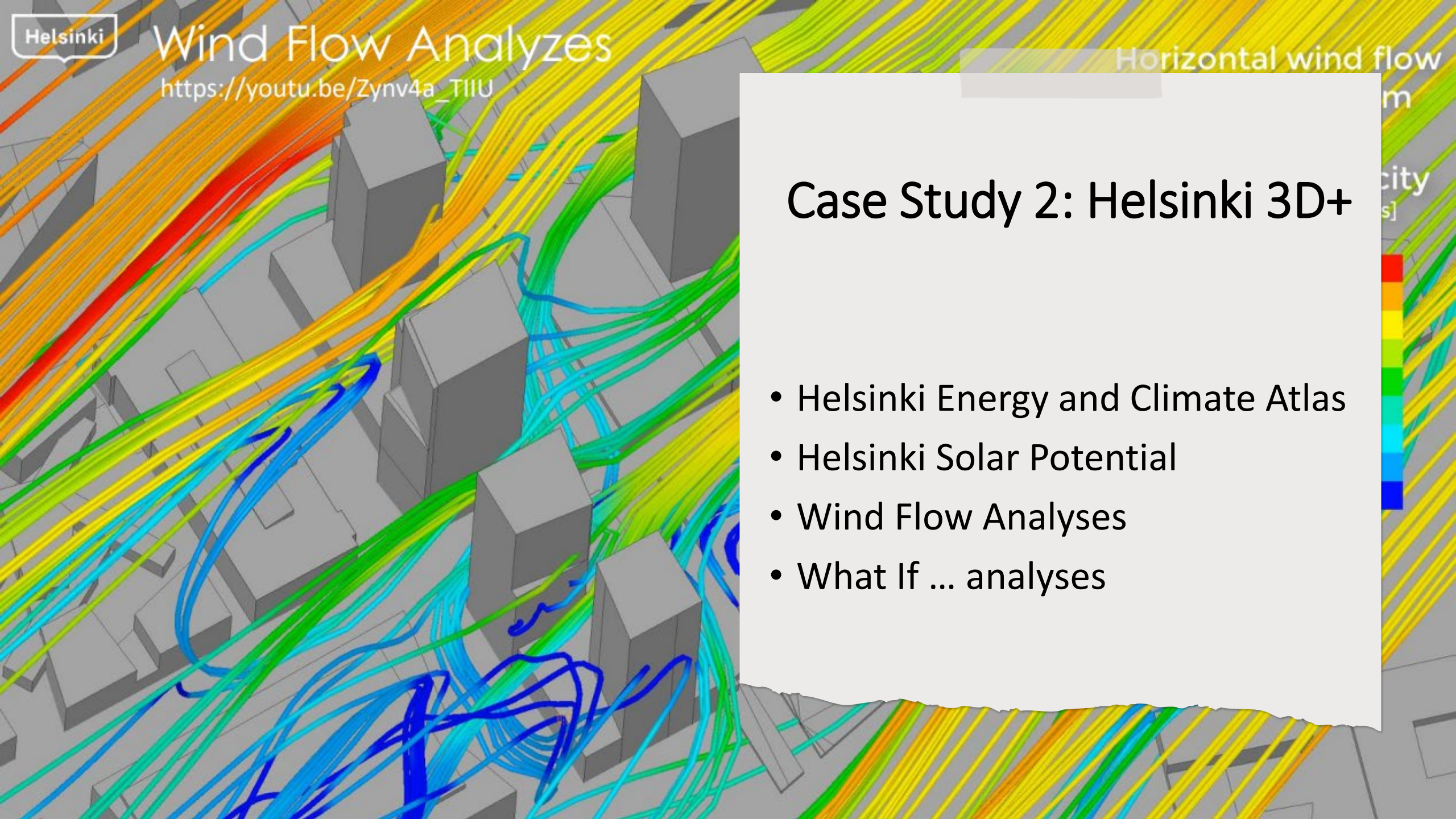
# Case study 1: Virtual Singapore


**Public Engagement:**

- The government uses Virtual Singapore to engage with citizens by providing them access to useful data, like real-time traffic updates and public service information.

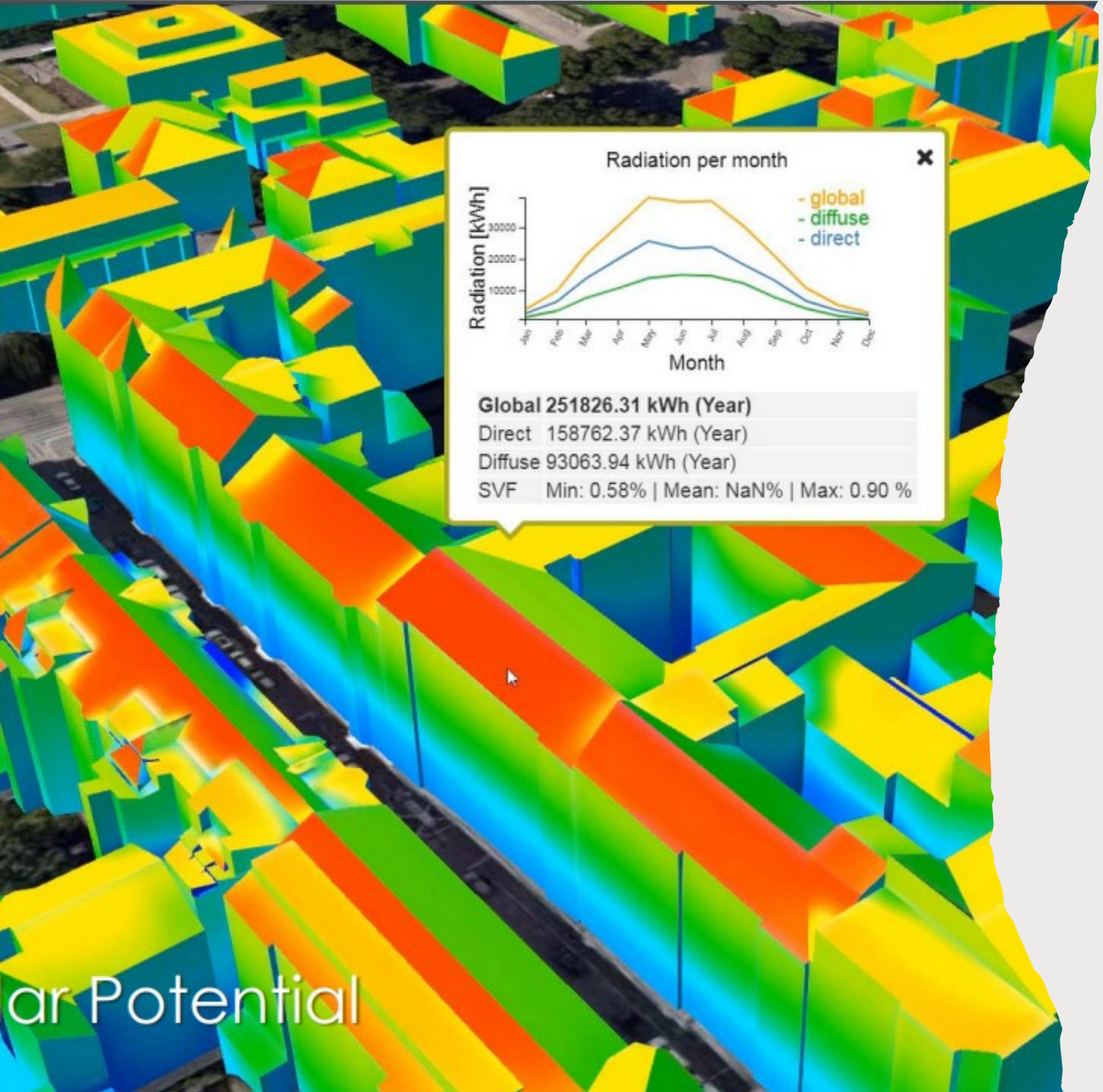
**Benefits:**

- Improved decision-making in urban planning and resource management.
- Enhanced citizen services and public safety.
- Better management of environmental impacts of urban projects.
- Facilitation of research and innovation by providing a platform for data integration and analysis.




# Case Study 2: Helsinki 3D+

- Helsinki Energy and Climate Atlas
- Helsinki Solar Potential
- Wind Flow Analyses
- What If … analyses




# Case Study 2: Helsinki 3D+

**6 challenges**

- Consistency between models
- Standardization
- Data quality
- Data Interoperability
- Data maintenance / governance
- From utopian pilots to real-world use cases

# Conclusions

1. **Data Revolution 2.0?**
    1. A new transformative era with the emergence of Digital Twins, Web 3.0, and Quantum Computing.
    2. Will this represent a paradigm shift in how we collect, share, analyze, and interpret data?

2. **Data: The backbone of innovation**
    1. Data will not just be a resource but the very foundation upon which these technologies operate.
    2. Data governance (including quality, availability, and ethics) are pivotal in harnessing the full potential of these advancements.

3. **Crucial developments for official statistics**
    1. In theory Digital Twin offers unprecedented real-time analyses, revolutionizing traditional statistical sources and methods.
    2. But we have seen false dawns before.
    3. A lot of issues around governance, ethics, culture, social contract, access and privacy to be worked through.