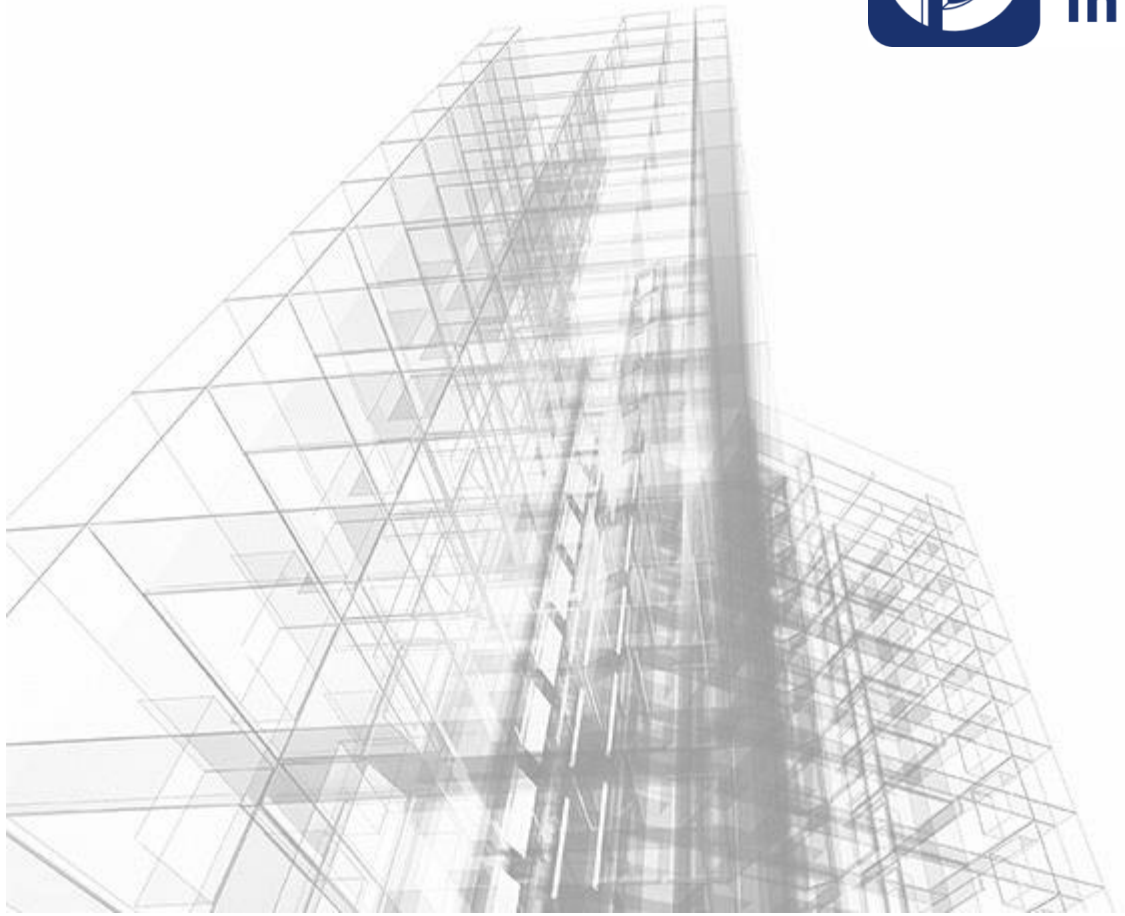
Pinnacle Infotech
Construct Certainty, with Technology



Infrastructure Digital Twin Decoded

Pinnacle Infotech Solutions

Key Challenges

No Centralized System

Operational Inefficiencies

No Tools To Predict The Health Of Assets

Reactive Maintenance

Limited Real-Time Visibility

Location referencing issues

Fragmented Asset Tracking

Sustainability monitoring

Scalability Challenges

About the Project- Integration of Roads/Bridges in a single Digital Twin platform

- Demonstrate capability of incorporating OpenRoads, OpenBridge, Civil3D, Trimble, Revit, IFC drawings into iTwin Digital platform to power a hyper-connected, self-monitoring environment.

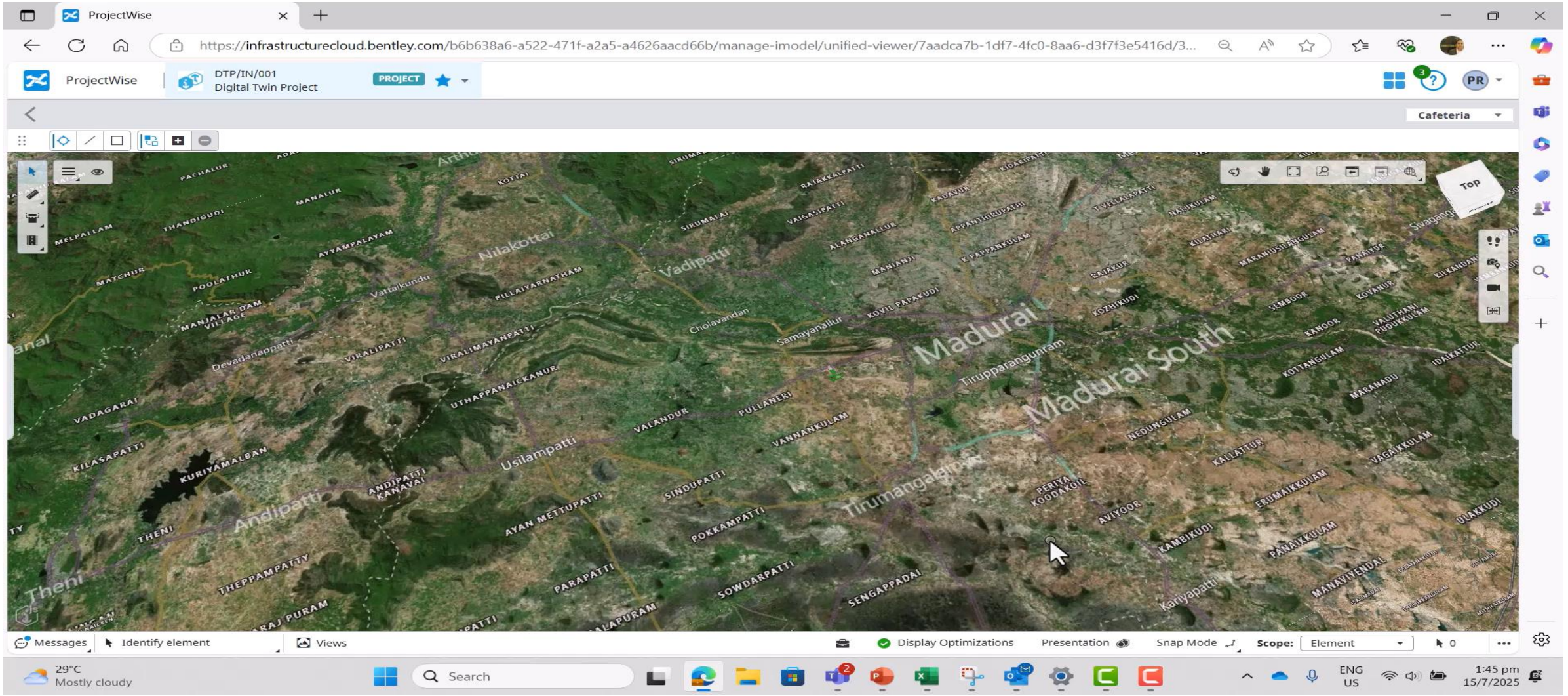
- This is central to resilient infrastructure, which can self-monitor, adapt and respond to unexpected events.

About the Project- CMMS integrated

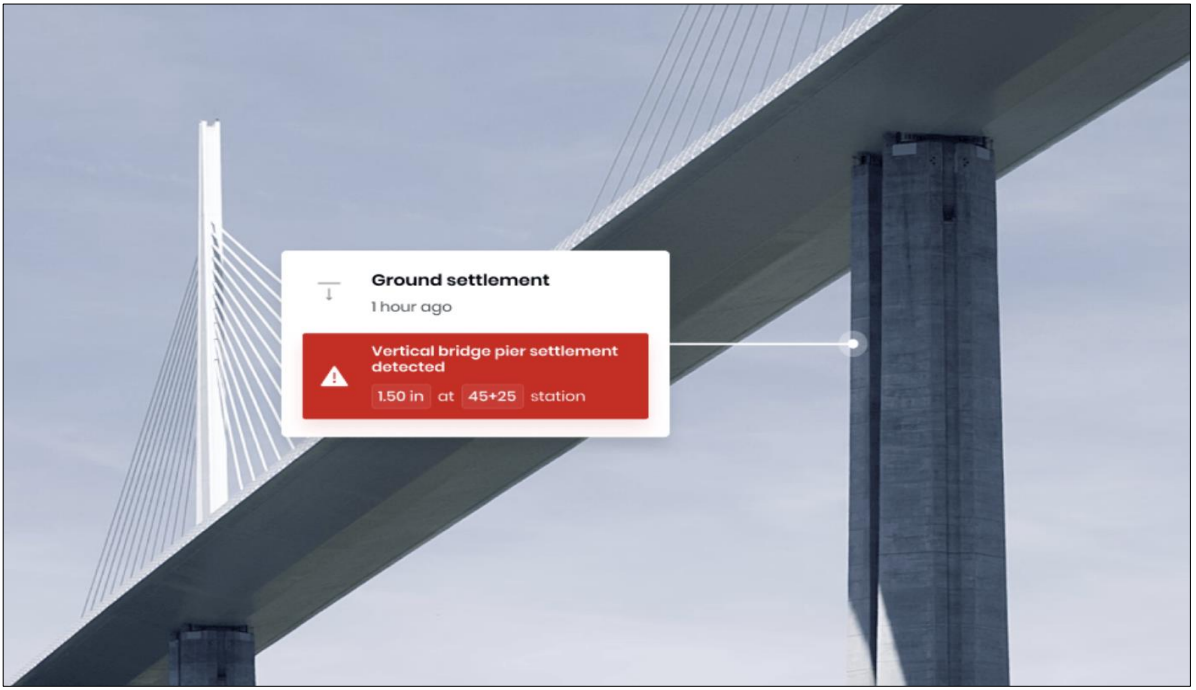
- From structural health monitoring of Bridges to real-time surface monitoring and visual analytics of Roads, Bridges and Pavements , set a benchmark for sensor-integrated infrastructure maintenance

- Empower multi-million dollar assets with dynamic validation of performance, usage, and sustainability.

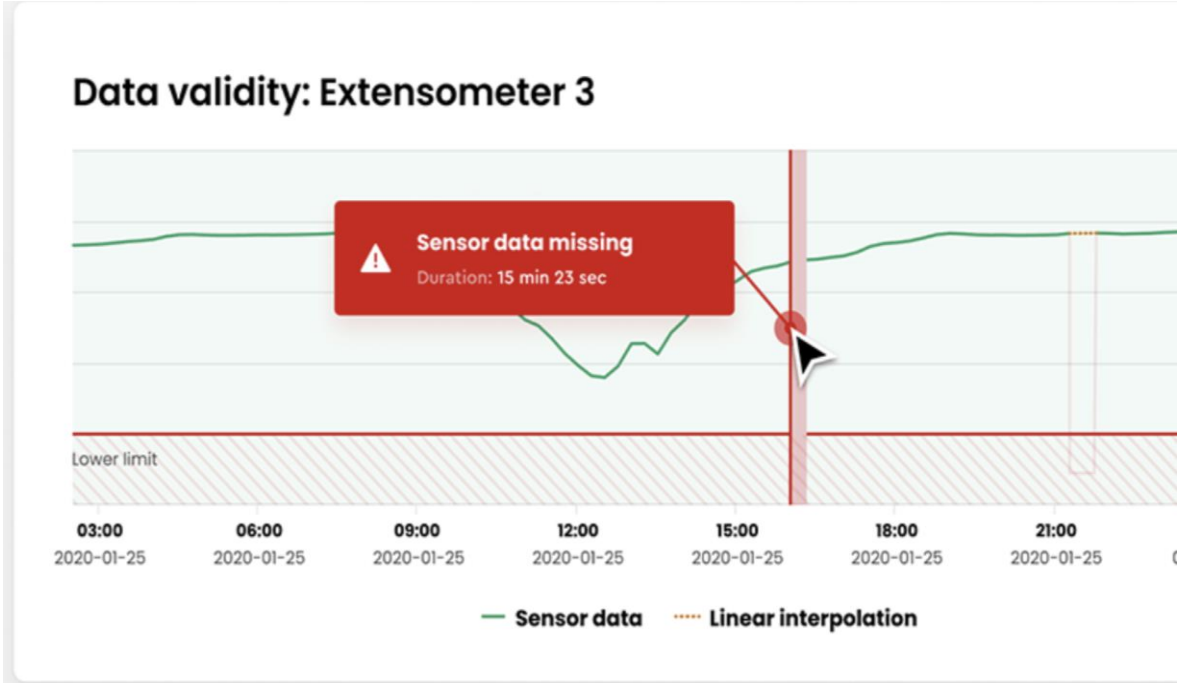
Step 1 - OpenRoads, Revit , Civil 3D, IFC ,Tekla integration



Step 2— Data Acquisition

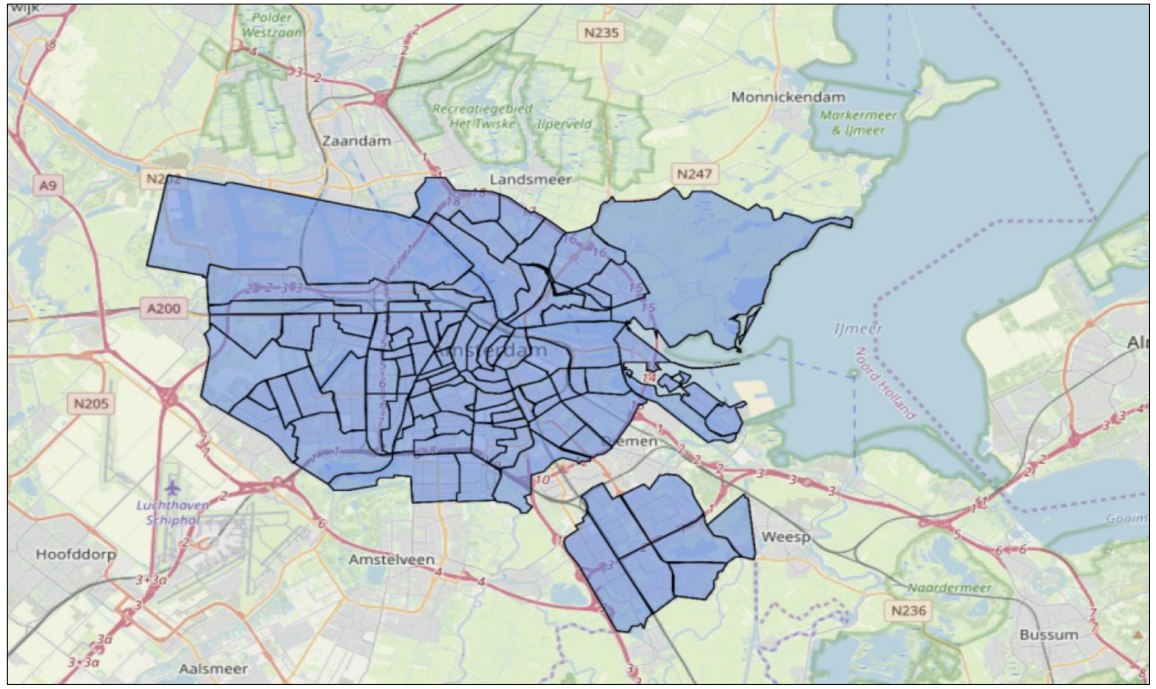


Gather data which is not possible by Manual inspection

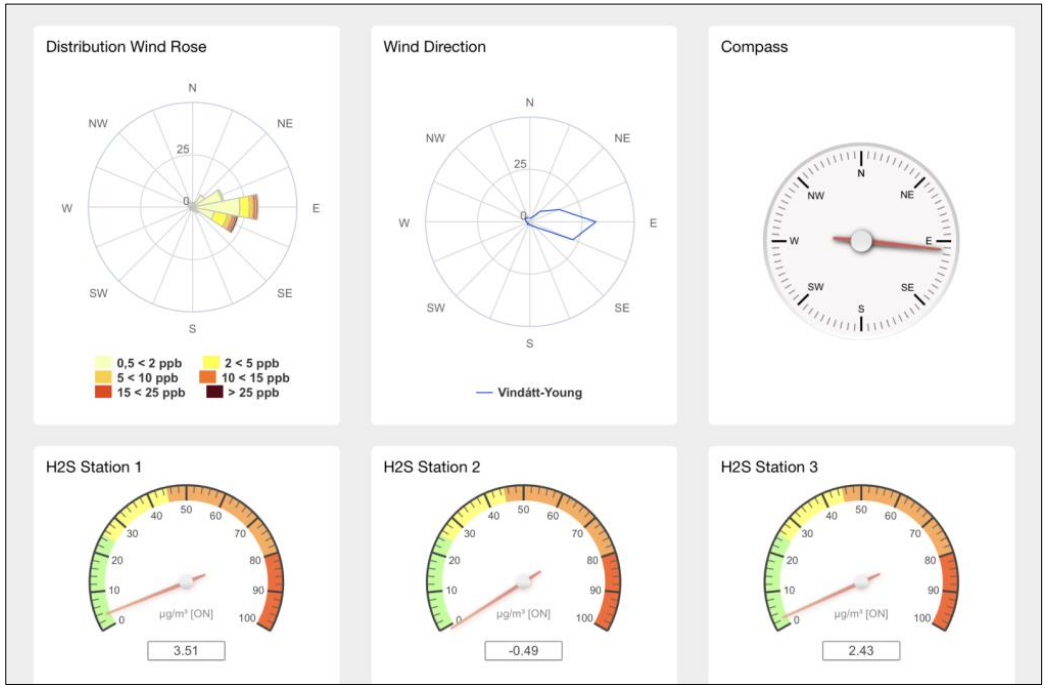


Monitor data quality

Step 3 — Visualization and analysis

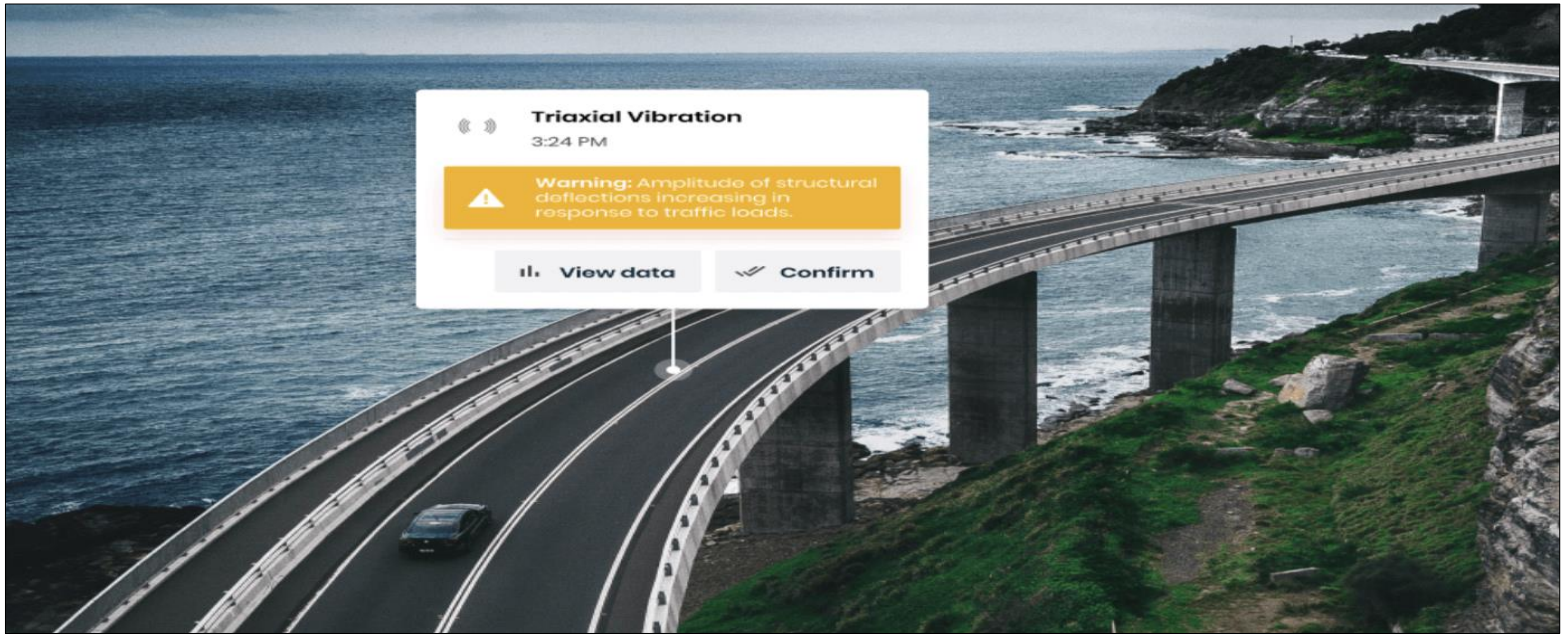


Show data in context

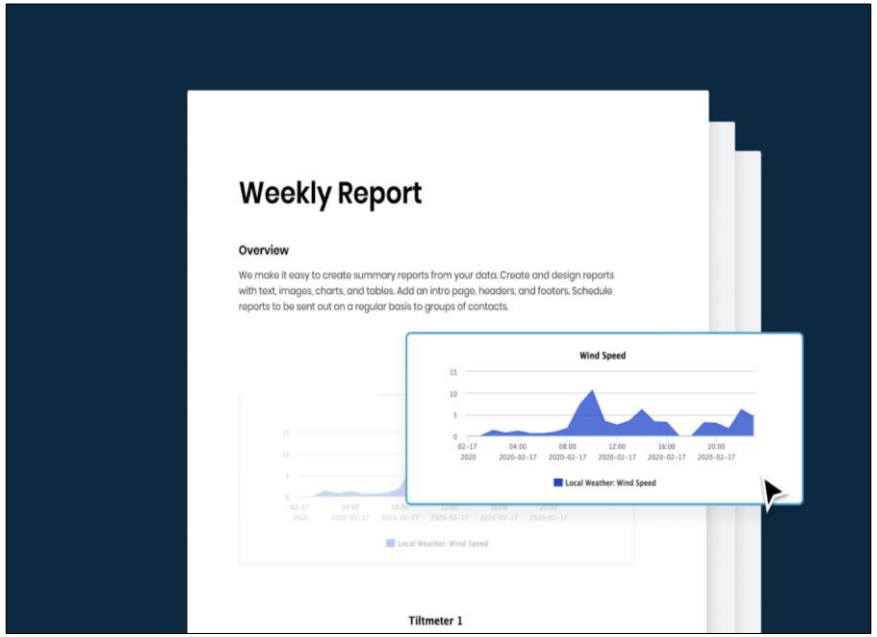


Visualizations and analysis

Step 4 —Alarms and Reporting

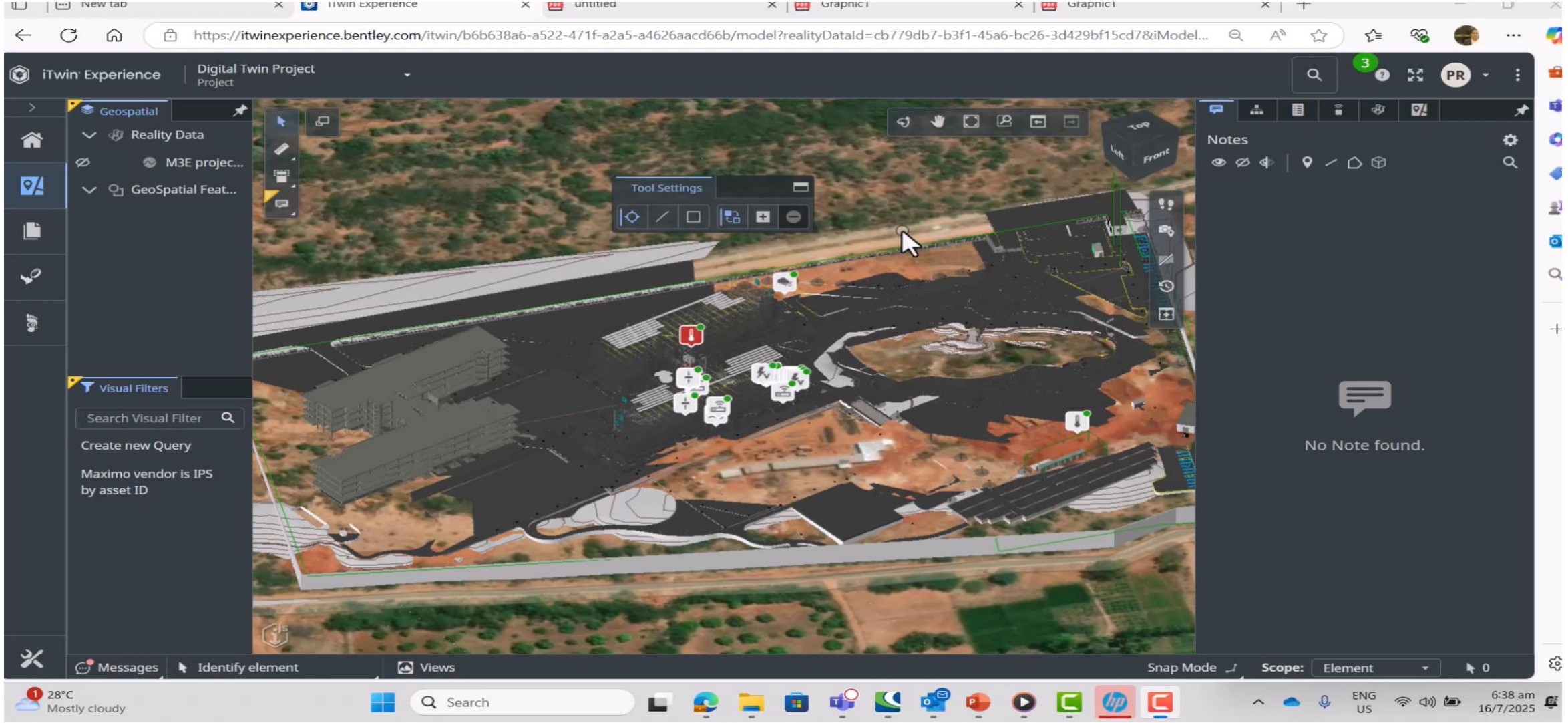


Alarms



Reports

Project Digital Twin- CMMS integration



Learnings

Benefits and Importance of Digital Twin integration for Bridges and Road

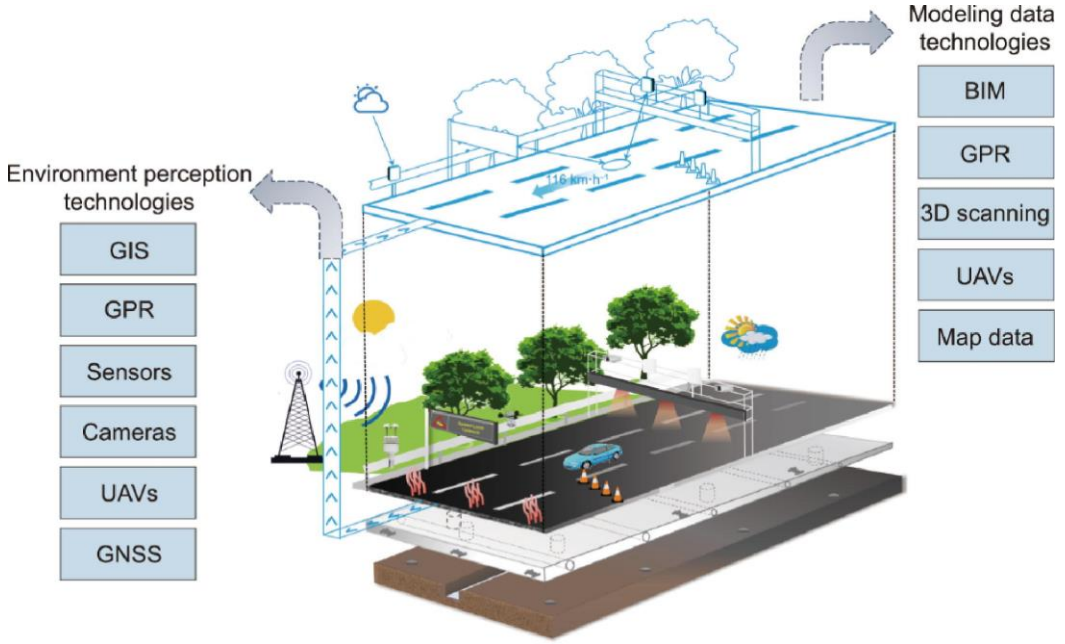
Key Points:

- **Structural Health Monitoring (SHM):** Real-time updates on load, tension, stress, and corrosion.
- **Preventive Maintenance:** Detects micro-cracks or fatigue before failure.
- **Asset Lifecycle Management:** Through intelligent data collection and comprehensive analysis of safety quality, noise, dust, and deformation monitoring.
- **Safety Assurance:** Prevents sudden collapses and ensures public confidence. DTs detect and notify stakeholders of safety risks, issue real-time warnings, and support early emergency detection
- **Disaster Preparedness:** Sensors can collect data on construction equipment, building materials, and environmental factors like temperature, humidity, and vibration, transmitting that data in real time to the DT platform. Simulates responses to earthquakes, floods, or heavy traffic surges.
- **Reduced Inspection Costs:** Drone/sensor data reduces manual inspection frequency.

Implementation Challenges for Roads

Key Points:

- **Data Integration Complexity:** Inconsistent data from sensors, vehicles, weather stations.
- **Infrastructure Upgrades:** Need to retrofit existing roads with IoT sensors and smart systems.
- **High Initial Cost:** Deployment of sensors, connectivity, and analytics platforms.
- **Data Privacy & Security:** Real-time user and vehicle tracking requires robust cybersecurity.
- **Interagency Coordination:** Municipalities, traffic departments, and IT vendors must collaborate.
- **Connectivity Gaps:** DT technology leverages virtual–physical mapping to facilitate the real-time monitoring and dynamic simulation of transportation infrastructure.

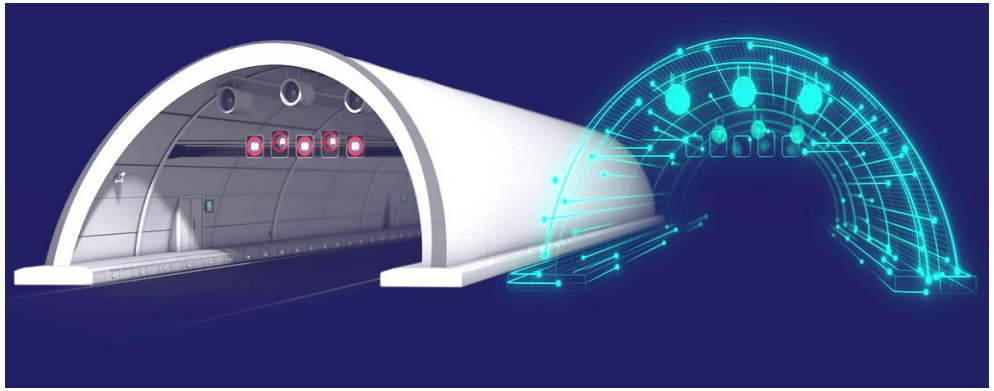


Implementation Challenges for Bridges

Key Points:

- **Retrofitting Legacy Structures:** Hard to install sensors on aging or inaccessible parts.
- **Data Volume & Processing:** Continuous structural data creates big-data challenges.
- **High Sensor Maintenance:** Sensors in harsh environments need regular calibration.
- **Cost of Implementation:** Especially high for long-span or iconic bridges.
- **Standardization Issues:** Lack of global norms for digital twin data models in infrastructure.
- **Legal & Compliance:** Ownership of data and regulatory approval processes.

Benefits and Importance of Digital Twin for Tunnels



Key Points:

- **Environmental Monitoring:** Real-time tracking of air quality, gases, humidity, and temperature.
- **Enhanced Safety:** Rapid detection of fires, gas leaks, structural faults.
- **Predictive Maintenance:** Avoids sudden breakdowns by simulating asset degradation.
- **Operational Efficiency:** Helps manage lighting, ventilation, drainage based on usage and weather.
- **Emergency Management:** Simulates evacuation during accidents or disasters.
- **Remote Supervision:** Minimizes human intervention in hazardous conditions.

Implementation Challenges for Tunnels

Key Points:

- **Hostile Environment for Sensors:** High humidity, limited airflow affect sensor performance.
- **Connectivity Limitations:** Underground settings cause signal and data transfer issues.
- **Energy Supply for Devices:** Powering IoT devices over long tunnel spans is a challenge.
- **High Installation Costs:** Due to complexity and safety requirements.
- **Data Overload:** Continuous monitoring generates large volumes of unstructured data.
- **Integration with Emergency Systems:** Needs to sync with fire, ventilation, and rescue protocols

Thank You

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