CONFERENCE OMAINTEC 2026 EXHIBITION FM

The 23rd International Asset Facility and Maintenance Management Conference

ENHANCING DIGITAL TWIN PERFORMANCE IN TRANSPORTATION INFRASTRUCTURE MANAGEMENT

A Comprehensive Approach Leveraging Advanced Asset Management Insights

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Agenda

1- Introduction

The concept of Digital Twin

2- Why do we need DT?

Aging infrastructure, rising maintenance costs and unpredictable failures

3- What is the outcome of DT?

The shift from reactive maintenance to predictive and prescriptive asset management

4- What is the core of DT?

BIM, IoT sensing, asset management systems and AI analytics

5- Case Study

smartBRIDGE Hamburg as a practical application of digital twin–enabled bridge asset management

6- What are the challenges?

Data quality, Interoperability and Security

1- Introduction

A digital twin is a dynamic, data-connected virtual model of a physical asset, updated in real time to monitor, simulate, predict, and optimize its real-world counterpart across its entire lifecycle.

Key Concept:

It's a living digital replica that evolves with the physical asset through continuous data exchange.

Core Components:

Physical Asset – Bridge, road, tunnel, railway
Virtual Model – Digital 3D representation
Data Link – Real-time sensor data, IoT, inspection reports
Analytics & AI – Predictive insights and decision support

A DT is more than a 3D model:

It's connected – fed by live sensor & inspection data
It's predictive – powered by AI and analytics
It's actionable – enabling smarter decisions across planning, operation, and maintenance

2- Why Digital Twin?

Our transportation networks are under unprecedented pressure from rapid urbanization, increasing traffic volumes, and the aging of existing infrastructure.

Problem	Consequence
Rapid Urbanization	Overloaded systems, increased demand
Increasing Traffic Volumes	Congestion, accelerated wear
Aging Existing Networks	Rising failures, safety risks, shortened lifespan
Fragmented & Siloed Data	Poor decisions, missed insights
Unpredictable Failures	Service disruption, public risk

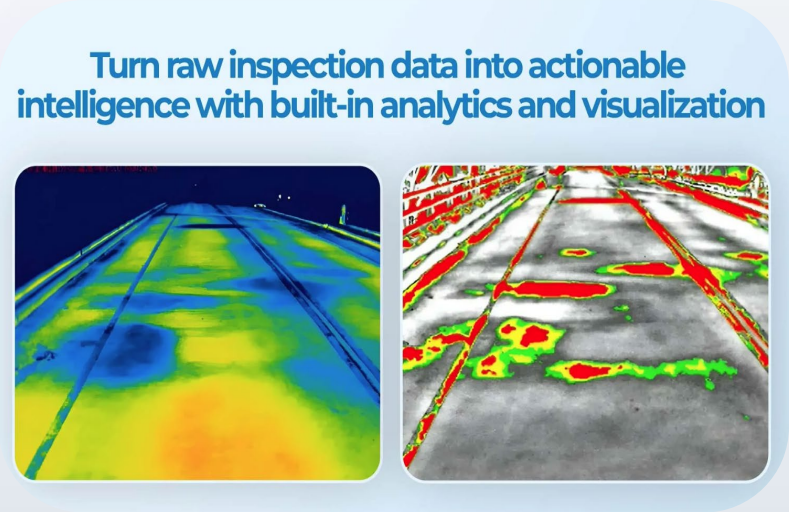
Digital Twins transform infrastructure from **a cost center into an intelligent**, **manageable** asset. They provide a living digital model that mirrors real-world conditions, allowing you to:

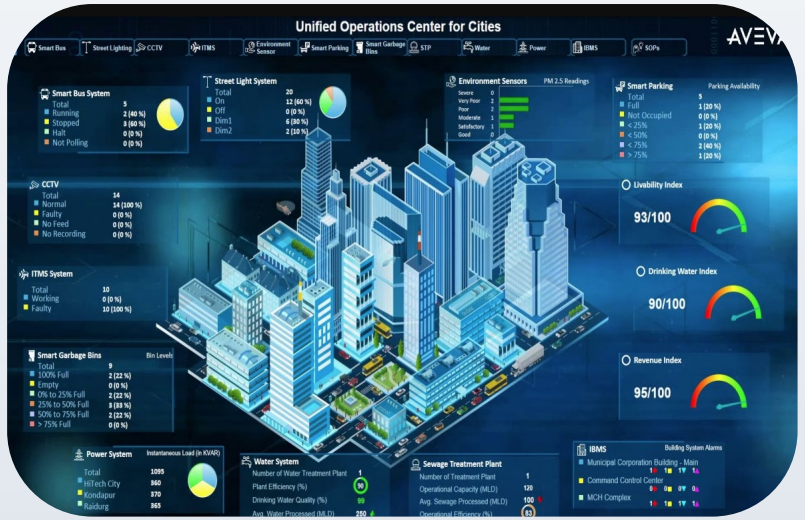
- Predict failures before they happen.
- Optimize maintenance schedules and resources.
- Simulate scenarios and impacts.
- Extend asset lifespan and improve safety.

On August 14, 2018, the Morandi Bridge in Genoa, Italy, partially collapsed during a rainstorm, killing 43 people:

- The bridge was an aging structure.
- limited continuous monitoring (periodic and visual).
- Degradation of pre-stressed concrete cables and corrosion.

3- What is the Outcome of DT?





From Reactive → Predictive Maintenance
Early failure detection & optimized scheduling

Unified Intelligence → Better Decisions
Real-time data fusion with AI-driven insights

Extended Asset Life and Lower Costs
Proactive preservation and smarter investment across the asset lifespan

4- What are the Tools of DT?

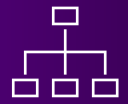
A Digital Twin is built on an integrated stack of advanced tools working together in real time

BIM & 3D Modeling

Foundation for geometry, asset structure and visualization across the lifecycle

Sensors & IoT (SHM)

- Continuous data flow from embedded sensors and devices.
- Real-time monitoring of structural behavior, condition and environmental impacts.



Asset Management Systems

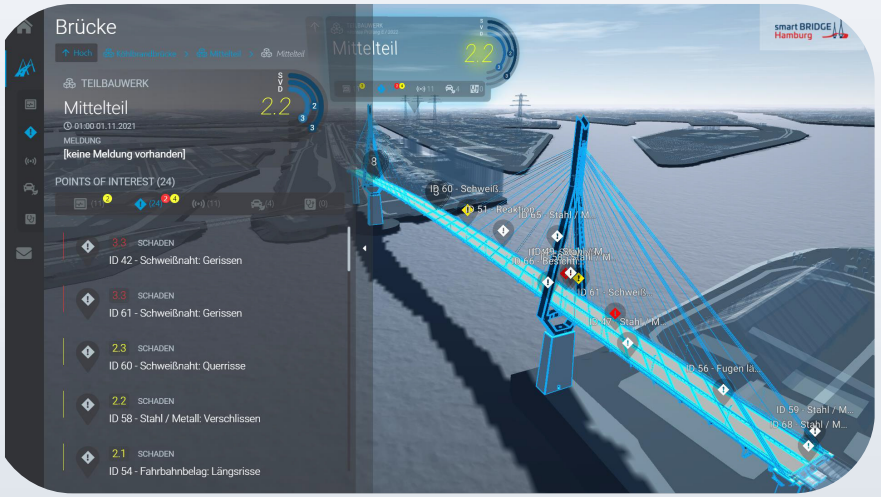
Historical data, condition ratings, risk logic, and maintenance records

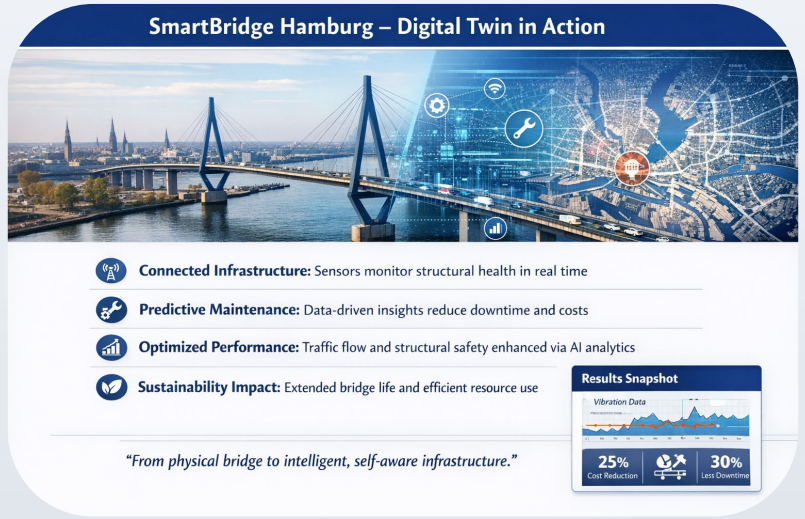
Advanced Analytics & AI

Predictive modeling, anomaly detection, maintenance optimization and automated decision-making.

5- SmartBRIDGE Hamburg – Digital Twin in Action

smartBRIDGE Hamburg demonstrates how a Digital Twin transforms bridge management from **periodic inspections** into **continuous, intelligent stewardship**





Digital Twin Implementation

A BIM-based digital model serves as the backbone, integrating classical visual inspections with continuous Structural Health Monitoring (SHM) data collected from sensors installed on critical bridge components

Data & Intelligence Layer

Sensor measurements are combined with inspection-based condition ratings to generate objective condition indicators (PCIs) creating a unified and consistent assessment of asset health

Decision Support & Outcomes

The system enables early detection of anomalies, supports predictive maintenance planning and shifts maintenance strategies from reactive interventions to proactive, data-driven decisions

6- What are the challenges of DT?

- **Data quality and integration:** heterogeneous sources, inconsistent formats, and data silos.
  (Define common data standards, focus on critical data first and apply automated validation)
- **System interoperability:** limited standardization across platforms and stakeholders.
  (Use open platforms, APIs, and align with ISO 55000 & ISO 19650 standards)
- **Real-time processing and model accuracy:** high computational, operational demands.
  (Combine edge and cloud computing; prioritize decision-relevant accuracy)
- **Skills, governance and cost:** need for multidisciplinary expertise and adoption strategies.
  (Build cross-disciplinary teams and invest in targeted training)

By addressing these interconnected challenges, we unlock the full potential of digital twins.

Turning data into actionable intelligence and transforming how we manage, maintain, and protect the infrastructure that builds our future cities.

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THANK YOU!

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