

A Guide to Digital Twins

The different types, their uses & how 3D reality twins support critical infrastructure

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In recent years, digital twins have emerged as a transformative tool for infrastructure management.

In the realm of infrastructure, digital twins are revolutionising how we approach the design, construction, and maintenance of critical structures.

Often referred to as **asset twins** or **3D Reality Twins**, these precise digital representations of large and complex assets (such as bridges, buildings, and energy systems) provide stakeholders unprecedented insights into structural integrity and potential vulnerabilities.

Explore the definition of digital twins and emerging applications across infrastructure in our white paper.

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Trendspek

Trendspek is a leading Structural Lifecycle Management System (SLMS) that supports digital inspections, reporting, maintenance planning and condition monitoring of infrastructure and built assets.



DEFINITION

What are Digital Twins?

A digital twin is a virtual representation of a physical asset, system, or environment, continuously updated with data to mirror its real-world counterpart at a point in time.

Digital twins can integrate data from IoT sensors, historical records, and predictive models to enhance asset management, optimise performance, and support decision-making.

Digital twins can be categorised into several types based on their scope, level of detail, and function.



1. Component (or Part) Twin

- A digital twin representing a single component of a system (eg. a sensor, or a motor).
- Used for performance monitoring, defect detection, and predictive maintenance.



2. Asset Twin

- Represents a complete asset, such as a machine, a bridge, or a building.
- Incorporates data from multiple component twins to provide insights into asset health, usage patterns, and lifecycle management.



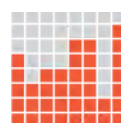
3. Process Twin

- Represents end-to-end workflows or operational processes
- Such as supply chains, logistics networks, or city-wide traffic systems.



4. System (or Unit) Twin

- Models an entire system made up of multiple assets working together, such as a factory production line, a railway network, or a power grid.



5. Urban or Infrastructure Twin

- A large-scale digital twin of entire cities, infrastructure networks, or regions.
- Used for urban planning, traffic management, disaster response, and smart city applications.

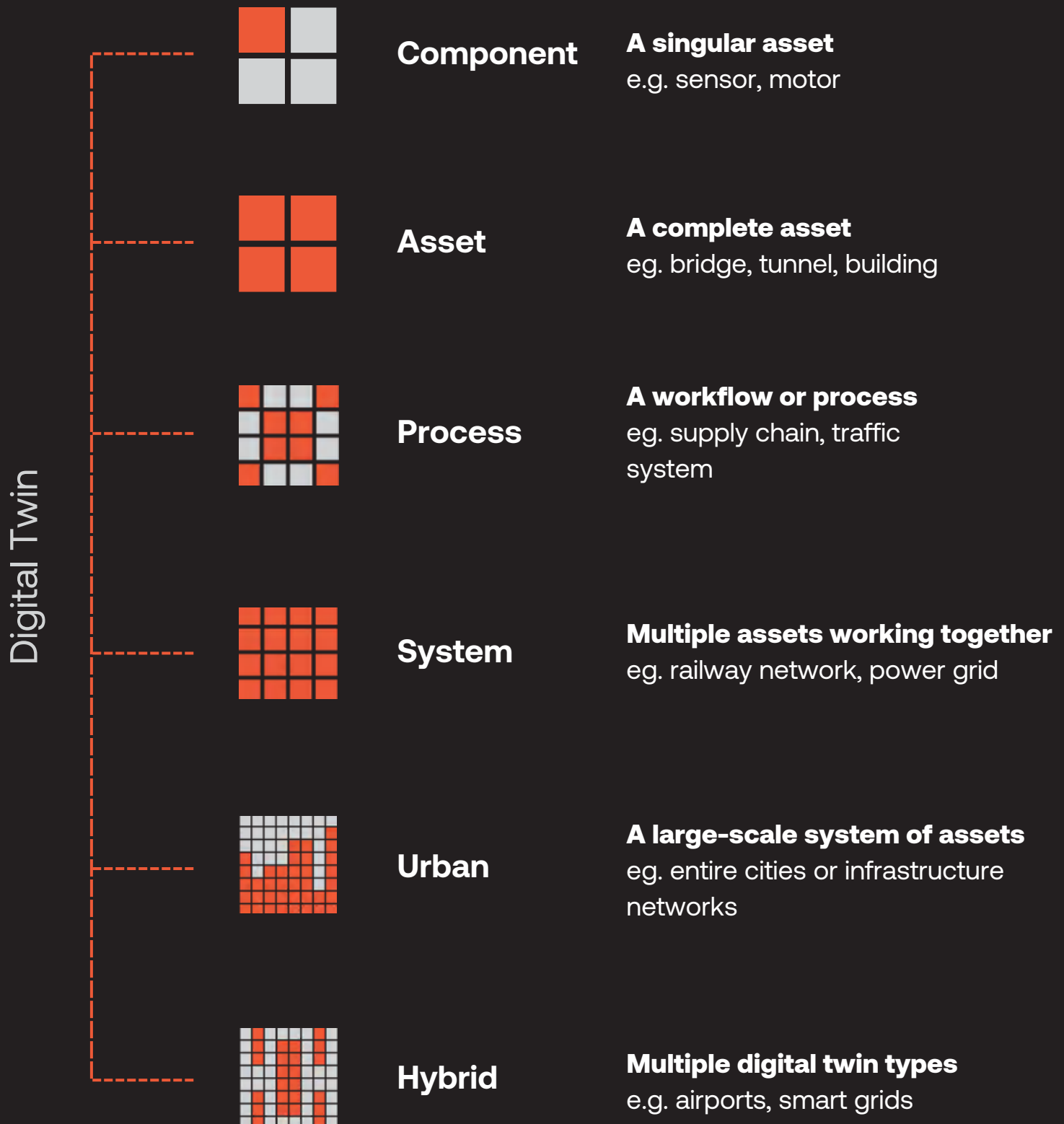


6. Hybrid Digital Twin

- Combines multiple types of digital twins (eg. Asset + Process + Urban) to provide a holistic view of interconnected systems.
- Often used in complex environments such as airports, ports, and smart grids.

DIAGRAM

Different types of Digital Twin and applications



DEFINITION

What are 3D Reality Twins?

Trendspek's 3D Reality Twins are **an advanced digital twin** that provide an accurate, sub-centimetre representation of assets at a specific point in time.

These highly-detailed digital replicas enable asset owners, engineers, and facility managers to gain a full picture of structural health by simply logging in online.

Reality Twins can integrate data from photogrammetry, reality mesh, point cloud, LiDAR or videos/photos to provide spatial scenario analysis of large and complex structures.

With up-to-date digital records of structural condition, this makes it easier to manage critical repairs, optimise performance, and support key decision-making.

While both Digital Twins and Reality Twins create digital representations of physical assets, they serve different purposes.

A Reality Twin is a specialised solution of a Digital Twin designed for asset management, providing a highly accurate, sub-centimetre representation of assets at a specific point in time.

The level of detail that Reality Twins provide is ideal for visual inspections, regulatory reporting, and structural lifecycle management of an asset over time.

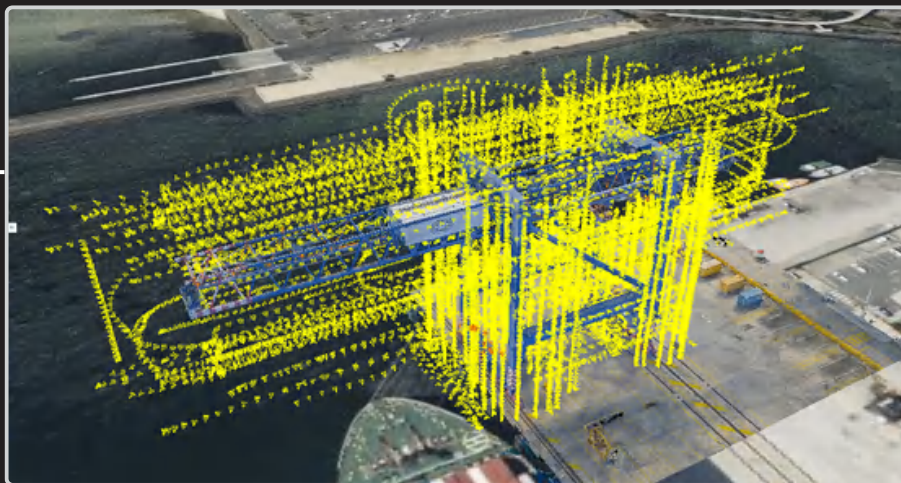


REALITY TWINS

How are Reality Twins created?

**Digital Capture**

(Photogrammetry,
Thermal, GIS, BIM)

**Data Uploaded**

Processed overnight
by Trendspek

**Interactive Reality Twin**

Accessible via web browser
with sub-centimetre detail

**Integrate & Share**

Connect to systems and
share with stakeholders

**Ship to Shore Container Crane**

Last Capture: 18 Sep 2024
Annotations: 16

[VISIT](#)**Virtual Inspections**

Condition assessments,
reporting and monitoring
completed online



REALITY TWINS

Comparison of Digital Twin vs Reality Twin

	Digital Twin	Reality Twin
Purpose	Operational monitoring & simulation	Asset management & visual inspection
Real-time data	Yes, from sensors and IoT devices	No, primarily visual data for analysis
Accuracy	Moderate	High (sub-centimetre level)
Data sources	Sensor data, operational metrics	Photogrammetry, LiDAR, drone imagery
Use Case Examples	Predictive maintenance, simulations	Structural inspections, maintenance planning
Decision Support	Based on operational performance	Based on detailed visual assessment





REALITY TWINS

Where Reality Twins deliver maximum impact



Record Management

Centralised, reliable asset data



Inspection

Replacing physical site visits with high-fidelity online inspections



Analysis

Accurate insights verified by multiple stakeholders



Reporting

From static PDFs to layered interactive 3D reports



Decision-Making

Moving from assumptions to evidence-led risk and capital allocation



Planning Remediation

Online assessments & accurate quoting before heading to site



Remediation Execution

Fewer variations, reduced rework, and faster project completion



Monitoring Over Time

A game-changing way to track structural changes

REALITY TWINS

Key applications of Reality Twins

Trendspek's Reality Twins can be used for a wide range of industry sectors and use cases, from underneath shipping wharves to over large reservoirs.

1. Structural Monitoring

Asset twins can transform the way that bridges, tunnels, and other buildings with restricted or hard-to-reach areas are monitored, providing:

- High-resolution 3D models that detect even the smallest cracks, deformations, or corrosion before they become critical.
- Remote inspections that eliminate the need for costly scaffolding, reducing risk for personnel
- Change detection over time, allowing asset managers to track deterioration and prioritise maintenance.

Real-world example

An owner of a standing reservoir can digitally compare past and present Reality Twin models to identify emerging façade damage, ensuring repairs are made before major structural issues arise.

2. City Planning & Smart Infrastructure

City and infrastructure planners/managers can also leverage asset twins to:

- Simulate real-world changes, such as the impact of new developments on surrounding buildings.
- Optimise urban layouts, using millimetre-accurate models to analyse sightlines, airflow, and shading.
- Enhance stakeholder collaboration between architects, engineers, and city officials.

Real-world example

A council can use Reality Twins to visualise how a new building would overshadow nearby public spaces before approving development applications.



Crack on a pier

Overview Drawings Data Images Files Discussions History

DETAILS

DRAWING TYPE	LineString
DATASET	27/09/2023
TOTAL DISTANCE	0.356 m
MAX HEIGHT CHANGE	0.157 m
OVERALL GRADIENT	-27.10°
ANNOTATION ID	9a7d112c-b14f-441b-9229-bf8570e3e544

REALITY TWINS

Key applications of Reality Twins

Trendspøk's Reality Twins can be used for a wide range of industry sectors and use cases, from underneath shipping wharves to over large reservoirs.

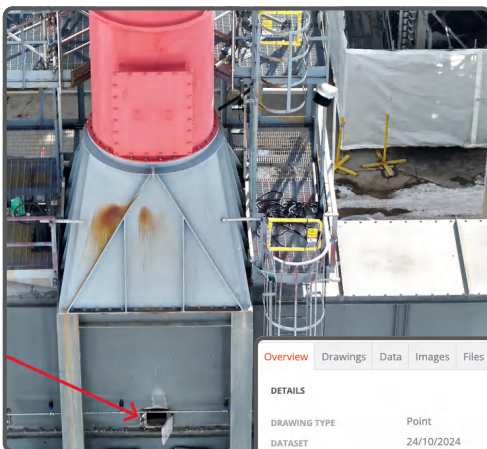
3. Safer Asset Management

For power grids, water systems, and transport networks, asset twins can improve:

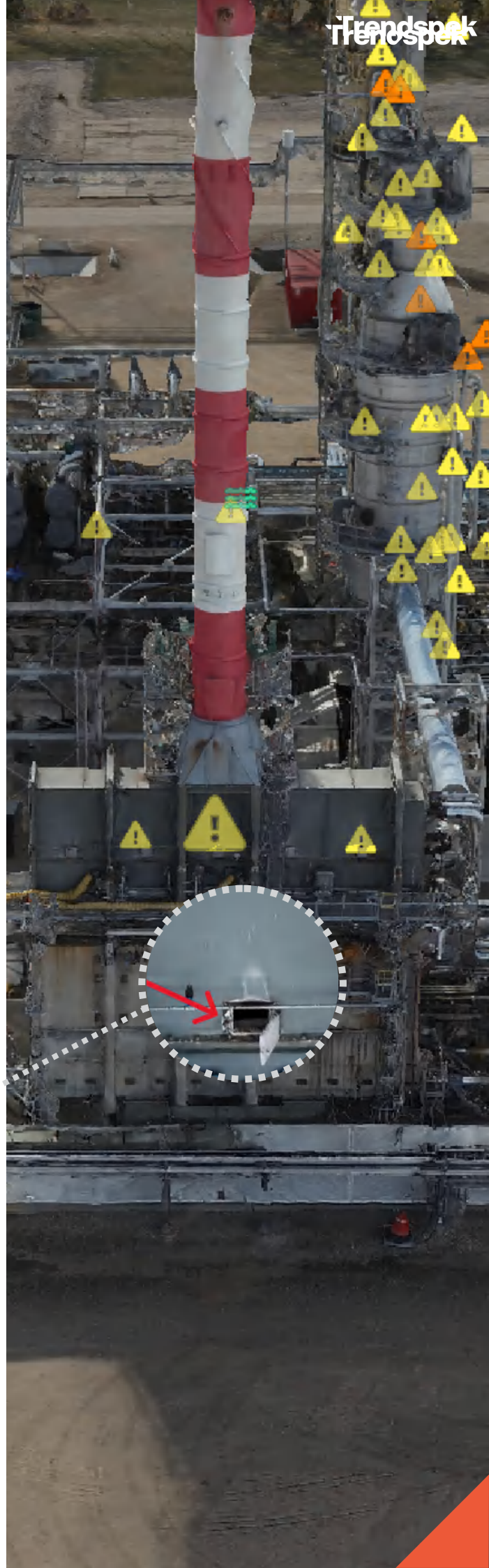
- Predictive maintenance, by identifying risks before failures occur.
- Regulatory compliance, with precise documentation of asset conditions.
- Operational efficiency, enabling teams to plan maintenance without unnecessary downtime.

Real-world example

An energy operator can inspect insulation or steam leaks across a large refinery using Reality Twins, reducing the need for manual, high-risk inspections while ensuring uninterrupted service.

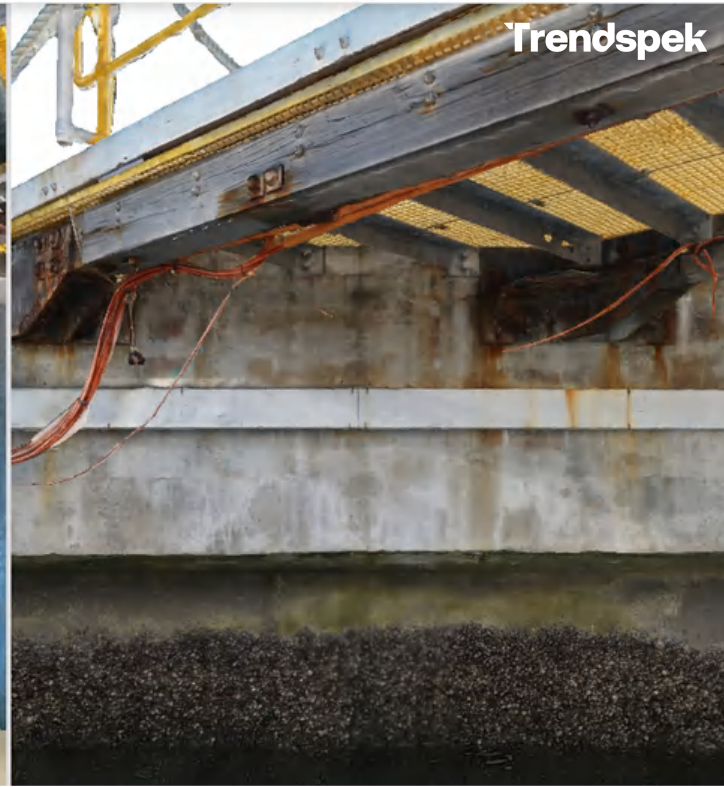
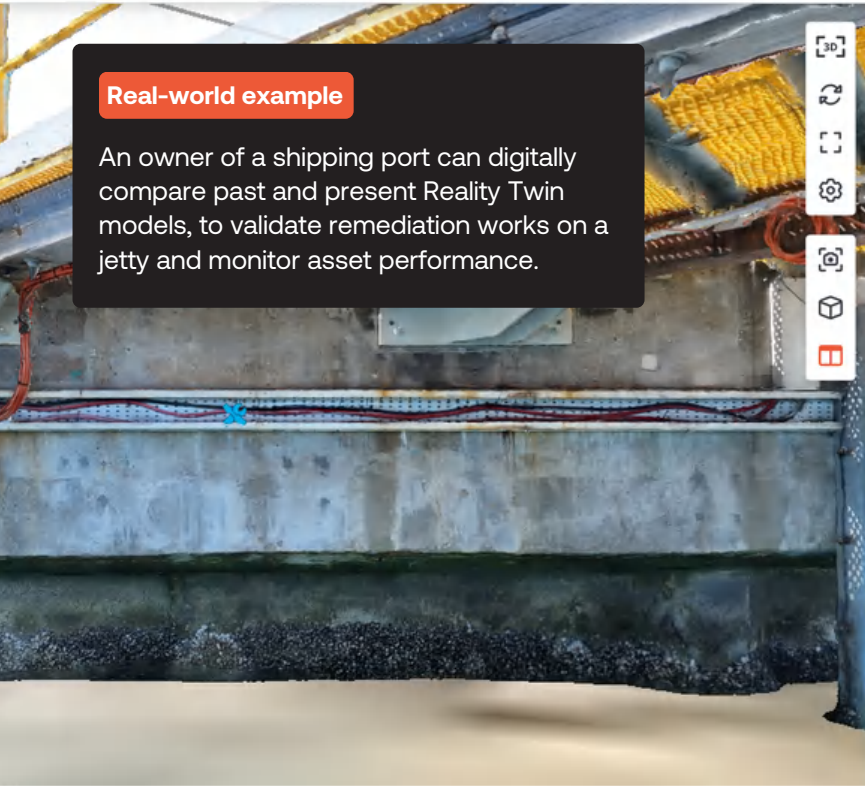


Overview	Drawings	Data	Images	Files	Discussions	History
DETAILS						
DRAWING TYPE	Point					
DATASET	24/10/2024					
LATITUDE	53.28916908°					
LONGITUDE	-110.02451870°					
ELEVATION	645.462 m					
ANNOTATION ID	9e4ef961-c272-4bc2-ab86-64d6cf62c4c6 ⓘ					
DESCRIPTION	Viewing hatch open on furnace. Unknown if intentional					



Real-world example

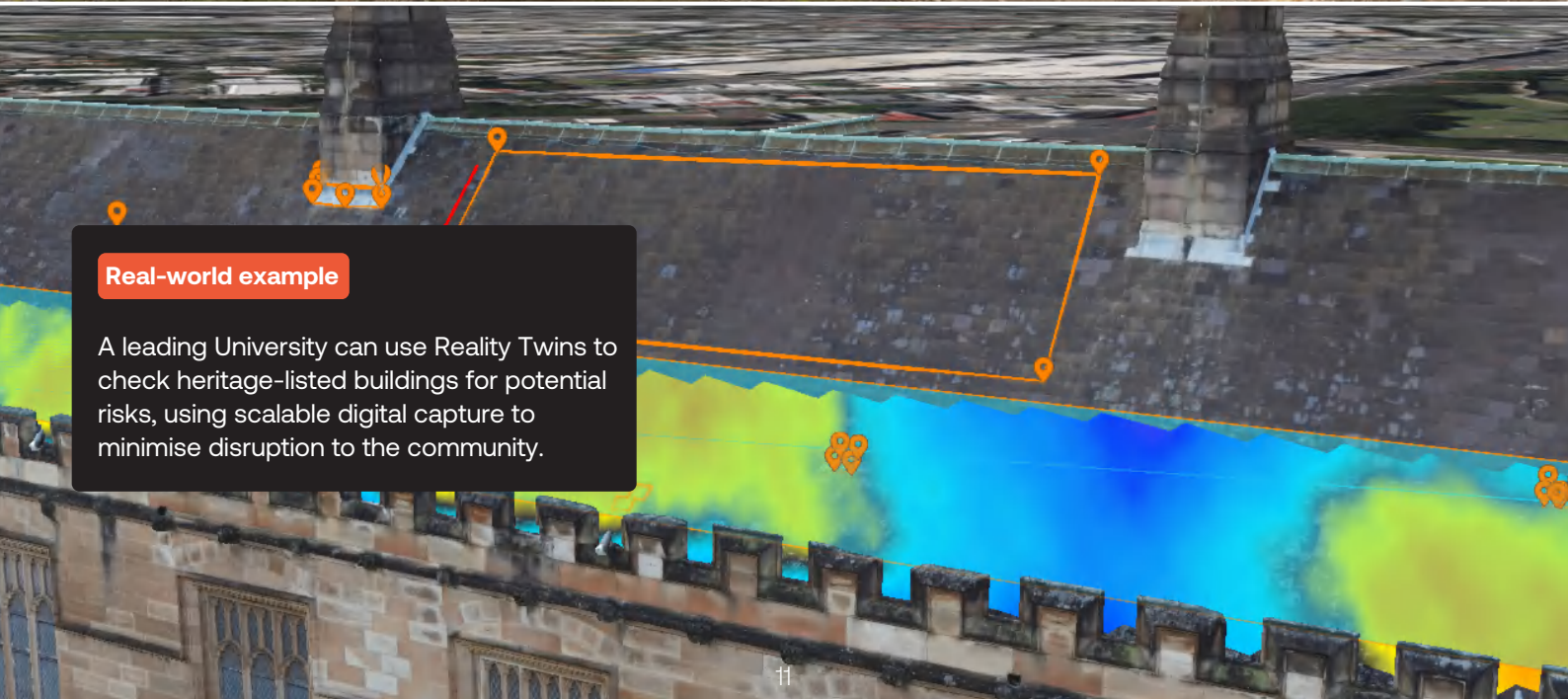
An owner of a shipping port can digitally compare past and present Reality Twin models, to validate remediation works on a jetty and monitor asset performance.

**Real-world example**

A project team managing routine maintenance for a large reservoir can use Reality Twins and thermal imaging to check the condition of concrete dam walls, without extensive site shutdowns or rope access.

**Real-world example**

A leading University can use Reality Twins to check heritage-listed buildings for potential risks, using scalable digital capture to minimise disruption to the community.



TIMELINE

History of the Asset Twin

Over the last decade, the technology landscape and outlook for asset management has changed markedly, and there are still many exciting milestones to come as we truly capture the power of AI and machine learning, continue to improve processing power, and enable greater remote management through industrial IoT.

1970

NASA used mirrored systems to save the Apollo 13 mission.

1960s

The basic concept of digital twins, called digital engineering or mirrored systems, was first used at NASA.

2002

Michael Grieves introduced the concept of the modern digital twin product lifecycle management.

2010

NASA updated the name from digital engineering to digital twin.

2013

Cloud computing had advanced enough to support the modern concept of the digital twin.

2014 – present

The use and manifestation of digital twins diverged based on industry requirements.

2021

Trendspek launches '3D Reality Twin' to define an advanced digital twin, purpose-built for structural asset management.

WHY REALITY TWINS?

Enhanced data that is useful and actionable

Traditional methods of asset inspection capture rely on abseilers manoeuvring themselves from top of an asset to the bottom, or inspectors on cherry pickers doing the same, taking pictures at various points as they move.

1. Minimal pictures are taken – just enough to include in a PDF report
2. Error prone – only of defects seen at the time recorded
3. Hard-to-reach areas are not photographed at all
4. The quality of pictures is inconsistent
5. Limited photo angles – full context hard to understand



The quantity and quality of data obtained through traditional asset inspections are far from optimal.

Once captured, images are often stored as individual photographs and typically saved in large files, categorised inconsistently or, at worst, lumped into a single folder.

This leaves asset managers with the time-consuming task of manually searching for defects to include in their reports.

A collection of disjointed images without broader context is insufficient for making accurate, data-driven decisions.

With drones and robotics revolutionising data capture – now generating tens of thousands of images instead of mere hundreds – the challenge moves to how this data is stored, organised, and, most importantly, contextualised.

The issue with traditional reporting is:

- **20%** of defects are untraceable
- **30%** of defects are misidentified
- **3x** more defects are missed
- **10x** longer to produce



SUCCESS STORY

Cenovus Energy



With the Trendspek model, it enables us to create notifications in our computerised maintenance management systems (CMMS). We plan it out, therefore it's more cost-effective. We schedule it and then we execute the repairs.

Now, if you're seeing a major steam leak; or you're seeing frost build up on one of our tank VRUs; or there's cladding that's flopping around in the wind; or something that I have to get to or put hazard mitigation into — we can use the technology.

cenovus
ENERGY

Marvin Smith
Senior Maintenance Supervisor
at Cenovus Energy

[Watch more](#)

