# A path to build Digital Twins for Observatory Systems through **3D models**

## ANID IDEA I+D 2026

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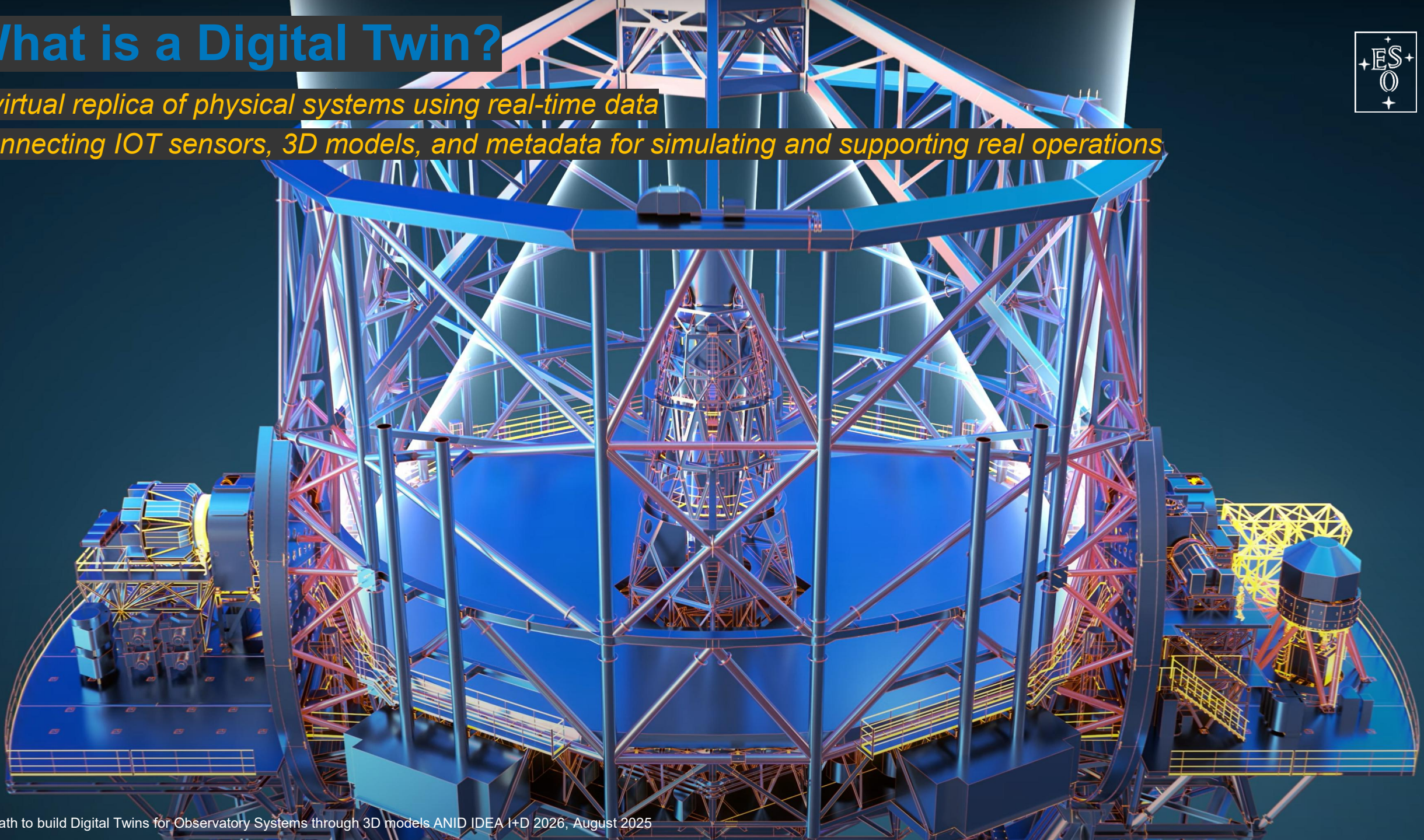Image developed by ESO/L. Calçada/J. Marrero Student: J. Thanner

# What is a Digital Twin?

*A virtual replica of physical systems using real-time data*

*Connecting IOT sensors, 3D models, and metadata for simulating and supporting real operations*

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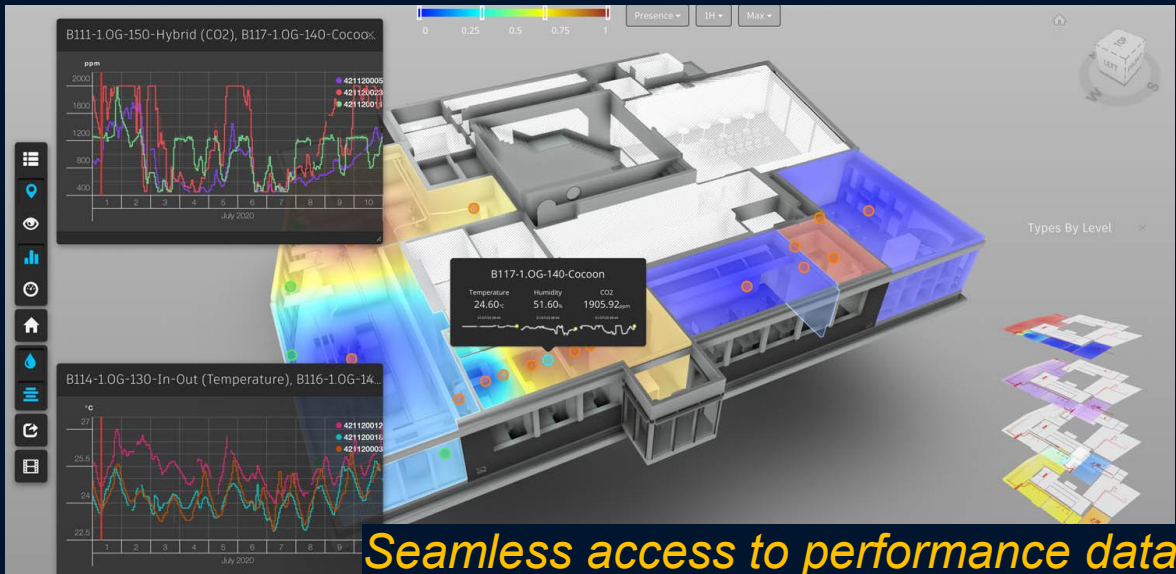# 3D models, from design & construction to operations



**Industry 4.0**

Uses include predictive maintenance, simulation, and energy efficiency

*Applied in complex facilities, such as airports and hospitals*

*Simulated factory floors*

*Seamless access to performance data*

Data Classification: INTERNAL

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# Paranal Infrastructure digitalisation



Very Large Telescope (VLT)

Basecamp

ELT (Extremely Large Telescope)
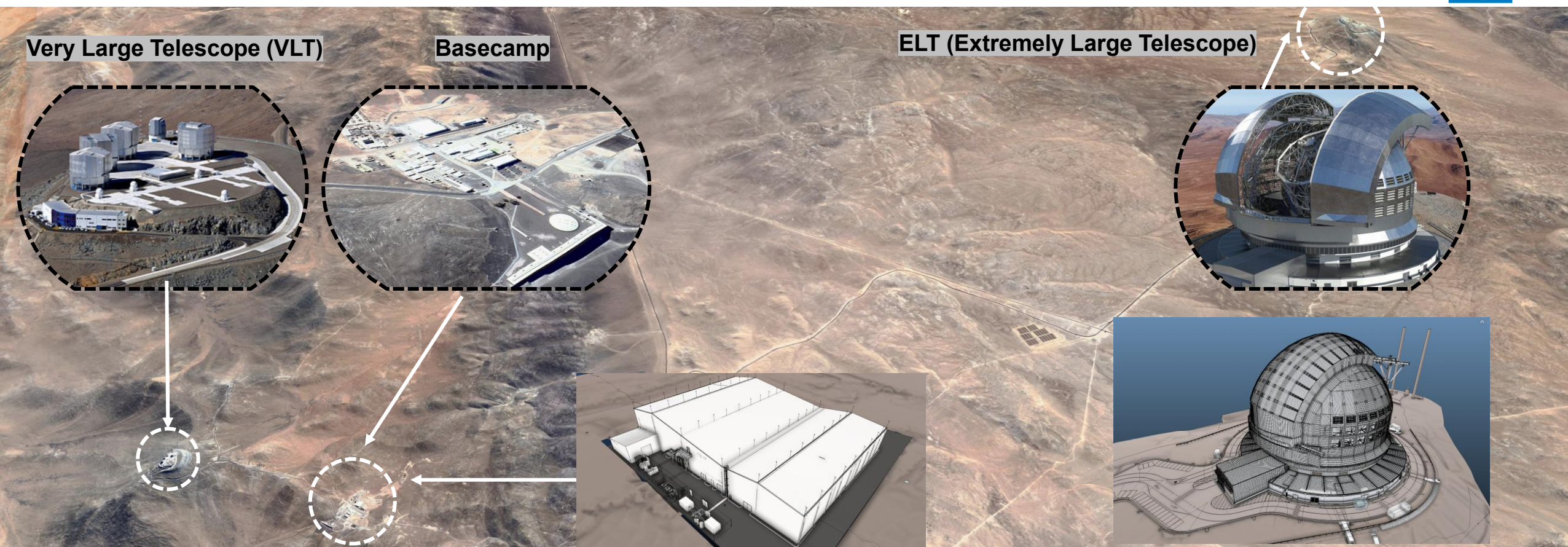
> ➢ The ELT was designed and is being built using **Building Information Modelling  (BIM)**

> ➢ The rest of the observatory infrastructure is currently being modelled using **BIM**
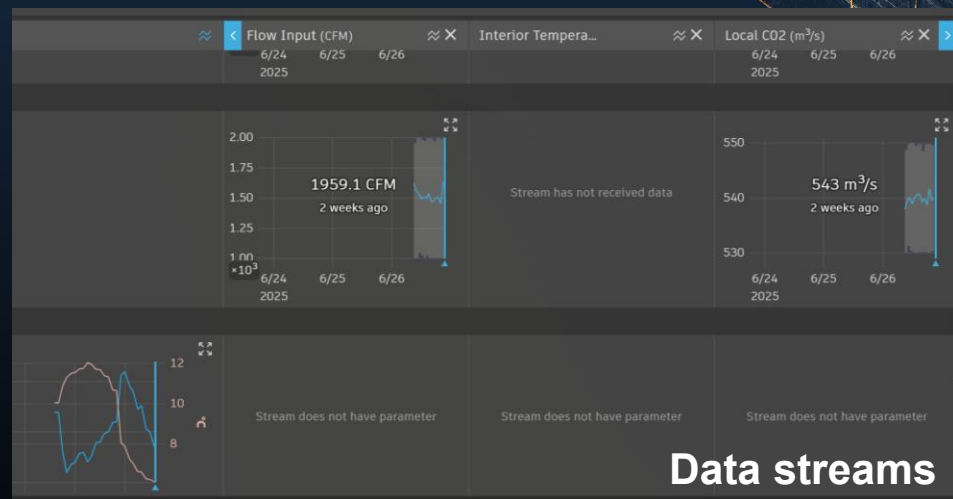
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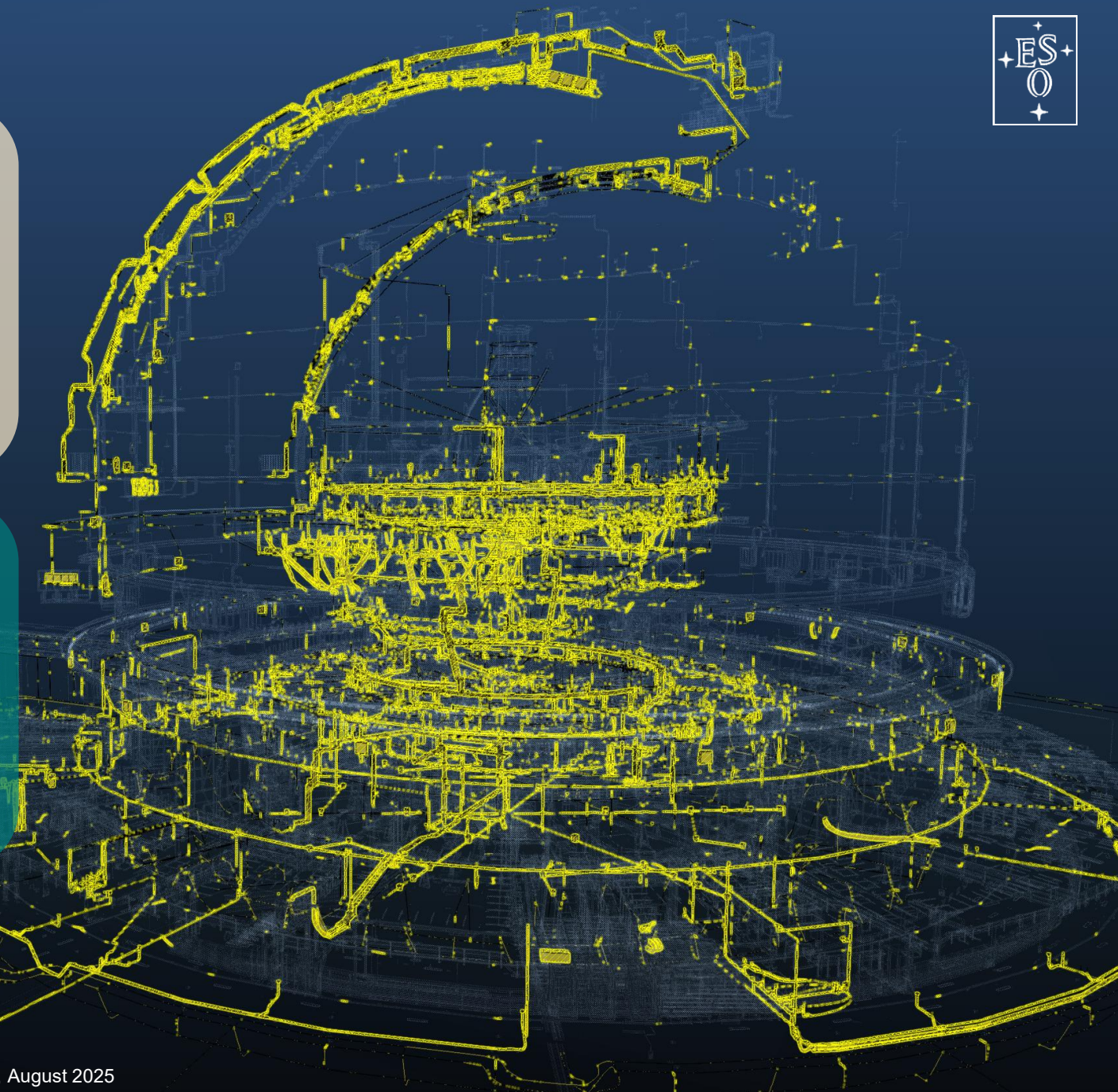
# Key Benefits



**Reduce the need for** on-site commuting **by enabling activity simulation, increasing preparedness before field deployment**

**Enhance collaboration between teams in Germany, Santiago and Paranal**

**Provide an** intuitive digital environment **that supports Digital Twin capabilities: Digital Shadow,** Informative, Predictive, **and** Autonomous **Twin**

**Reduce time in planning activities, through seamless access to data, route calculations and analysis.**

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# Skills Involved

*Developers: Experience with Python, React, and User Experience Design.*

*3D Experts: Experience with CAD, BIM, OpenUSD, materials, lighting, physics, and animation.*

*Technologists: Experience with IT/OT systems integration, DevOps, and data architecture.*

# Virtual Training Settings



Dedicated spaces at Paranal, Vitacura, and Garching, equipped with audiovisual systems and retrofitted to serve as training rooms optimised for remote, virtual, and collaborative process simulations

fopoints discovered

Video developed by ESO/L. Calçada/J. Marrero Student: J. Thanner

# Innovation Opportunities with 3D based -Digital Twins
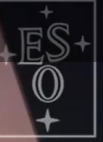
Cerro Armazones

Latitude: -24.589285,  Longitude: -70.191667
2024-9-29, UTC: 11:35
Local Sideral Time:112.401

Telescope Orientation

Alt: 71.85                    Ra: 114.125
Az: 175.928                  Dec: -42.684

**Possible features to be implemented:**

Simulating climate impact on mirror performance or dome rotation.

Digital twin-based telescope alignment and calibration tools.

Wide field DSS2 view

**Optics Cabinet**
fopoints discovered

ELT Explorer - Prototype

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ESO/L. Calçada/ J. Marrero

# Innovation Opportunities with 3D based -Digital Twins

**Possible features to be implemented:**

**Structural health monitoring through sensors and real-time analytics..**

**Telematic telescope coordination via digital twin interfaces.**

**Smart scheduling by linking digital twins with scientific planning tools.**

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# Thank you!

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