



Technology  
Development Institute

# Building Scanning and Digital Twin Creation

Technology Development Institute  
510 McCall Road  
Manhattan, Kansas 66502  
[www.ksu.edu/tdi](http://www.ksu.edu/tdi)

# What is a Digital Twin?

A digital twin is a virtual replica of a physical object, person, or system presented in a digital version of its environment. Digital twins can help many kinds of organizations simulate real situations and their outcomes, ultimately allowing them to make better decisions.

- Lots of different tools that can do this
- Lots of different software that can work with the scans (will touch on this later)
- TDI originally begin evaluating these tools with a focus on creating digital twins of local manufacturing facilities
  - Could then virtually optimize flow and automation for that site



Source: [NavVis.com](https://navvis.com). A NavVis scanner being used to document a BMW automotive factory.

# TDI Background...

- We focus on acquiring new technologies and pushing the boundaries of how they are being used.

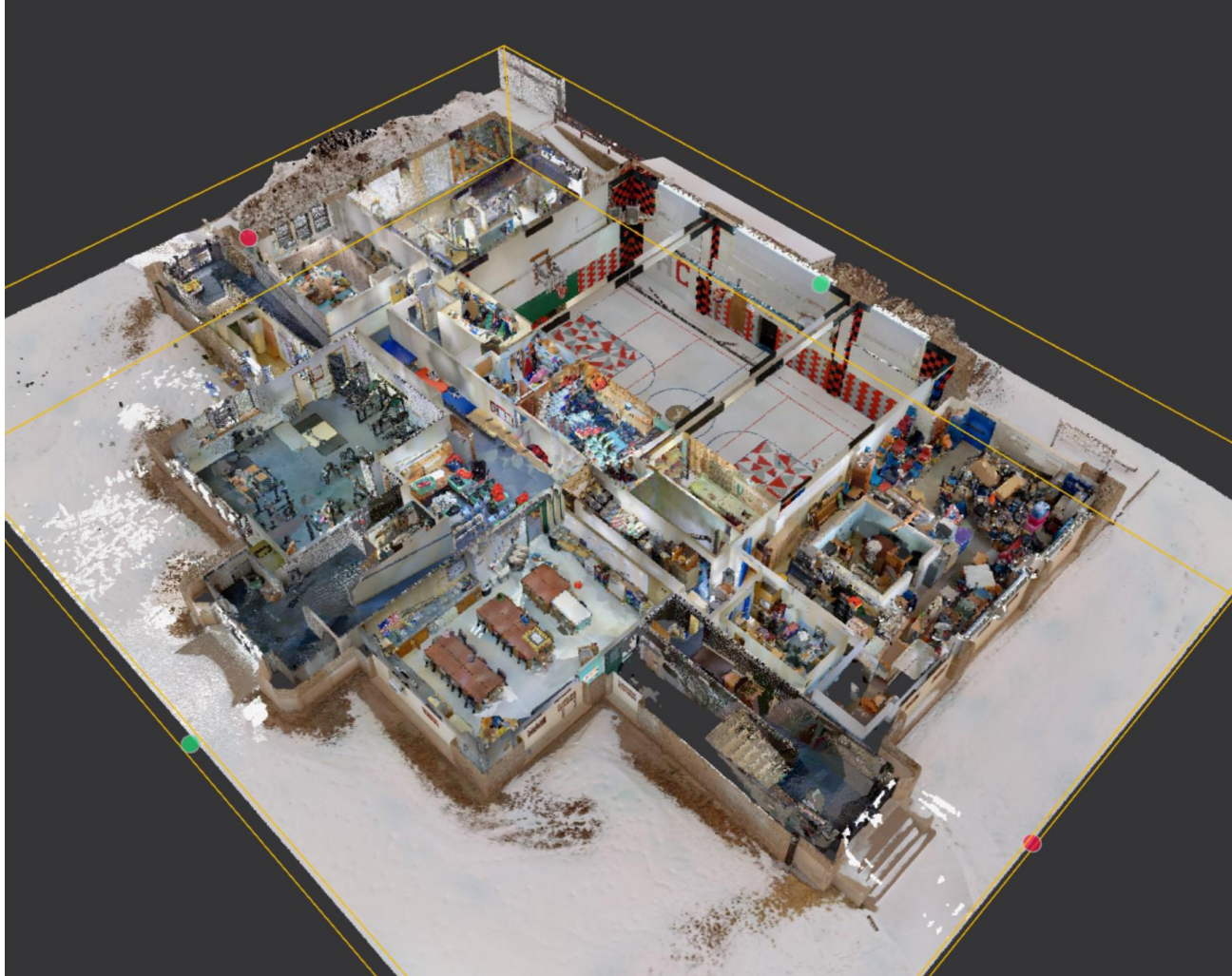


NavVis VLX 2





# What is a Digital Twin?



- Screenshot of TDI's scan of Memorial School Building in Hill City, KS (2024)
- Potential uses of Digital Twins:
  - Pre-Construction / Topographic Surveys
  - Post-Construction
    - I.e. "As-built" verification
  - Manufacturing Planning
  - Renovation Planning
  - Historical Documentation



# Digital Twin – Potential Uses



- Pre-Construction / Topographic Surveys
  - Rivers, trees, other features
  - Elevations
- Scan of KSU's International Student Center (2025)
  - Top view

# Digital Twin – Potential Uses



Construction verification

- Post-Construction
  - I.e. “As-built” verification
  - Can be done during construction
  - Much higher frequency / speed than traditional survey techniques
- Source: [NavVis.com](https://navvis.com)



# Digital Twin – Potential Uses



Heritage

- Historical Documentation and Preservation
- Source: [NavVis.com](https://navvis.com)



# Digital Twin – Potential Uses



Renovation planning

- Renovation Planning
  - Especially older buildings without existing or complete documentation
- Source: [NavVis.com](https://navvis.com)

# Digital Twin – Potential Uses



- Manufacturing Planning
  - Shop floors may need to be updated / changed based on company needs
  - Engineers may not know all of the changes that the operators and supervisors have made after initial construction
- Source: [NavVis.com](https://www.navvis.com)
  - A NavVis scanner being used to document a BMW automotive factory.



# TDI Background...

- K-State College of Engineering
  - Established 1985
- Primary focus is to provide technical support in an effort to:
  - develop (demo) new technologies
  - grow companies and communities
- Both Engineering and Business Development Support



Leander, LLC - Chiropractic Table, 2022  
Lawrence, KS



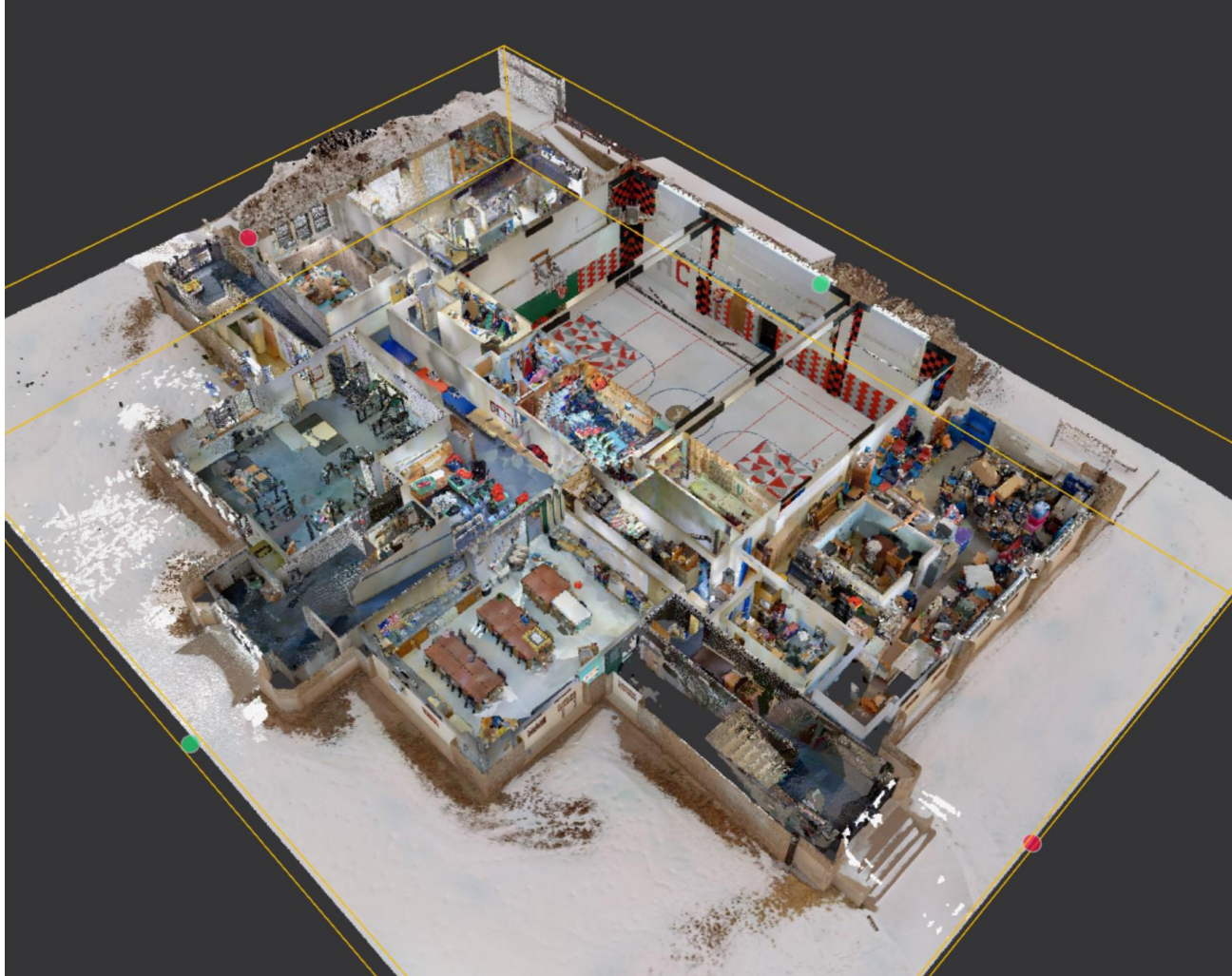
Left: Entrepreneur  
Andy Sedlacek  
- Power Line  
Stripping Tool, 2020



Right: TDI staff  
scanning Memorial  
School Building in  
Hill City, KS  
2024



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## Questions?

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# Digital Twin – Use Case



- NavVis (and TLS) Scan of Margam Castle, UK
- [Captured with NavVis: Margam Castle | Port Talbot, Wales, UK](#)
- Source: [NavVis YouTube Channel](#)



# Digital Twin – Use Case

Captured with NavVis: Margam Castle | Port Talbot, Wales, UK





# Digital Twin – Use Case



# Digital Twin – Use Case





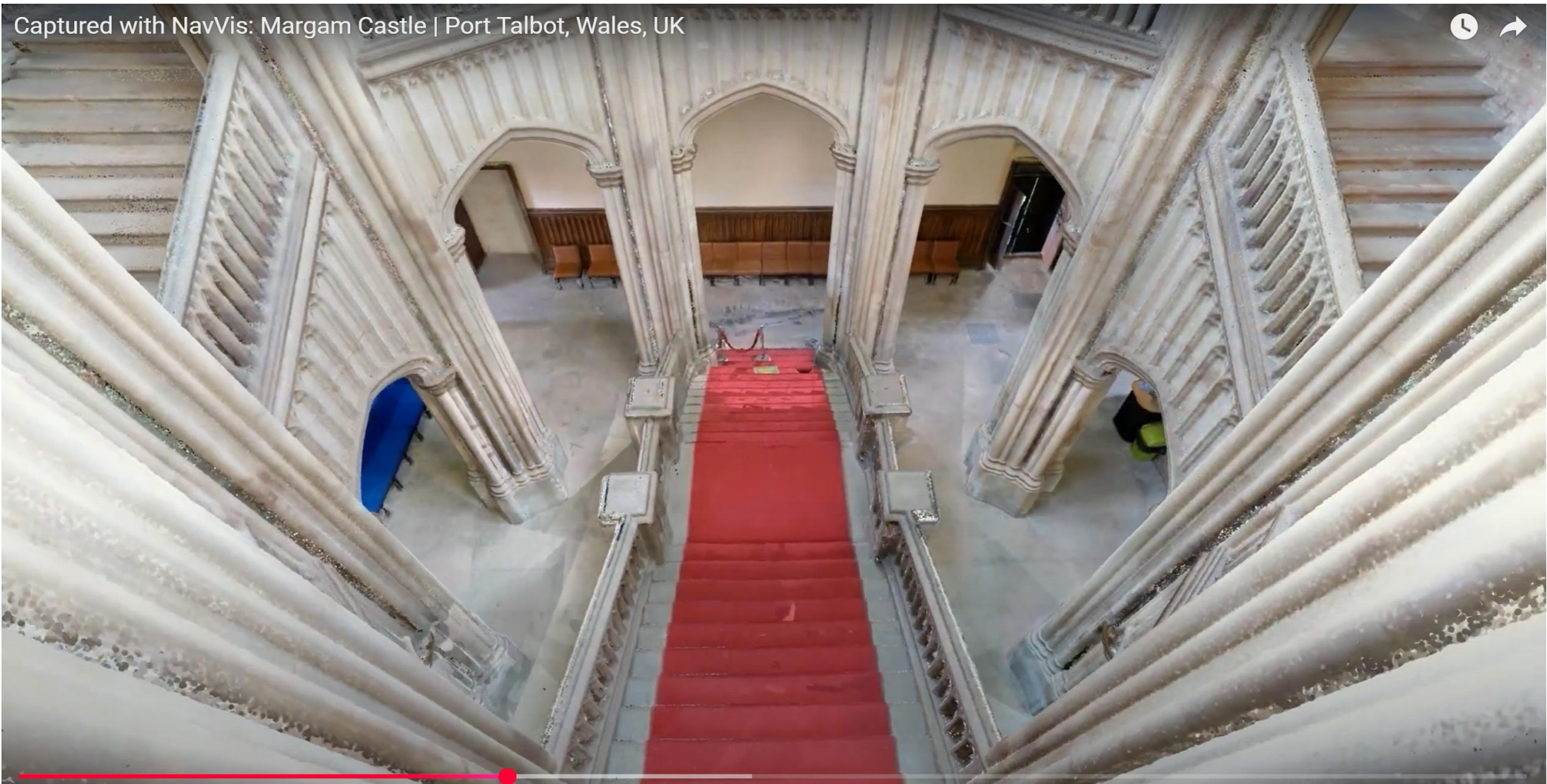
# Digital Twin – Use Case

Captured with NavVis: Margam Castle | Port Talbot, Wales, UK





# Digital Twin – Use Case





# Digital Twin – Use Case



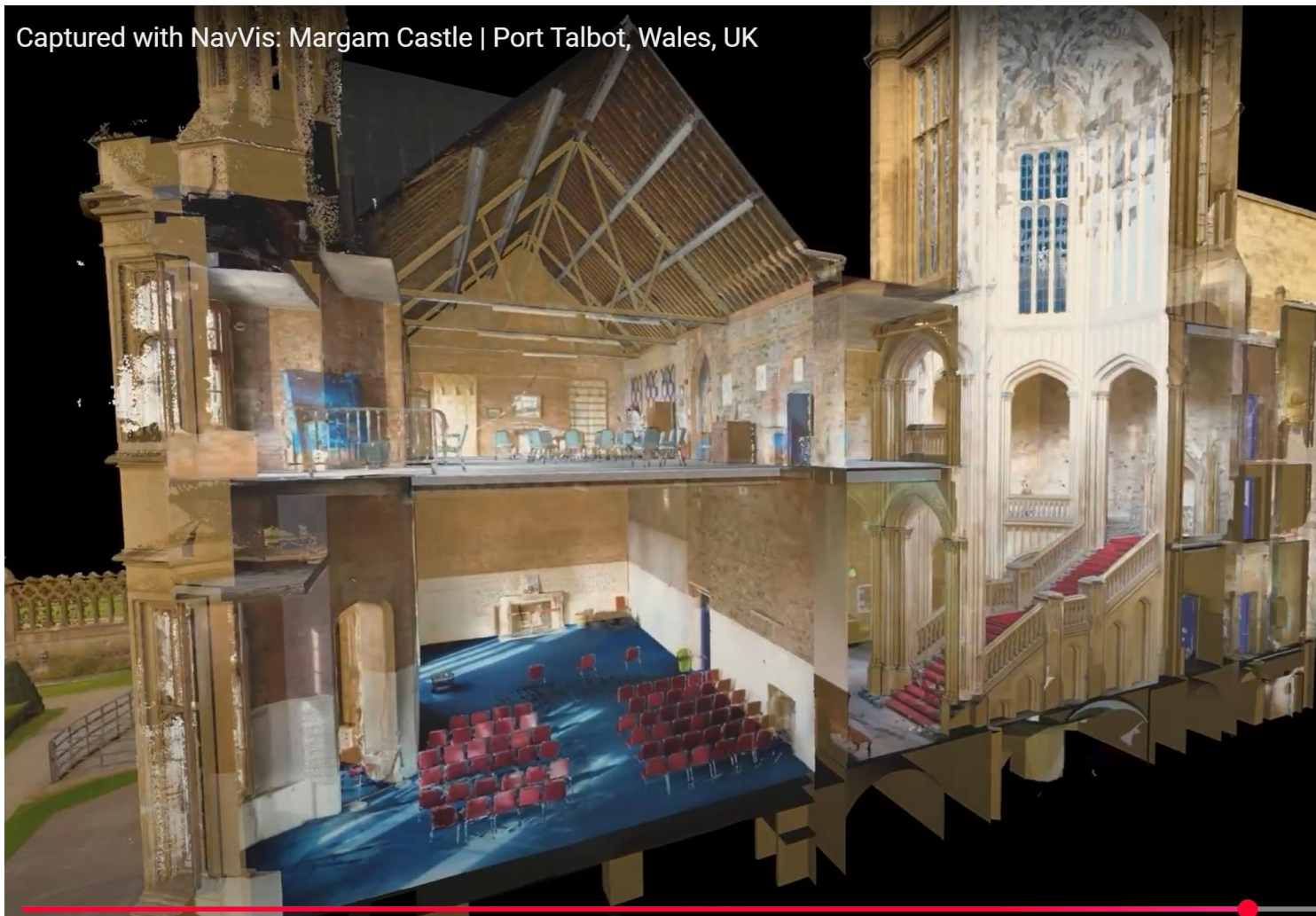
# Digital Twin – Use Case

Captured with NavVis: Margam Castle | Port Talbot, Wales, UK





# Digital Twin – Use Case



# TDI Digital Twin Creation Tool

## NavVis VLX 2 Scanning System

- NavVis is a German company that originally developed the technology to help BMW lay out their automotive manufacturing facilities
  - Developed mobile mapping systems in the 2010's
  - Released the VLX 2 in 2020
- Shoulder mounted scanning system
  - 4 optical cameras (20 Megapixels) to take panoramic images
  - 2 LIDAR scanners
  - Capable of scanning up to 50,000 square feet/hour
  - Depends A LOT on the environment; in many projects, 20-30,000 sqft/hr is best case
    - Small rooms vs. large areas
    - Obstacles / low-clearance

NavVis





# TDI Digital Twin Creation Tool

## NavVis VLX 2 Specifications and Demo

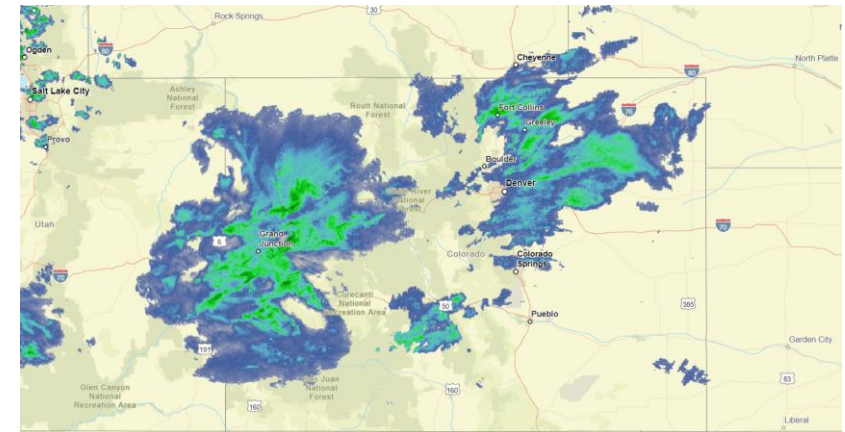
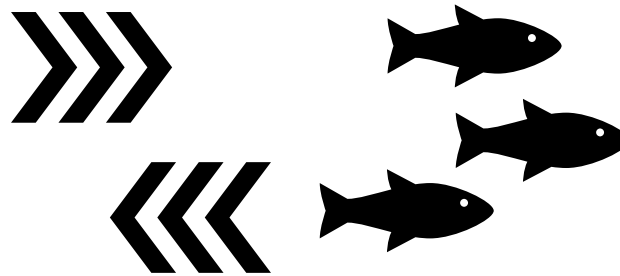
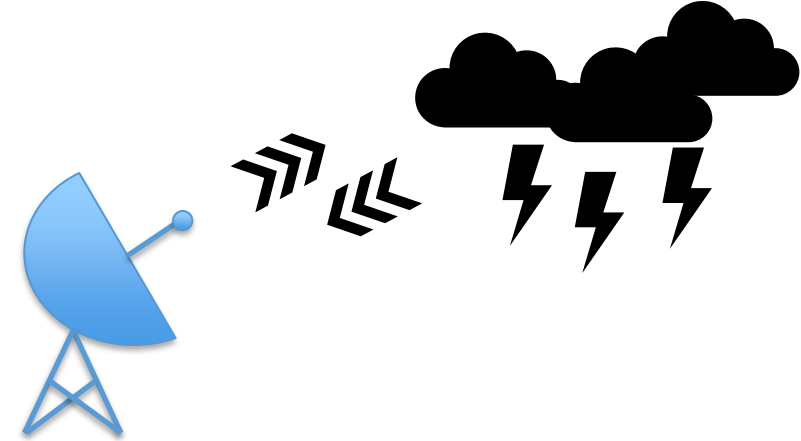
LiDAR	
Number of laser scanners	2
Layers	2 x 16
Speed	2 x 300,000 pts/s
Other specifications	
Accuracy	6 mm ⓘ
Weight	8.7 kg
Battery life	1,5 hours (with 1 set of 2 batteries)

### What is a Point Cloud?

- Every measurement is a “point”
- Distance and angle from the scanner
- All the points together look like a “cloud” when looking at the finished scan
- Source: [NavVis.com](https://www.navvis.com)

# What is LiDAR?

- **Acronym: Light Detection and Ranging**
- **RADAR: Radio Detection and Ranging**
  - Airplanes, ships, weather (ie. clouds)
- **SONAR: Sound Navigation and Ranging**
- **Basic Principle: Echolocation**



\*Source: [radar.weather.gov](https://radar.weather.gov), 05NOV2024



# What is LiDAR?

## 2018: LiDAR used in archaeology

- National Geographic explorer Dr. Albert Lin and others
- Used LiDAR to discover and map long-lost ruins
- Mayan Civilization in Central America

[YouTube Video: Scientists use laser technology to uncover more Mayan ruins](#)



Source: [CBS Mornings YouTube Channel](#)

# What is LiDAR?





# What is LiDAR?



# What is LiDAR?



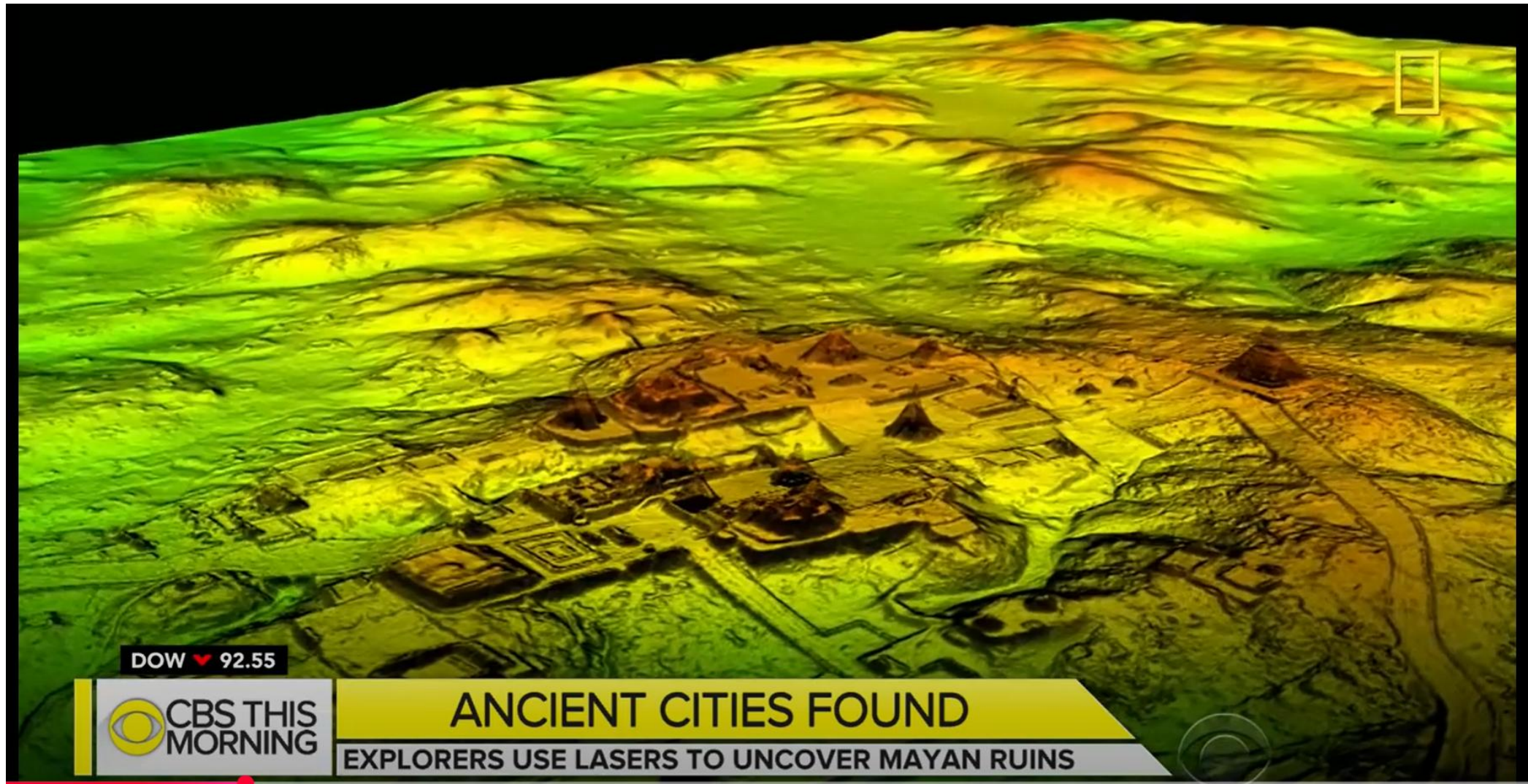


# What is LiDAR?





# What is LiDAR?



DOW ▼ 92.55

 CBS THIS  
MORNING

## ANCIENT CITIES FOUND

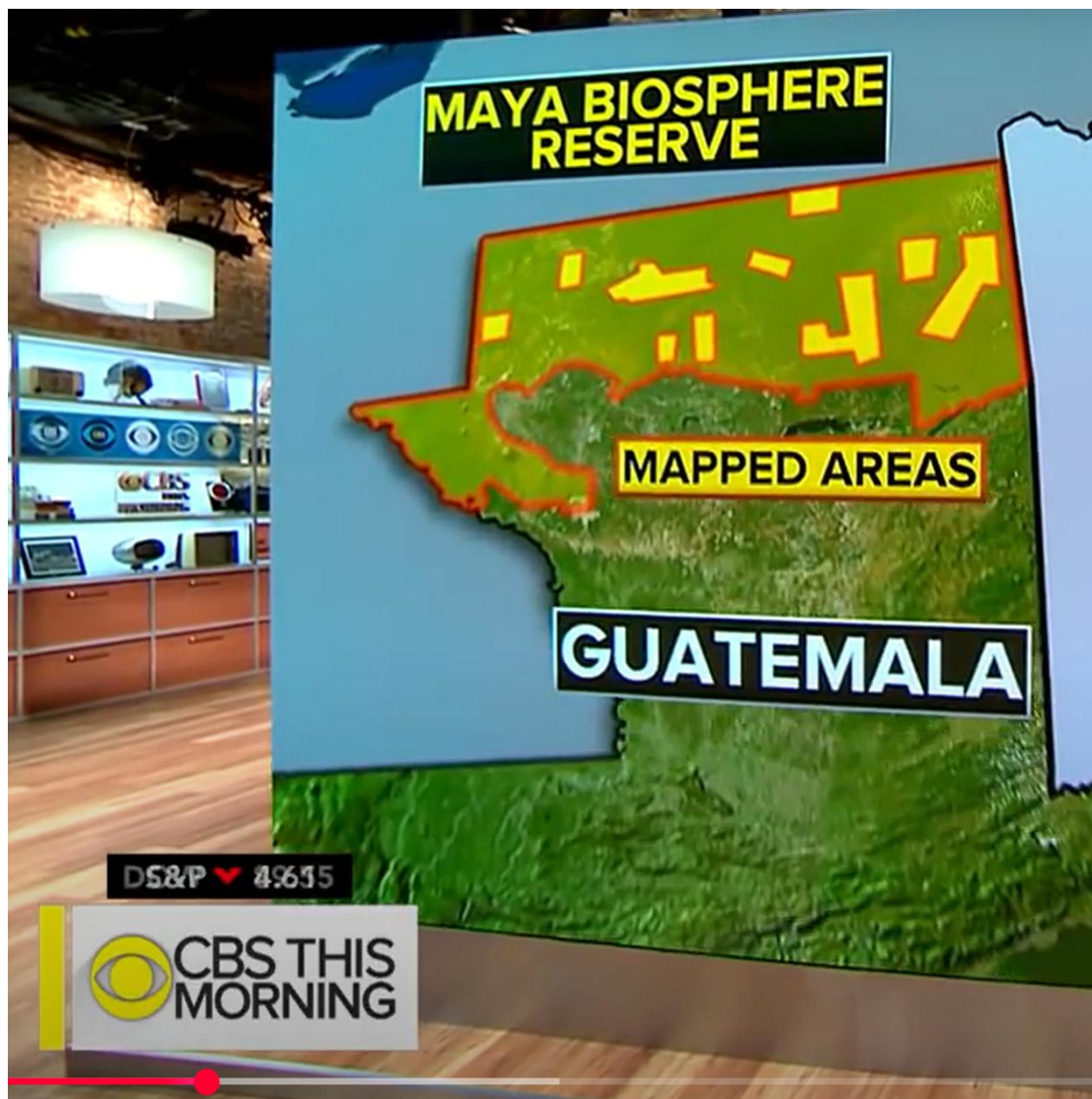
EXPLORERS USE LASERS TO UNCOVER MAYAN RUINS

**KANSAS STATE**  
UNIVERSITY

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# What is LiDAR?



- Mayan Civilization in Central America
- How does LiDAR “see-through” the rainforest / jungle?
  - So many laser pulses / second, that the scanner can “thread the needle” through the gaps in the leaves
- [LiDAR Mapping Through Vegetation - 5 Tips You Should Know!](#) - Phoenix LiDAR Systems YT Channel
- [How a LiDAR Drone Maps the Bare Earth through trees!](#) - Indiana Drones YT Channel
- [Seeing Through the Trees with a New LiDAR System](#) - US Naval Research Laboratory YT Channel

# What is LiDAR?





# What is LiDAR?



- One key takeaway from the news segment
- Earlier Estimate: Civilization of **~1 million** people in the area
- New Estimate: Possibly up to **20 million**



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# How is the VLX 2 used?

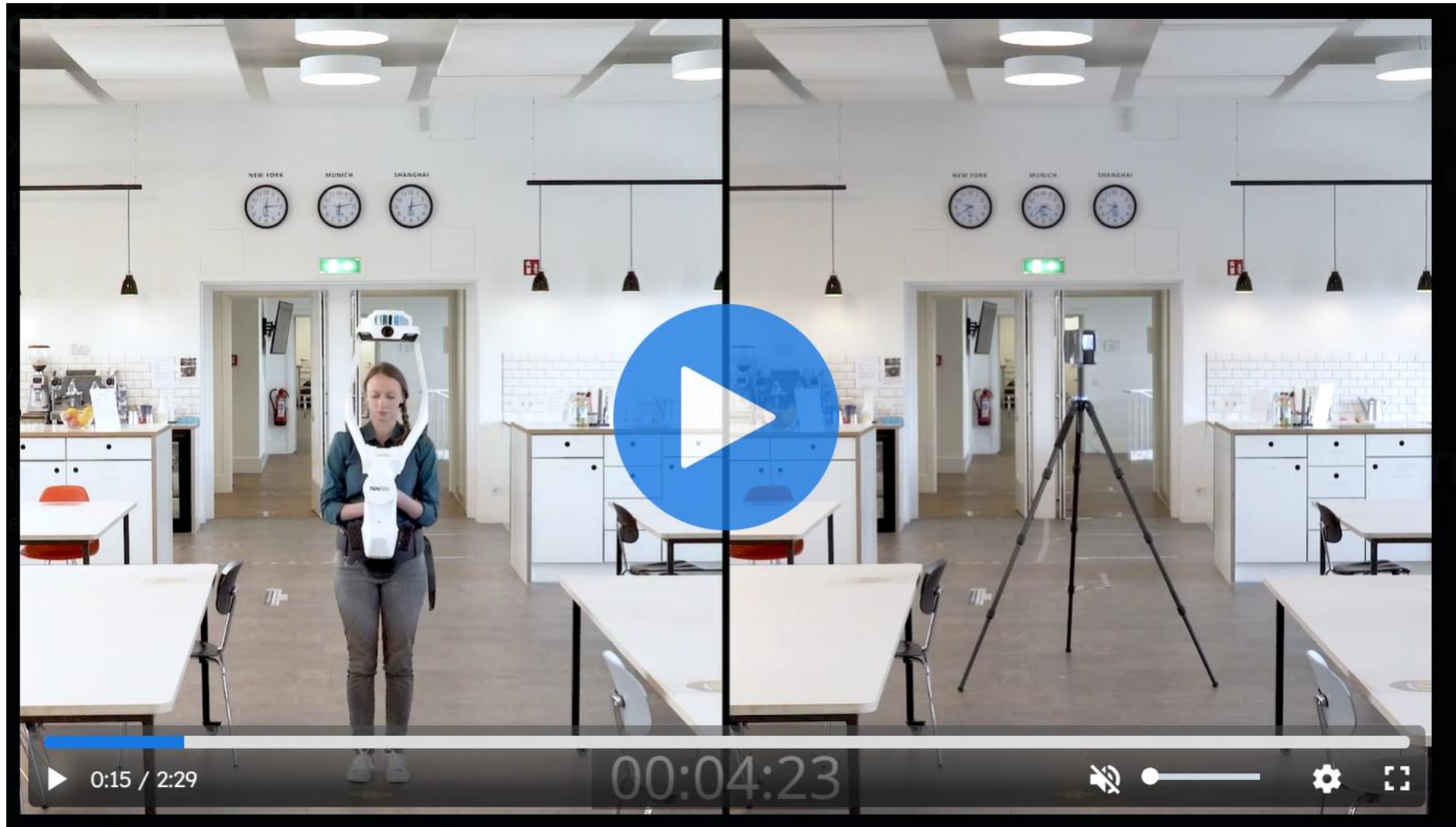


**NavVis VLX 2  
vs TLS Video**

Source:

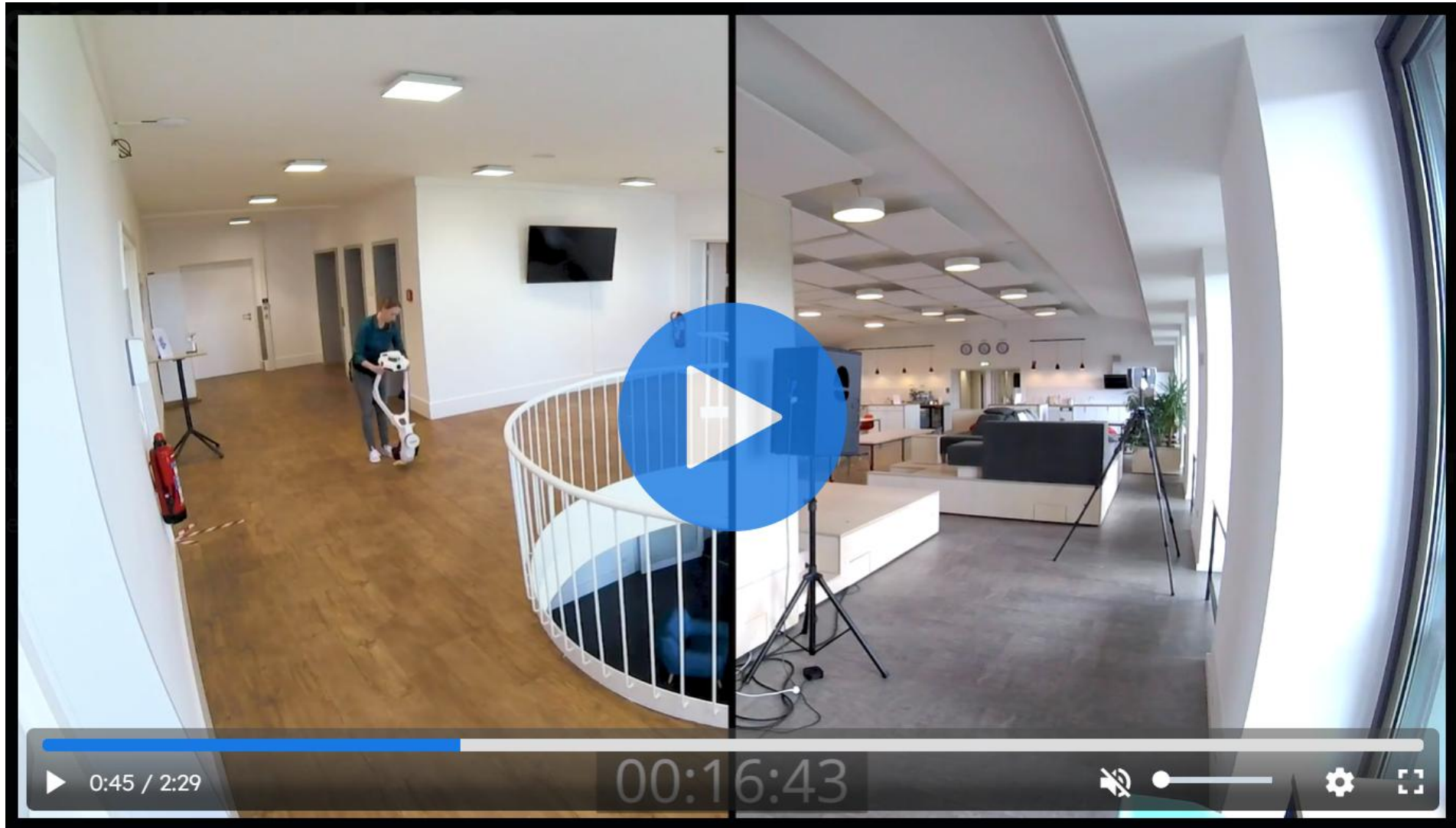
[NavVis.com](https://www.navvis.com)

# How is the VLX 2 used?

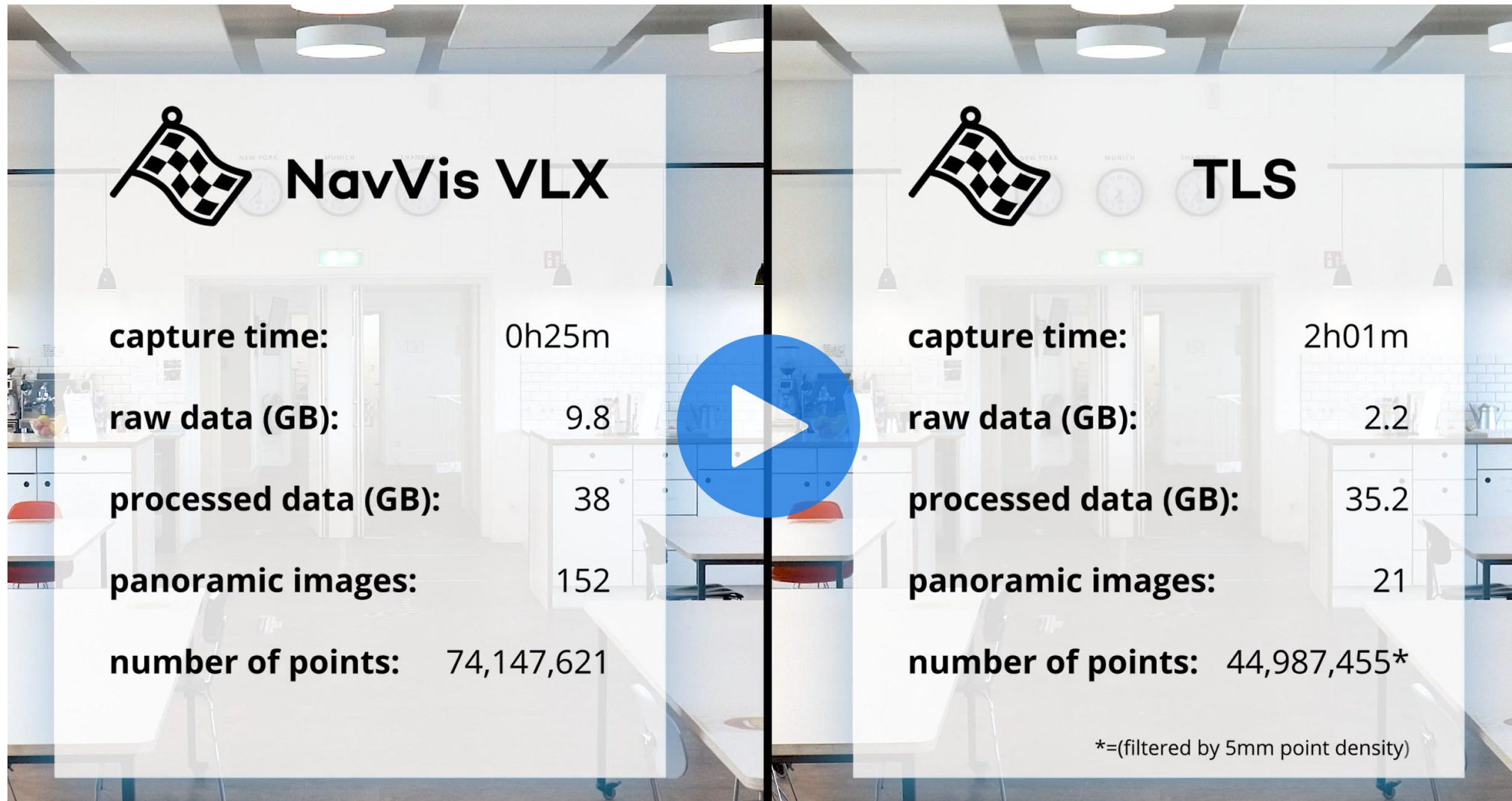






# How is the VLX 2 used?



# How is the VLX 2 used?

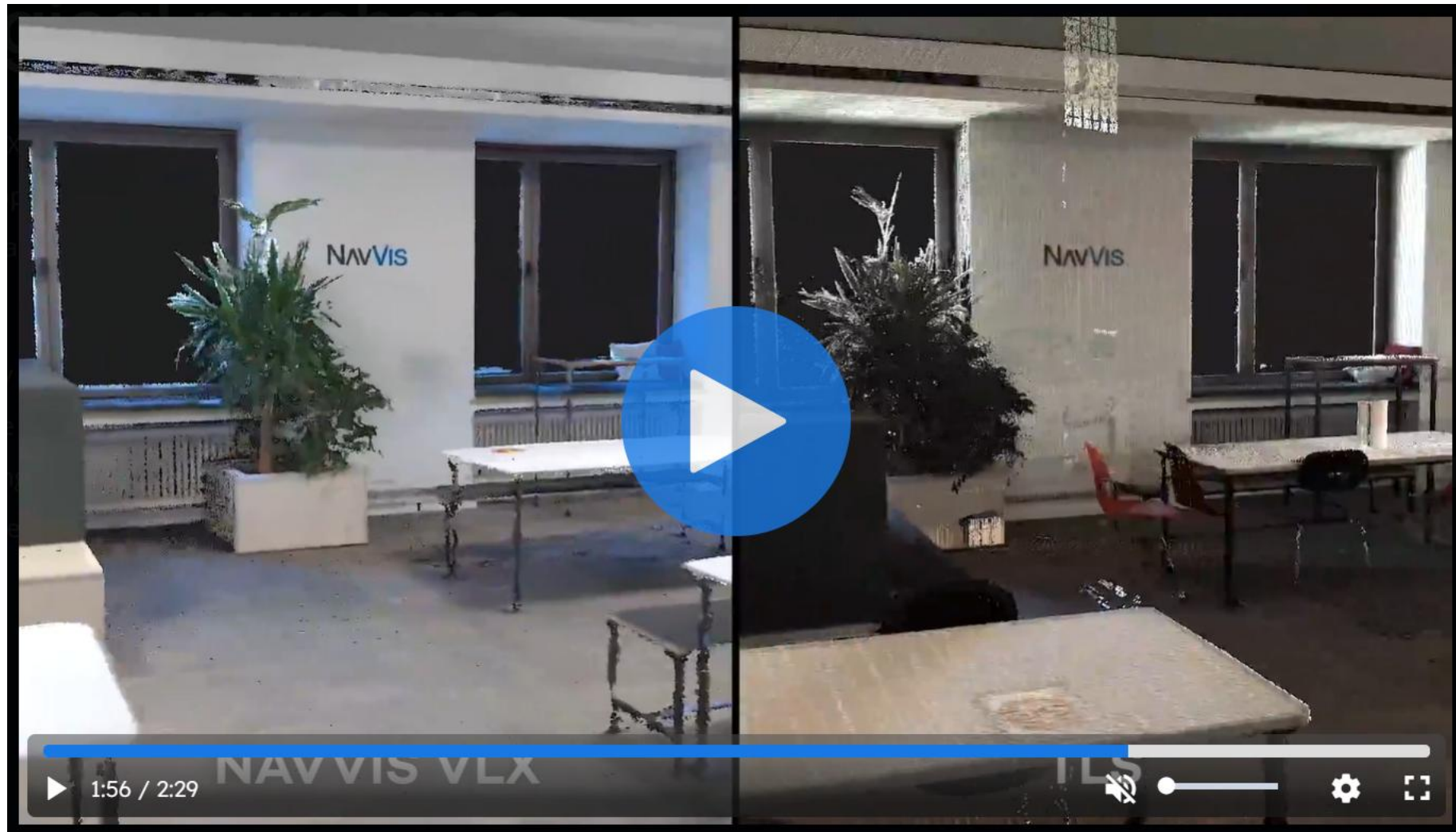


 NavVis VLX	 TLS
capture time: 0h25m	capture time: 2h01m
raw data (GB): 9.8	raw data (GB): 2.2
processed data (GB): 38	processed data (GB): 35.2
panoramic images: 152	panoramic images: 21
number of points: 74,147,621	number of points: 44,987,455*

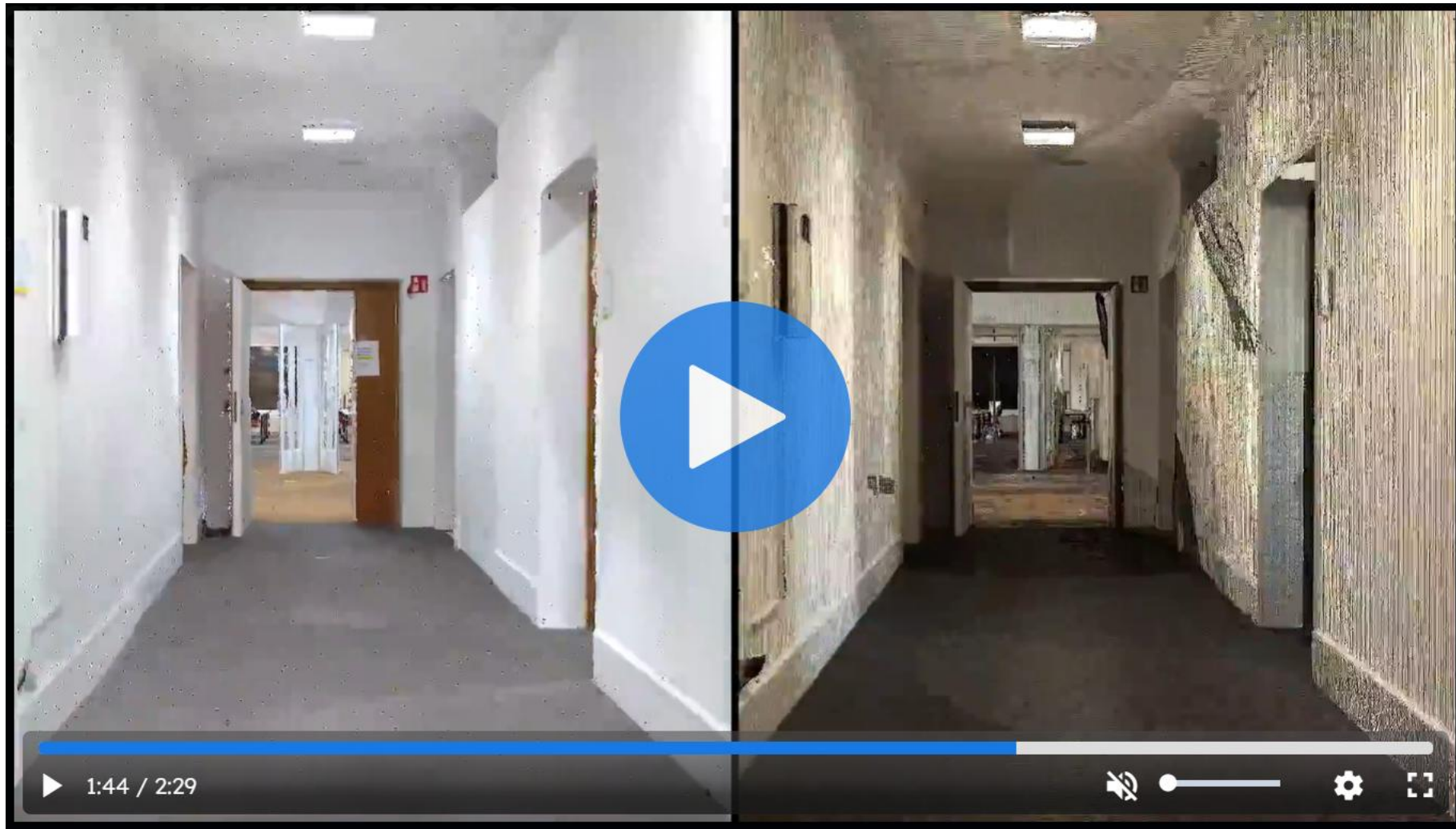
\*(filtered by 5mm point density)



# How is the VLX 2 used?

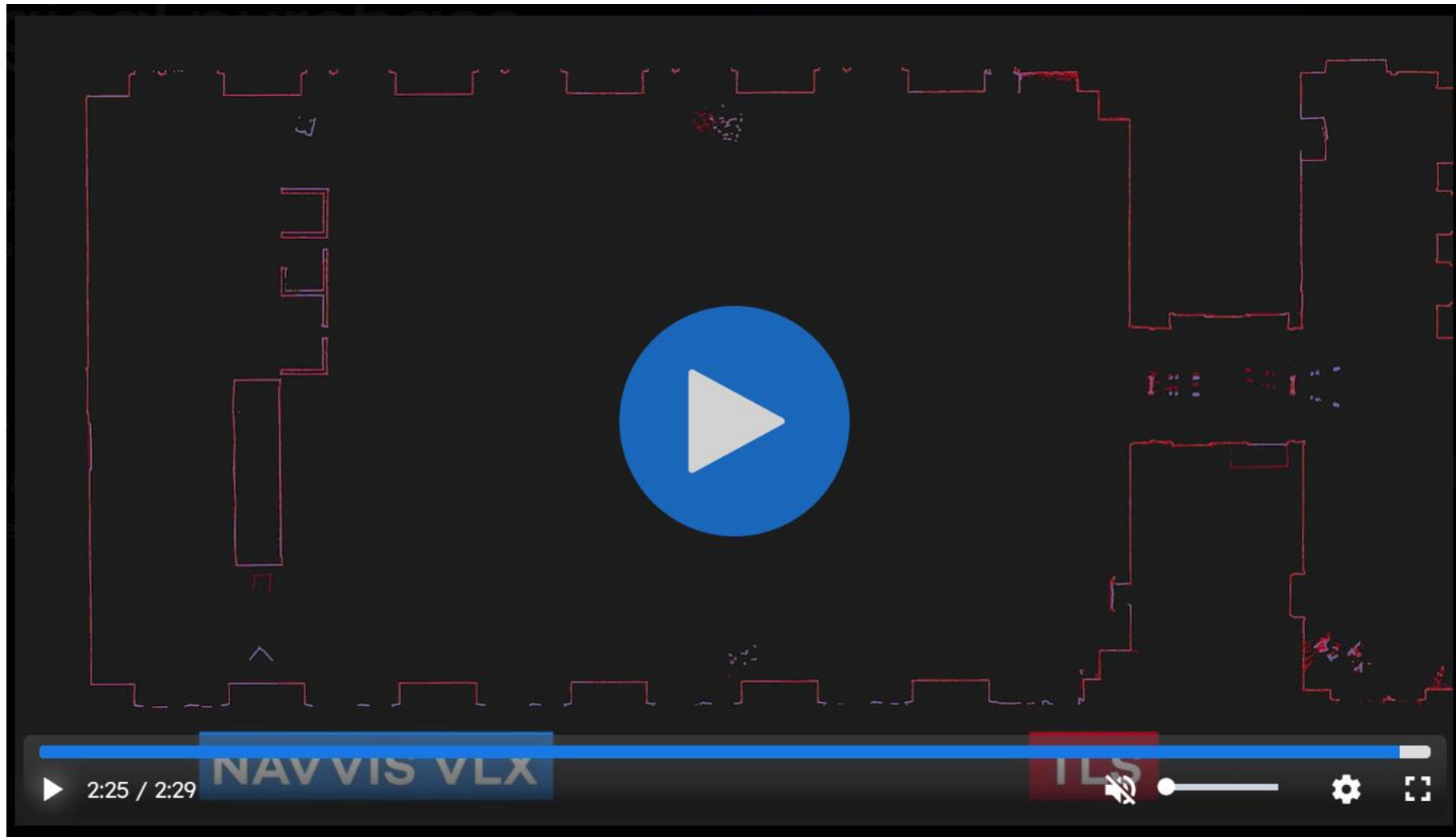


# How is the VLX 2 used?





# How is the VLX 2 used?





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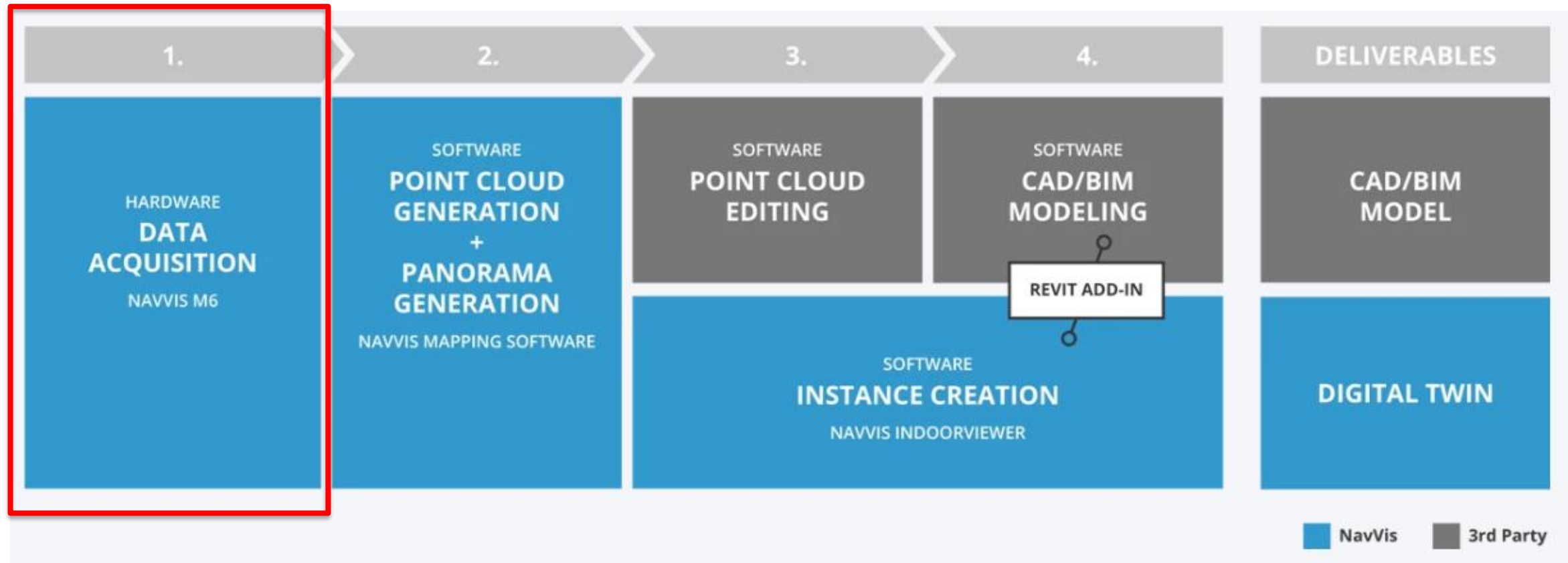
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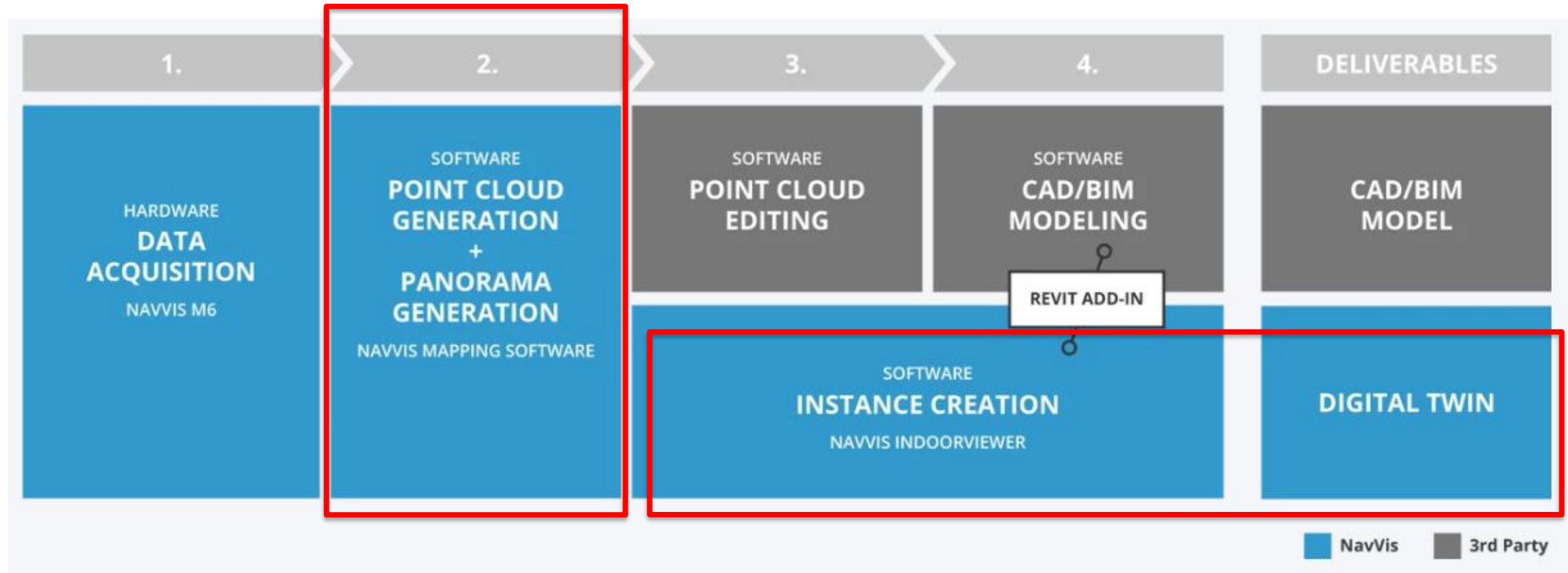
# Digital Twin Creation

- Process Overview



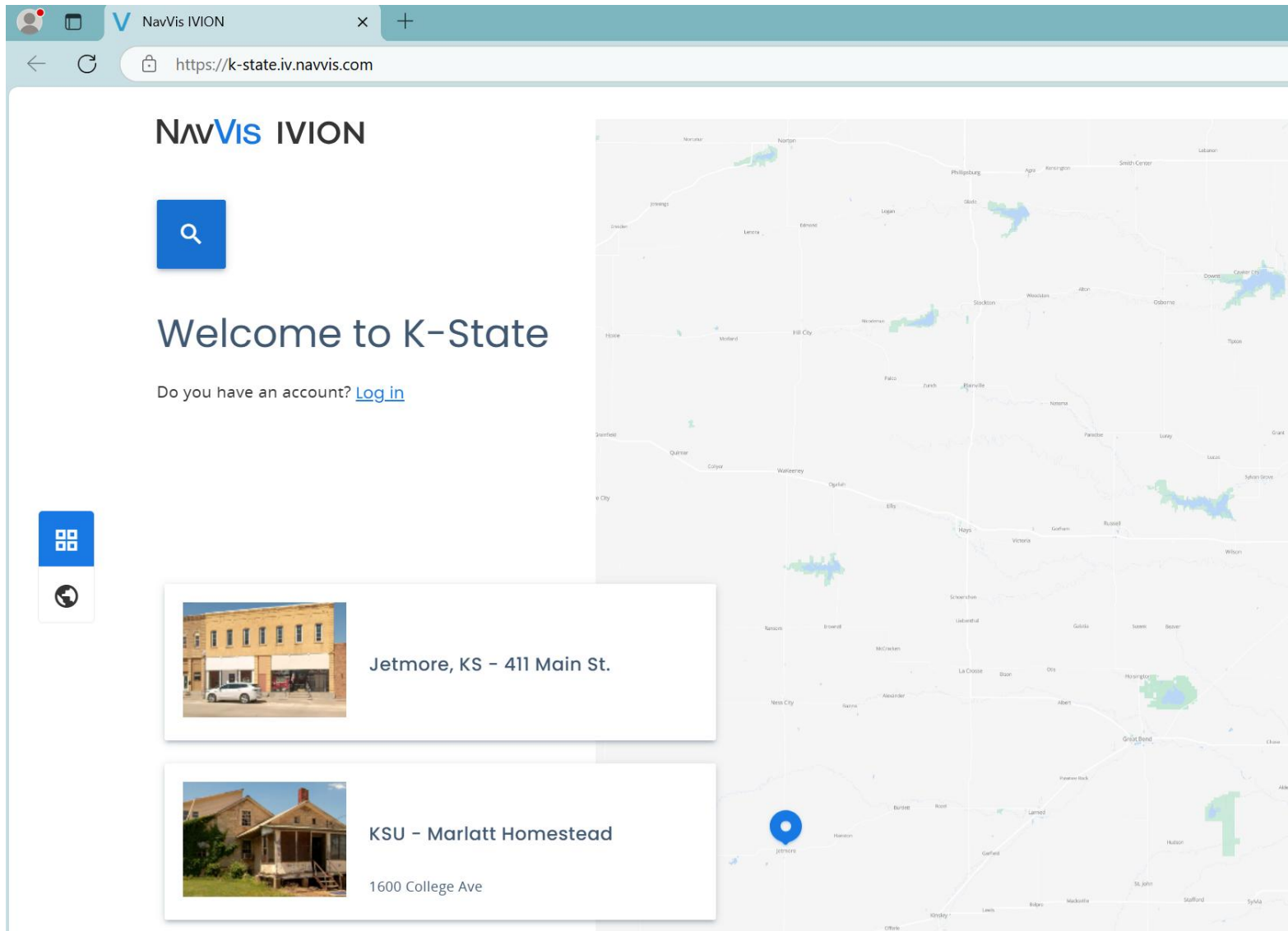
# Digital Twin Creation

- Process Overview





# Digital Twin Software



## NavVis IVION Cloud Viewer

- Web-based
- Subscription
- Any client with a web browser can view scans

# Digital Twin Software

## NavVis IVION Demo



### NavVis IVION Cloud Viewer

- TDI hosts its clients' scans at <https://k-state.iv.navvis.com/>
- Most are password-protected, but some are publicly viewable
  - Marlatt Homestead at KSU's campus
  - TDI's shop and offices
  - Jetmore, KS: Renovation project



# Digital Twin Software





# Digital Twin Software





# Digital Twin Software



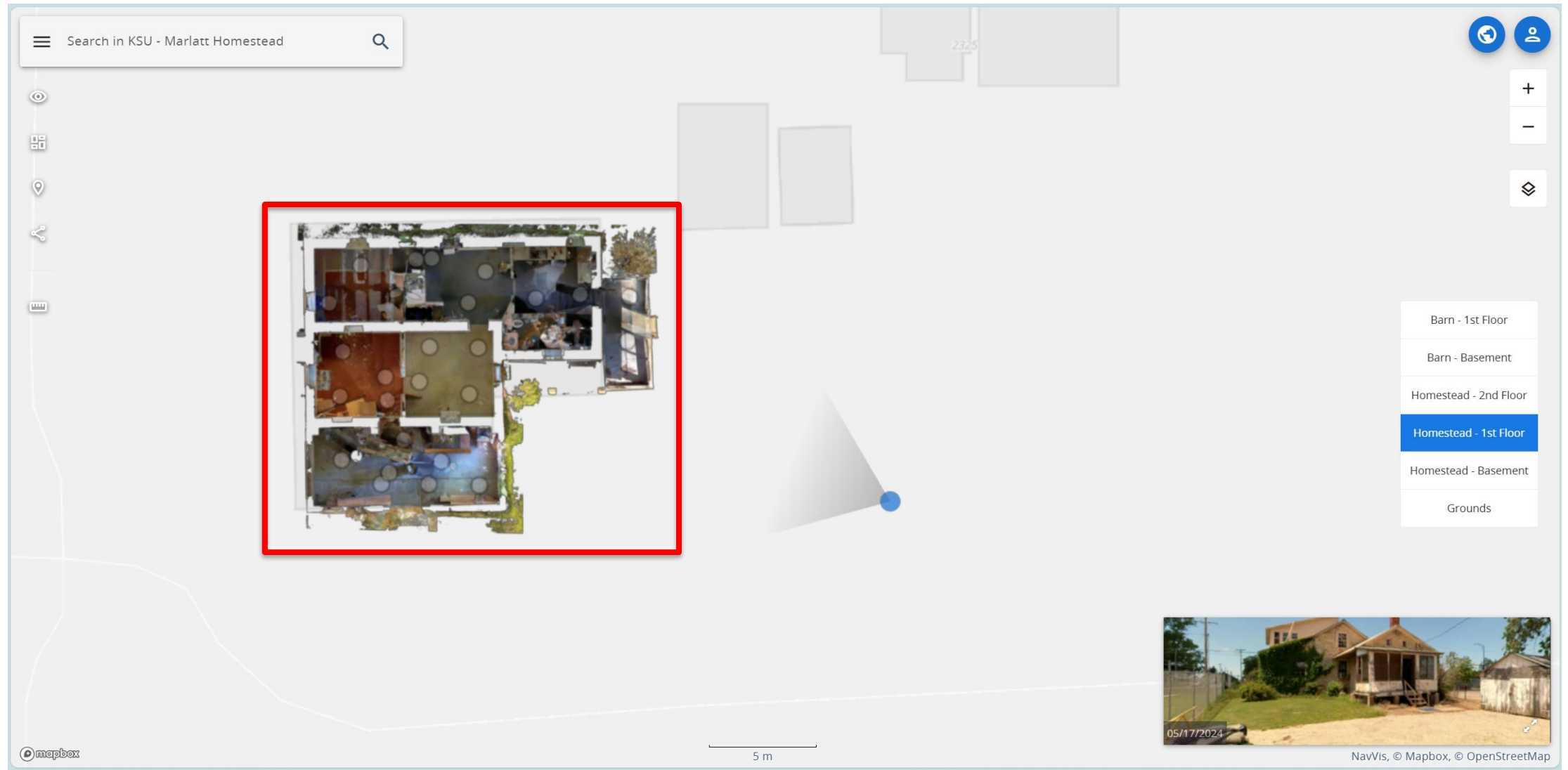


# Digital Twin Software





# Digital Twin Software



# Digital Twin Software





# Digital Twin Software



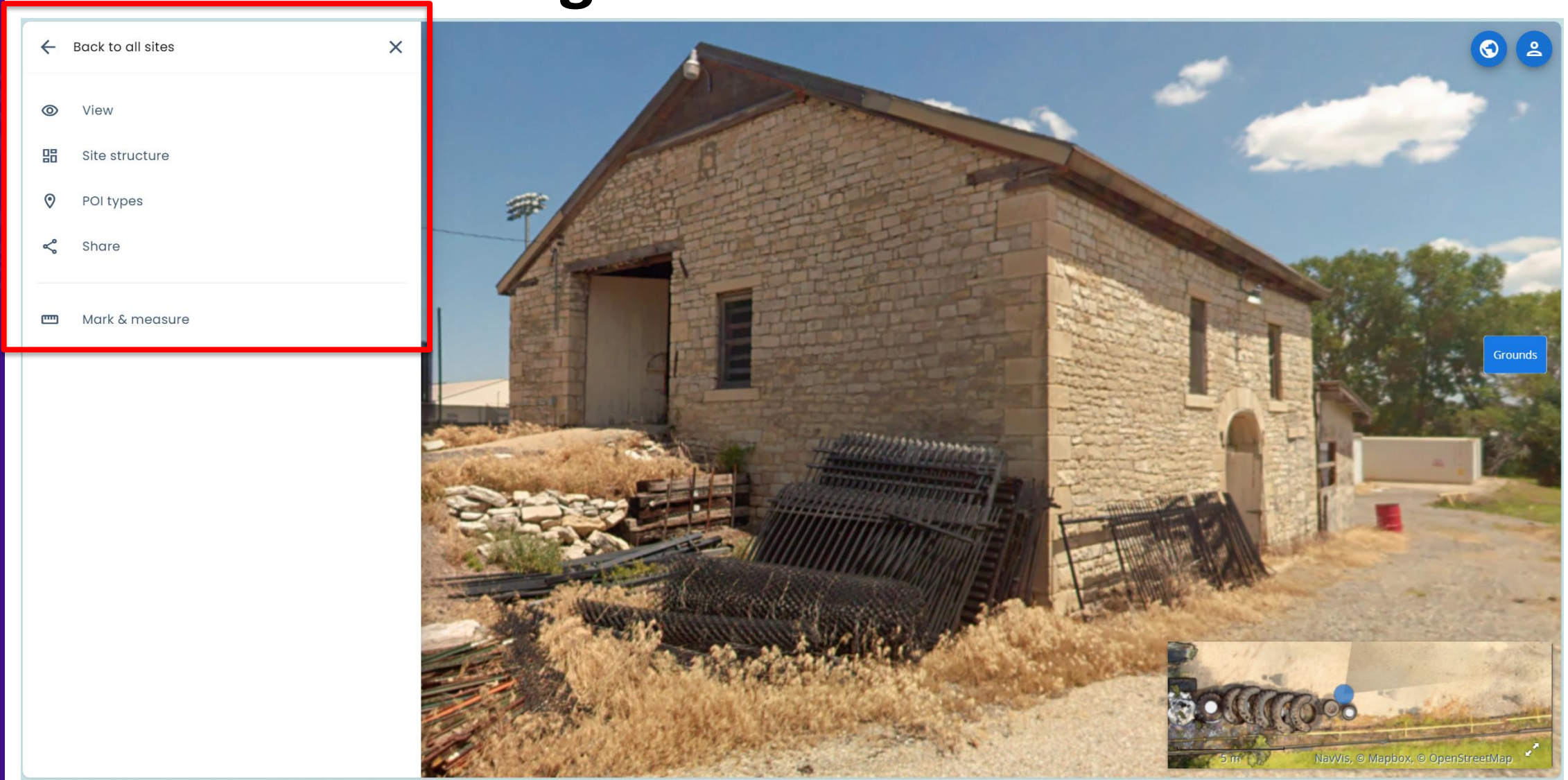


# Digital Twin Software





# Digital Twin Software



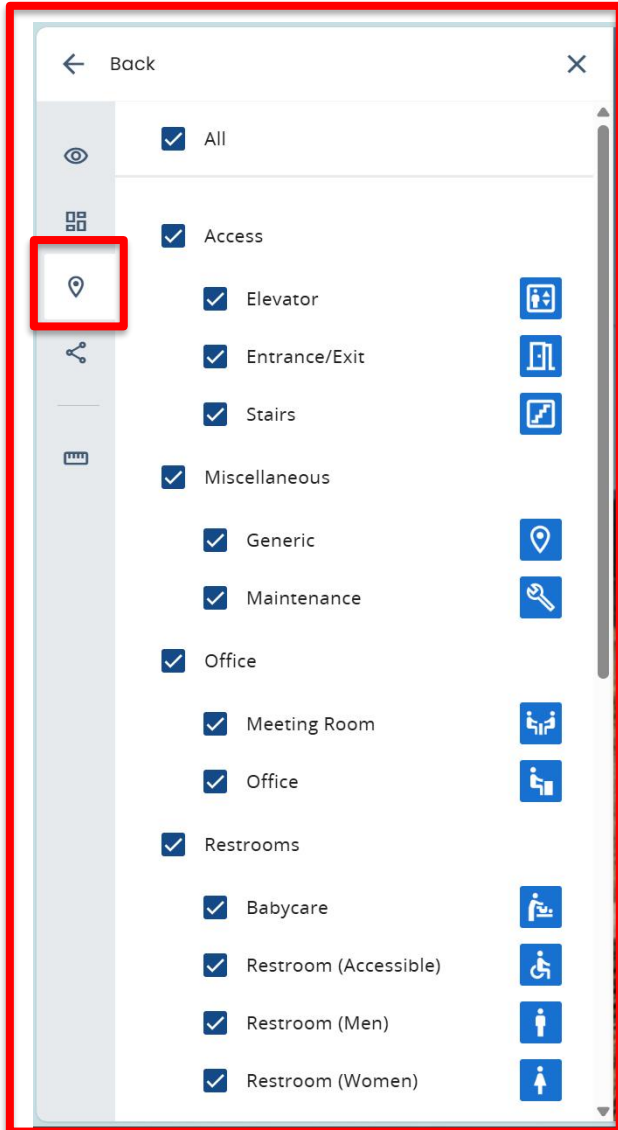


# Digital Twin Software

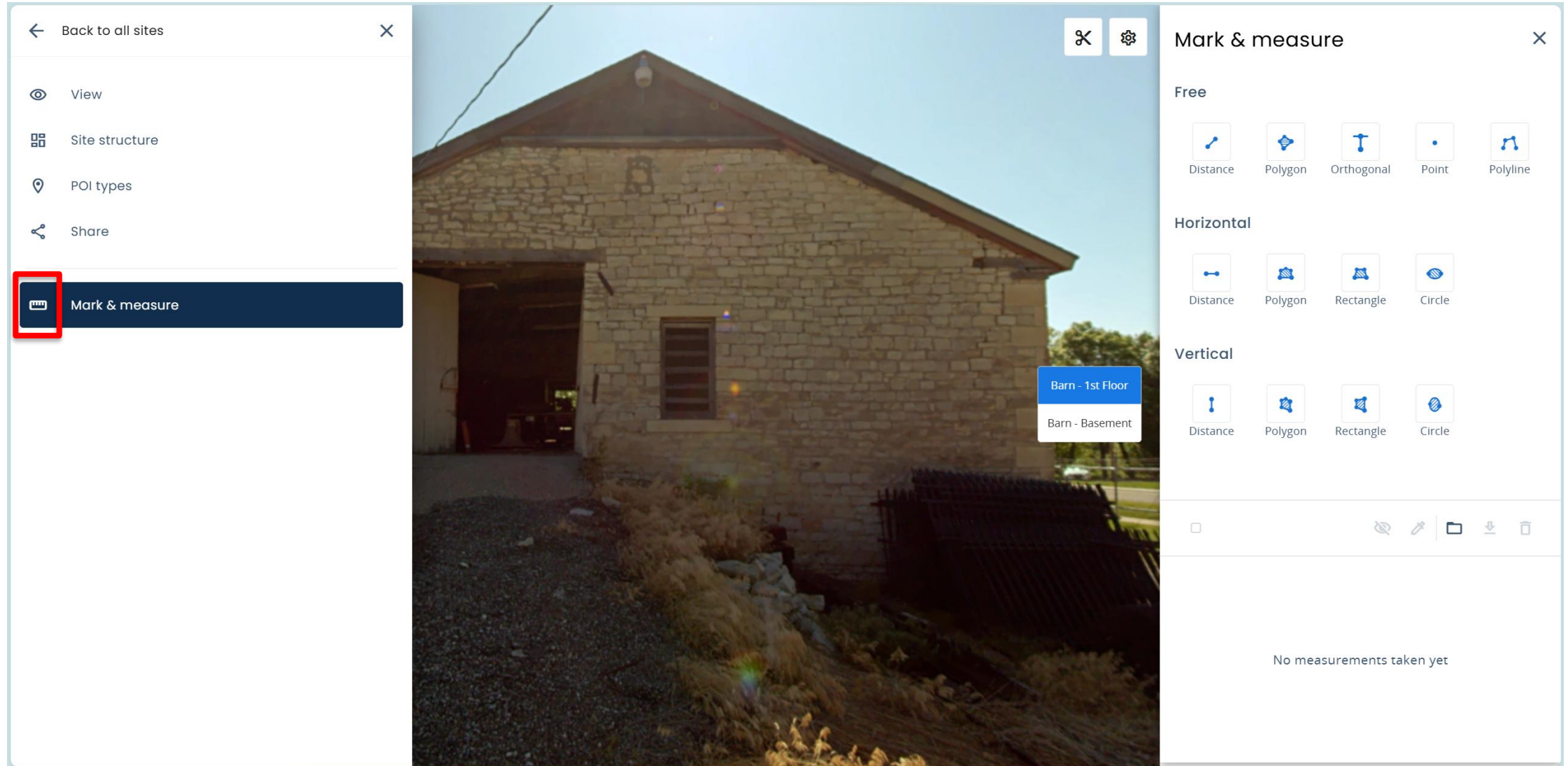




# Digital Twin Software

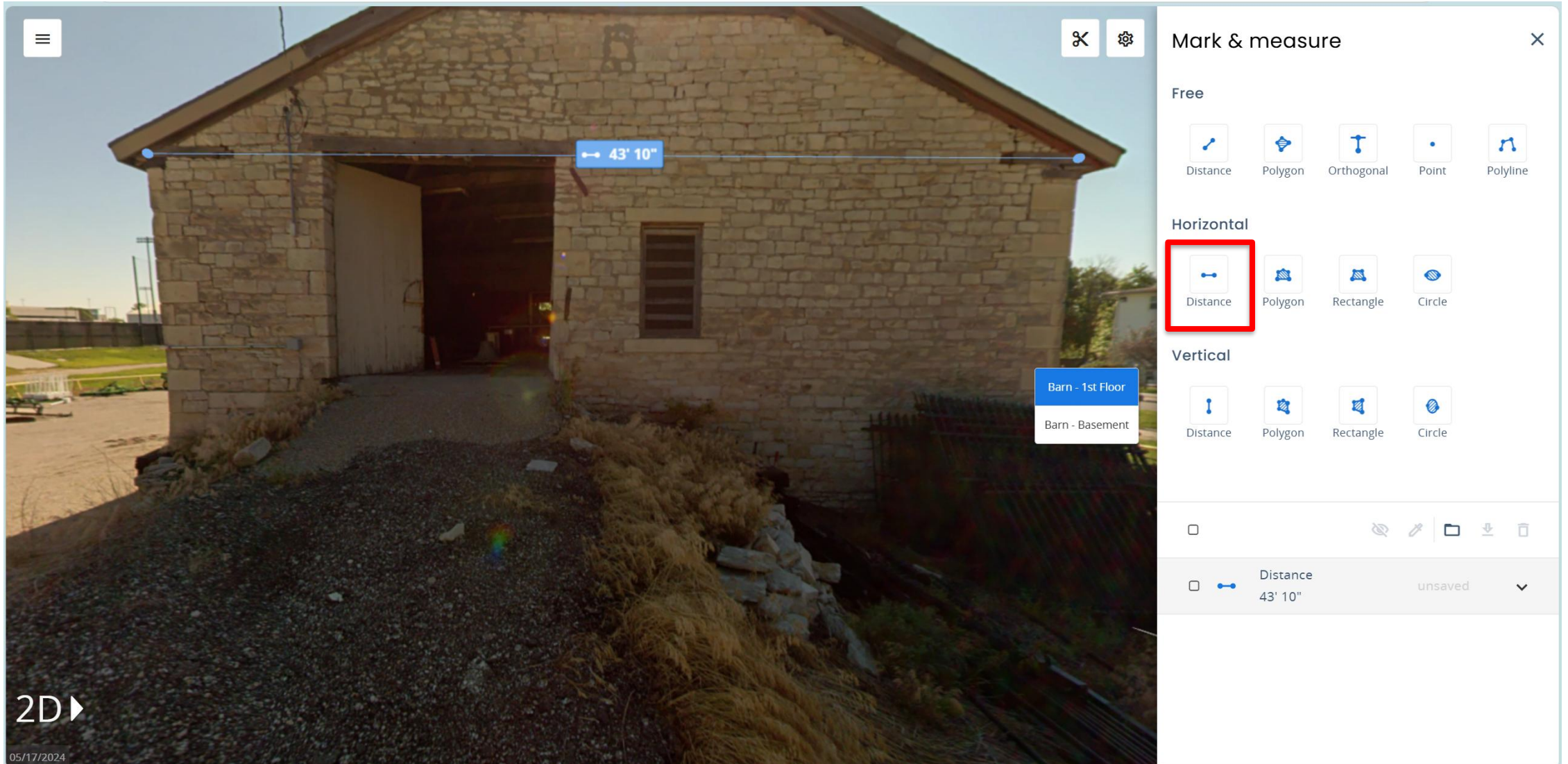


# Digital Twin Software



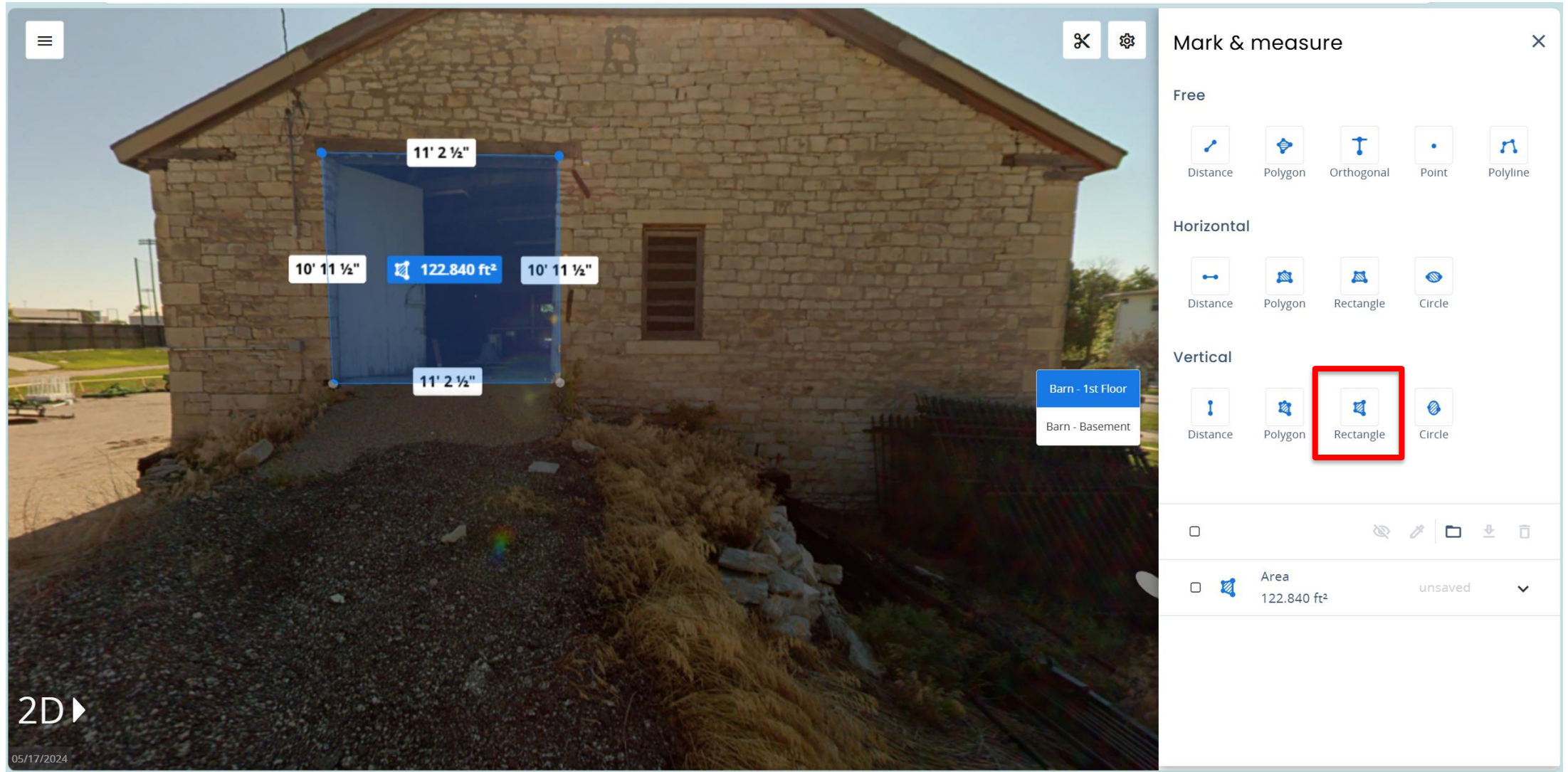


# Digital Twin Software





# Digital Twin Software



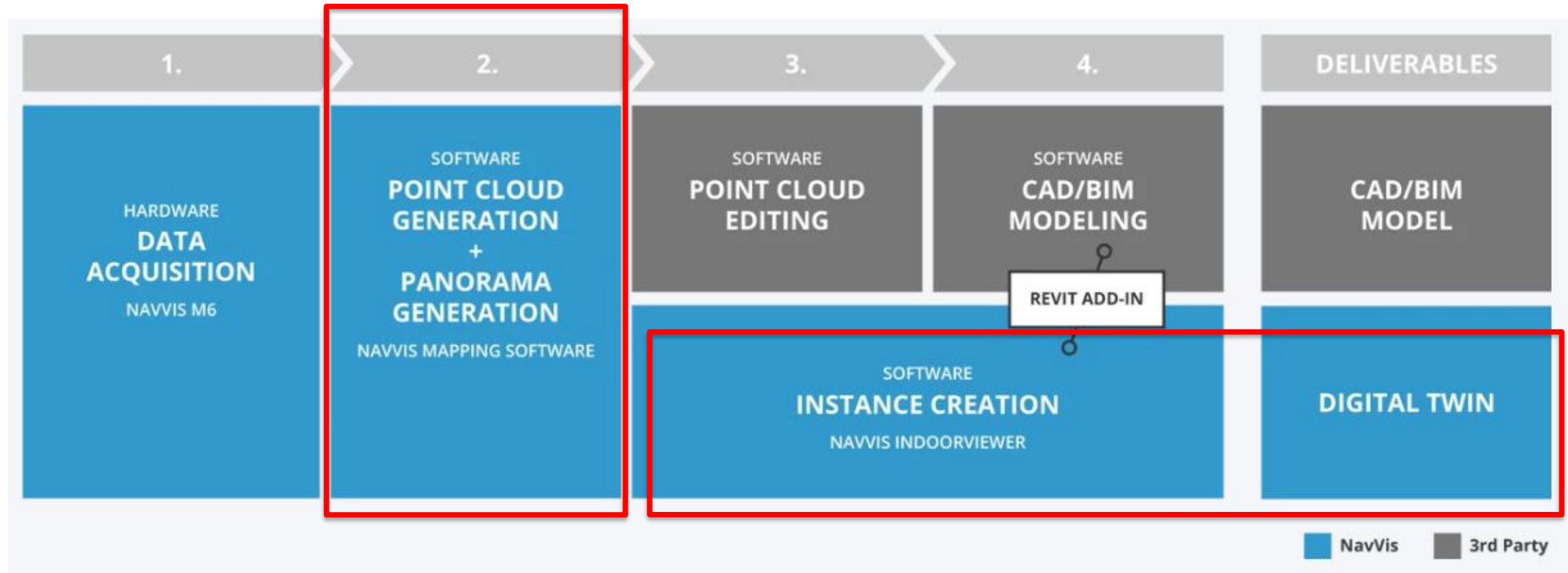


# Digital Twin Software



# Digital Twin Creation

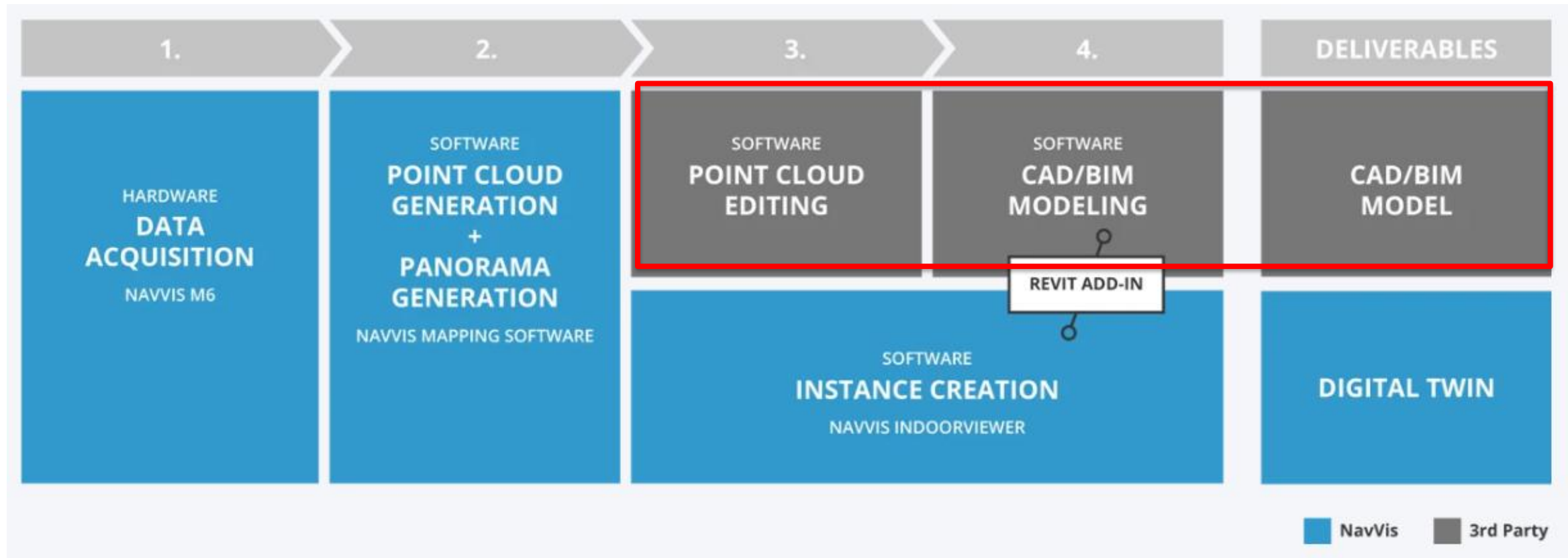
- Process Overview





# Digital Twin Creation

- Process Overview – Next Steps





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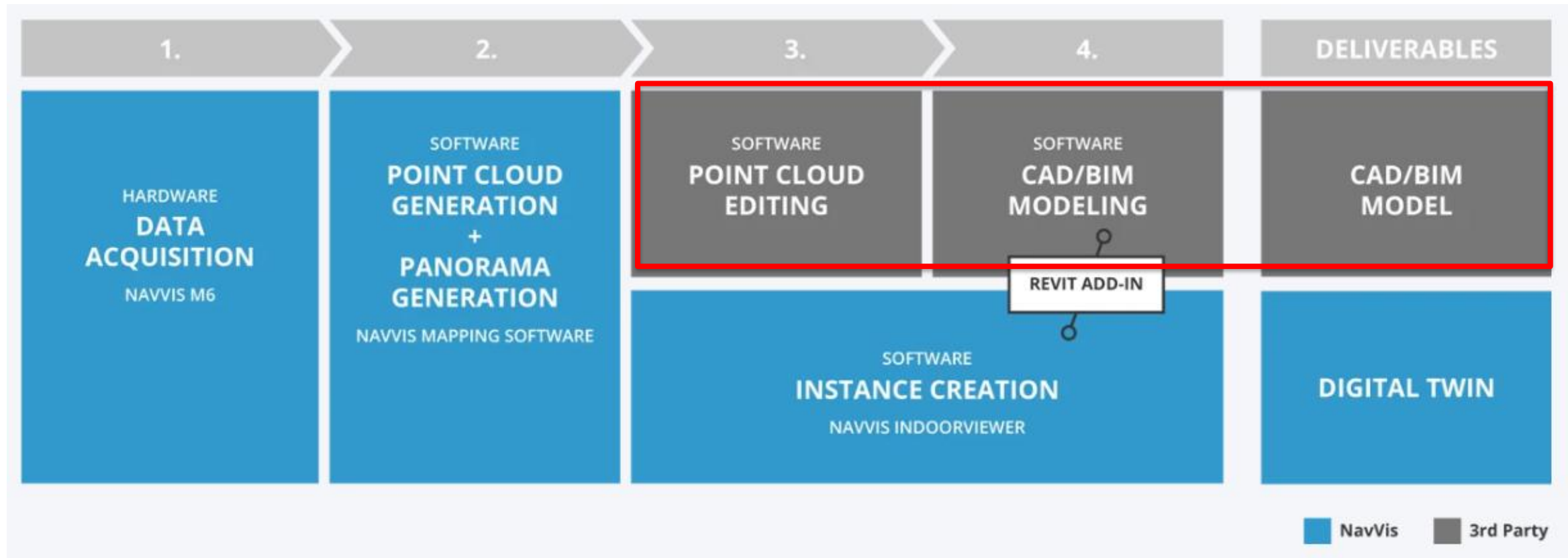
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# Digital Twin Creation

- Process Overview – Next Steps



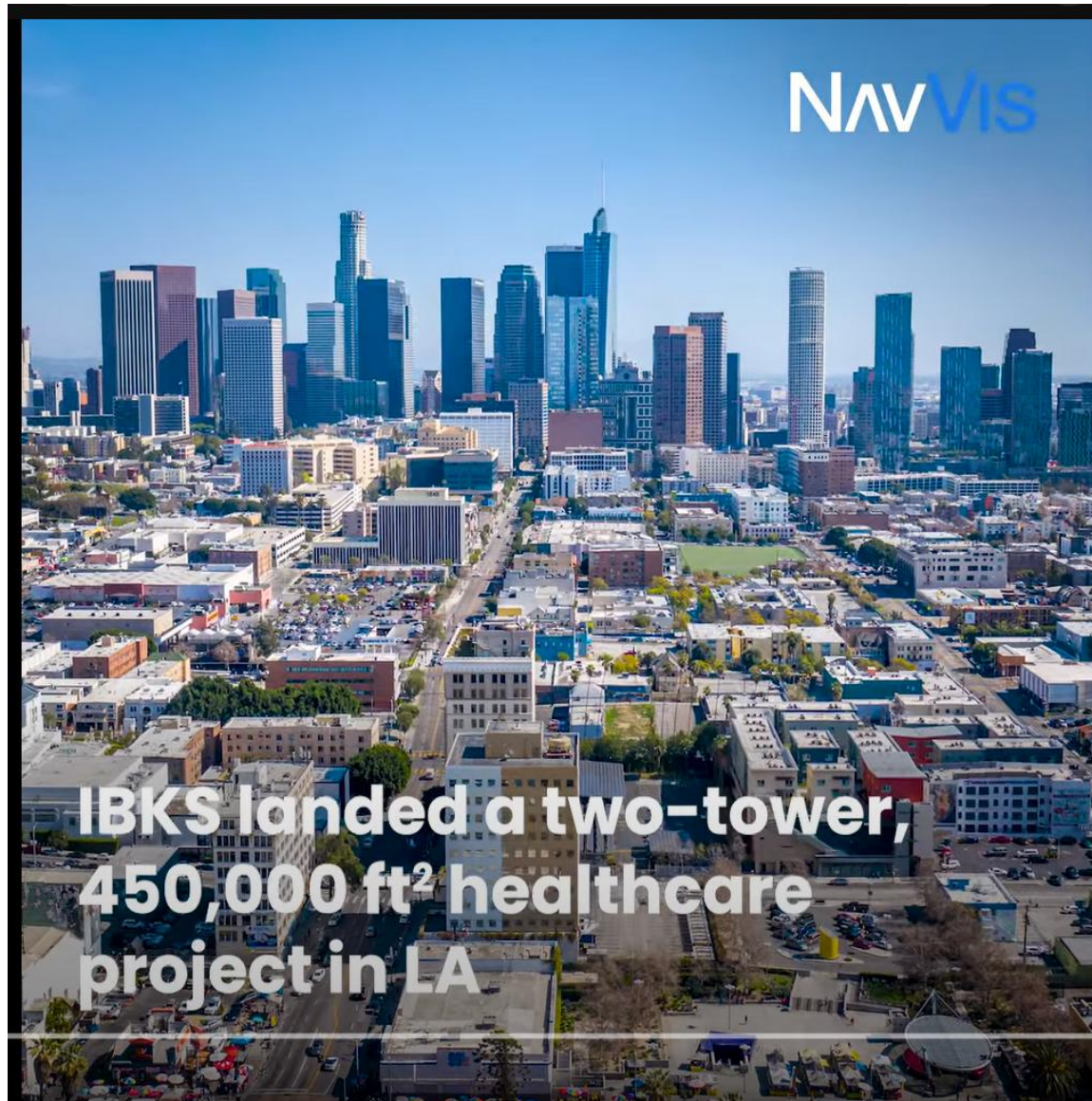
# Digital Twin Creation

## What are some of the other uses of scans?

- Computer-Aided Design (CAD) Model
  - Digital 3D design of a building that can be used for planning/construction
  - Reverse engineering if existing documentation is incomplete
- Building Information Model (BIM)
  - Can also include a CAD model (above)
  - A way to keep all information of a building in one place
    - I.e. Functions of a building, like HVAC, or equipment documentation in a factory
  - Probably more common in industrial applications / large projects
- Scans/tours with photo-realism or realistic freedom of movement
  - Allow more detailed viewing than just hopping between panoramas



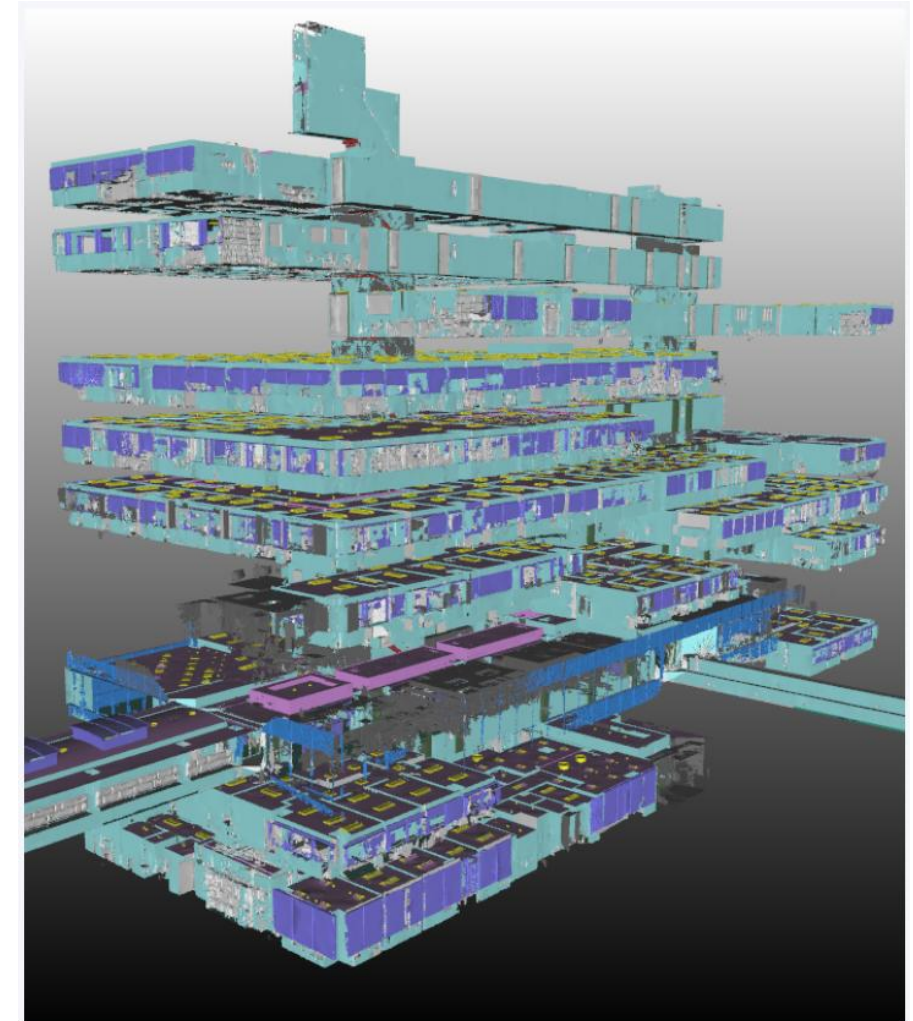
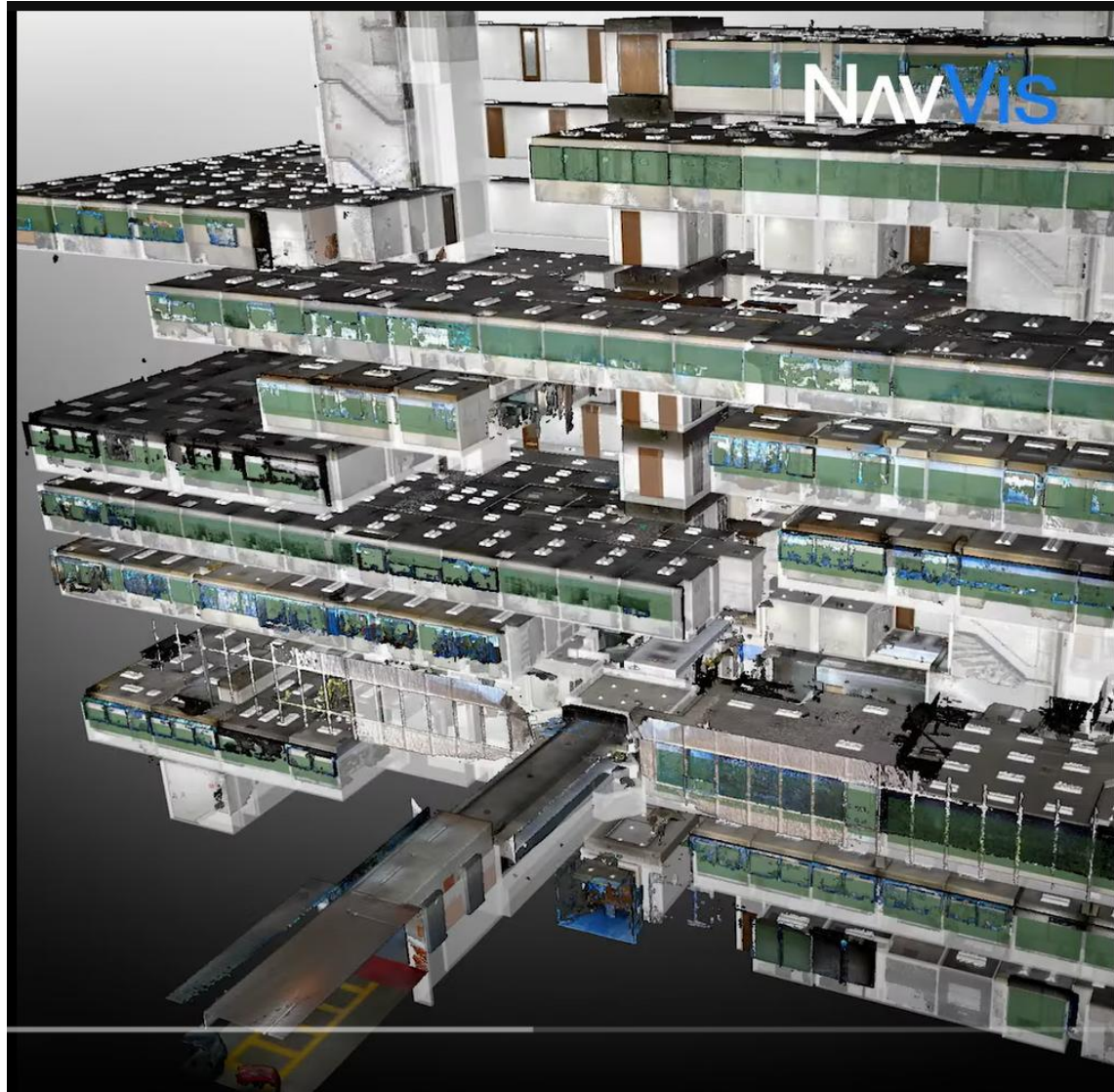
# Scan-to-CAD and Scan-to-BIM



- CASE STUDY: IBKS pushes the boundaries of scan-to-BIM with NavVis & PointFuse in a towering project
- Source: [NavVis YouTube Channel](#)



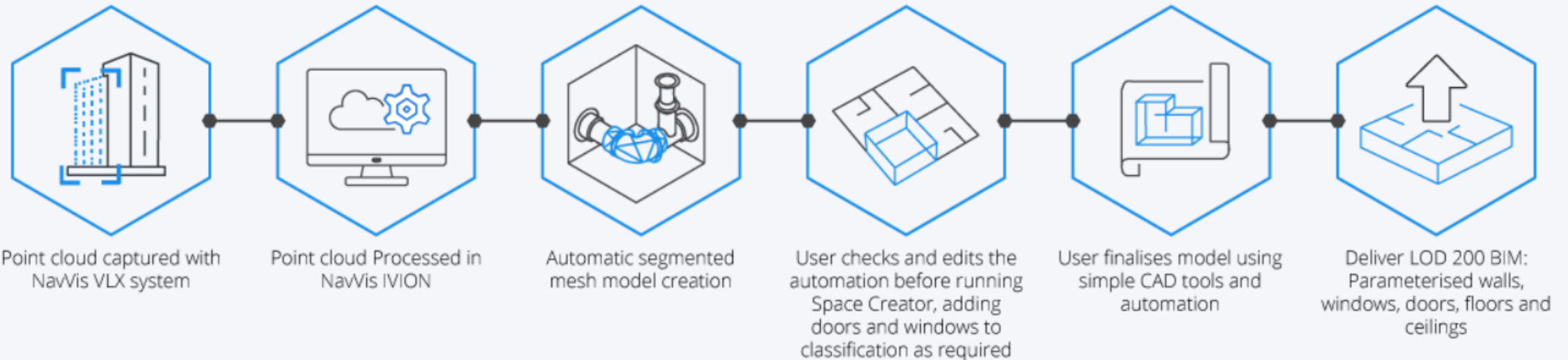
# Scan-to-CAD and Scan-to-BIM





# Scan-to-CAD and Scan-to-BIM

## NavVis to PointFuse to Autodesk Revit Workflow

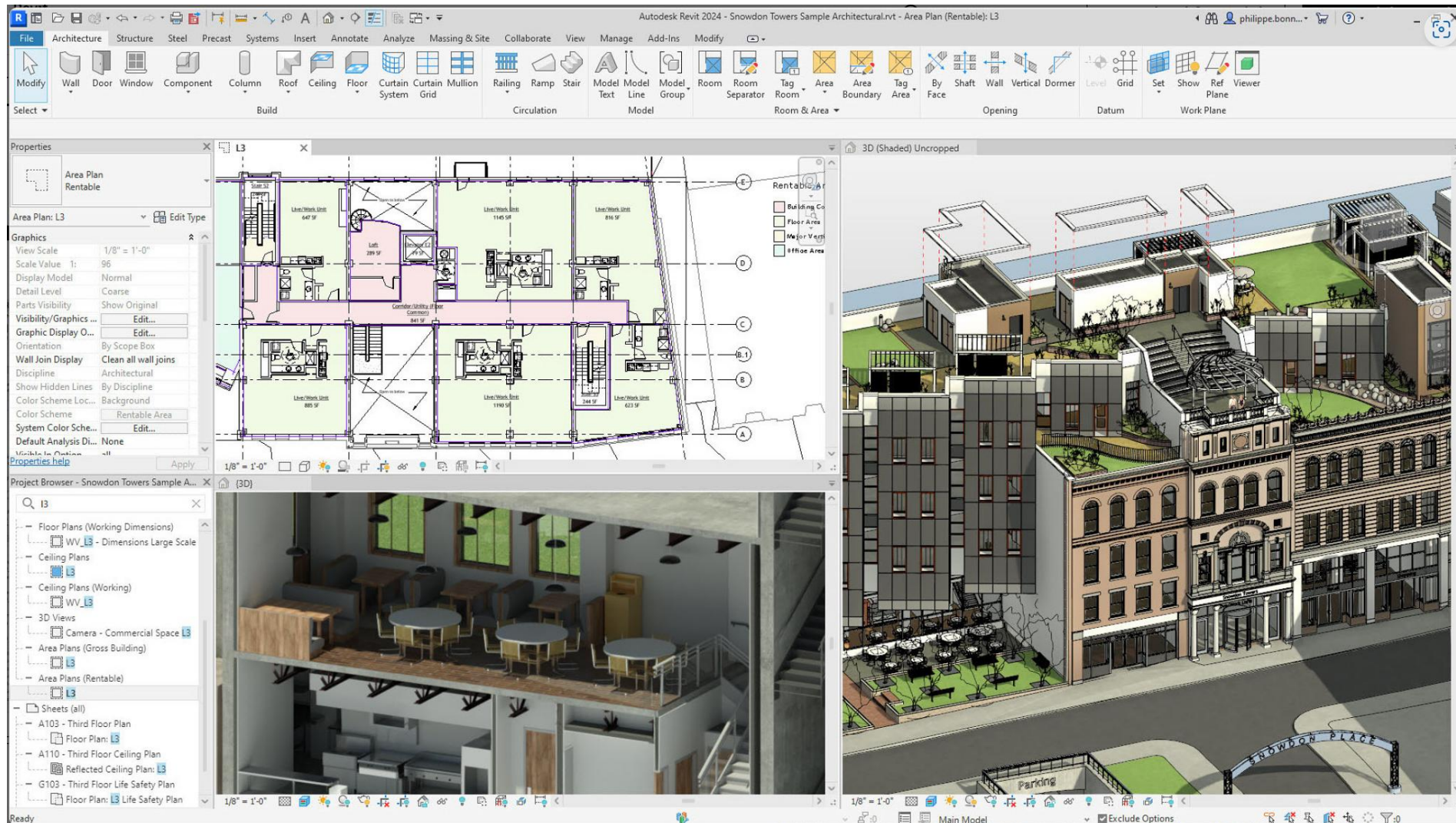


NavVis

POINTFUSE®

R Revit

# Scan-to-CAD and Scan-to-BIM



Example of  
CAD model  
built using  
Autodesk Revit

Source:  
[Autodesk.com](https://www.autodesk.com)



# Improved Realism in Scans

- [Overview video](#) of Prevu3D



## RealityPlatform™

Centralized cloud platform to securely manage and collaborate on 3D scanning data.

### Features

- [Store & Host Reality Capture Data >](#)
- [3D Mesh Processing >](#)
- [Advanced 3D Data Visualization >](#)
- [Collaboration & Site Management >](#)

## RealityPlan™

Optimizes engineering workflows by turning reality capture data into actionable 3D assets, accelerating design and CAD work.

### Features

- [Visual Asset Management >](#)
- [View and navigate >](#)
- [Engineering tools >](#)

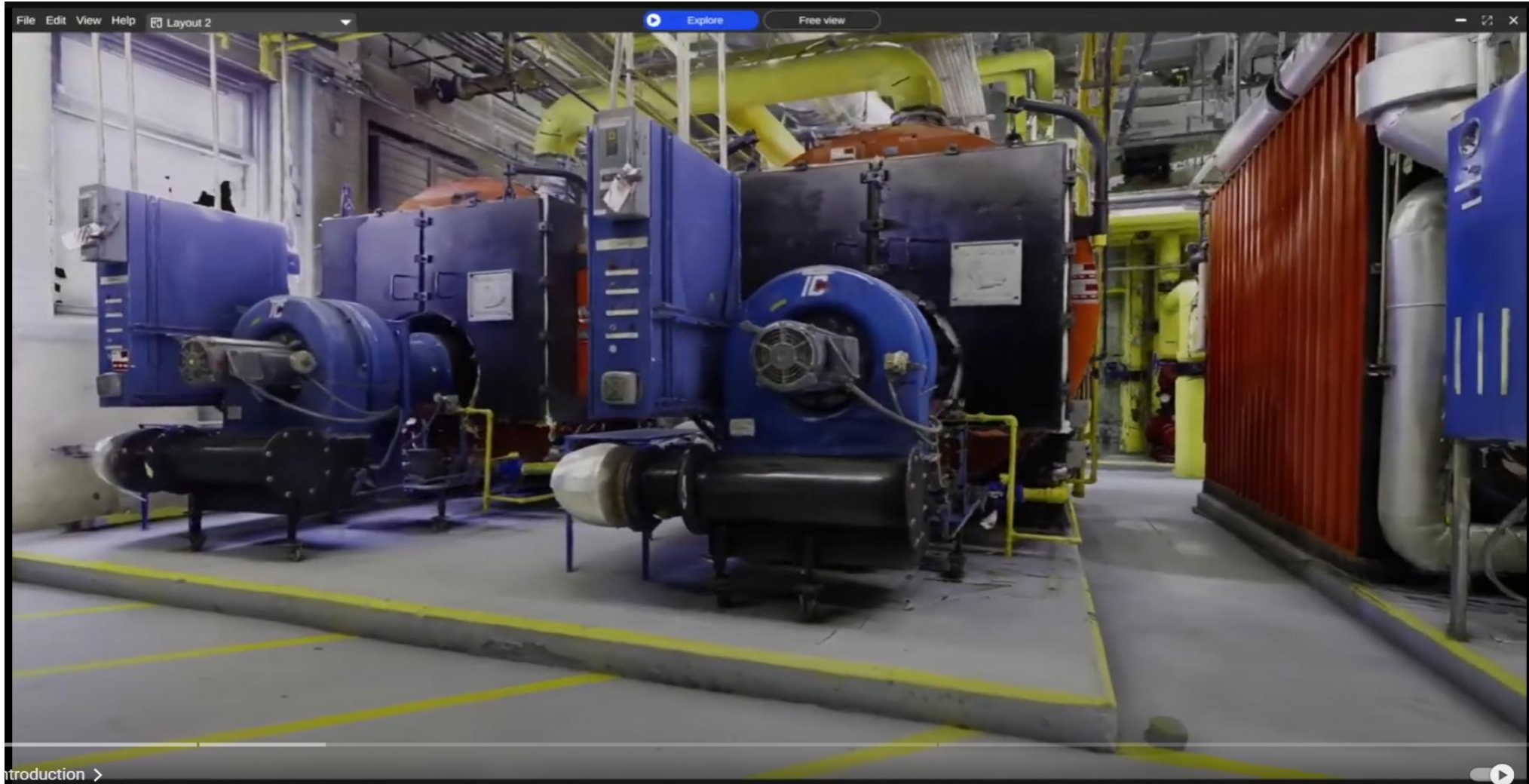
## RealityConnect™

Native plugins provide seamless, bidirectional integration with industry-leading design and modeling software.

### Features

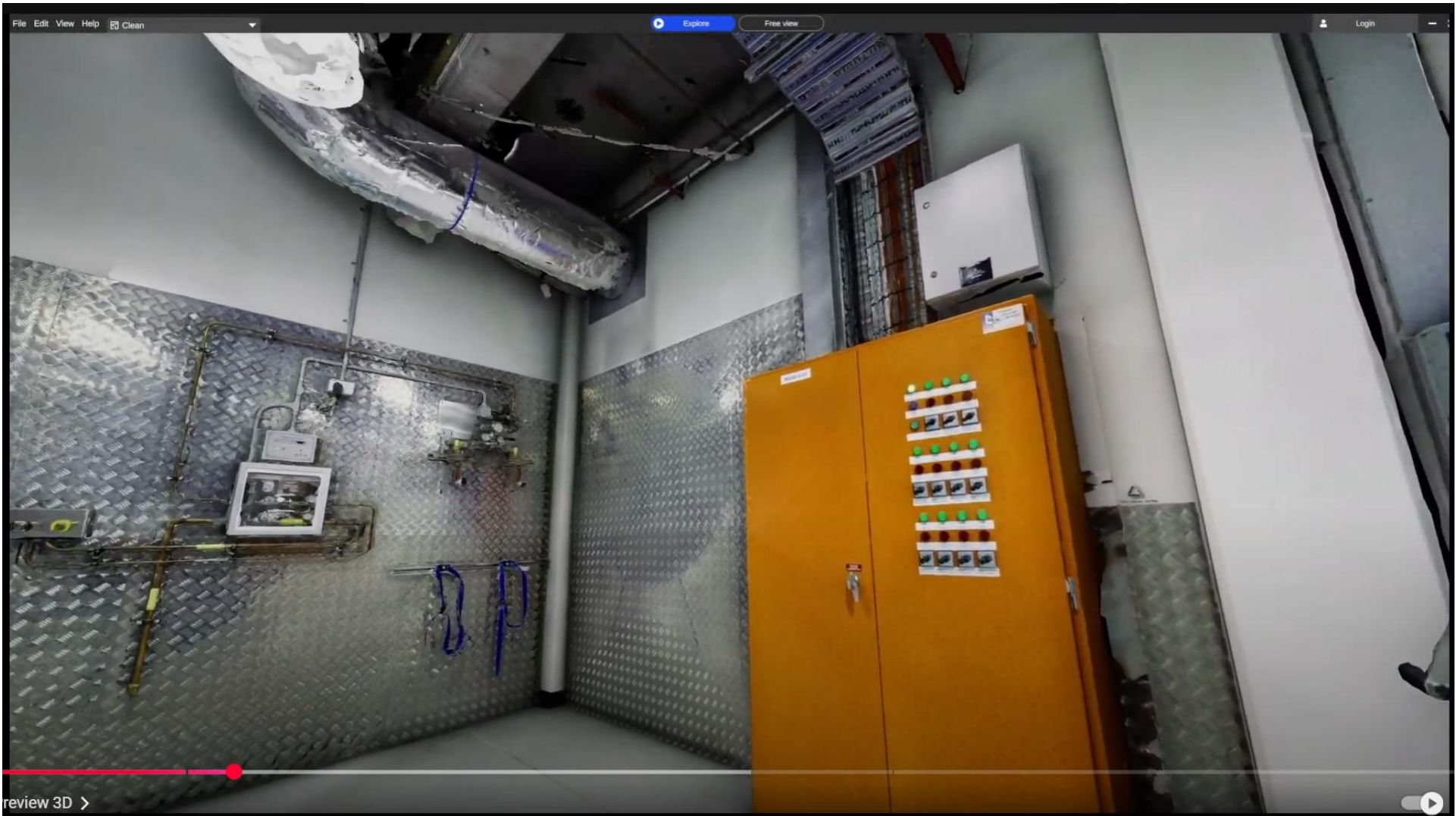
- [RealityConnect™ Inventor >](#)
- [RealityConnect™ AutoCAD Plant 3D >](#)
- [RealityConnect™ Revit >](#)
- [RealityConnect™ Omniverse >](#)

# Improved Realism in Scans





# Improved Realism in Scans



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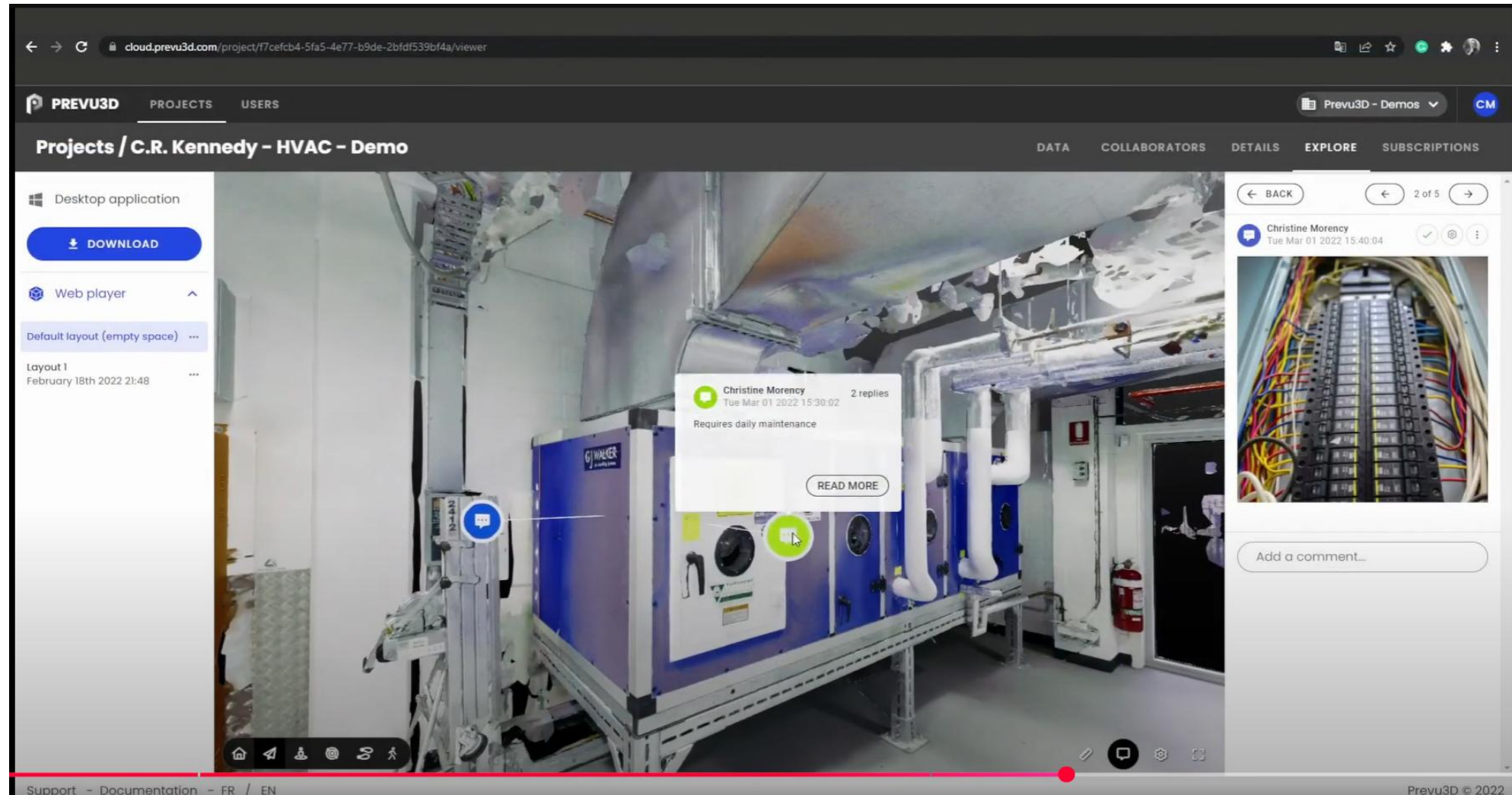




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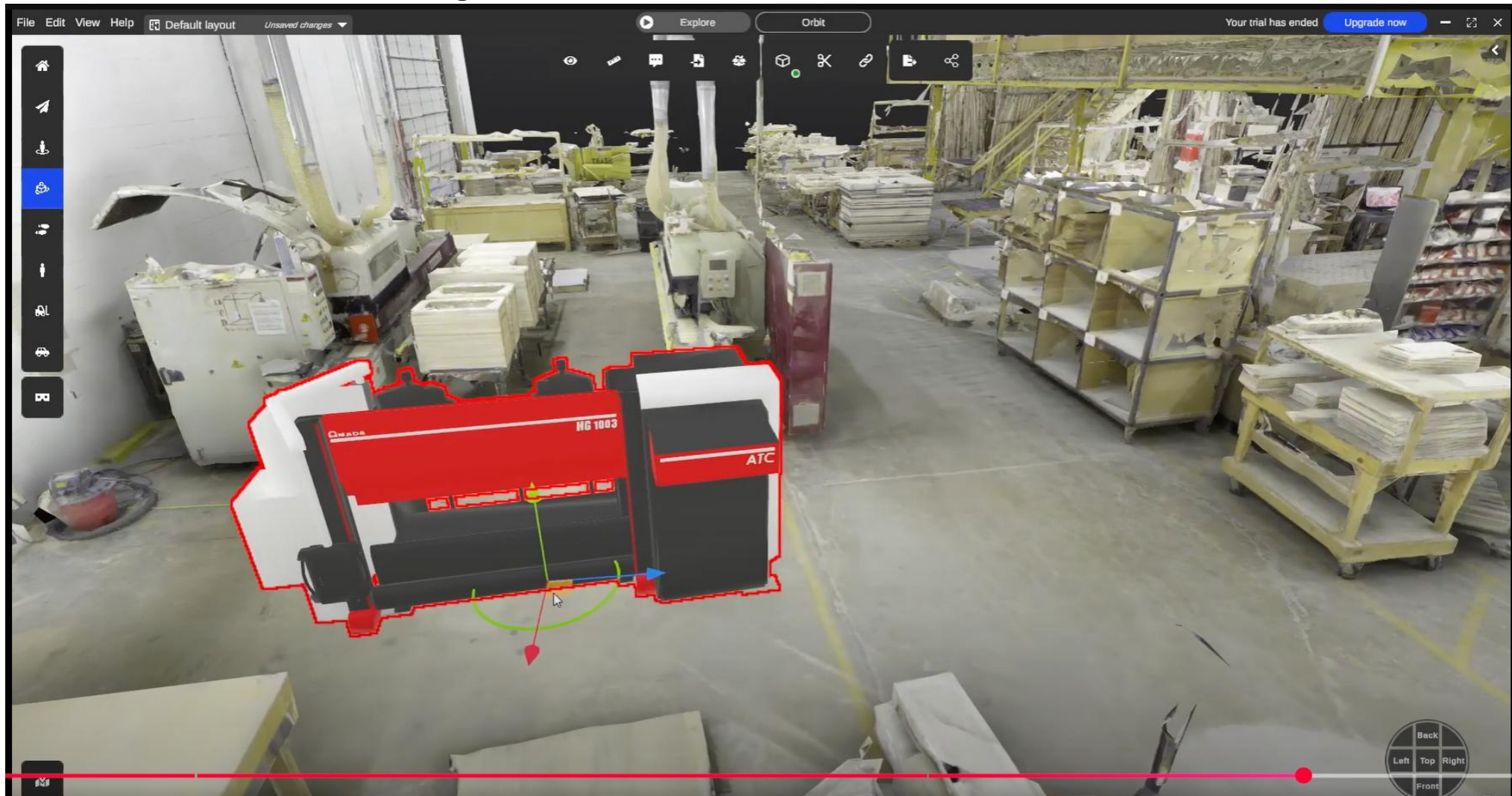


# Improved Realism in Scans





# Improved Realism in Scans





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# Background...

- **TDI – Fast Facts**
- Since 1995
  - >2800 projects
  - ~600 clients
- Over 650 interns
  - Great opportunity for students in engineering or business to get hands-on experience

