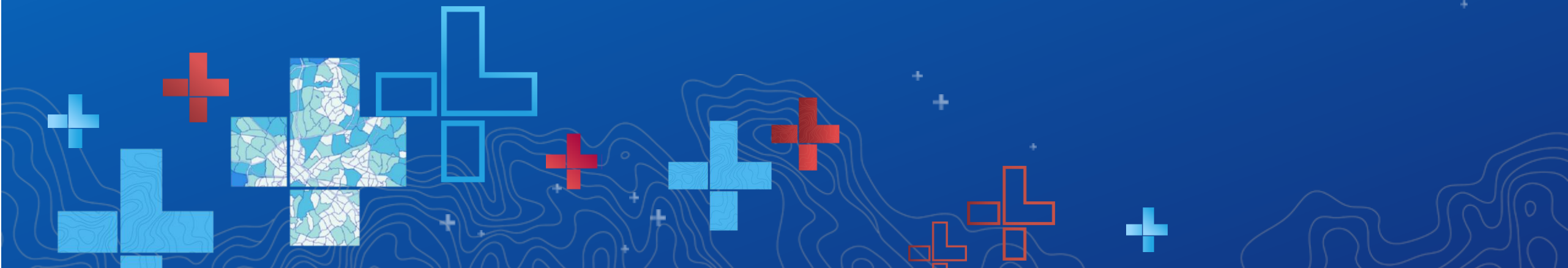
CAD, BIM, & GIS Integration

Linking Design with Context to Drive Life Cycle Value

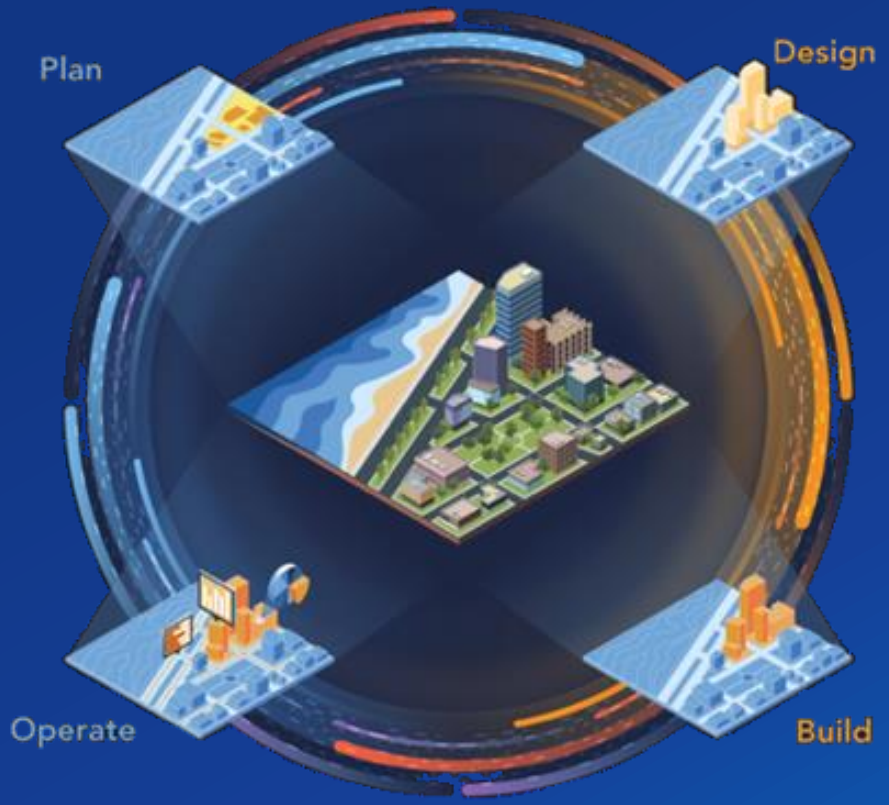
Anthony Renteria | Esri Product Manager - AEC Workflow Integration
Larisa Kruger, GISP | GIS Manager - The Ohio State University

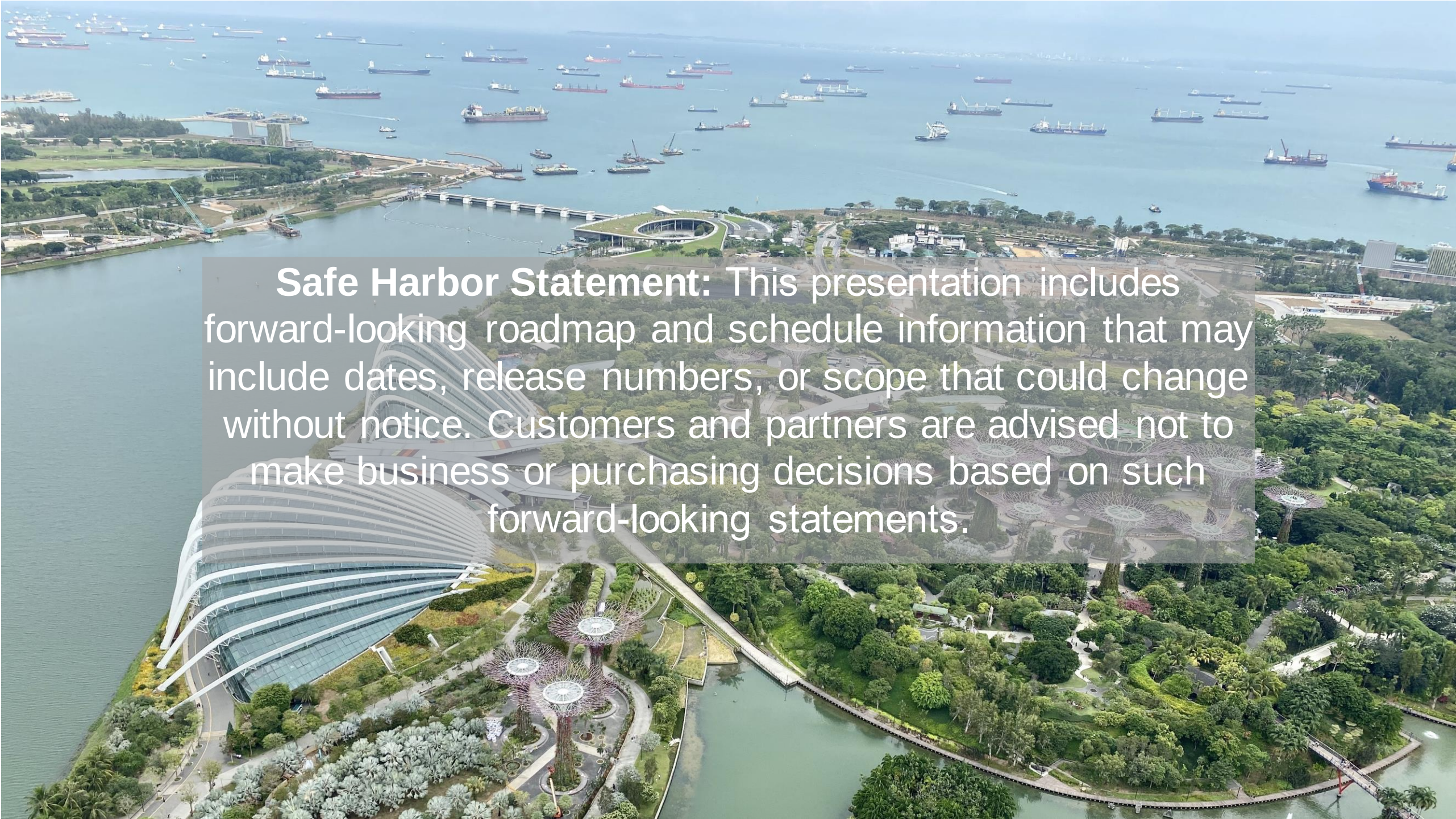
2020 ESRI FEDERAL GIS CONFERENCE | WASHINGTON, D.C.



Session Overview

- Industry influencing CAD/BIM/GIS Integration
- ArcGIS integrations for CAD & BIM within the design ecosystem
- New ArcGIS Pro 2.5 updates handling multiple BIM datasets
- Web Services Driving Engagement
- Life Cycle Use of Project Data Into Campus Management: The Ohio State University



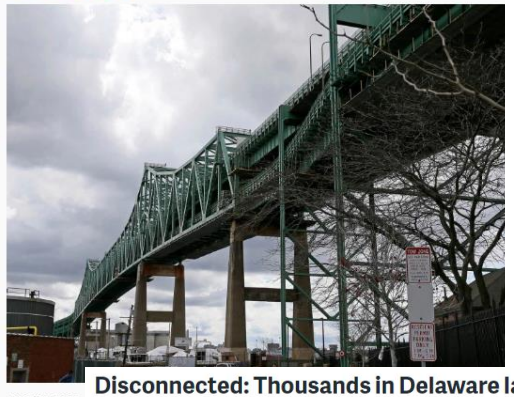


Safe Harbor Statement: This presentation includes forward-looking roadmap and schedule information that may include dates, release numbers, or scope that could change without notice. Customers and partners are advised not to make business or purchasing decisions based on such forward-looking statements.

Industry Drivers for CAD-BIM-GIS

Planning, Design, Build, and Operation Problems…

Bold thinking needed to bring Mass. transportation into future



BOSTON MA.
(Staff Photo By

By RICHARD
January 29, 20

Garbage Trucks And Potholes: San Antonio Launches Research And Development Program To Solve Problems

By PAUL FLAHIVE • JAN 28, 2020

Share Tweet Email

"City Hall To Go" is one of the R&D League's initiatives. The goal is to identify where departmen outreach and intake efforts overlap and to ailgn those efforts in a mobile truck that can deliver t low-income, hard-to-reach residents.

OFFICE OF INN

Disconnected: Thousands in Delaware lack access to safer public water

By Zoë Read · January 27, 2020

Listen 5:44

Consuelo McGowan from SERCAP collects samples for testing at a mobile home in Ellendale, Del. McGowan works for a non-profit that provides kits for testing well water. (Zoe Read/WHYY)

Salt Lake City braces for traffic problems as five skyscrapers rise amid a wave of downtown construction

(Francisco Kjolseth | The Salt Lake Tribune) Captured during a recent timed exposure, the intersection of 200 S. and West Temple where work has begun on the 26-story Hyatt Regency convention center hotel, is about to become difficult to navigate. With at least six major construction projects unfolding this year in the state's urban core — five skyscrapers and the historic renovation of the Salt Lake Temple — key arteries feeding the heart of the city are expected to be congested, with lane closures and heavy truck traffic.

Shutterstock

Email Twitter 40

By the end of this century, the world's population will have increased by half – that's another 3.6 billion people. According to the UN, the global population is set to reach

MI6 floor plans lost by building contractor

27 December 2019

Share

Fort Lauderdale Mayor Pushes City's Plan To Fix Infrastructure Problems During Town Hall

By CAITIE SWITALSKI • JAN 10, 2020

Share Tweet Email

Fort Lauderdale Mayor Dean Trantalis addressed more than 255 people in City Hall Thursday night. Residents asked questions about plans to fix the sewage pipes, some of which are more than 50 years old.

CAITIE SWITALSKI / WLRN

U.S. Cities Vowed To Have More Mass Transit By 2020. Most Are Still Waiting.

January 9, 2020 | Cameron Sperance, Bisnow Boston

Facebook Twitter LinkedIn Email Print

Planners in many U.S. cities benchmarked 2020 as the year transit plans would get rolling down the tracks.

Master plans and vision studies proclaimed regional transit networks would expand, easing congestion and efficiently zipping residents to and from their jobs and homes in growing metropolitan areas like Austin, Columbus and Nashville.

Let's Move Nashville was a nearly $9B plan to add light rail and bus rapid transit across Music City. Transit advocates hoped Project Connect would bring light rail to Austin, ranked the worst city in Texas for traffic congestion.

But 2020 is here and, despite booming economies, these cities aren't any closer to solving their traffic misery — and that could threaten their growing real estate markets.

SMART UTILITY

Energy Industry Gets Cracking on New Challenges

The task is cut out for planners, engineers, operators and protection folks.

Mark Johnson
MAR 08, 2019

We All Have Problems We Are Trying to Solve!

[Smart Assets + Project Delivery] = GeoEnabled Systems

Facilities & Public Works O&M
ArcGIS Indoors
ArcGIS Utility Network Management

Urban Planning
ArcGIS Urban

Public Safety
ArcGIS Mission
ArcGIS Earth
Dashboards

Land Records
ArcGIS Parcel Fabric
ArcGIS for AutoCAD

Citizen Engagement
ArcGIS Hub
Community Analyst

3D
Parcels
Planning
Utilities
Indoors
Imagery

GIS
(…an Information, Visualization & Analysis System)

Architectural & Structural Design
Revit

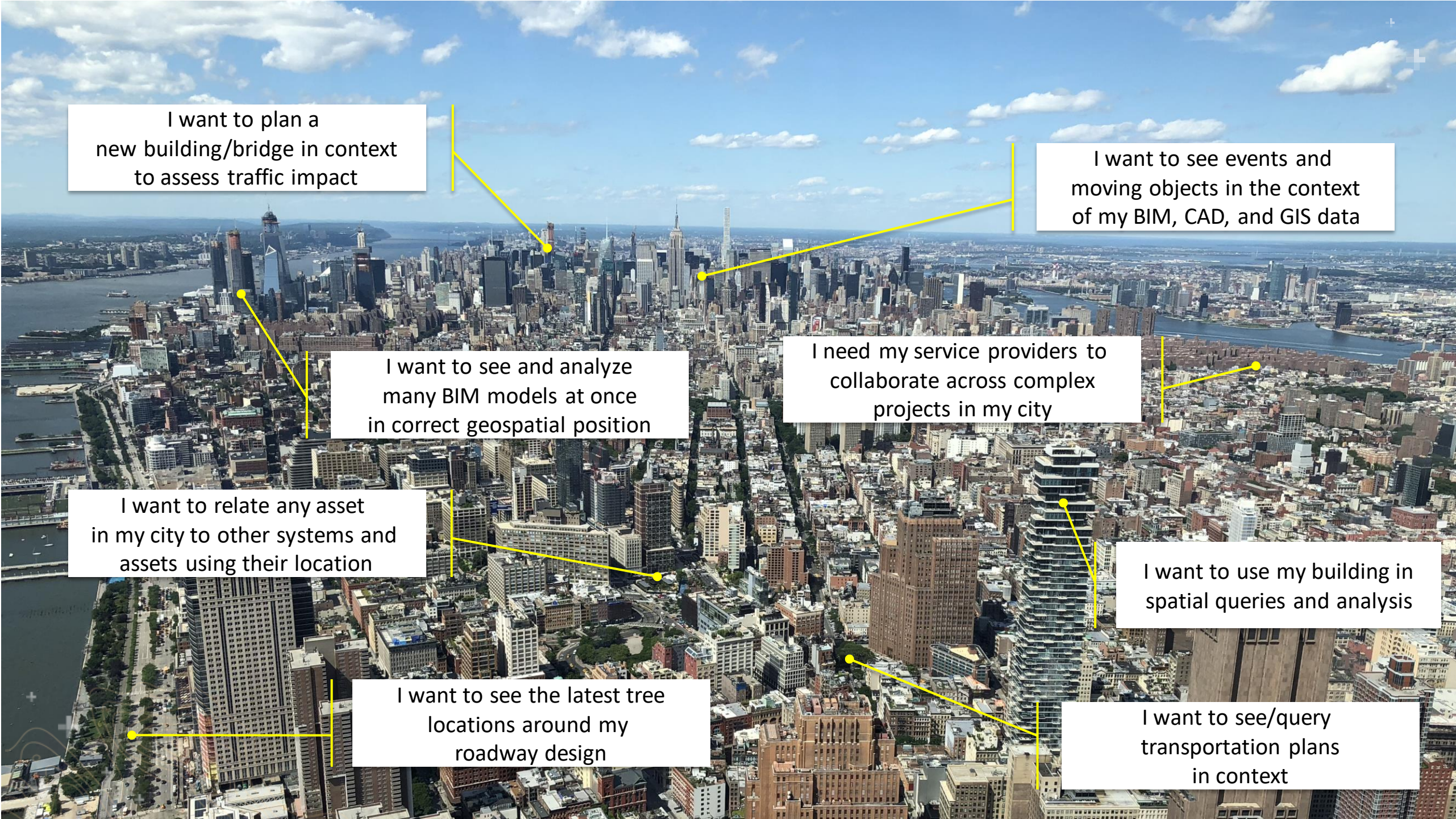
Conceptual Design
InfraWorks

Transportation and Utilities Engineering
AutoCAD Civil 3D

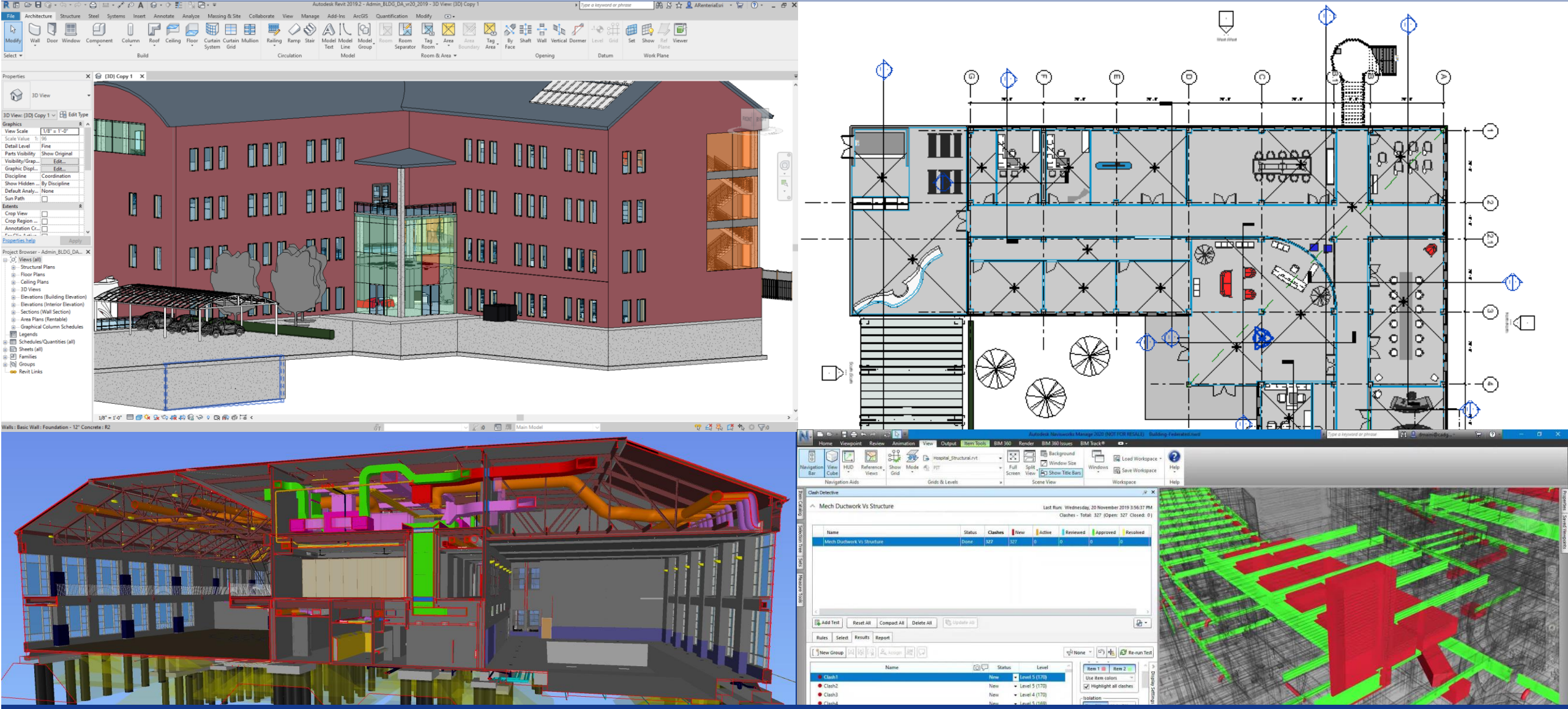
Construction
AutoCAD
BIM360 Integration
ArcGIS Collector

Models
Costs
Materials
Schedules

BIM & CAD
(…an Information-oriented Design & Construction Process)


I want to plan a new building/bridge in context to assess traffic impact
I want to see events and moving objects in the context of my BIM, CAD, and GIS data
I want to see and analyze many BIM models at once in correct geospatial position
I need my service providers to collaborate across complex projects in my city
I want to relate any asset in my city to other systems and assets using their location
I want to use my building in spatial queries and analysis
I want to see the latest tree locations around my roadway design
I want to see/query transportation plans in context

#1 priority request from customers and partners…
GIS + CAD/BIM
Interoperability

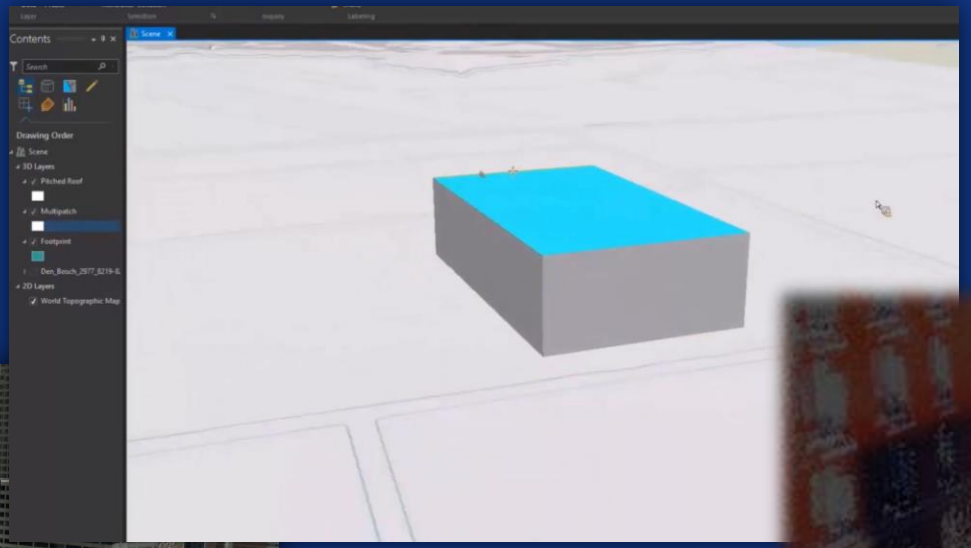


BIM is the process for collaboratively creating and using detailed information about built assets throughout their lifecycle

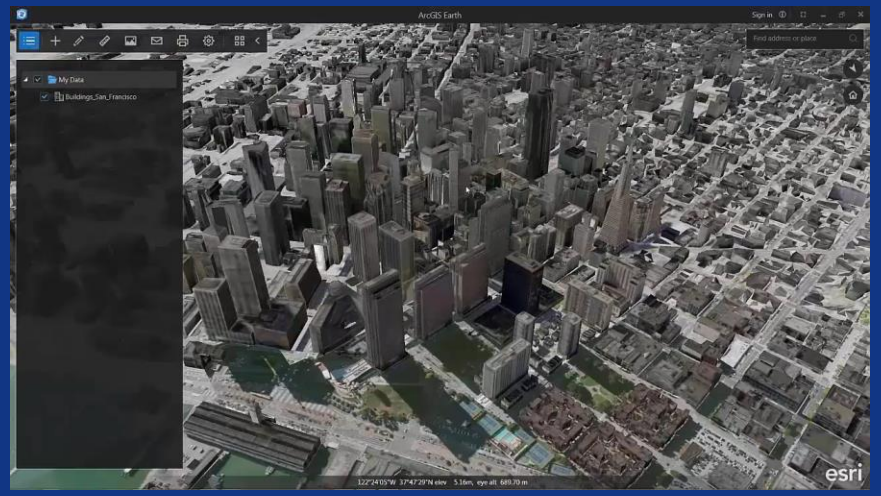
BIM supplies detailed information about assets

GIS provides information about assets in the context of the built and natural environment

GIS is 3D!

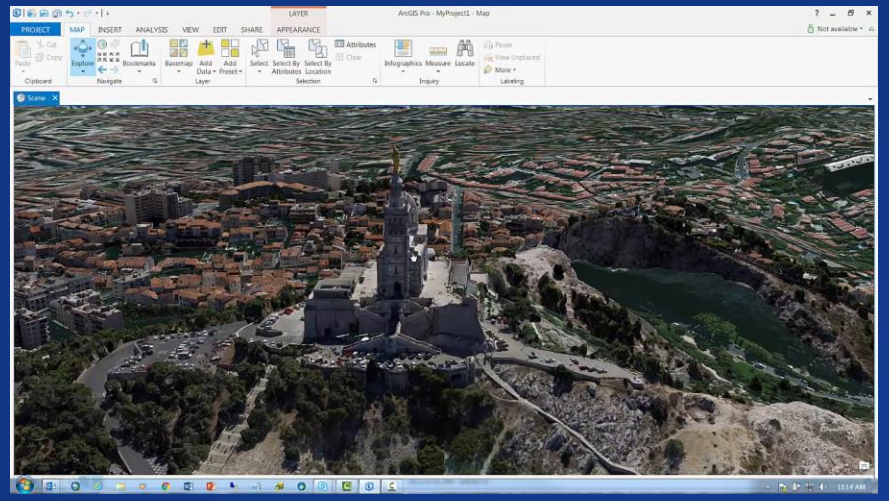

Contents
Drawing Order
Scene
3D Layers
Pitched Roof
Multipatch
Footprint
2D Layers
World Topographic Map

Terrestrial Lidar
esri

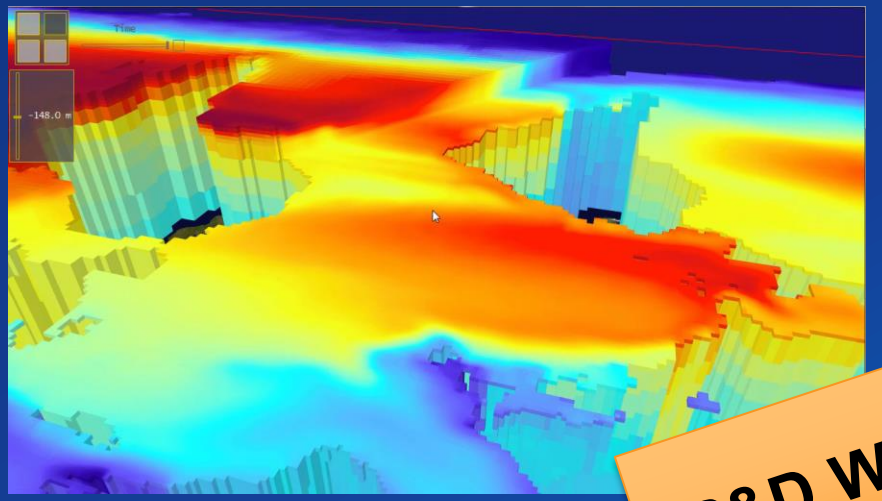


3D Objects

Point Cloud



Mesh



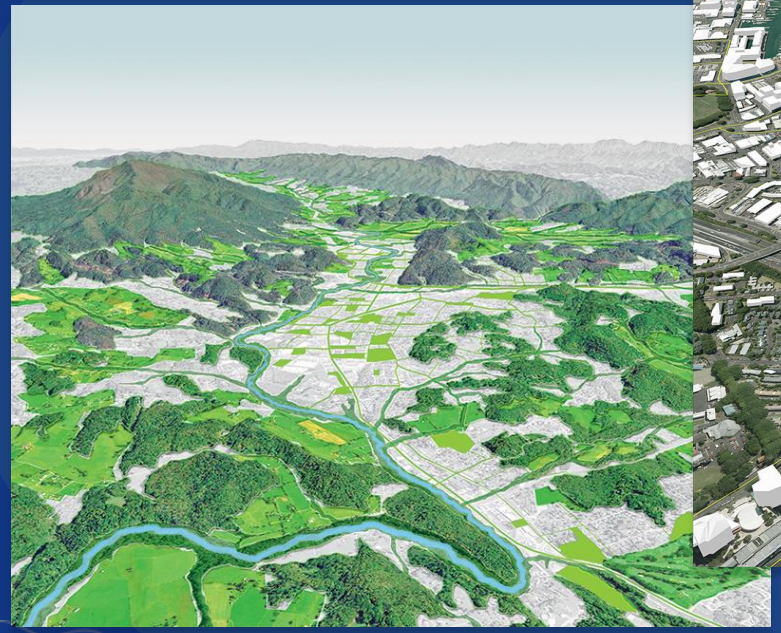
Voxel

R&D WORK IN PROGRESS

BIM & CAD Need Context to Ensure Better Outcomes Into O&M

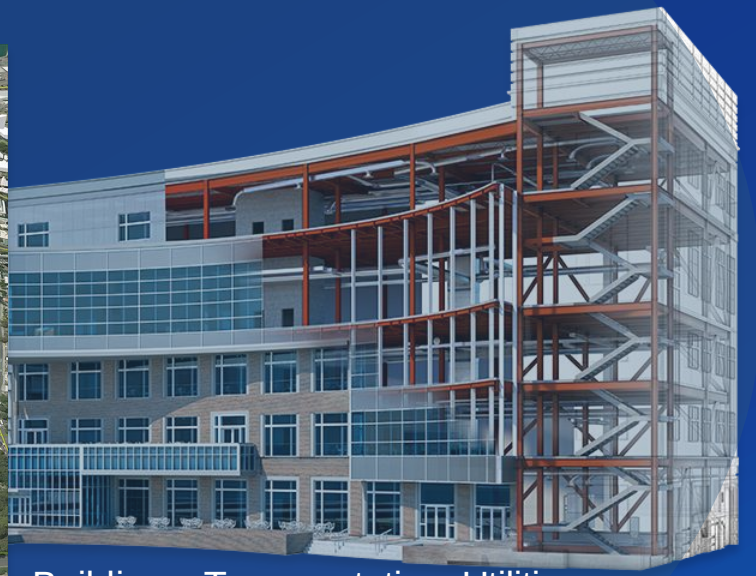
Context

Content



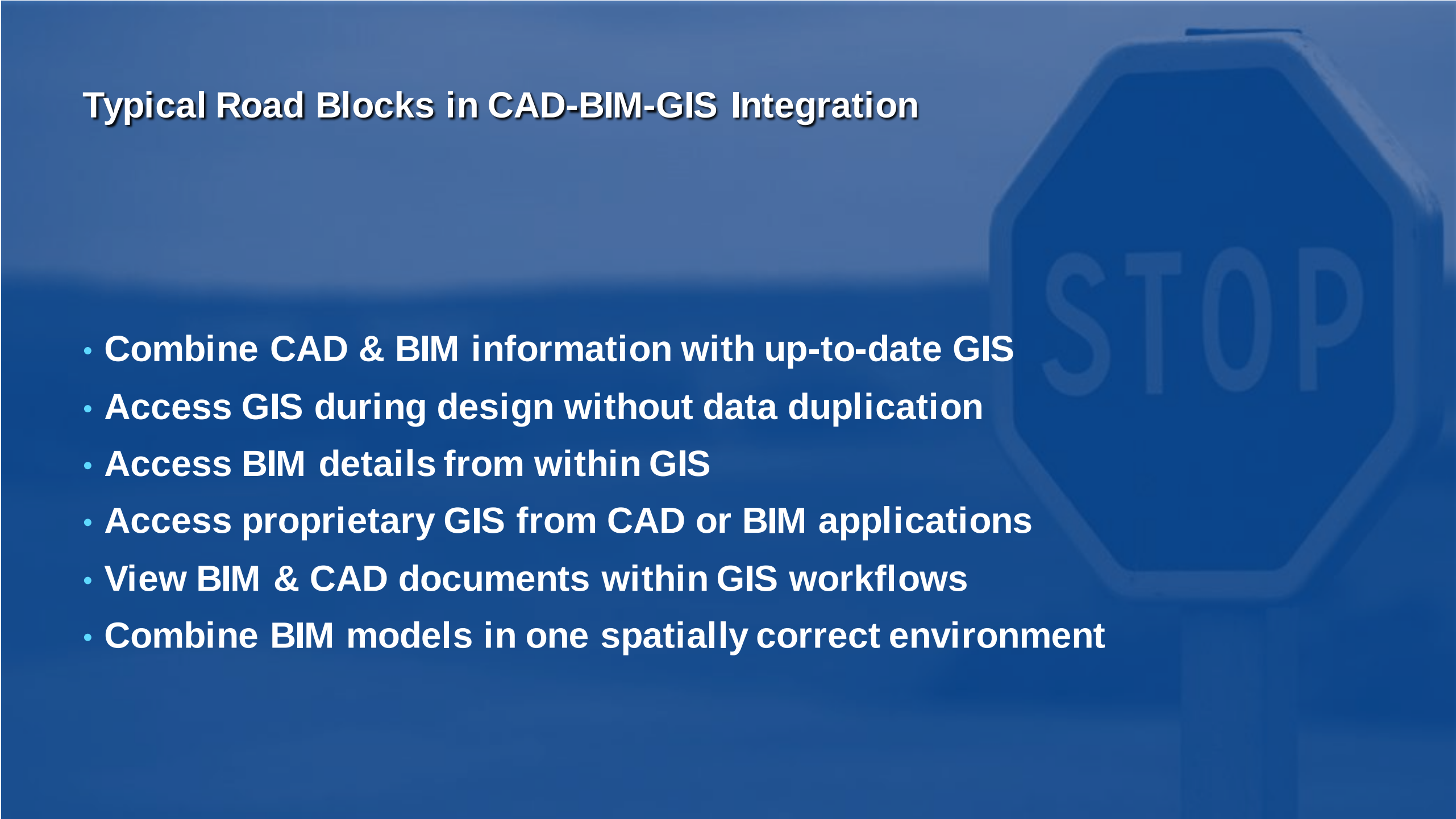
Landscape

City



Buildings, Transportation, Utilities

Typical Road Blocks in CAD-BIM-GIS Integration



- Combine CAD & BIM information with up-to-date GIS
- Access GIS during design without data duplication
- Access BIM details from within GIS
- Access proprietary GIS from CAD or BIM applications
- View BIM & CAD documents within GIS workflows
- Combine BIM models in one spatially correct environment

Integrations Enabling ArcGIS in Design and Back

Which design format do you need to integrate with GIS?

2D CAD

Design BIM

Concept BIM

Trades BIM

Record BIM

"As-Maintained" BIM

Scan to BIM

3D CAD w/ Attributes

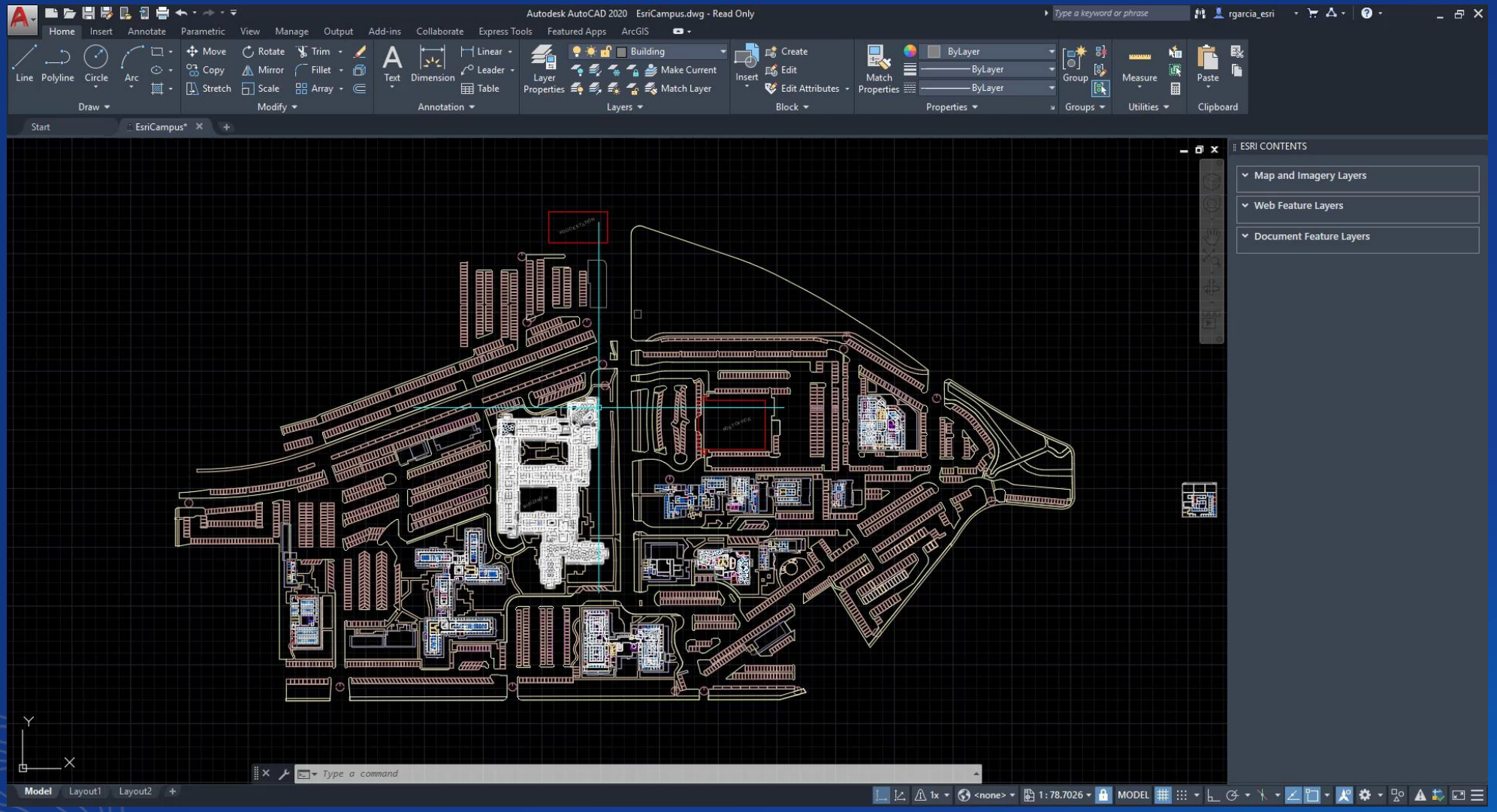
CONSTRUCTION BIM

Transportation BIM

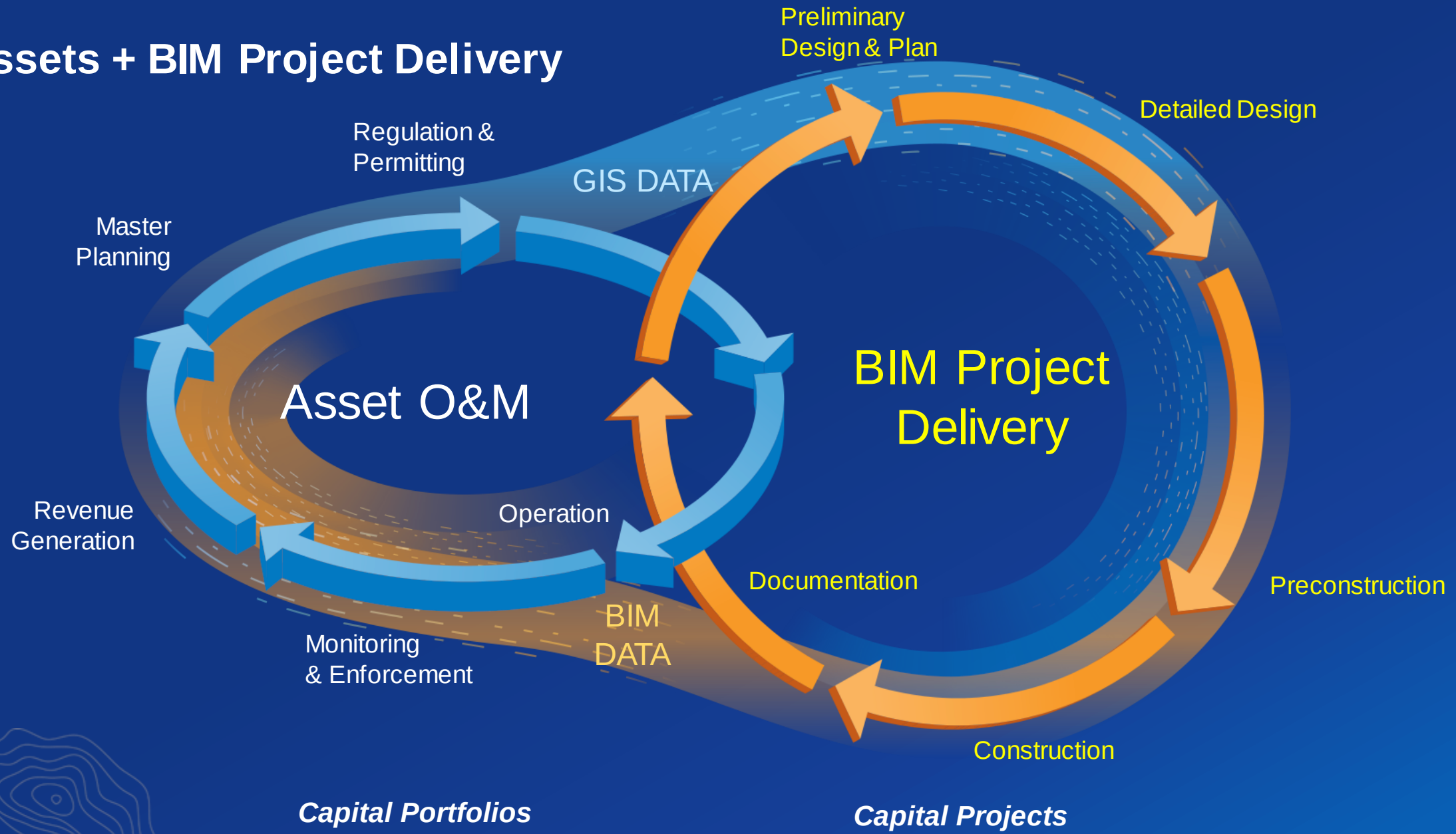
As-Built BIM

ArcGIS for AutoCAD

https://earlyadopter.esri.com/key/ArcGISforAutoCAD



Assets + BIM Project Delivery



Partnering to Bring Together BIM & GIS

Make Anything with The Science of Where

State of Integrations Today

AUTODESK. Make anything.

AUTODESK CIVIL3D

AUTODESK INFRAWORKS

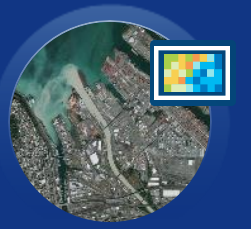
AUTODESK REVIT

ArcGIS Pro

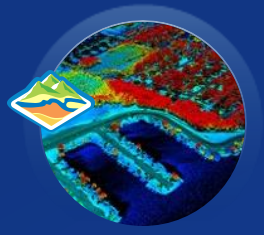
esri THE SCIENCE OF WHERE

ArcGIS Online

ArcGIS Enterprise



Imagery

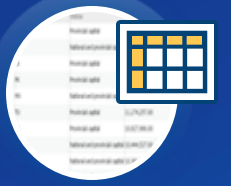


Lidar

CAD

3D

Vector



Tabular

Real-Time (IoT)

Unstructured

Additional data types TBD

AUTODESK AUTOCAD

AUTODESK BIM 360

In Development

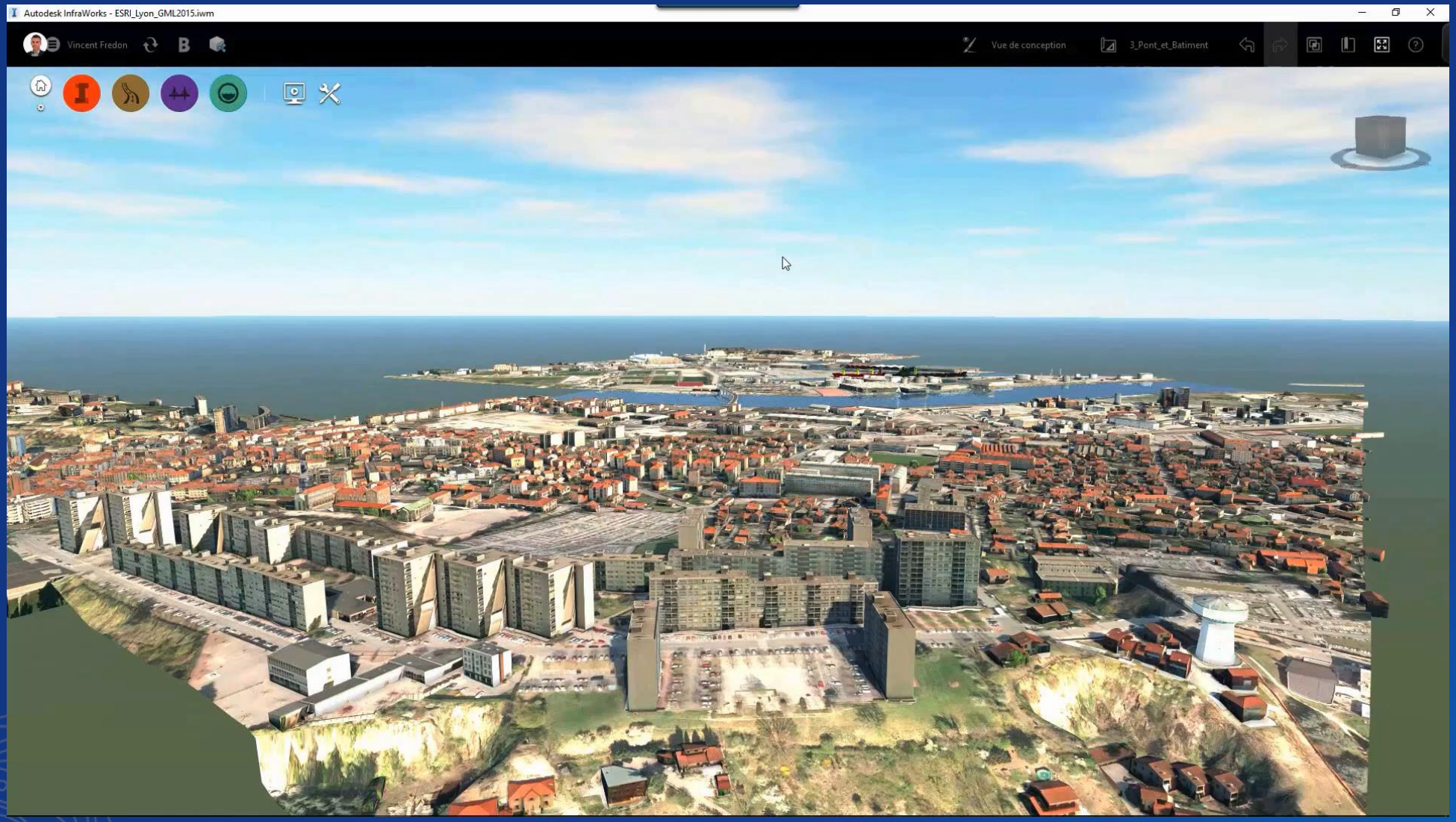
In Development

ArcGIS Online

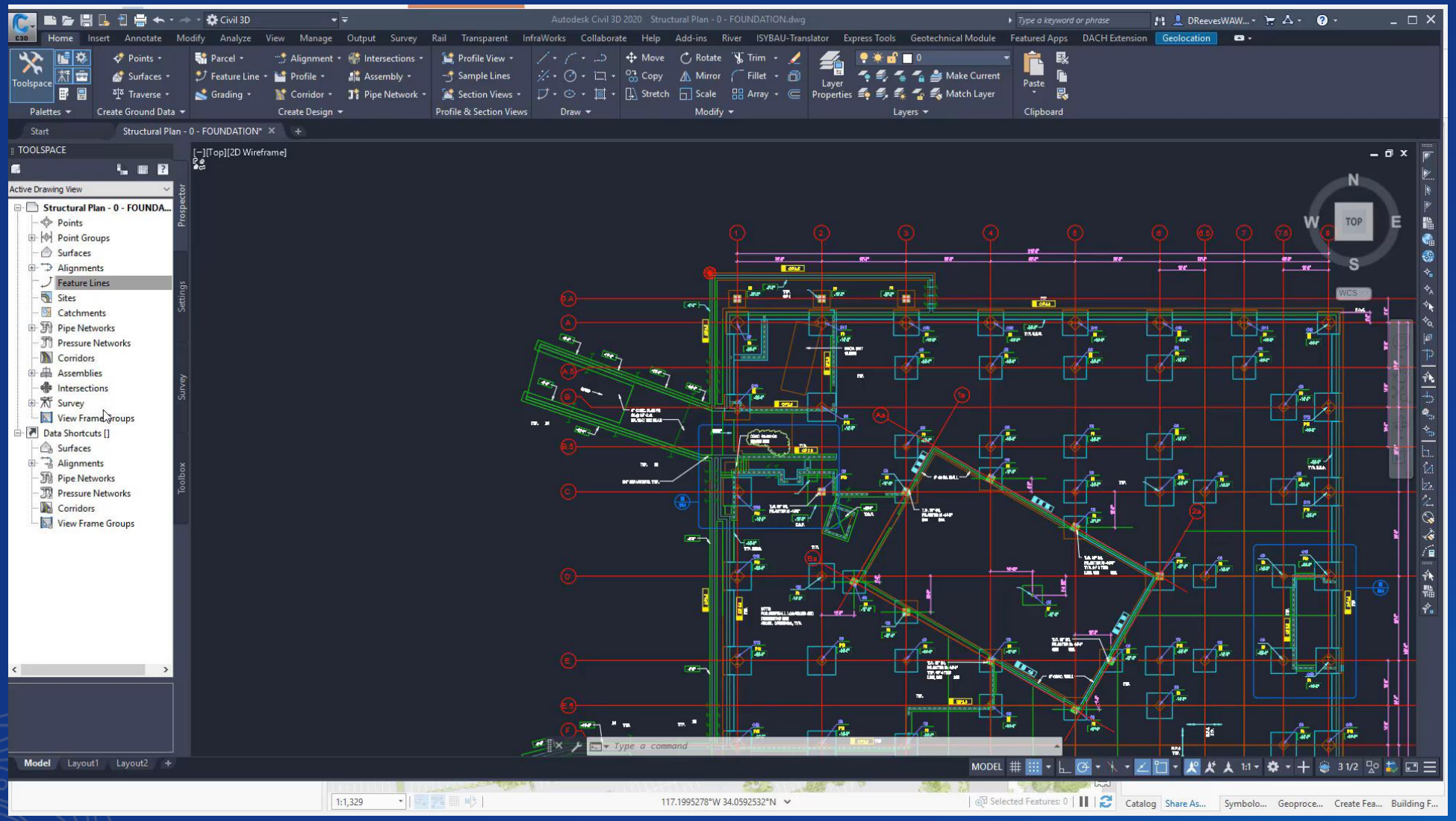
ArcGIS Enterprise

Coming Soon

Autodesk Connector for ArcGIS in InfraWorks



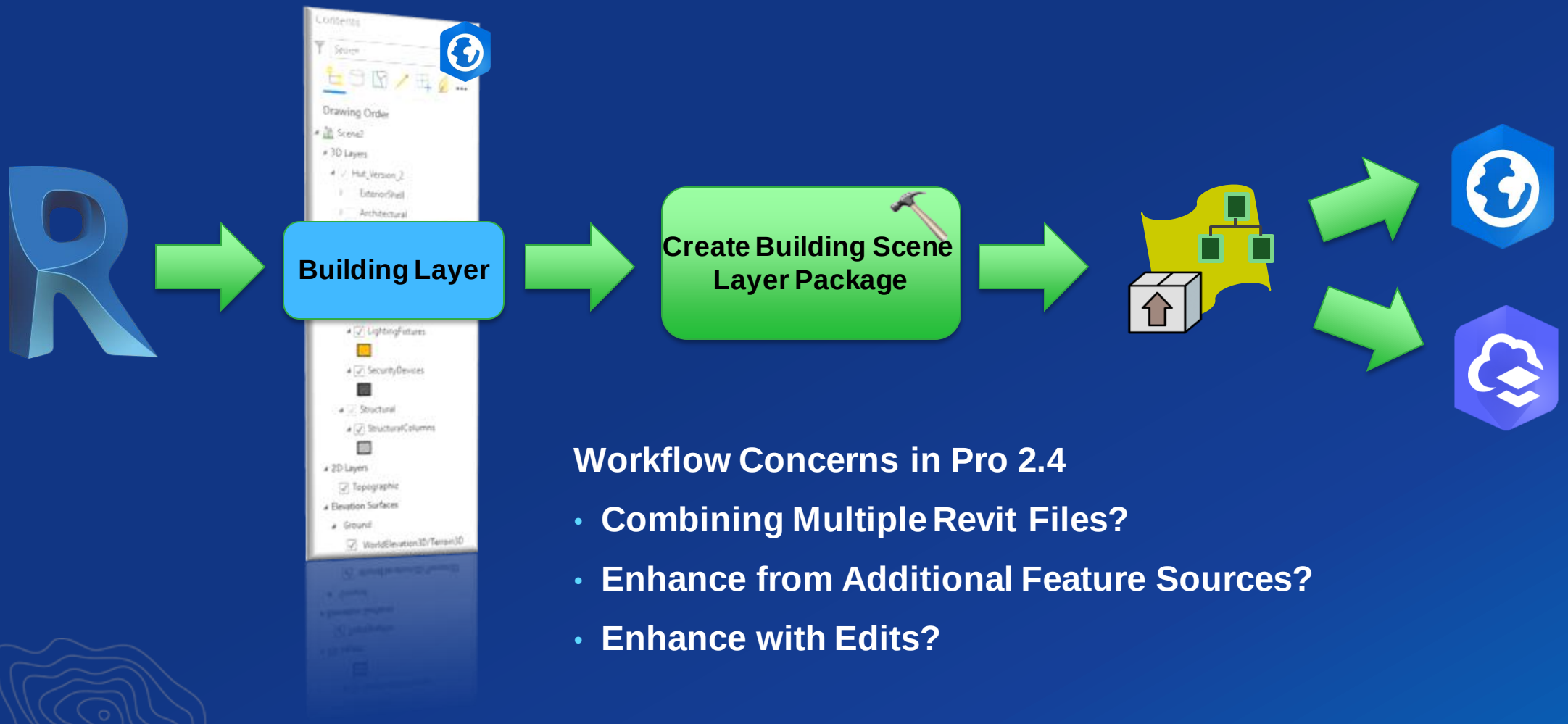
Autodesk Connector for ArcGIS in Civil3D



ArcGIS Pro 2.5 Enhancements with Design Data

Enabling Stakeholder Engagement

Building Scene Layer

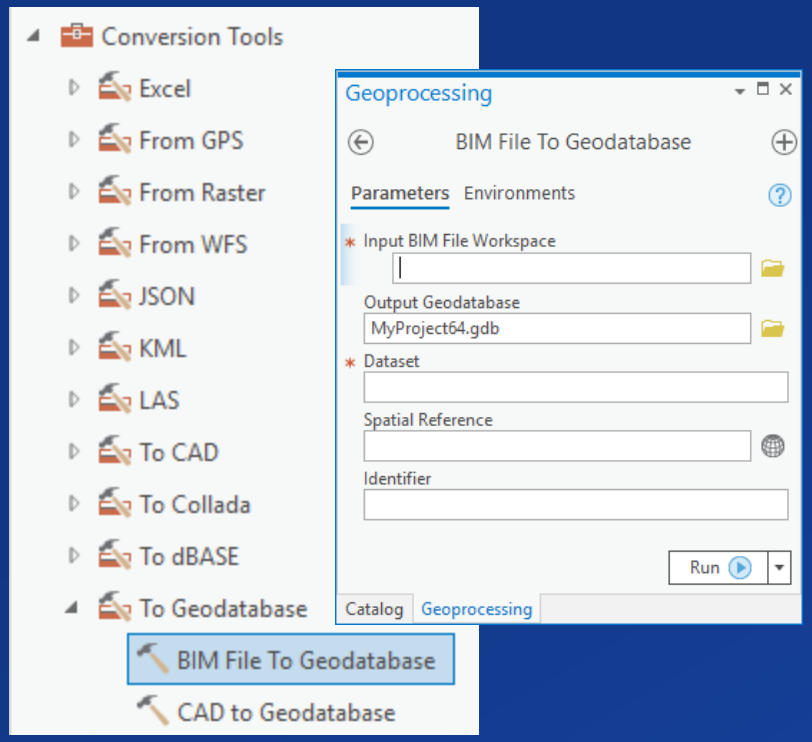


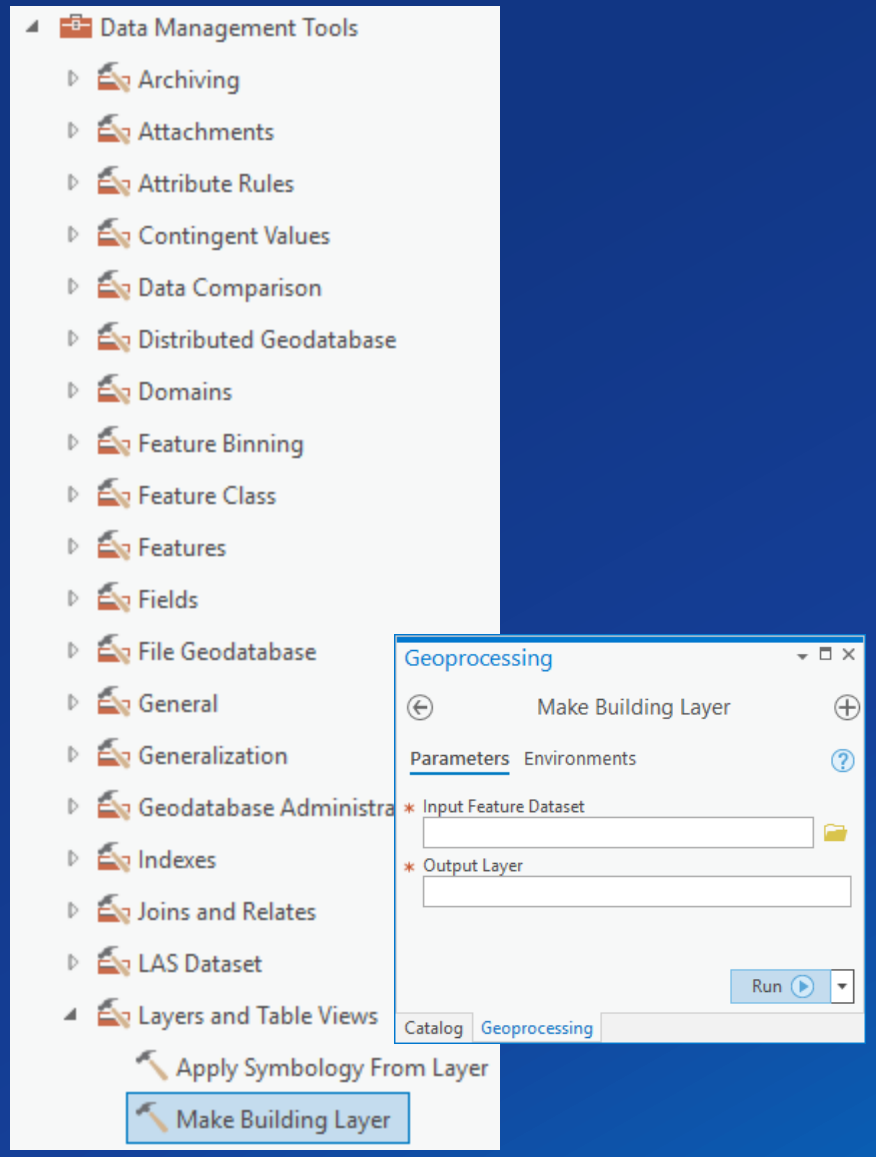
Workflow Concerns in Pro 2.4

- Combining Multiple Revit Files?
- Enhance from Additional Feature Sources?
- Enhance with Edits?

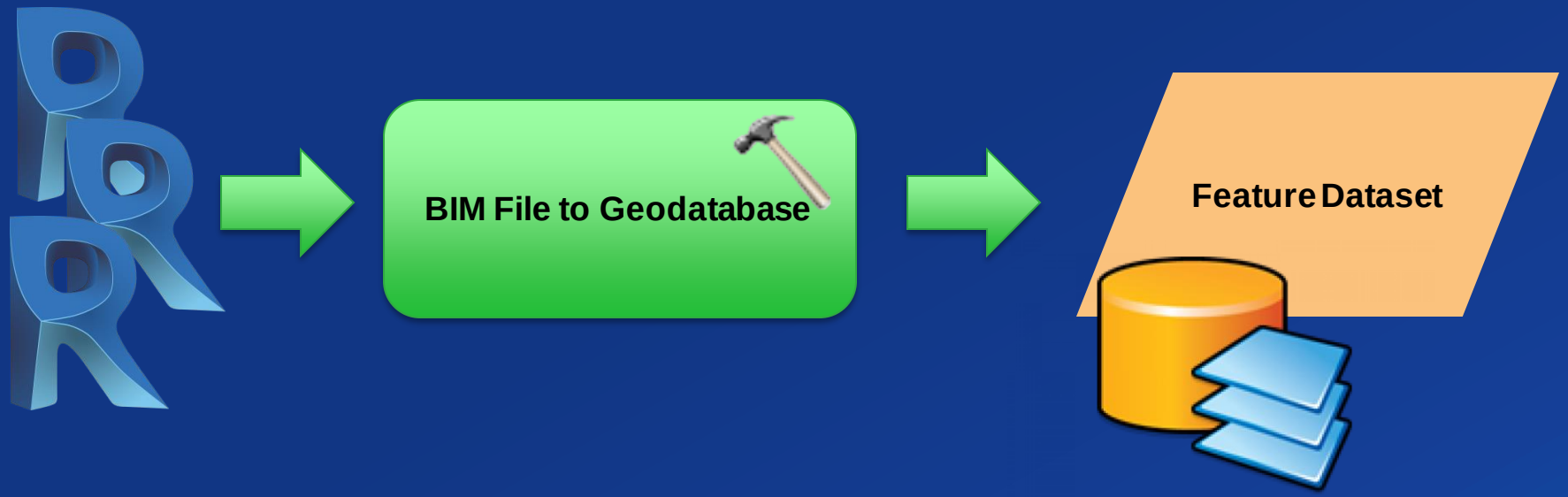
New in ArcGIS Pro 2.5

- **BIM File to Geodatabase**
- **Make Building Layer**

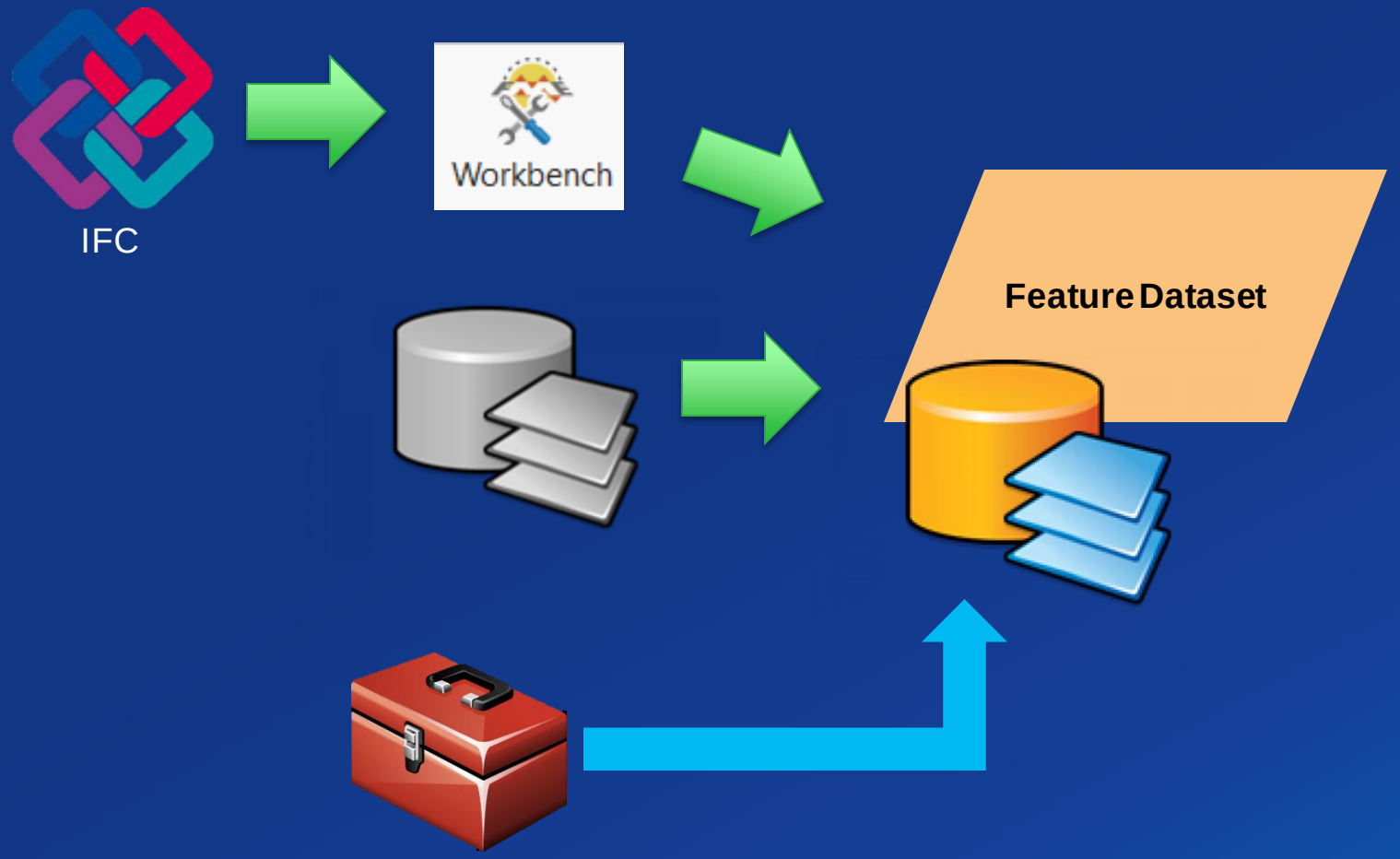




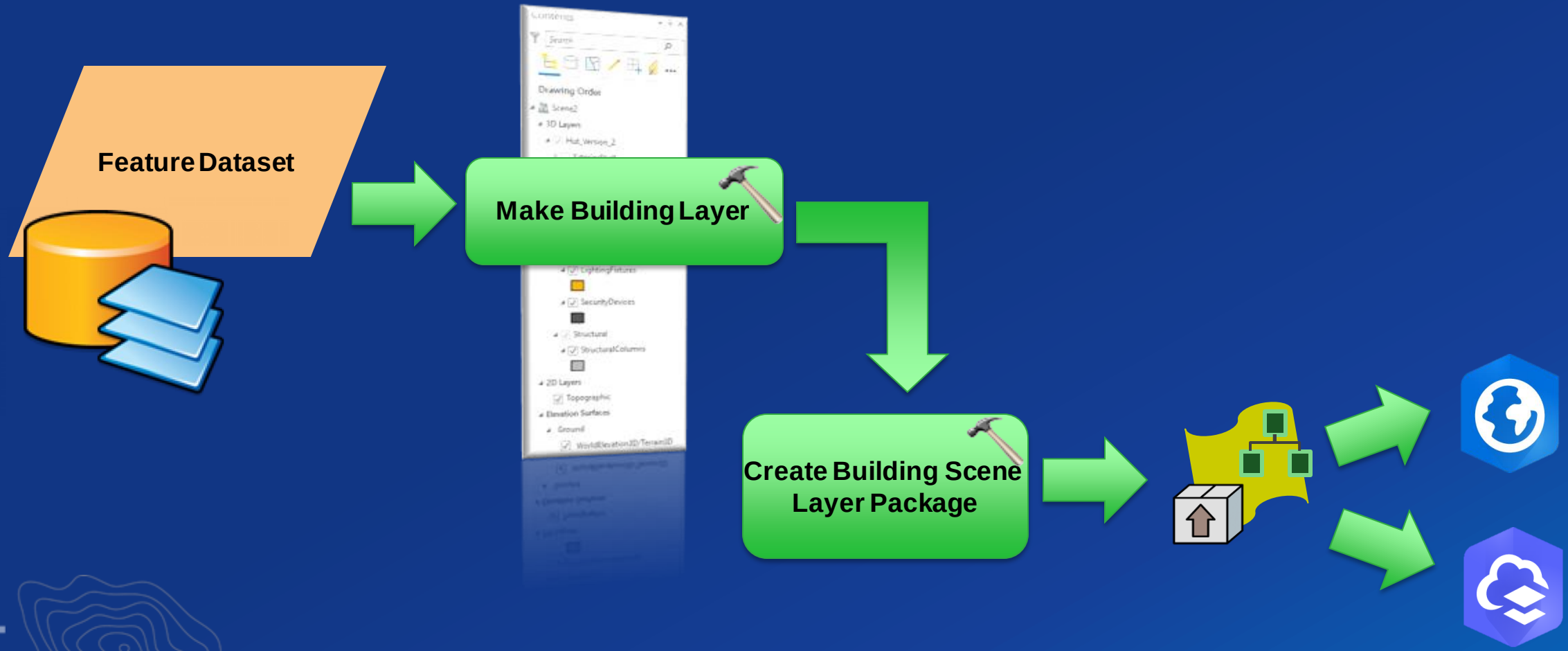
BIM File to Geodatabase



Enhance Dataset



Make Building Layer

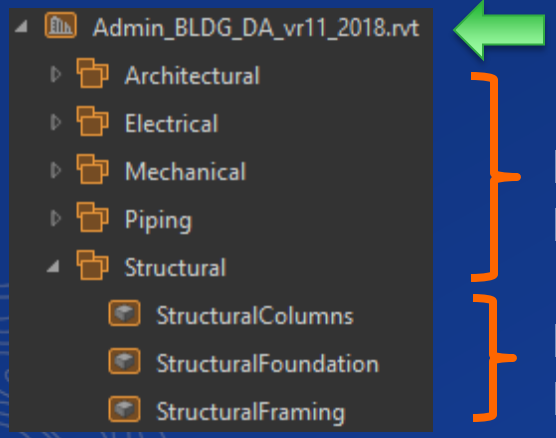


BIM File to GDB tool (Pro 2.5)

Key Reminders

- **Output GDB**
- **Assumption: BIM file is in the correct location (Georeference, coordinate system)**
- **Generates**
  - **a single Dataset with all the feature class inside it (flat structure)**
  - **can then be used to create Building Layer**

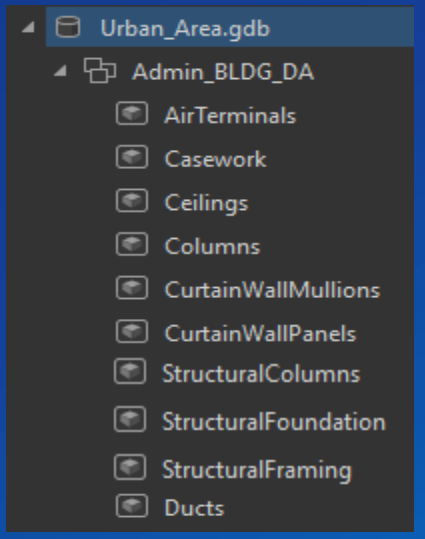
Input BIM File Workspace Structure → Output GDB Structure



BIM File Workspace

Disciplines\ BIM File Dataset

Feature Classes \ BIM File Multipatch Feature Class

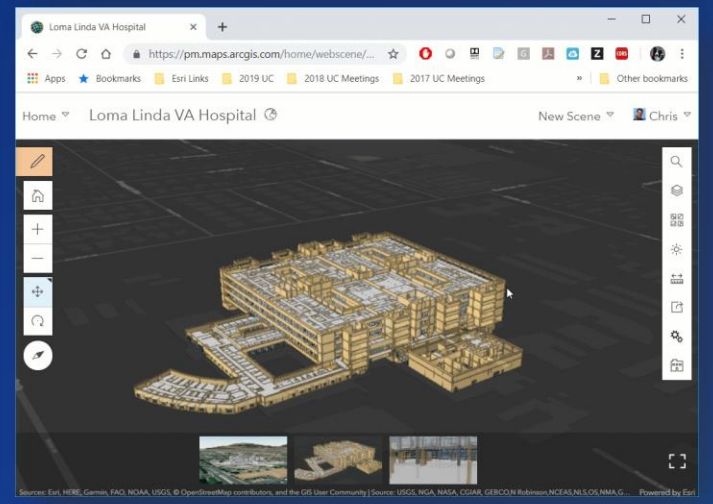


Web Services Driving Planning, Design & Construction

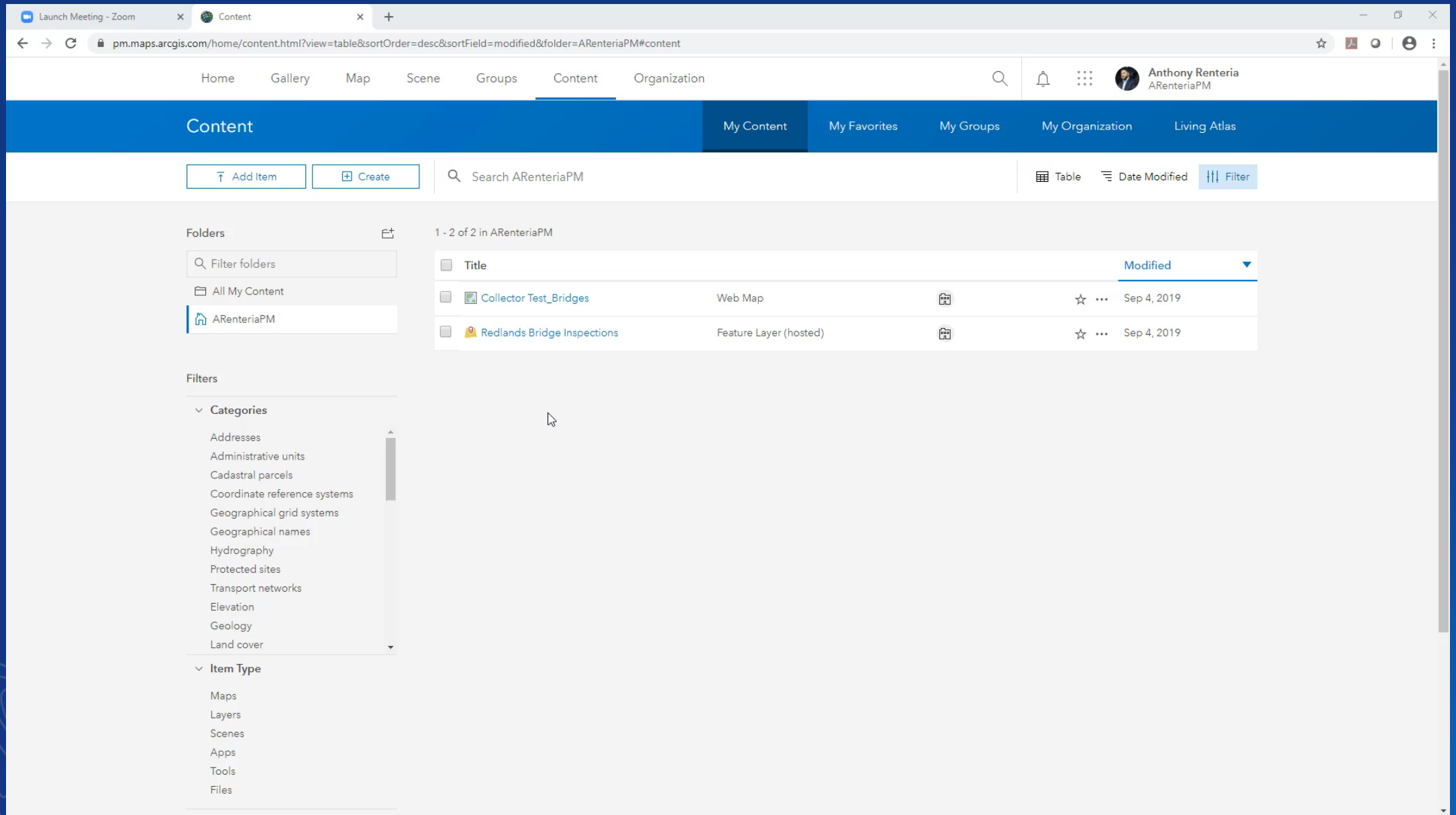
I3S layer for Buildings

- Buildings Scene Layer
  - Sourced from Revit content with model categories & attributes
  - Load Revit in ArcGIS Pro -> publish as SLPK -> upload to Online or Enterprise
  - Also publish as scene layer directly or as part of a web scene (cached locally)
  - Visual filtering, preset filters – levels, categories

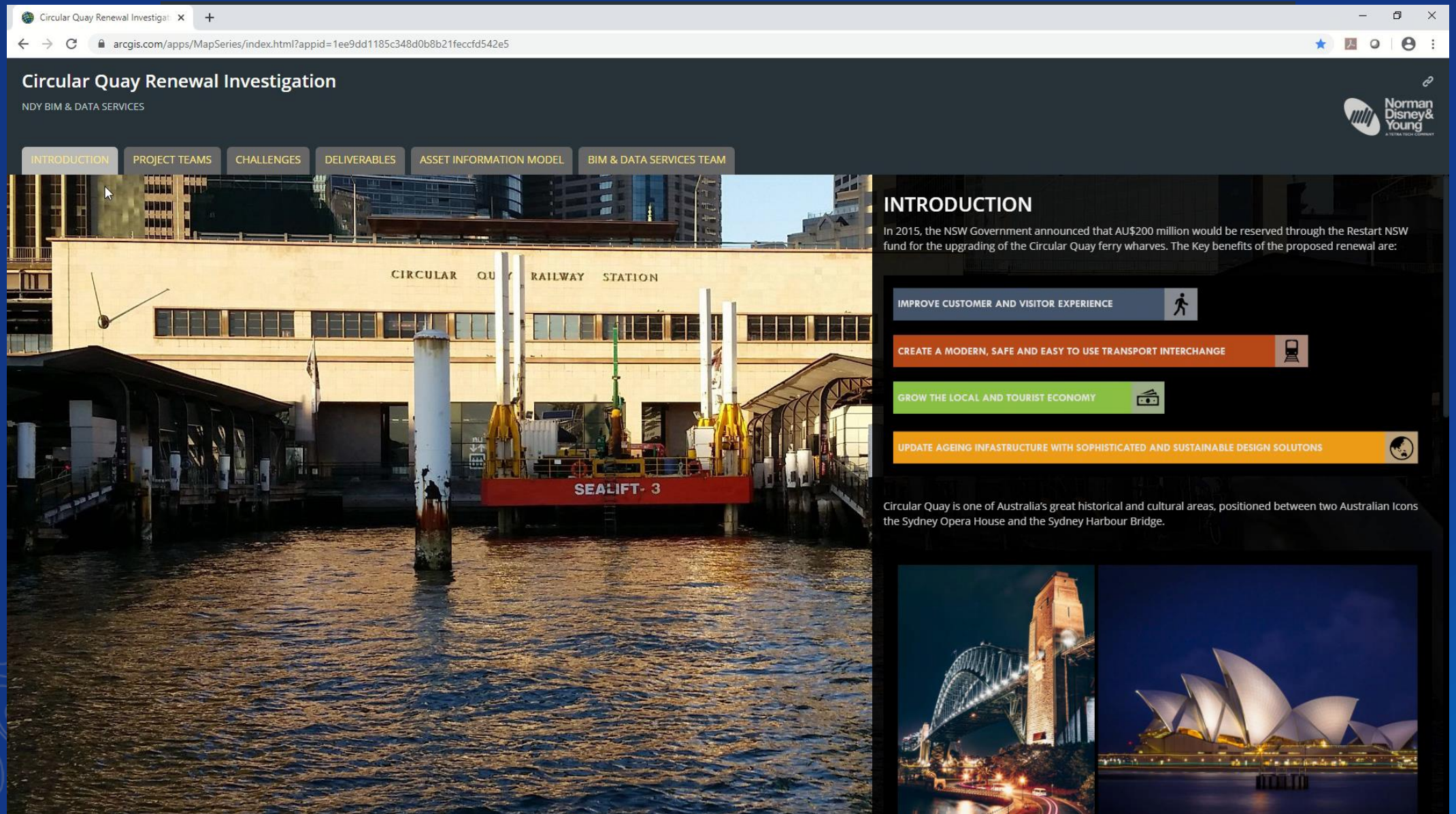
- Current Version Limits:
  - Not updatable from source directly
  - No materials/textures



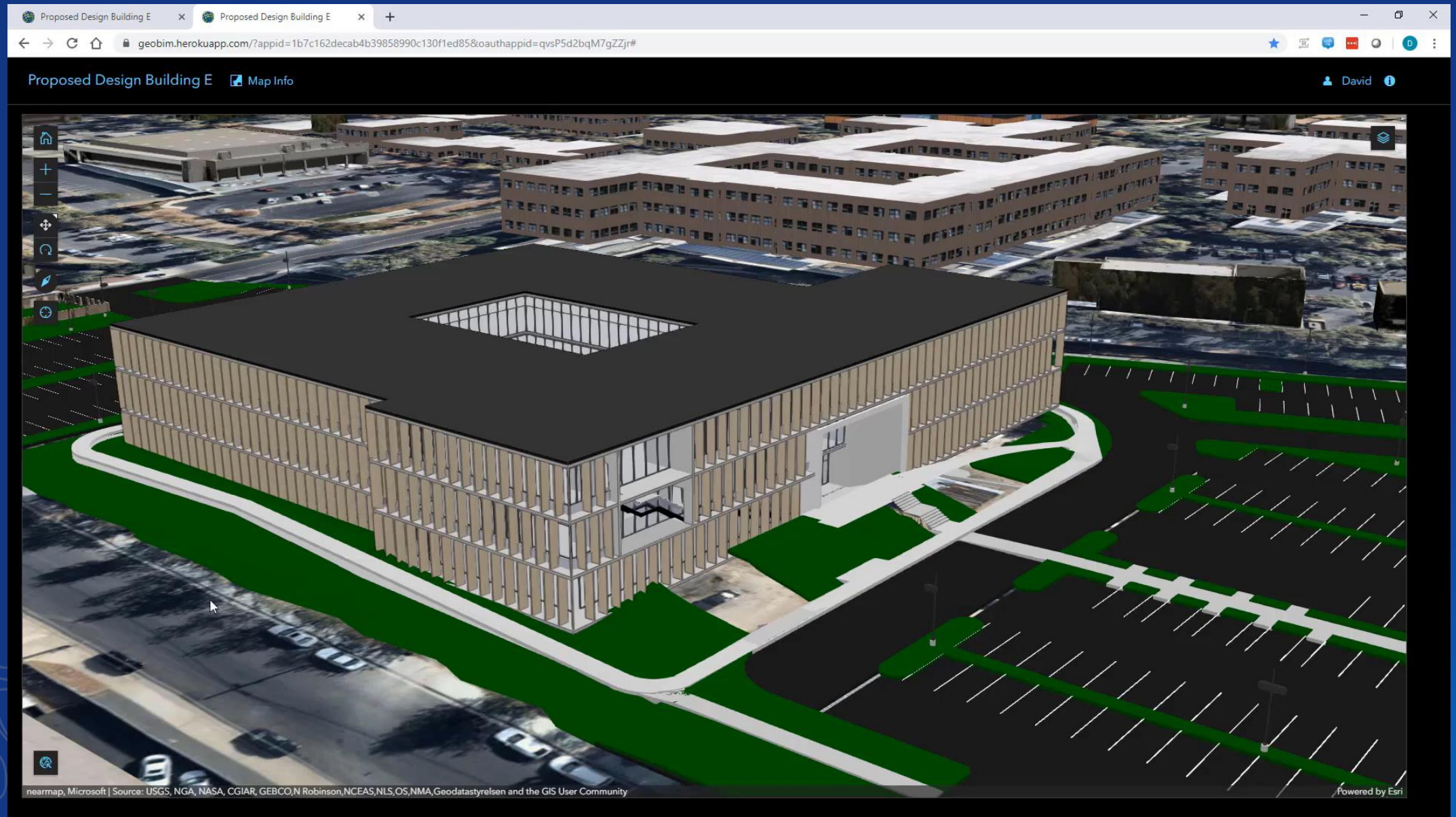
Create Web Scene with Building Scene Layer



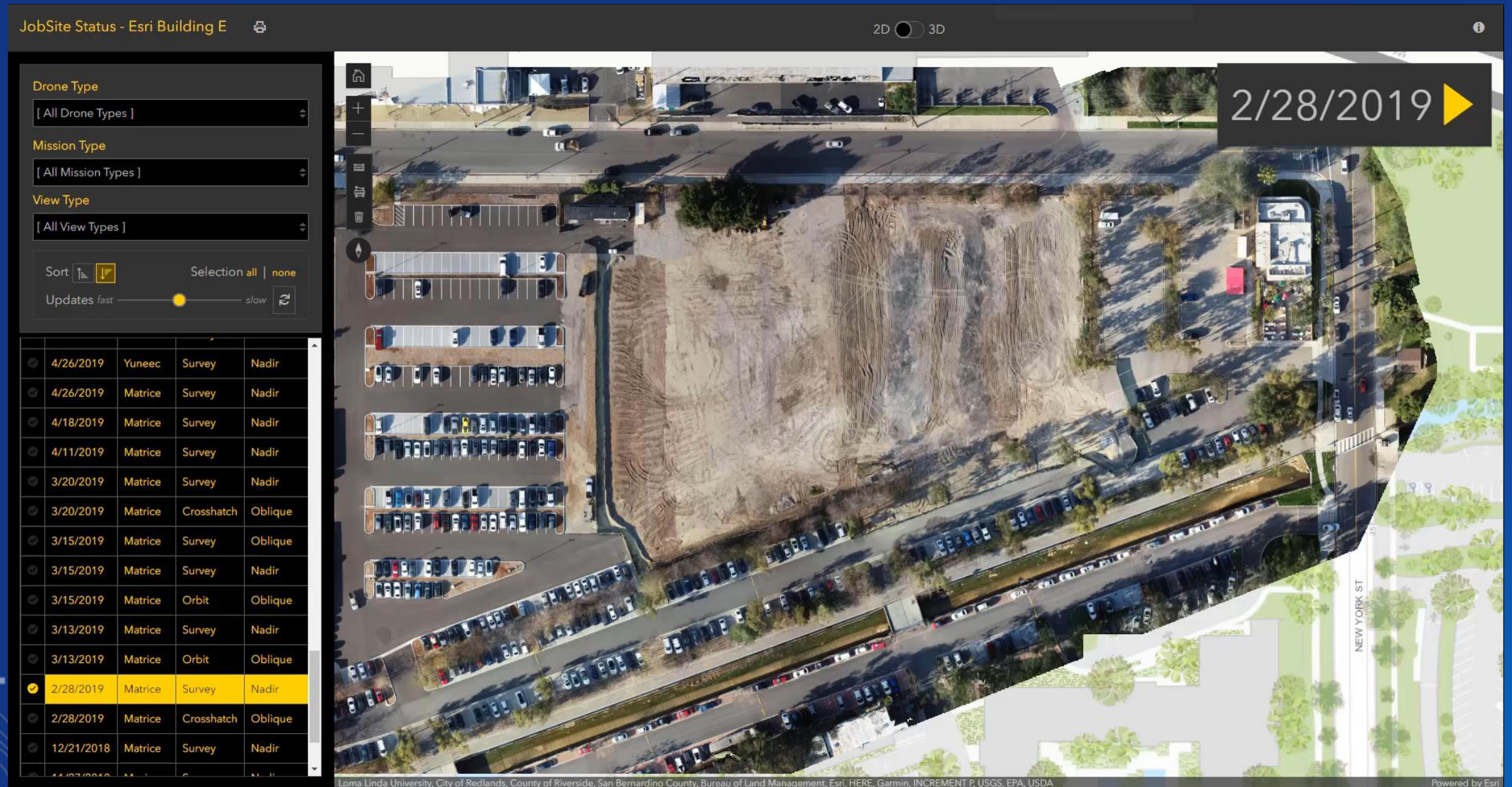
Our users can build incredible 3D web scenes in StoryMaps!



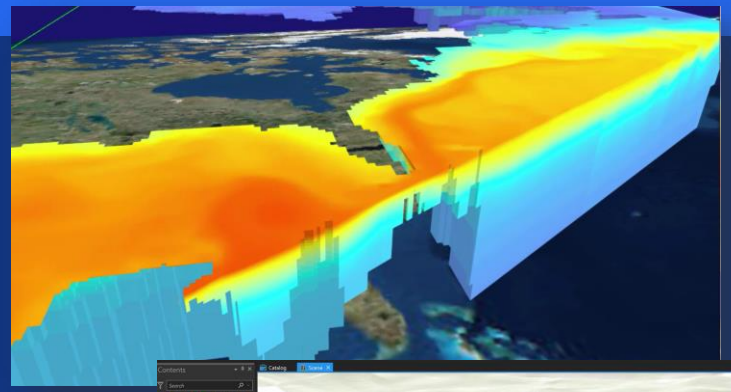
Project Keystone Prototype – Web to Web Integration

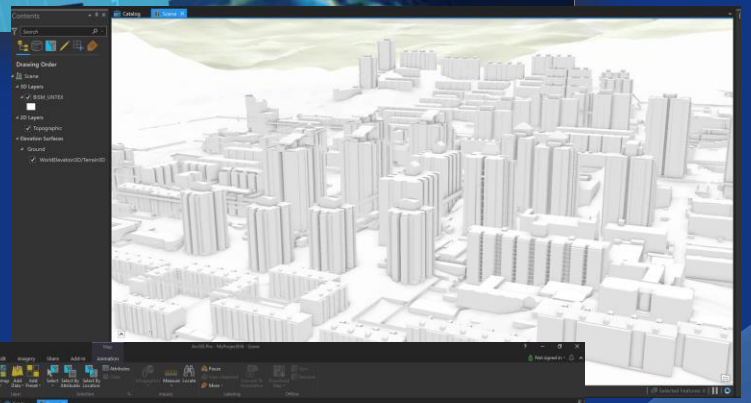


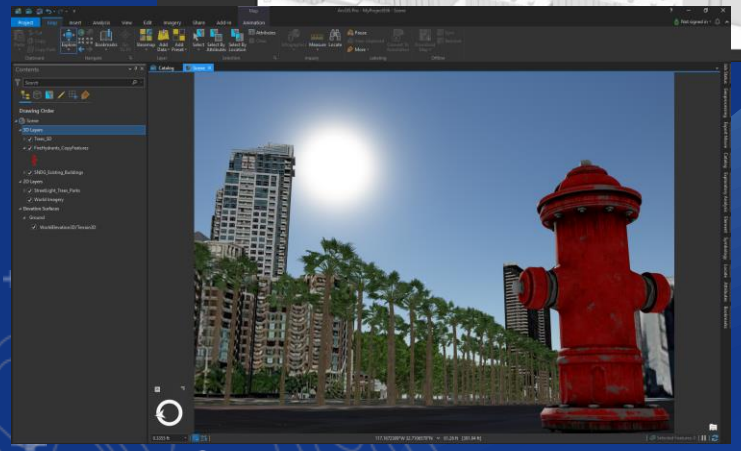
Web Enabled Construction Status Monitor



What's coming next for CAD/BIM/AEC at Esri







Recently New

- Building scene layer
- 3D Slice, Merge, & Explode
- 3D Empirical Bayesian Kriging
- Mobile Scene Packages
- Point clouds in Runtime
- Water effects
- Cut & Fill tools (Pro)
- Profile Viewing (Pro)

New at FedGIS 2020

- Earth mobile
- ArcGIS for ACAD 400
- New 3D Editing Options
- Multi BIM File to GeoDatabase (Pro)
- Building Scene Layer Performance Updates
- Autodesk Connectors for ArcGIS in InfraWorks & Civil3D

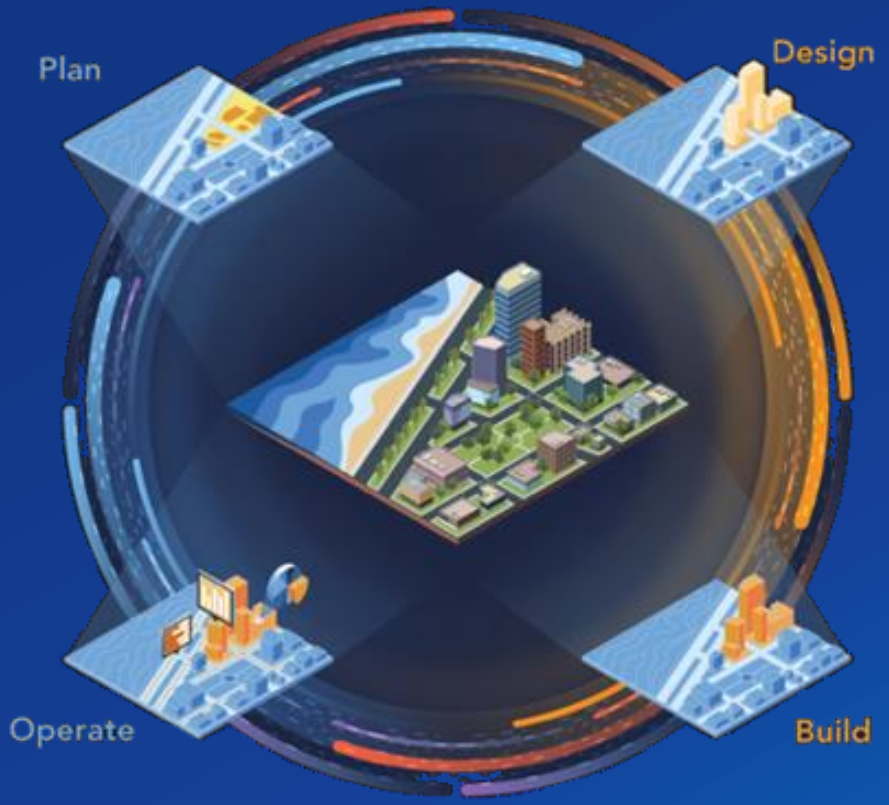
Mid term+

- Civil 3D DWG import (Pro)
- BIM 360 Catalog view
- Color & Texture Support from Revit
- Voxel desktop UX
- Voxel web experience
- IFC Import (Future)
- Indoor navigation in 3D scenes
- 'Blue dot' IPS location

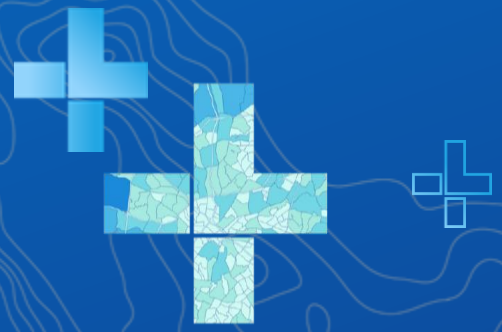
Forward looking plans, dates, and scope subject to change without notice.

Value of GIS + BIM / CAD Integration

- **Solve problems & make evidence based decisions faster!**
  - **Break down internal/external silos**
  - **Digitally optimize existing workflows**
  - **Move data to center of process and out of systems**
  - **Move through the design \ build process faster**
  - **Expose new engagement opportunities that drive your business**

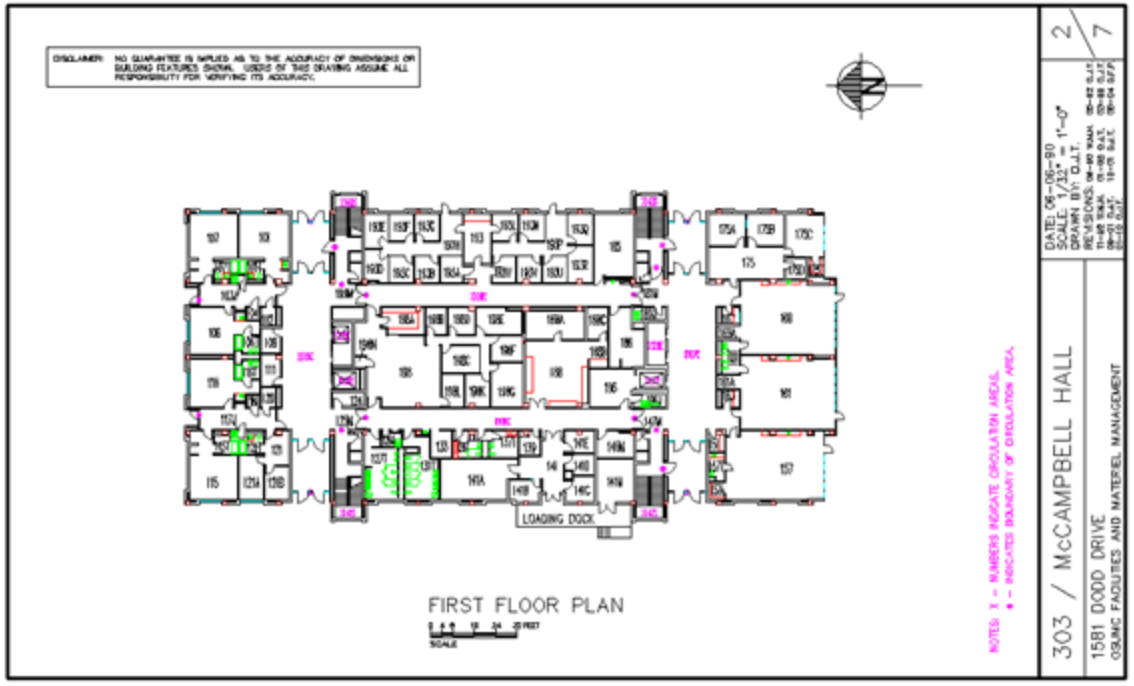


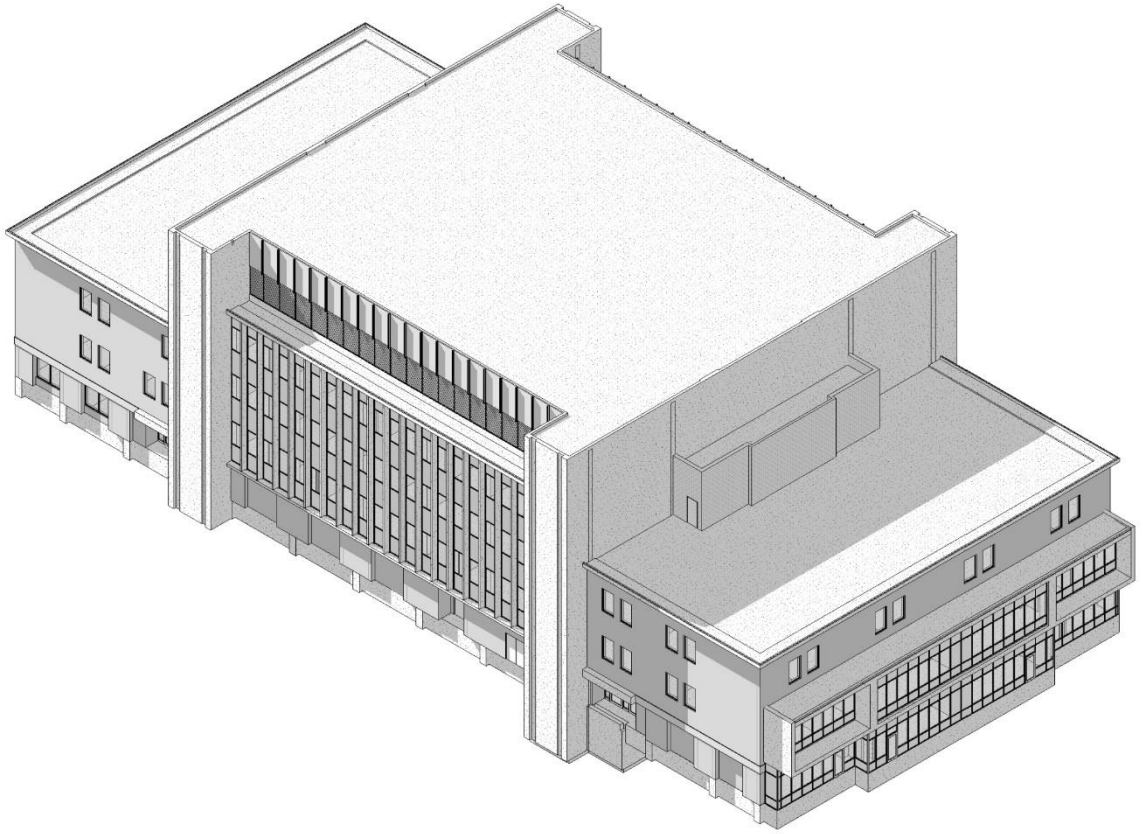
Life Cycle Use Into Campus Management



THE OHIO STATE UNIVERSITY

CAD to BIM

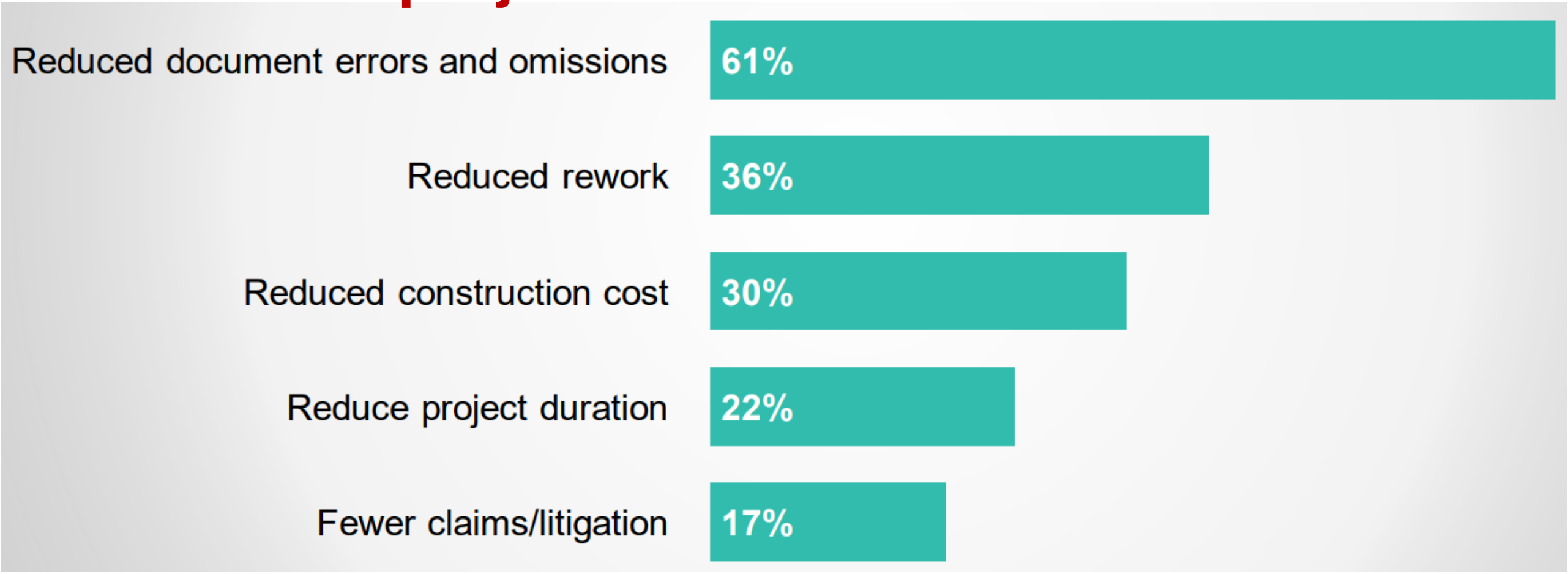

DISCLAIMER: NO GUARANTEE IS IMPLIED AS TO THE ACCURACY OF DIMENSIONS OR BUILDING FEATURES SHOWN. USERS OF THIS DRAWING ASSUME ALL RESPONSIBILITY FOR VERIFYING ITS ACCURACY.
LOADING DOCK
FIRST FLOOR PLAN
303 / McCAMPBELL HALL
1581 DODD DRIVE
OSUMC FACILITIES AND MATERIEL MANAGEMENT
2
7

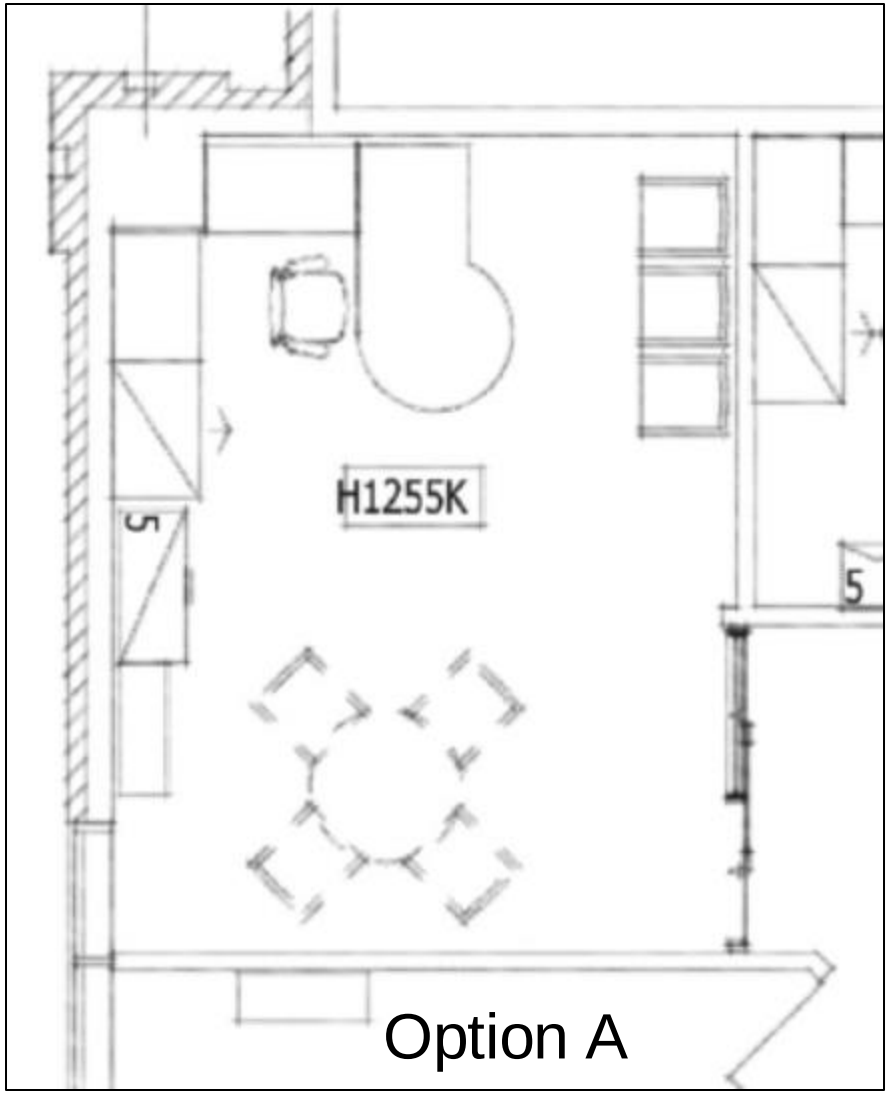


Why BIM for OSU?

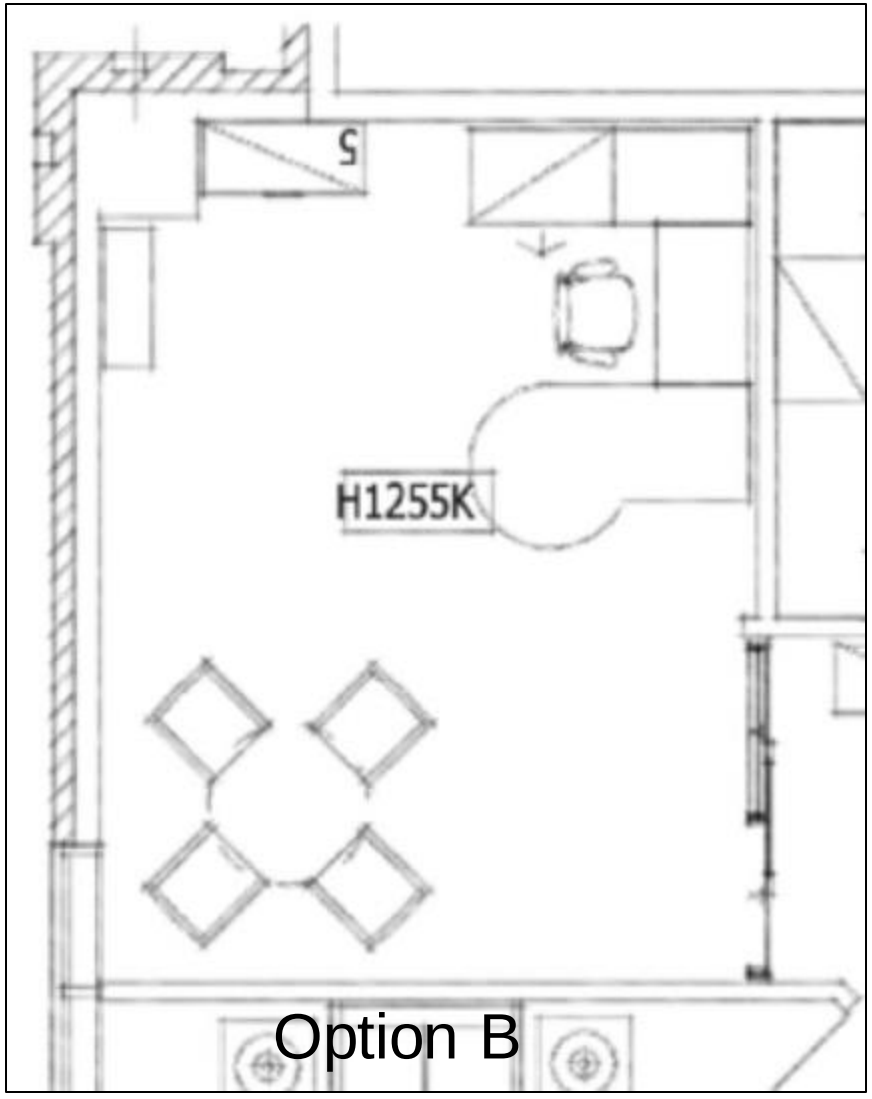
- Improve the quality and speed of decision-making
- Reduce the Total Cost of Operations/Ownership
- Drive more efficient and collaborative project delivery methods
- Leverage structured data to streamline the turnover process and integration of data into new and existing technologies
- Integrate BIM and GIS to exploit GIS capabilities and analytical solutions

Top internal business benefits of using BIM for construction projects for owners

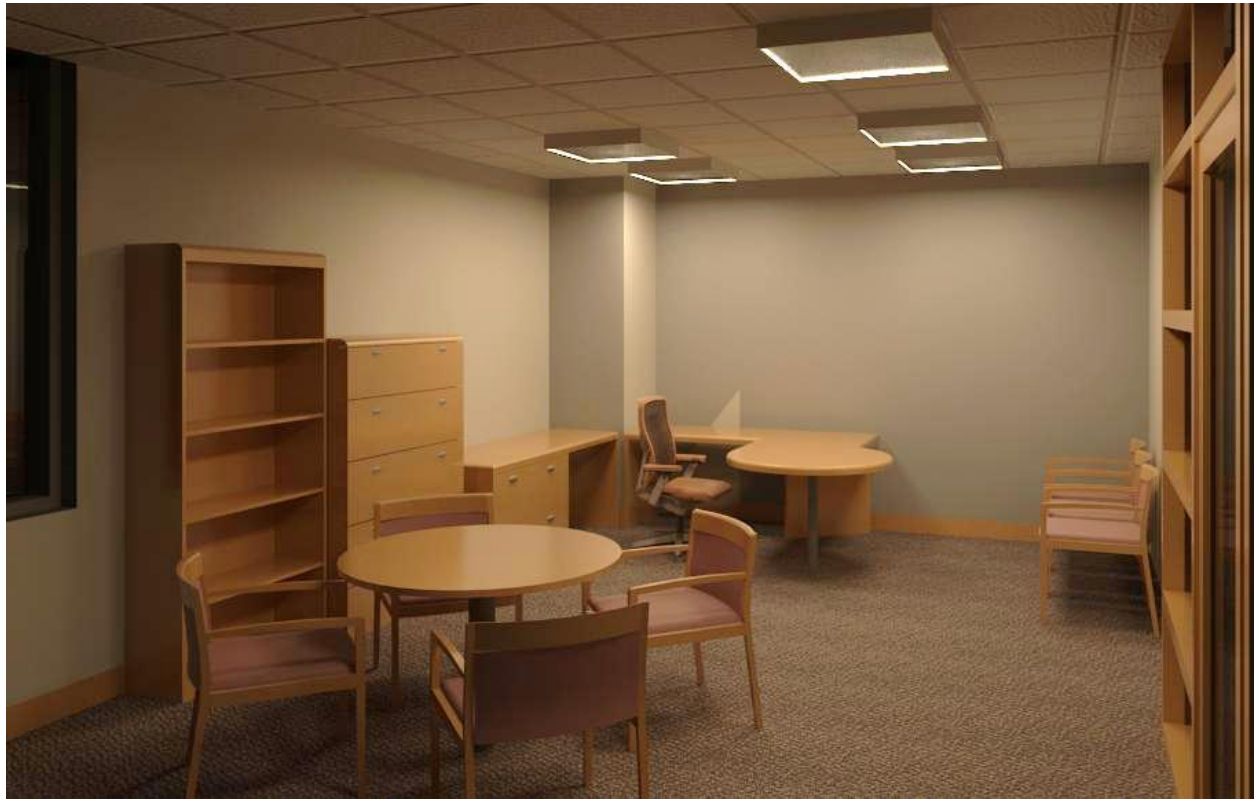




Option A

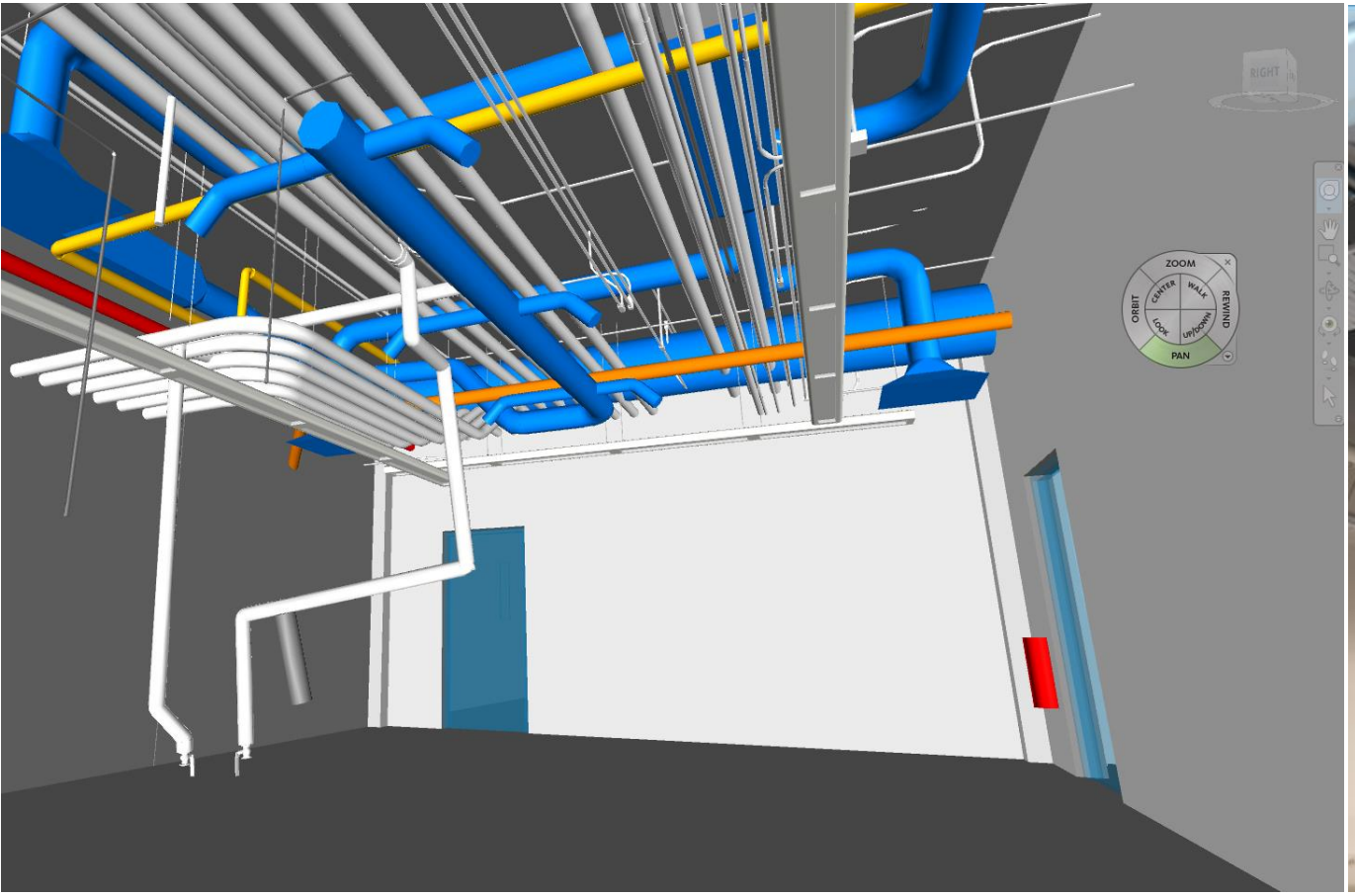


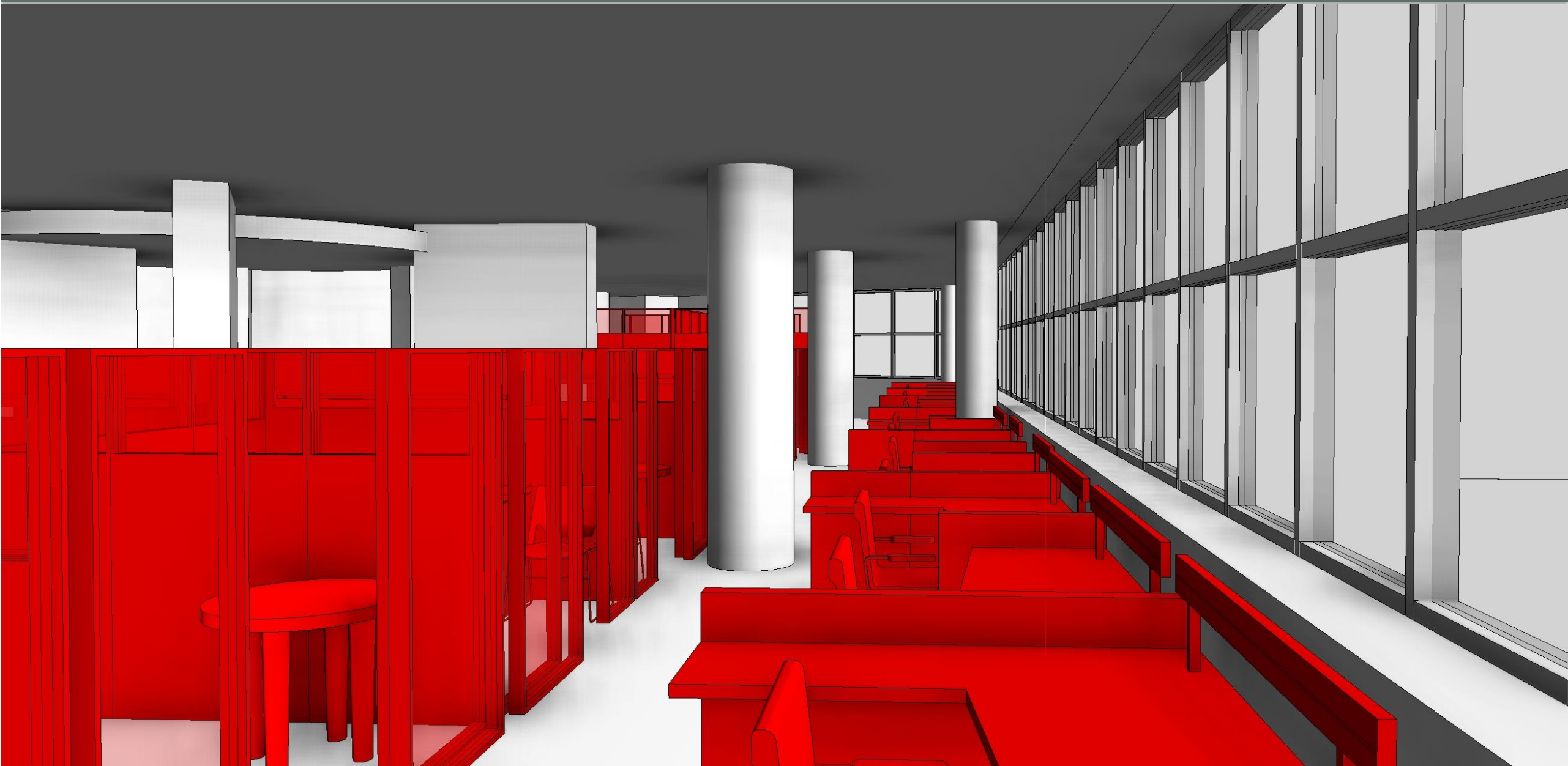
Option B



Option A

Option B


RIGHT
ZOOM
ORBIT
CENTER
WALK
REWIND
LOOK
UP/DOWN
PAN



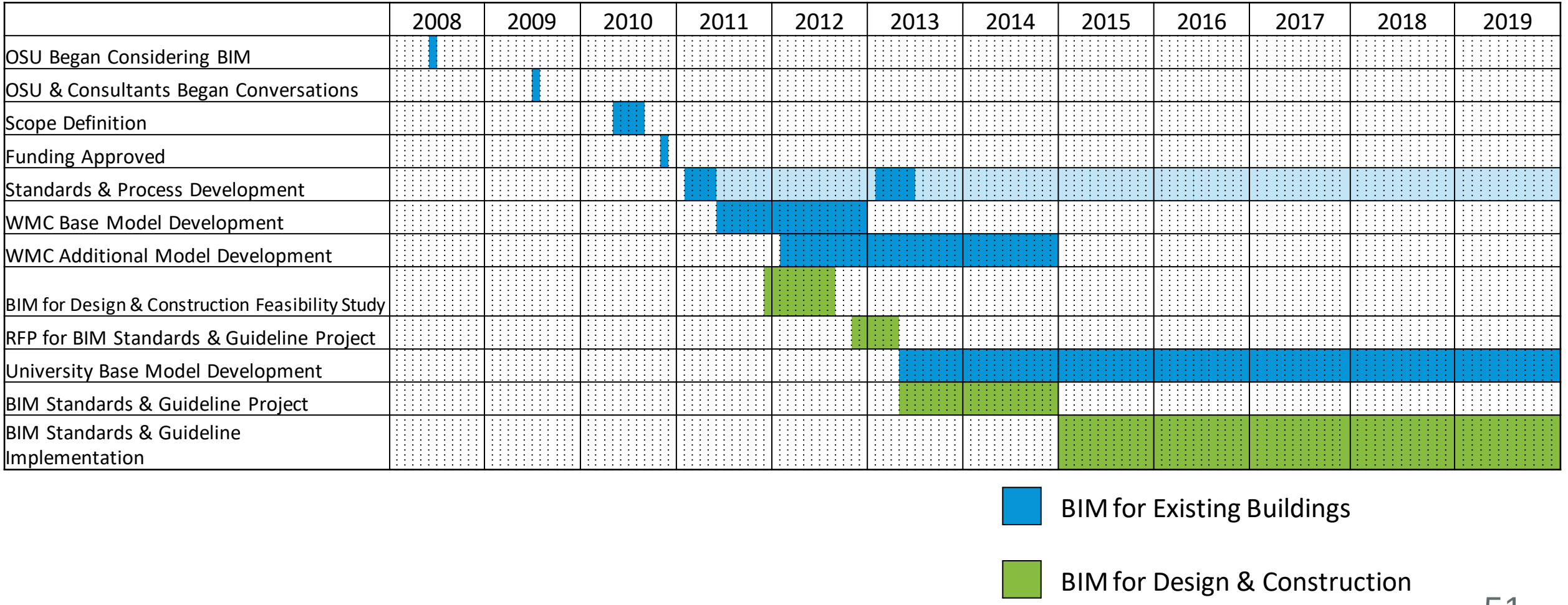
Dorothy M. Davis
Heart and Lung
Research Institute

Dorothy M. Davis
Heart and Lung
Research Institute

Buckeye BIM Initiative

- BIM for Existing Buildings
- BIM for Design & Construction
- BIM for Operations

Buckeye BIM Initiative Timeline

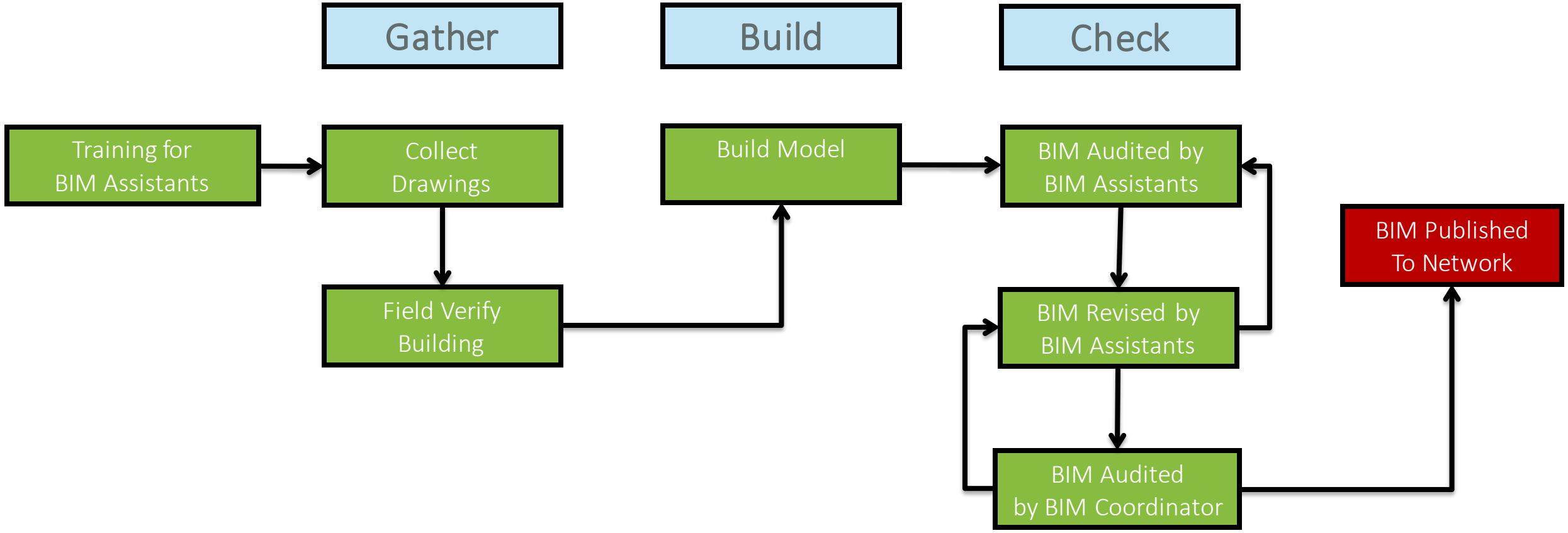


Buckeye BIM Initiative

Owner's Model Planning and Focus

- Design Intent vs. Work Intent vs. As-Built vs. As-Maintained
- What needs to be modeled?
- What supports our planning and operations efforts?
- What can be reasonably maintained?
- What has the best ROI for the organization?

BIM for Existing Buildings



Why Implement a BIM Standard?

- Improve project planning, communication and schedule
- Improve coordination between architectural, structural & mechanical systems
- Increase quality of Construction Documents
- Maintain consistency and accuracy of “as-built” conditions
- Critical for data translation and automation to other systems
- Establish use of model and data during building lifecycle
- Decrease cost of managing information

TOTAL COST AVOIDANCE

If a BIM Standard is fully adopted.

	Chiller Plant	McCampbell Hall	Kennedy Commons	Total
Project Statistics	Size: 95,737 SF Cost: $77,302,597 Const: $54,784,978 Design: $6,458,966	Size: 104,000 SF Cost: $17,171,045 Const: $13,882,483 Design: $1,363,045	Size: 30,000 SF Cost: $12,539,306 Const: $7,931,390 Design: $1,004,258	Total Size: 229,737 SF Total Cost: $107,012,948
2004 NIST Report **Planning Costs**	A/E: $86,163 CM: $151,264 Owner: $158,923 Total: $396,350	A/E: $93,600 CM: $164,320 Owner: $172,680 Total: $430,560	A/E: $27,000 CM: $47,400 Owner: $49,800 Total: $124,200	Total $951,110
2007 NIST Report **Design Costs**	Total: $322,948	Total: $68,173	Total: $50,212	Total $441,333
2007 NIST Report **Trade Package Creation**	Total: $547,849	Total: $138,824	Total: $79,313	Total $765,986
2007 NIST Report **Coordination**	Total: $3,865,129	Total: $858,552	Total: $626,965	Total $5,350,646
2004 NIST Report **Recapture of Data**	A/E: $1,915 CM: $20,105 Owner: $16,275 Total: $38,295	A/E: $2,080 CM: $21,840 Owner: $17,680 Total: $41,600	A/E: $600 CM: $6,300 Owner: $5,100 Total: $12,000	Total $91,895
Total Project Cost Avoidance	$5,170,571	$1,537,709	$892,690	**Total $7,600,970**
% of Total Project Cost	6.6 %	8.9 %	7.1 %	Avg. = 7.1 %
Cost Per Square Foot	$54	$15	$30	Avg. = $33

BIM Project Delivery Standard

- How project will be executed?
- How deliverables will be formatted?
- OSU's PDS focuses almost entirely on turnover documentation
- Available at fod.osu.edu/resources

Standards Development

Naming Conventions:

Floor Plans

Ceiling Plans

Elevations

Sections

Area Plans

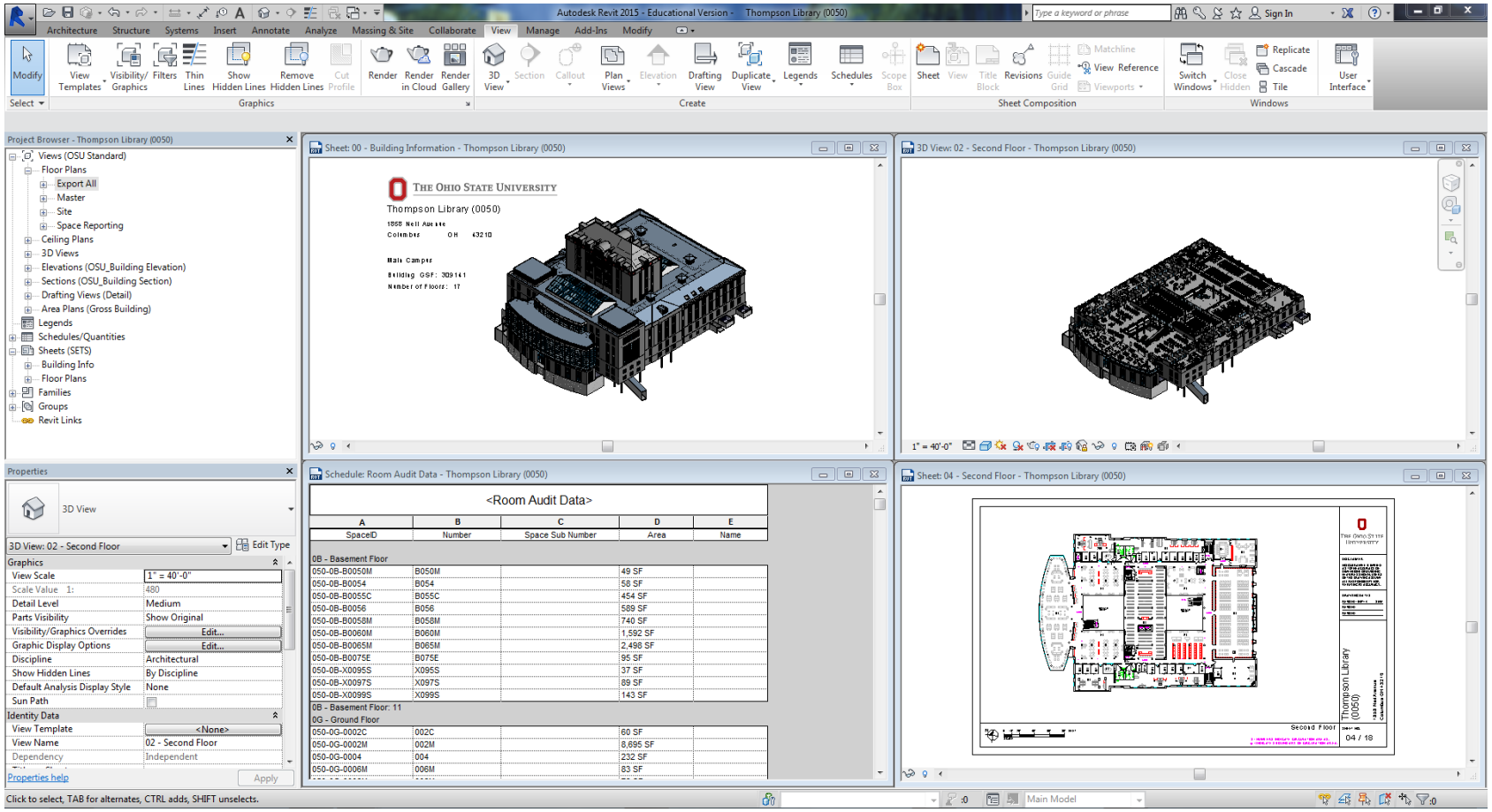
Sheets

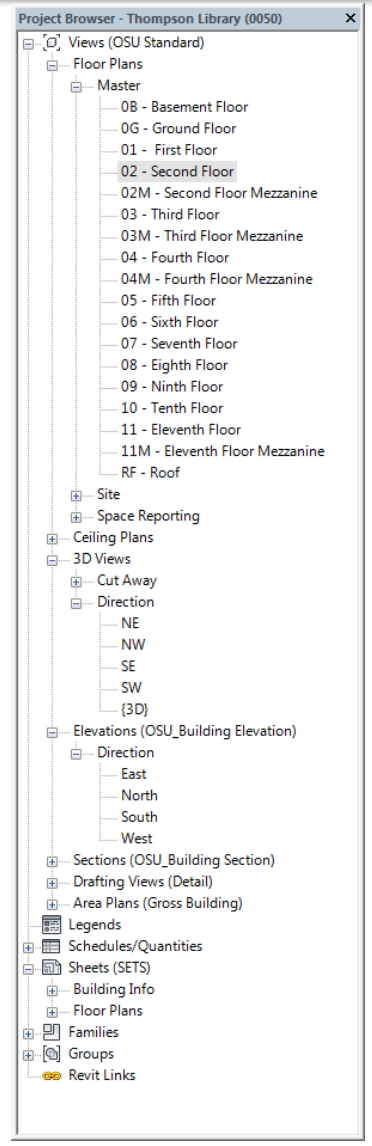
Families

Model in Place

Profiles

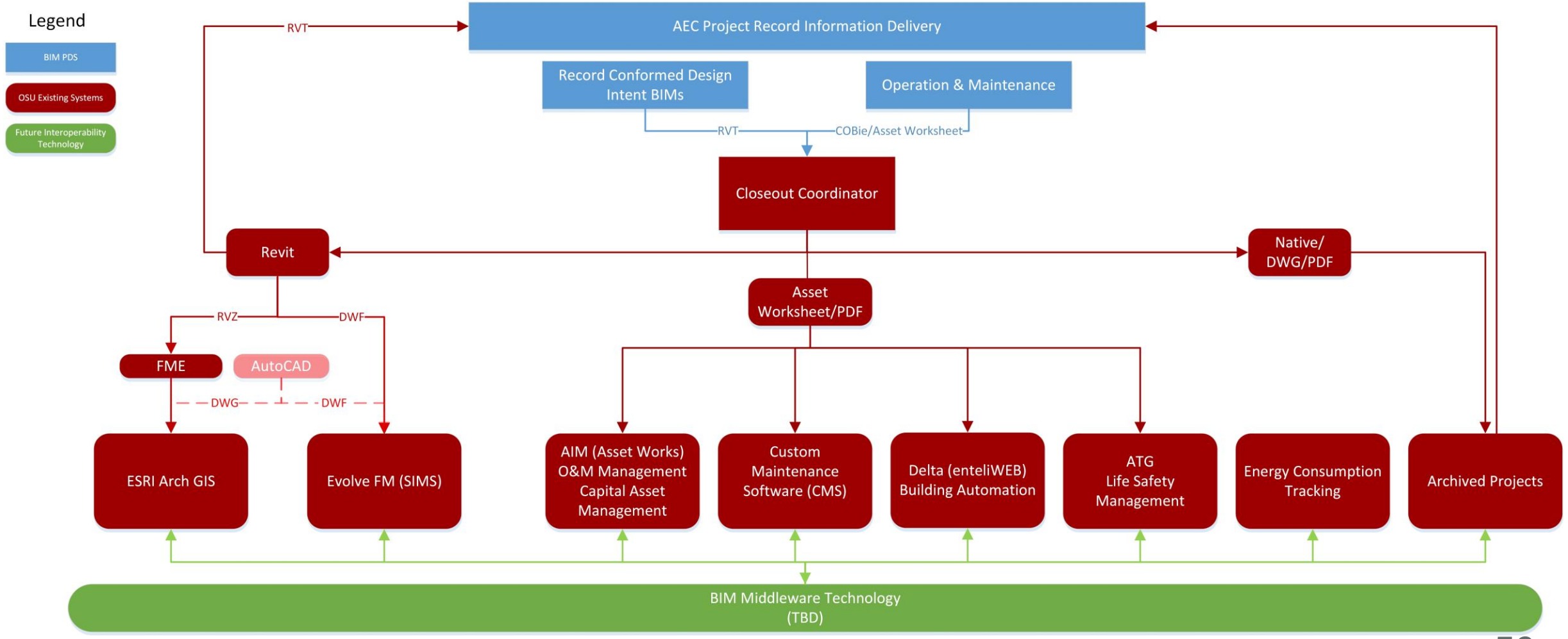
Room/Space





THE OHIO STATE UNIVERSITY

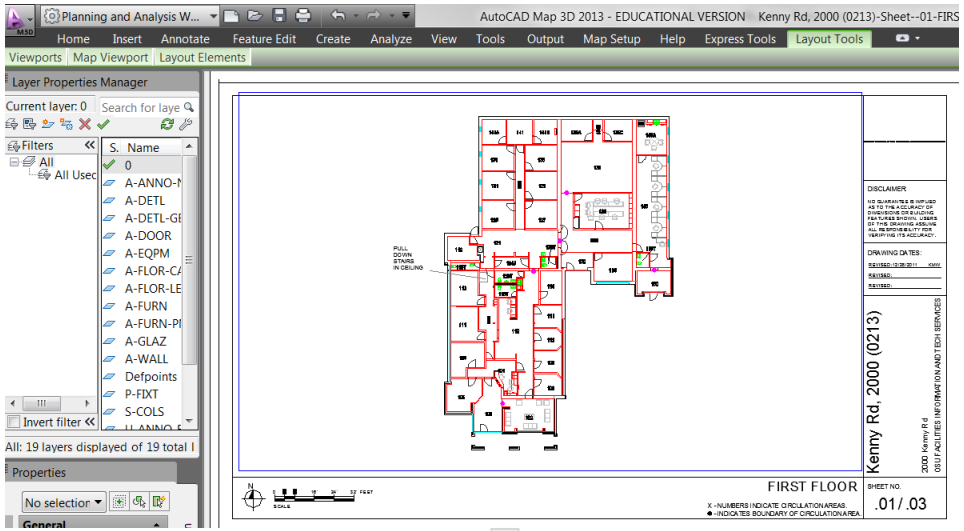
The OSU Buckeye BIM Initiative Map

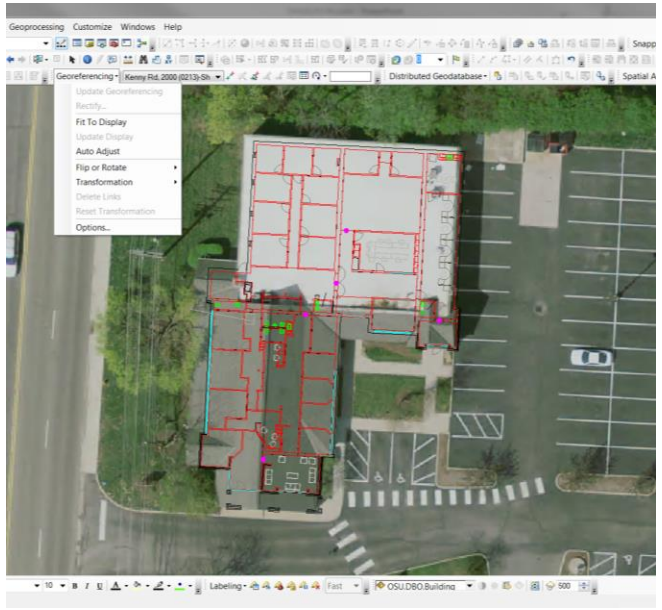


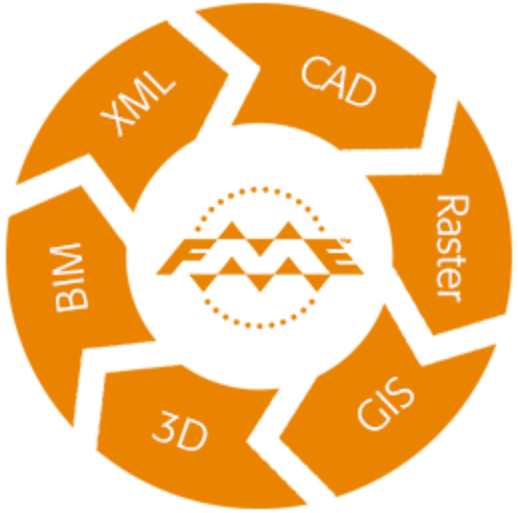
Ongoing Challenges

- Model maintenance and upgrades
- Maintaining MEP models
- Collaboration with other campus departments
- Further automation/checking through Clarity
- Leveraging the transfer of data for use in operations
- Visualizing the entire campus three dimensionally
- Real World Coordinates

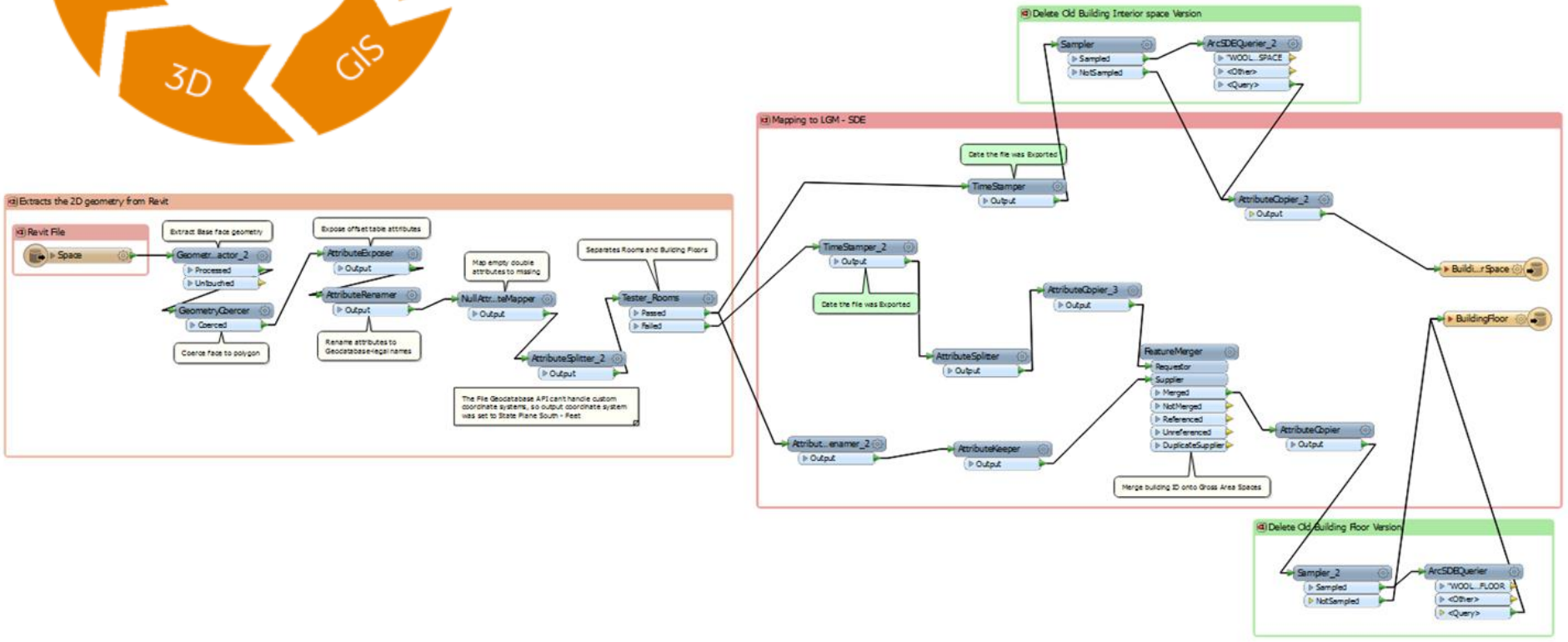
CAD to GIS


AutoCAD Map 3D 2013 - EDUCATIONAL VERSION
Kenny Rd, 2000 (0213)-Sheet--01-FIRS
Layer Properties Manager
Properties
Kenny Rd, 2000 (0213)
FIRST FLOOR
.01 / .03

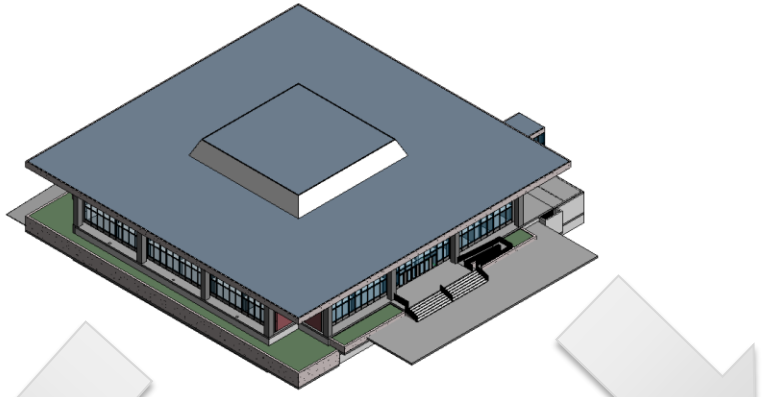

Geoprocessing
Customize
Windows
Help
Georeferencing
Fit To Display
Auto Adjust
Flip or Rotate
Transformation
Options...

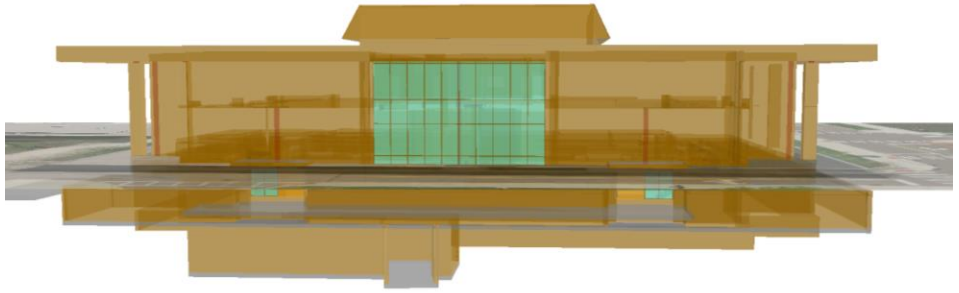


SAFE SOFTWARE™



BIM (Revit) to GIS

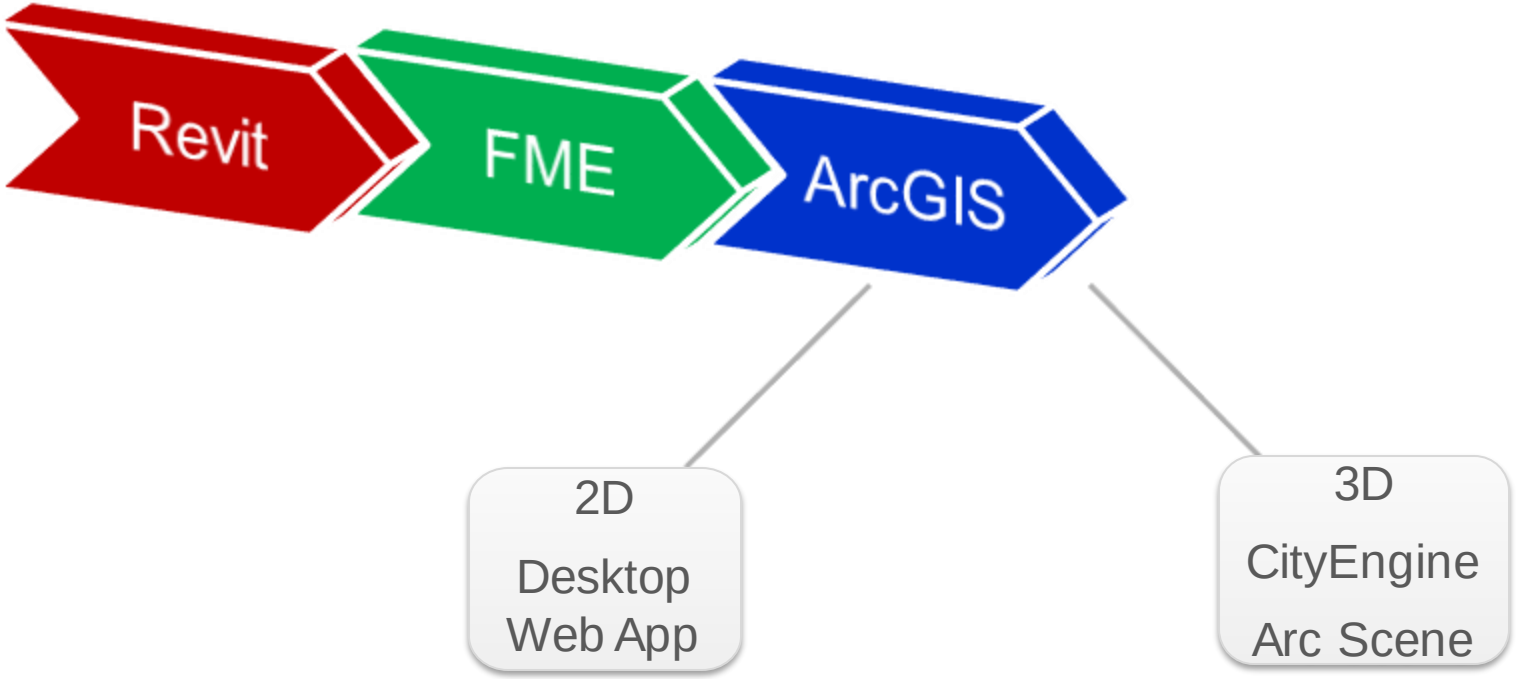


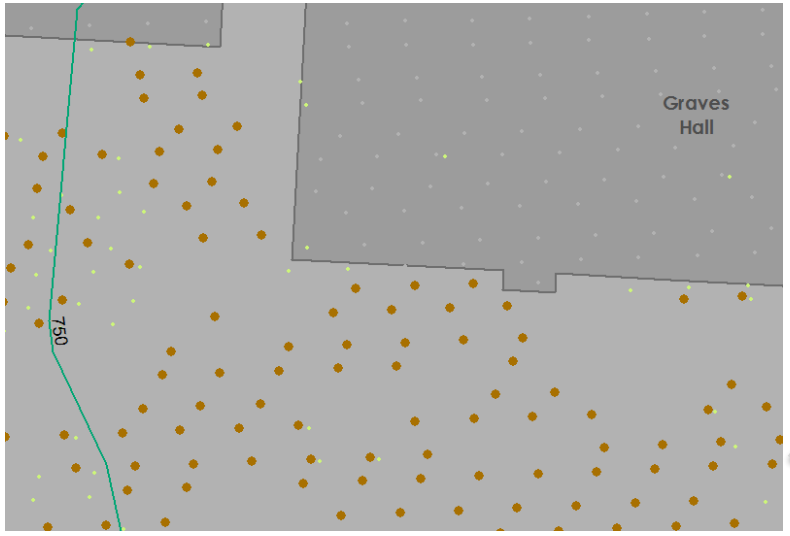


3D

2D

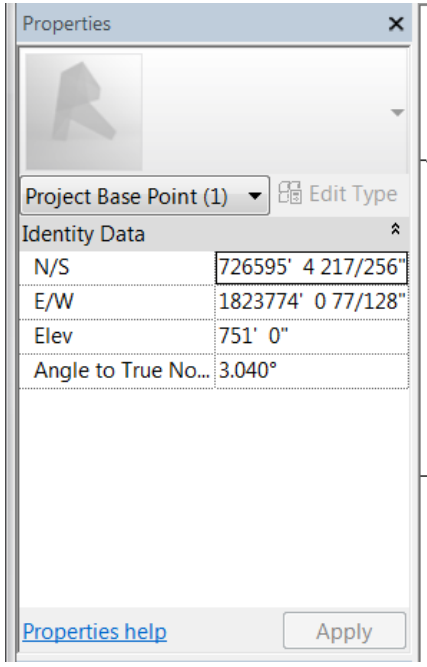
Data Conversion Workflow

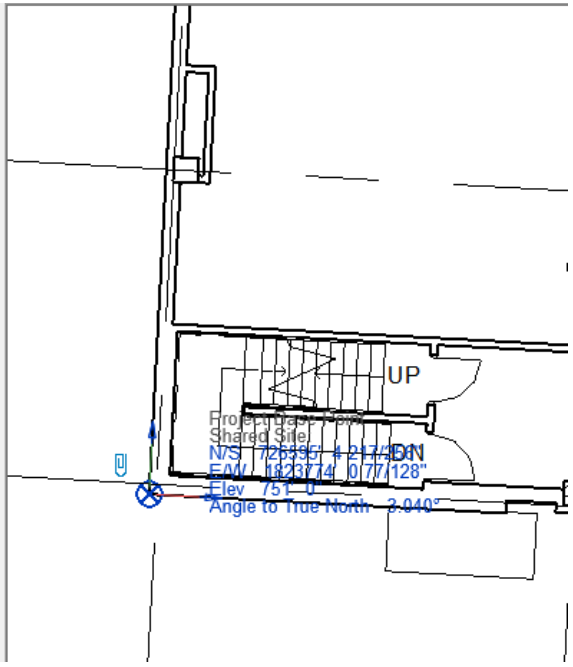


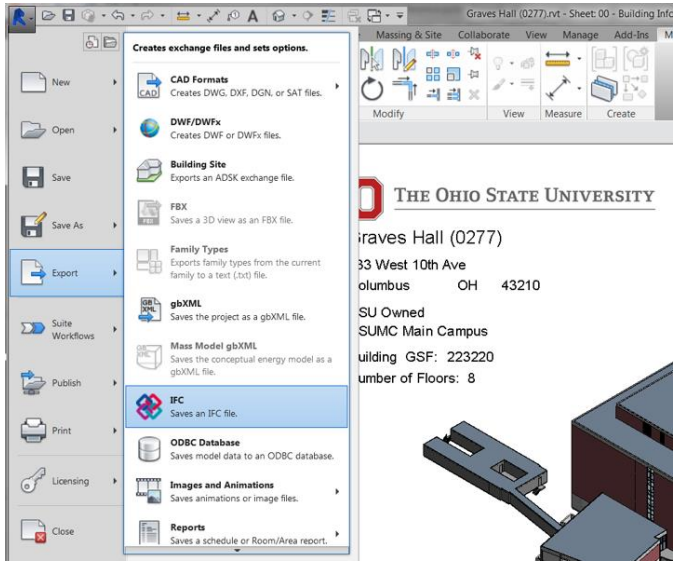


Coordinates and Elevation from ArcMap

Enter Coordinates in Revit

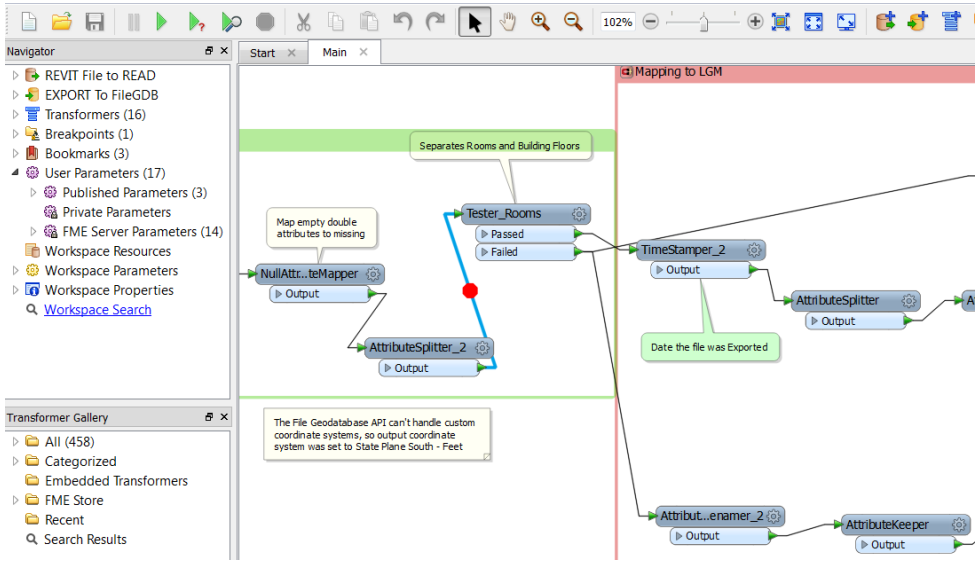




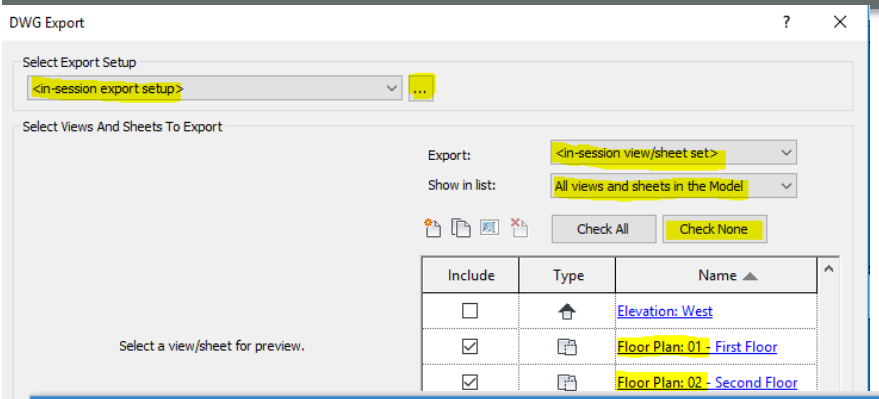


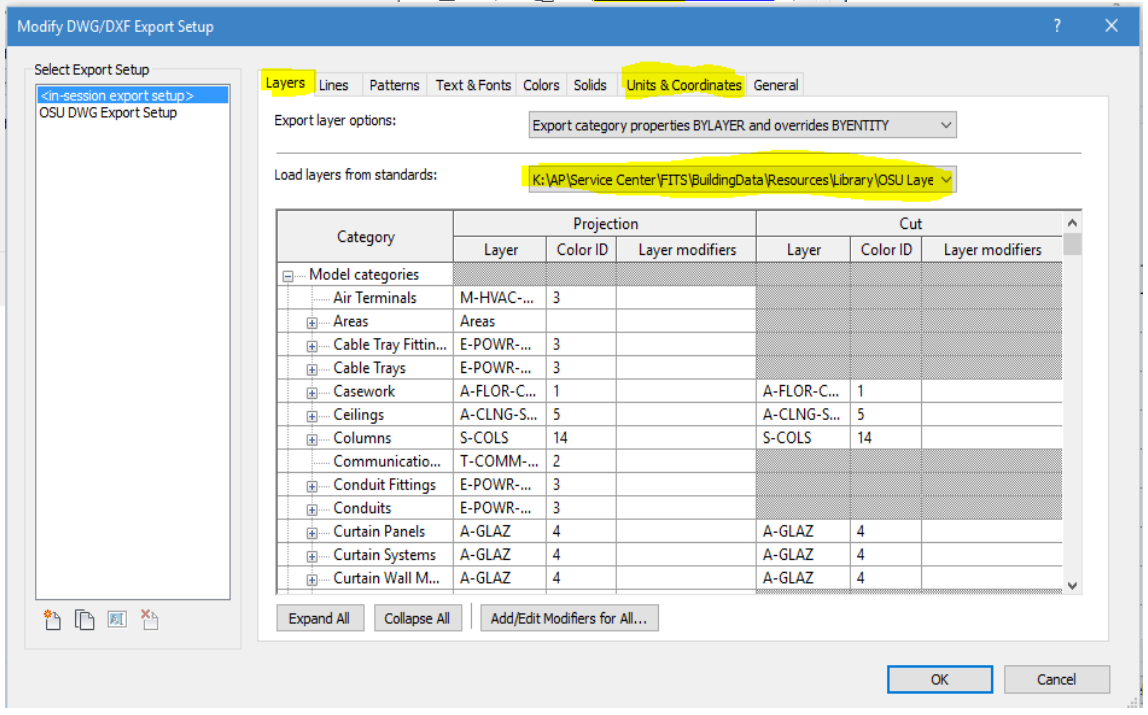
Export to IFC

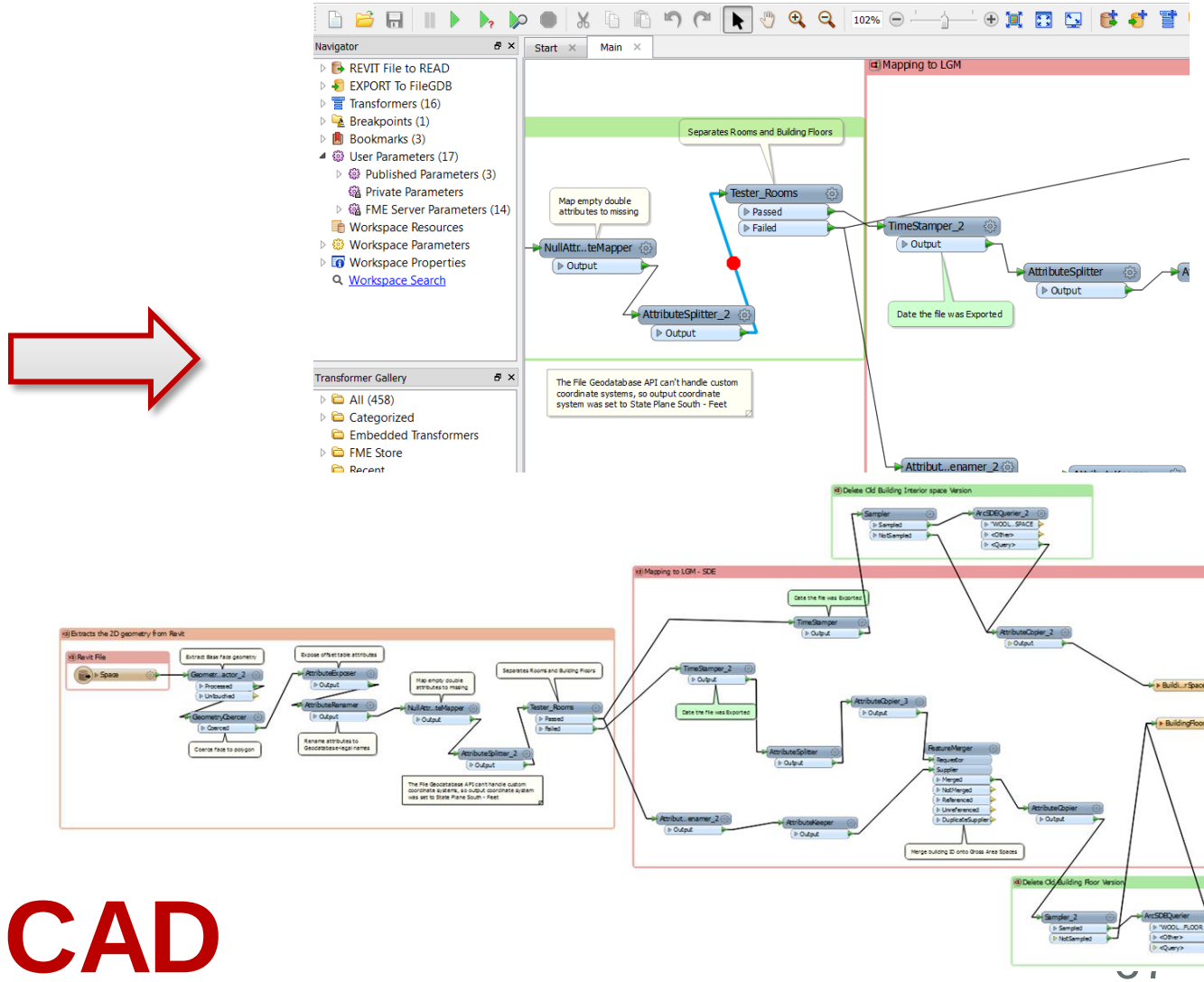
Run FME Models



Run FME Models







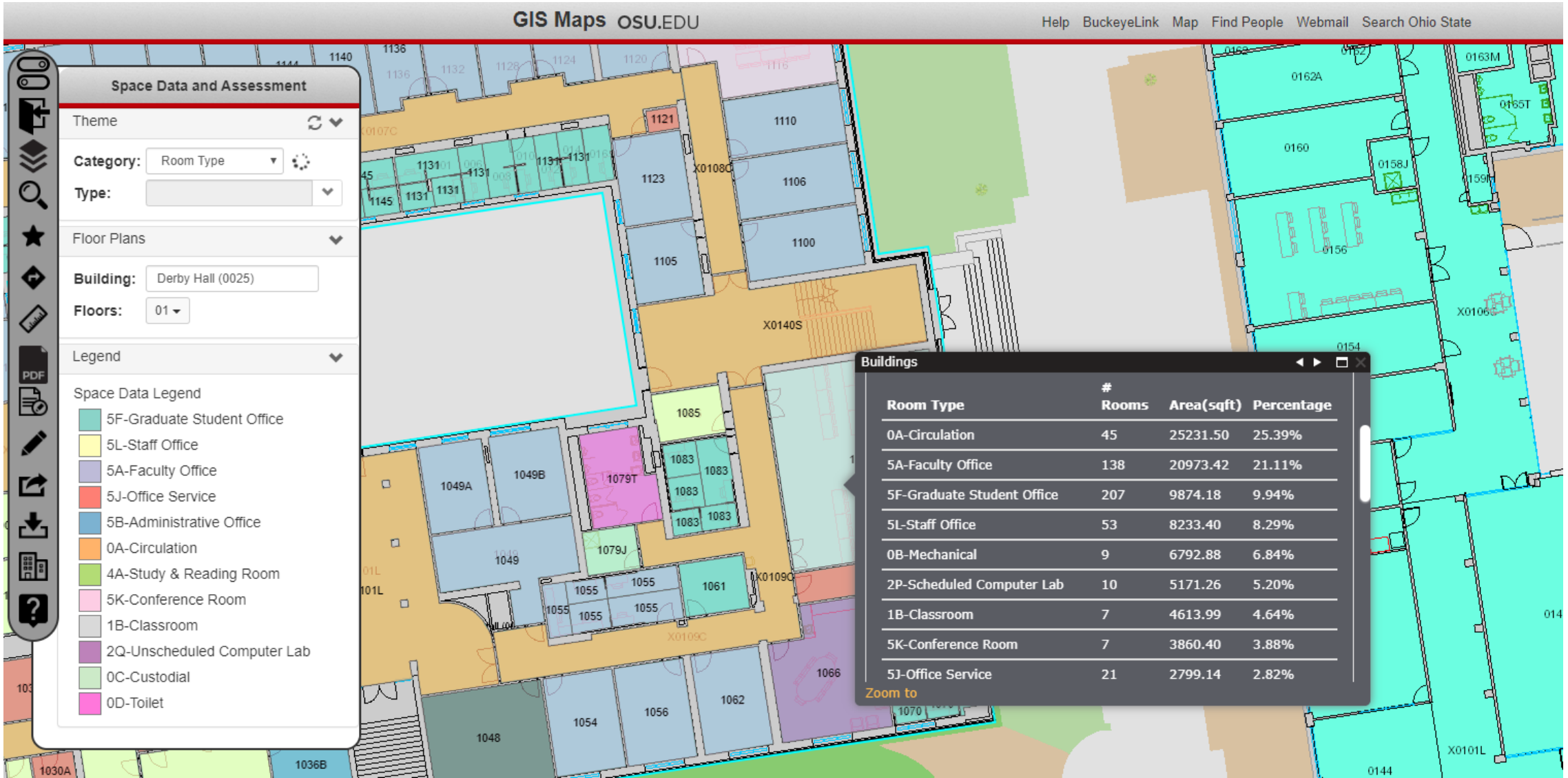
Exports from Revit & CAD

2D Data Used in Web Applications and Desktop

- Display floors around campus
- Find detailed information about a room
  - Organization
  - Department
  - College
  - Room Type
  - Function
  - Sub Room Type
  - Capacity
  - Room Number/Space ID
- Display building assessments and assets
  - Interior Finishes
  - Exterior
  - Life Safety
  - Accessibility
  - Plumbing
  - HVAC
  - Electrical
  - Shut off Valves
  - Fire extinguisher locations

GIS Maps- Floorplans Link to Space Data (SIMS)

Categorization & Query of Space Utilization



2.5D Applications– Building Assets

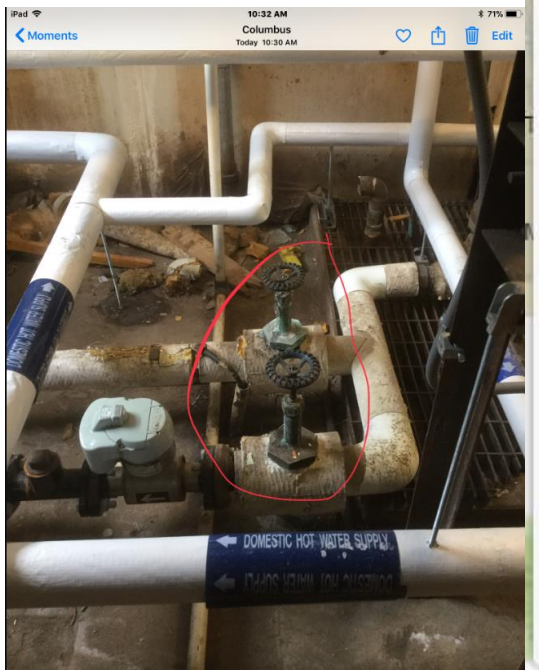
Shutoff Valves

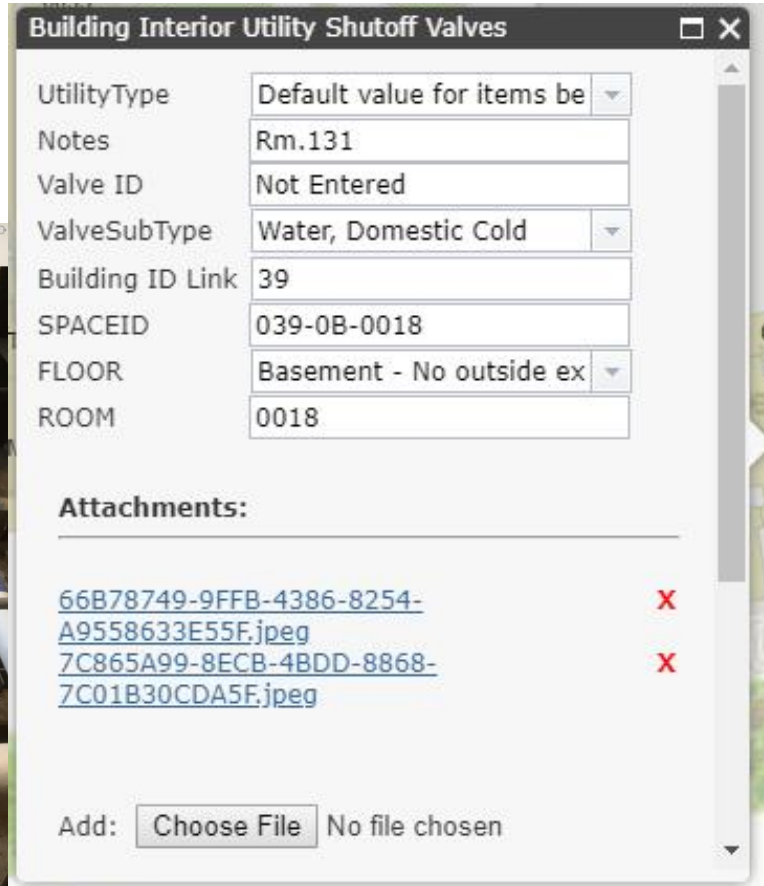
Released in January 2018

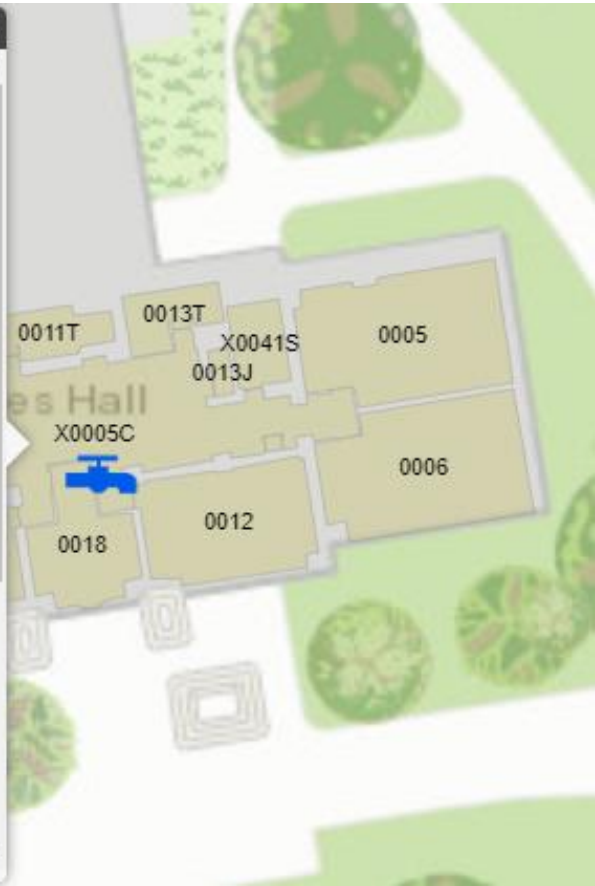
Savings of $133k upfront,
$88k annual

167 valves

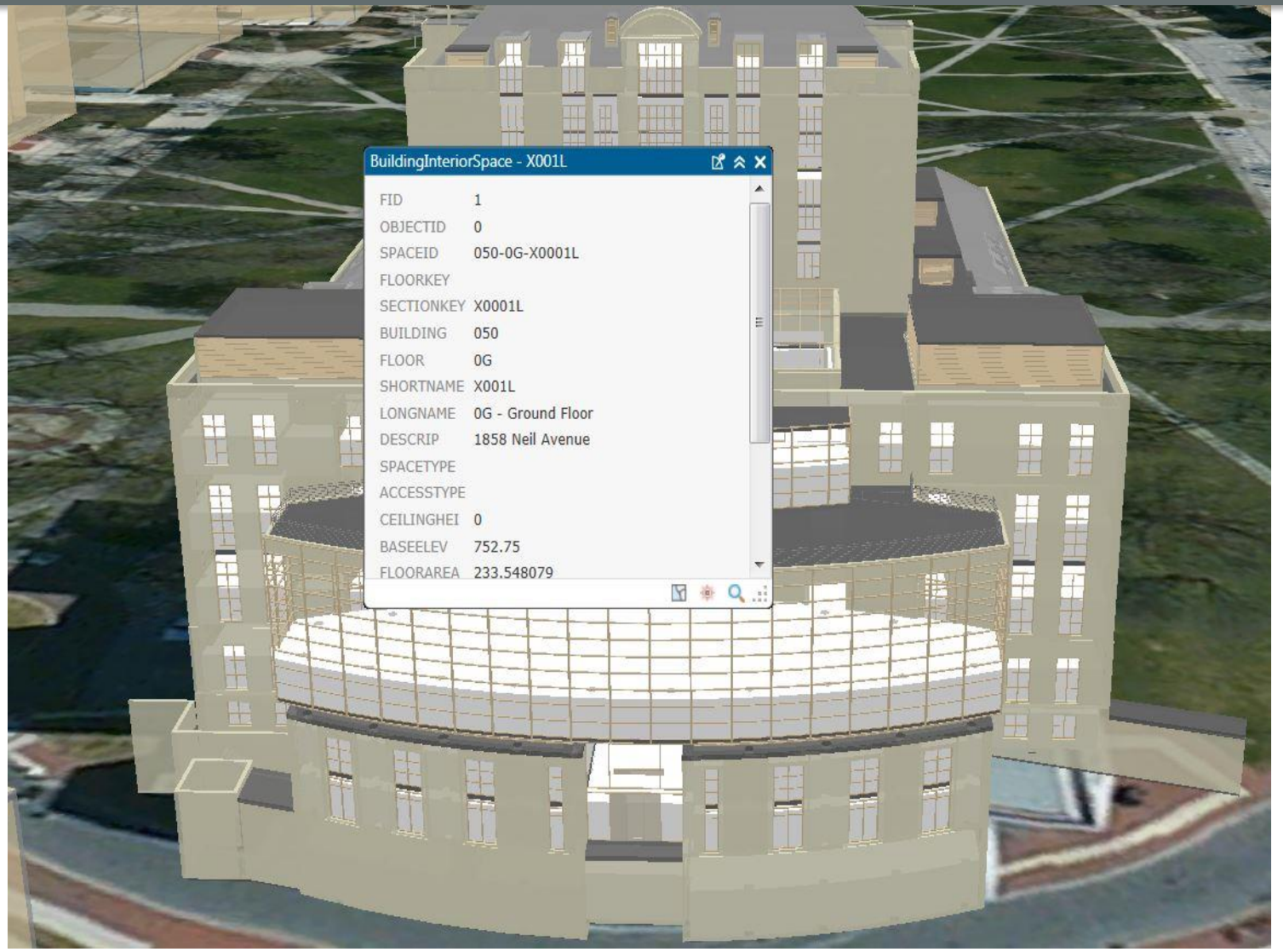
112 photos





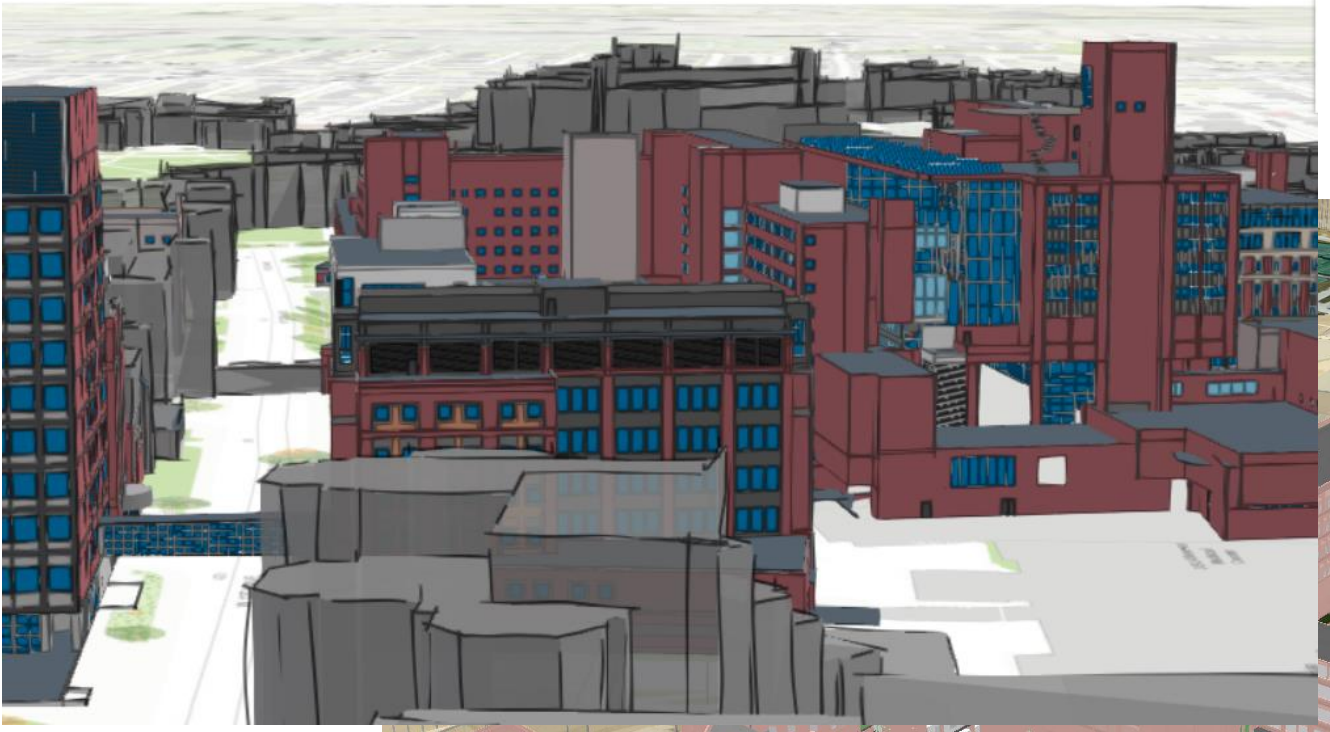


LIDAR Extracted Buildings & 3D shapes from BIM

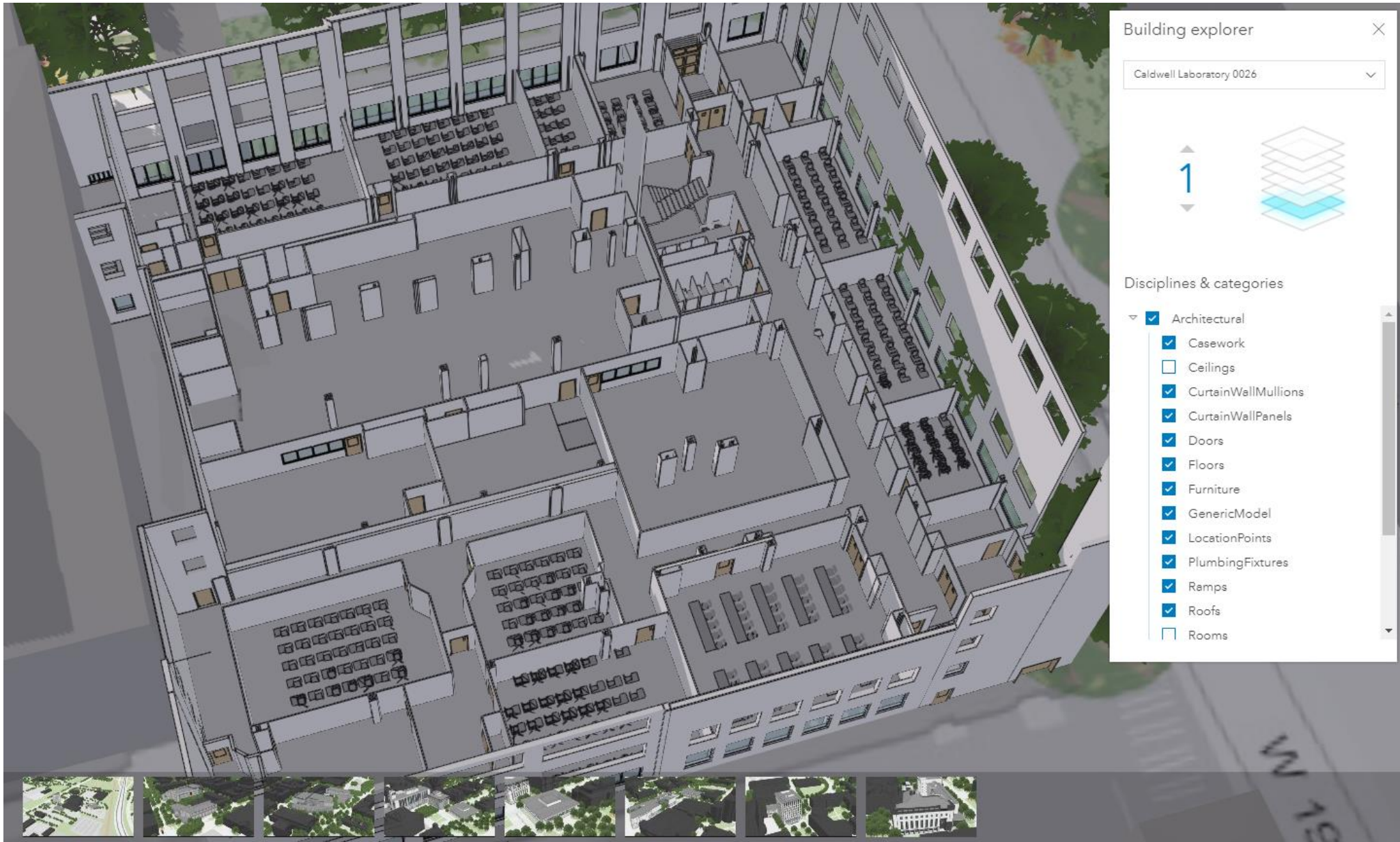


Challenge in Scalability

ArcGIS Pro or ArcGIS Urban



3D Web Scene


Building explorer
Caldwell Laboratory 0026
1
Disciplines & categories
Architectural
Casework
Ceilings
CurtainWallMullions
CurtainWallPanels
Doors
Floors
Furniture
GenericModel
LocationPoints
PlumbingFixtures
Ramps
Roofs
Rooms

Demo:

Campus Building Scene Layer
Web Experience

Contact Us!

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Product Manager – AEC Workflow Integrations

arenteria@esri.com
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@Anth0nyRenteria

Larisa Kruger

GIS Manager – The Ohio State University

kruger.57@osu.edu
www.linkedin.com/in/larisakruger

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Print Stations Located in 150 Concourse Lobby

Tuesday

12:30 pm – 6:30 pm
Expo
Hall B

5:15 pm – 6:30 pm
Expo Social
Hall B

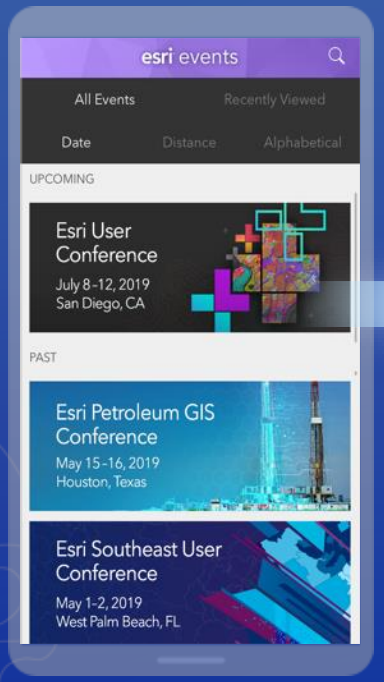
Wednesday

10:45 am – 5:15 pm
Expo
Hall B

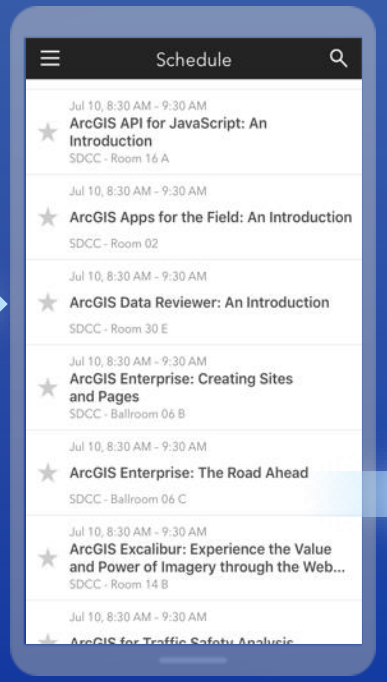
6:30 pm – 9:30 pm
Networking Reception
Smithsonian National Museum of Natural History

Please Share Your Feedback in the App

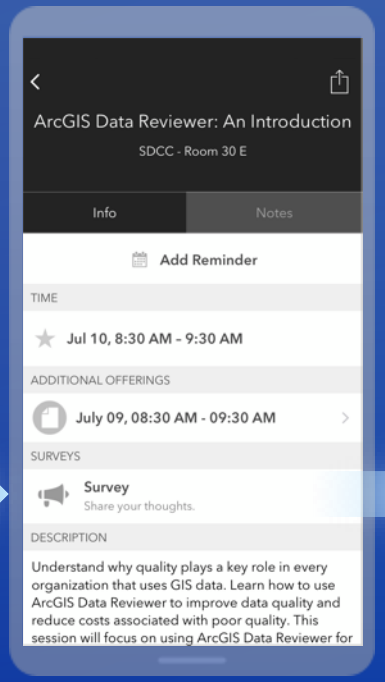
Download the Esri Events app and find your event



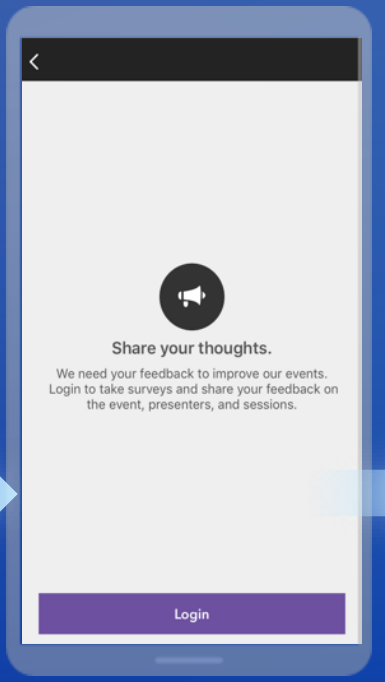
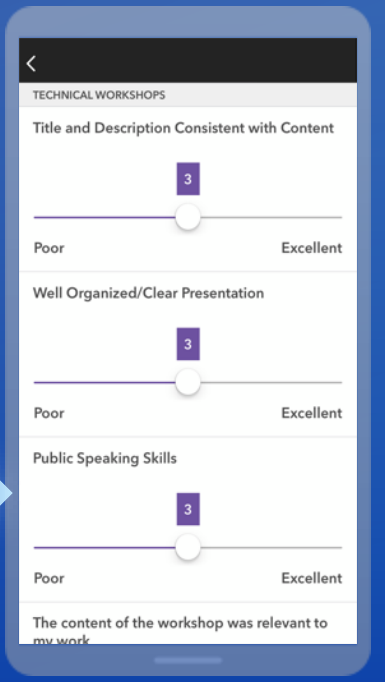
Select the session you attended



Scroll down to "Survey"



Log in to access the survey



Complete the survey and select "Submit"