Bringing BIM into GIS with OGC I3S and OGC 3D Tiles

Persisting Building Information Modeling Data in Geospatial Web 3D Streaming Formats

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EuroSDR Webinar – Evolutions in the Production, Representation and Use of 3D Geoinformation

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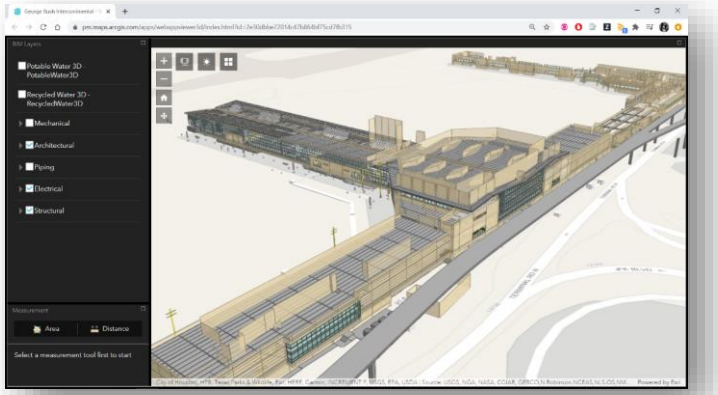
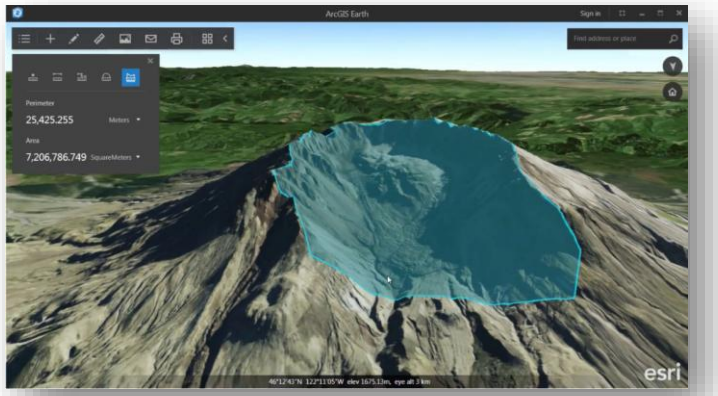


Esri AEC & Digital Twins, ArcGIS GeoBIM



Esri 3D, I3S, ArcGIS Earth

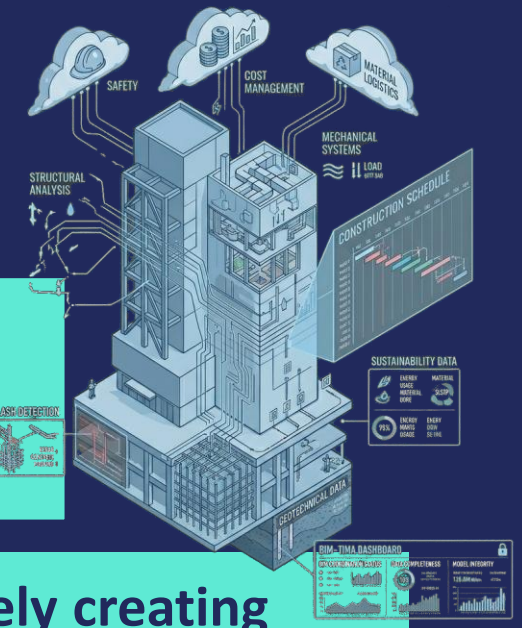
Autodesk Project Galileo/InfraWorks

Chris Andrews

Background:

- Based in France & focused on product advisory and consulting in 3D, AEC-GIS integration, digital twins and anything spatial
- Open Geospatial Consortium member
- Former product leadership at Autodesk, Esri, IBM, Bentley Systems
- Led from inception through production
  - Autodesk InfraWorks
  - ArcGIS Earth, ArcGIS GeoBIM, ArcGIS Urban
- Co-initiated Esri-Autodesk Partnership
- Involvement with OGC CAD-BIM-GIS discussions since 2008

Why should we care about BIM?



We lack adequate resources to create and maintain buildings and infrastructure to ensure resilient human habitation, social support, defense, and natural biodiversity

Building Information Modeling (BIM) is the process for collaboratively creating and using detailed information about built assets throughout their lifecycle to control costs and manage schedules

For decades, practitioners familiar with geospatial and BIM have understood that combining the disciplines leads to:

- More accurate risk analysis and cost savings during planning and preconstruction
- Better coordination of design and construction across and within sites
- Higher likelihood of compliance with energy, environmental, and safety regulations

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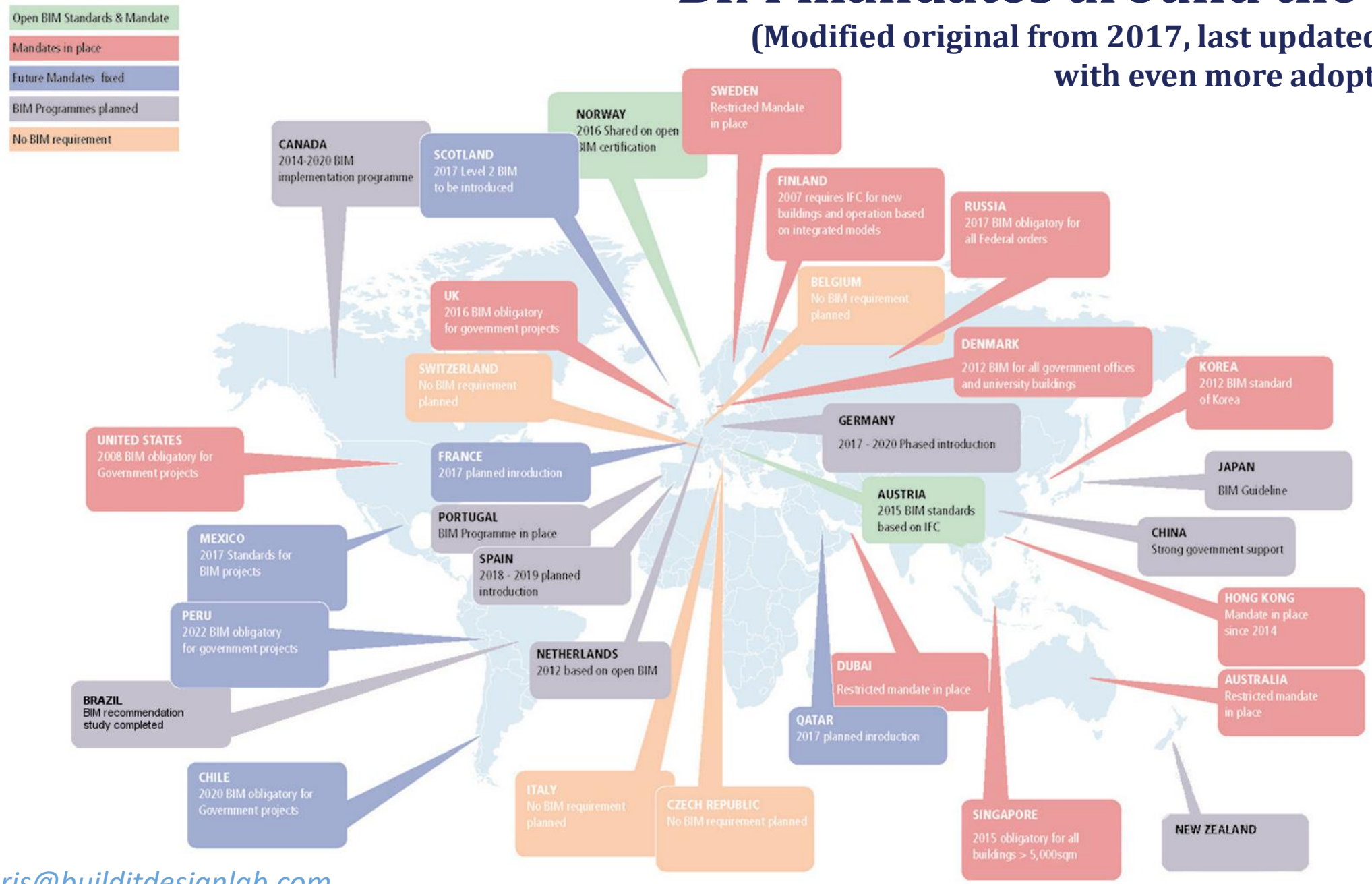
BIM mandates around the world

(Modified original from 2017, last updated in 2019… with even more adoption today)



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What role can NMCAs play in the conversation?

NMCAs have opportunities to:

- Influence and/or set requirements, guidelines, and standards for geospatial in construction and renovation
- Participate in standards discussions to ensure inclusion of relevant national requirements from a geospatial data and technology perspective
- Create or foster geospatial data exchange, standardization, and accessibility for multi-disciplinary use throughout the lifecycle of assets in the context of national change

It helps to know:

- Opportunity for massive cost savings across large asset portfolios using BIM processes **(20%+)**
- **It's possible to consume and use 3D BIM data in geospatial applications through standards today!**
- Differences between traditional GIS, reality capture, and BIM data creation drive analysis, storage, access
- High-level technical 'language' for working with BIM and geospatial information together
- Temporal and spatial specificity along with accuracy become critical in the use of geospatial data for BIM

NMCAs are the agencies who have the 'spatial' perspective on sustainable growth, natural resources management, sovereignty, and society

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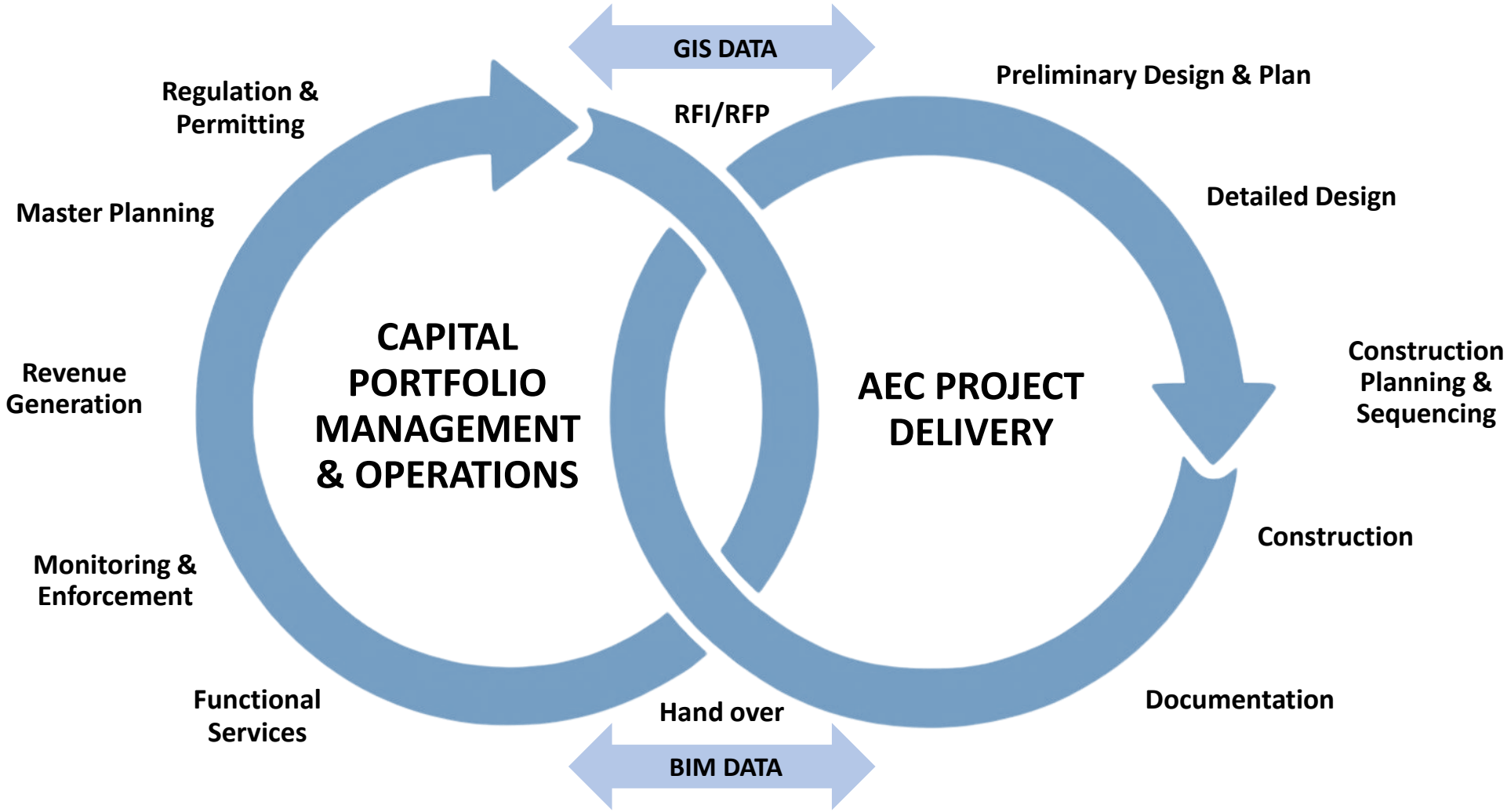
BIM-GIS integration is driven by the business model, not the data

Concept from Esri, Inc.



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Standards for streaming massive data sets

Both I3S and 3D Tiles stream large 3D datasets for web and GIS use and can represent data converted from IFC and other BIM and 3D formats

buildingSmart International IFC (Industry Foundation Classes):

An open BIM schema storing rich semantics — object types, relationships, spaces, systems, properties, and quantities. Conversion to a web delivery format usually keeps only part of that richness. ***Not built for streaming large datasets.***

OGC I3S — Indexed 3D Scene Layer

- Created by Esri; OGC Community Standard since 2017
- Supports complex 3D scenes with multiple layer types: 3D objects, integrated meshes, point clouds, buildings, voxels
- Closely aligned with GIS publishing workflows, especially traditional GIS layer-types and environments
- **Broad horizontal and vertical coordinate system support**
- Includes an **explicit notion of building-oriented content** including **support for MEP-type features and attributes**

OGC 3D Tiles — General 3D Streaming

- Created by AGI; OGC Community Standard since 2019
- Designed for scalable streaming of heterogeneous 3D content
- Flexible tileset structure with hierarchical level of detail; general-purpose framework, **not building-specific**
- **Primarily supports WGS84, ellipsoidal heights**
- Can be used for buildings, BIM, CAD, point clouds, terrain, photogrammetry

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Courtesy of

Demo:
Zürich Digital Twin

geoBIM.app
GEOSPATIAL INTELLIGENCE

THE BIM PERSPECTIVE

GEOBIM
CREATING CONTEXT

Christof Lorenz · OGC Connect Helsinki · 135th Technical Meeting

About those 3D formats… there are many!

OGC CityGML

- Geospatial standard for representing built assets, especially buildings
- Combines performance and semantics
- Not a detailed representation of BIM assets

Khronos glTF/glTB

- specification for efficient transmission and loading 3D scenes and models by engines and applications
- streamlines authoring workflows by enabling the interoperable use of 3D content

Universal Scene Description (USD)

- Designed for scalable streaming of heterogeneous 3D content
- Used for buildings, BIM, CAD, point clouds, terrain, photogrammetry

Notable proprietary and alternative BIM formats:

- **DWG** – Autodesk AutoCAD
- **RVT** – Autodesk Revit
- **PLN** – NEMETSCHEK ArchiCAD
- **NWF/NWD/NFC** – Autodesk NavisWorks
- **DGN** – Bentley Microstation
- **COBie** – National Institute of Building Sciences Construction to Operations Building information exchange
- **BOS*** – BIM Open Schema; new parquet-based open interchange format

*Recommendation: Focus on IFC and *other exchange mechanisms or formats when accessing BIM data in these formats*

Notable alternative 3D formats:

- 3DS
- *OBJ*
- *KML/KMZ*
- *VRML*
- *X3D*
- SHP
- BLEND
- PLY
- …

Numerous formats exist for generic interchange of different sources and types of 3D content with more created every year

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Building Semantics

How well each format models a building's internal structure

I3S

- Has a well-defined **Building Scene Layer** concept
- Supports component-level building organization
- Naturally fits floors, disciplines, spaces, and building elements
- Best when the result should behave like a structured building layer in GIS

3D Tiles

- No built-in BIM or building hierarchy
- Uses general metadata structures for features, tiles, contents, and tilesets
- Building semantics must be created through schema design and conversion rules
- More flexible, but less prescriptive for BIM structure

Both formats are well adopted by commercial and open source tools. Both are royalty-free, actively maintained, and driven by community input in the OGC Community Standards process.

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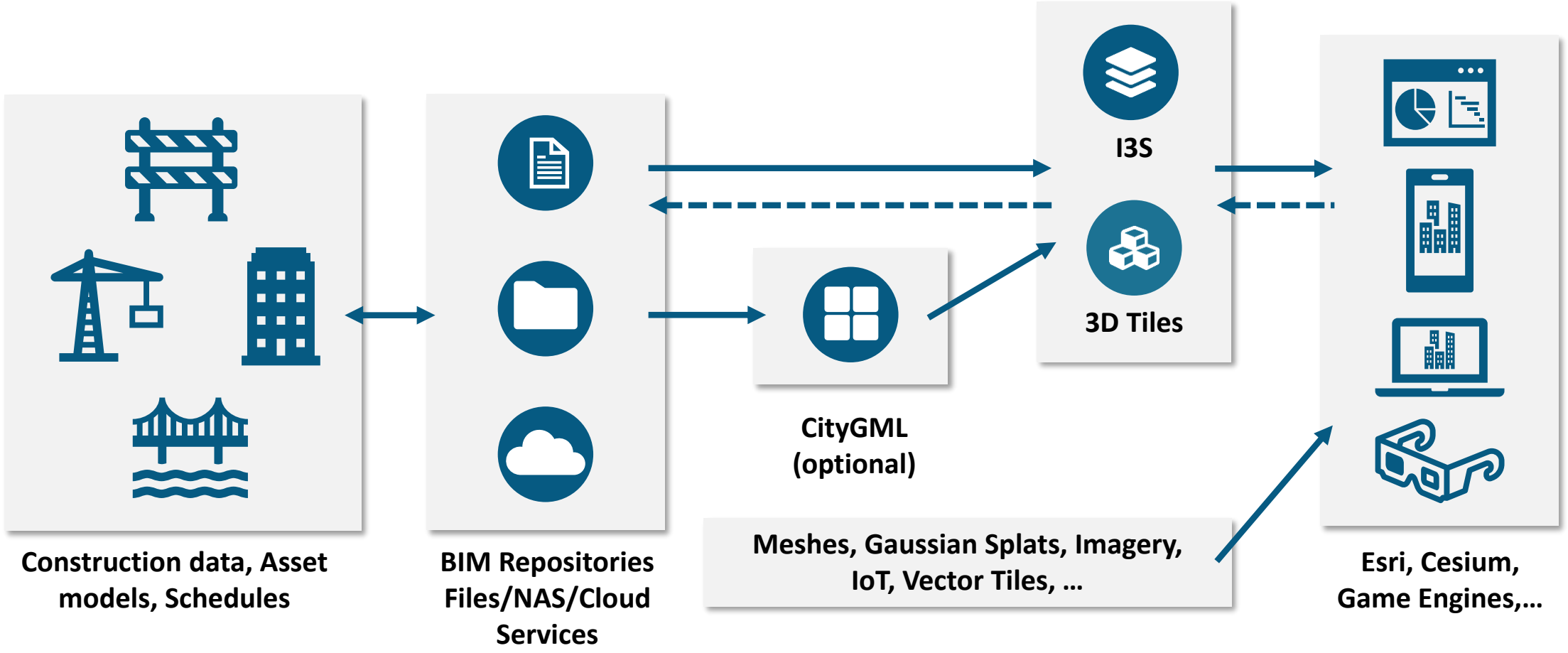
How standards are used together across domains



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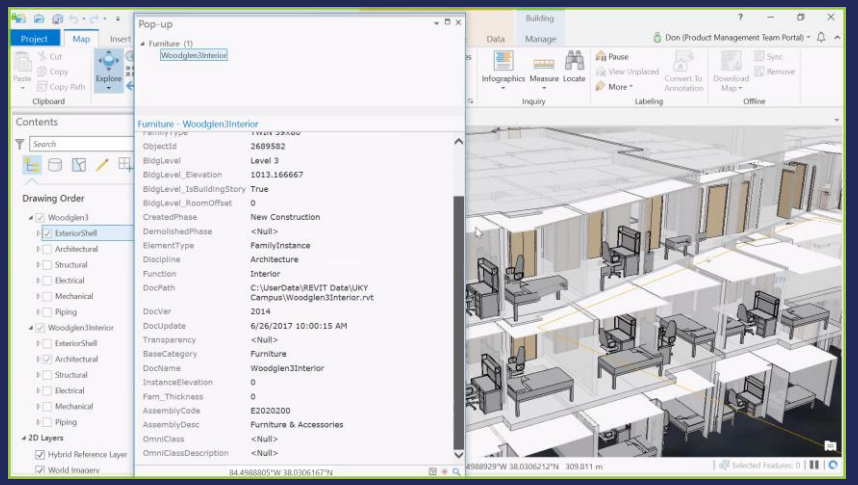
Geometry from IFC

In both formats, IFC geometry is converted into tessellated meshes. The original parametric or constructive BIM geometry is not preserved in native form.

Both are good for viewing and navigation, but neither fully substitutes for source IFC model when exact BIM reconstruction is required.



I3S Geometry Pattern

- Meshes organized in node-based scene layer structures
- Profiles for different types of geometry for diverse layer types
- Works well for structured scene delivery and GIS-based display across devices

3D Tiles Geometry Pattern

- Meshes commonly stored as glTF-based tile content
- Rapid adoption of industry-wide compression and streaming improvements
- Works well for browser-based rendering and scalable 3D streaming

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Attribute Persistence & Georeferencing

I3S — Attribute Persistence

- Strong support for feature identity and attributes
- Well suited for storing BIM-derived properties on building and other physical infrastructure asset components
- Useful for keeping IFC properties queryable inside a GIS-style scene layer

3D Tiles — Attribute Persistence

- Strong metadata system with flexible attachment points
- Can preserve a broad subset of IFC properties
- Success depends heavily on how the export schema is designed

I3S — Georeferencing

- Explicitly supports geodetic coordinate reference handling and vertical reference concepts
- Helpful when BIM needs accurate placement into larger GIS scenes

3D Tiles — Georeferencing

- Supports local and global spatial placement within tileset structure
- Georeferencing can be very good, but depends more on export workflow and conventions

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IFC Information Persistence

Where I3S is Stronger

- Building-aware output
- Better alignment with floors, disciplines, and structured building components
- More natural fit for GIS publishing of BIM-derived building layers

Where 3D Tiles is Stronger

- Flexible web visualization
- Mixed 3D environments with many content types
- Custom metadata models for browser-based applications

Shared Limitation

Neither format should be treated as the full authoritative BIM source. Full IFC round-trip fidelity is usually not preserved. Source IFC should remain the system of record when rich BIM semantics matter.

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Practical Takeaway

NMCAs can influence the standards and information content about the built and natural environment that is used to manage and support the countries they serve… and the broader international community as well.

I3S Building Scene Layers

When the main goal is a building-aware GIS scene with structured BIM-derived components and attributes.

- Semantically maps BIM geometry and attributes
- Behaves like CRS-aware, layered GIS content

3D Tiles

When the main goal is flexible, browser-oriented streaming across mixed 3D content types.

- Performance optimized
- Flexibility through custom implementation

In both cases, encourage the preservation of the original IFC (or native source BIM files) when long-term BIM fidelity and detailed asset traceability matters

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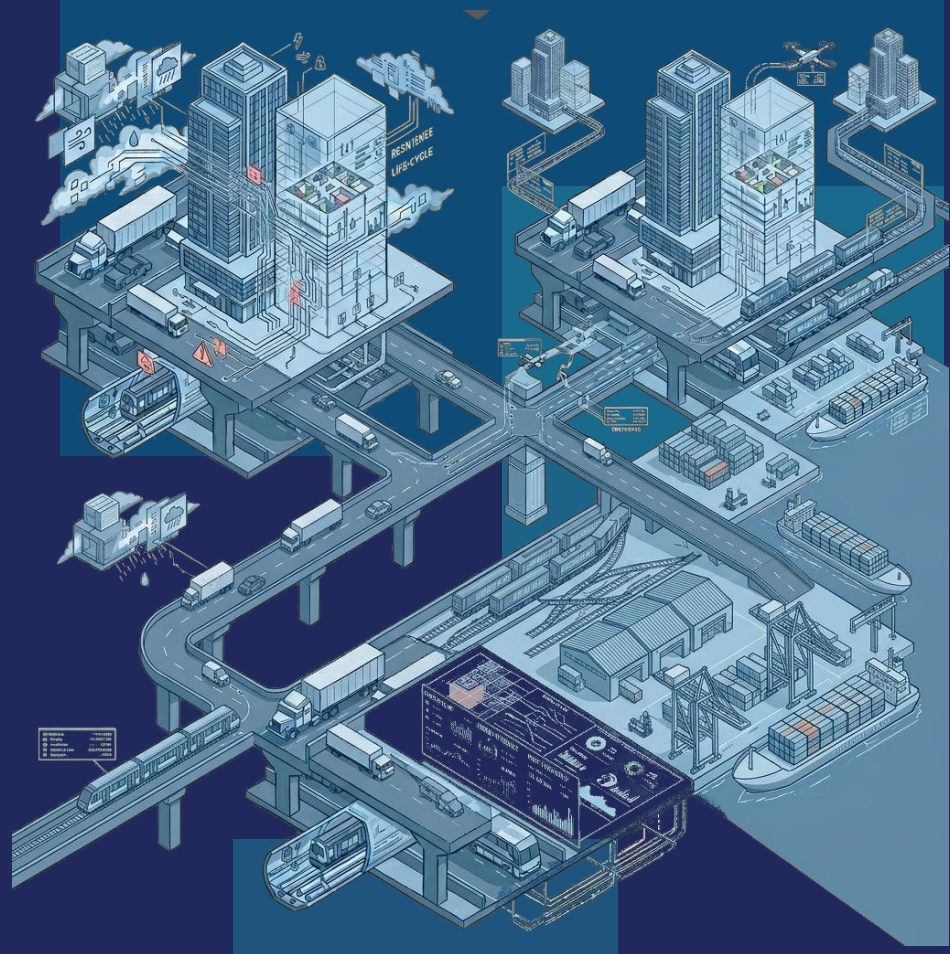

Thank you

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With special thanks to:

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Jasmine Du – JDu@esri.com

Outline Comparison – Both are OGC Community Standards

Dimension	I3S	3D Tiles
Primary orientation	3D GIS scene layers with explicit building support	Generic 3D streaming for many data types
BIM-specific structure	Includes an explicit Building Scene Layer profile for mapping BIM and asset-related data	Relies on metadata conventions rather than a built-in BIM hierarchy
IFC semantic mapping	More direct mapping for building components and disciplines	Flexible mapping, but more dependent on implementation choices
Geometry after export	Tessellated meshes in scene layer nodes; can be glTF	Tessellated meshes in glTF-oriented tile content
Attribute persistence	Strong feature-level attributes for structured building workflows	Strong schema-based metadata with high flexibility
Best fit	GIS-centered, building-aware GIS workflows	Open web visualization and heterogeneous 3D scene delivery
Round-trip back to IFC	Limited	Limited
Community support	Deep support within Esri ecosystem, adoption by numerous commercial data providers and open source community	Large community adopting through CesiumJS Open Source, adoption in vendor products from Esri, Bentley, many others

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