INDUSTRY INSIGHT

buildingSMART International

Enabling information continuity across BIM-GIS domains:

A bSI and OGC strategic roadmap

Open Geospatial Consortium

CONTENTS

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1. Introduction

This strategic roadmap is a work product of a joint working group of buildingSMART International (bSI) and the Open Geospatial Consortium (OGC). It is the latest attempt in a decade-long effort by these organizations to bridge the gap between building information modeling (BIM) and geographic information systems (GIS) to leverage open data standards and foster continuity of information across any business domain (e.g., environment, transportation, infrastructure, buildings) where both BIM and GIS data are needed for informed decision-making. The roadmap seeks to tap into the membership, activities, and reach of both organizations while at the same time aligning with other similar efforts within the larger industry to enhance infrastructure lifecycle management and support sustainable development.

2. Background and Need

Consistent and integrated use of BIM and GIS data and technologies addresses the growing demand for seamless information flow across different scales and domains of the built and natural environments. This integration is pivotal for advancing digital transformation in various domains such as construction, urban planning, and infrastructure management. Moreover, an effective exchange of information between the two domains would support several use cases related to sustainability (e.g. environmental analysis, energy use, circular economy). By combining the highly detailed information of BIM with the extensive, geospatial context provided by GIS, stakeholders can achieve a comprehensive understanding of projects and their context, leading to more informed decision-making and sustainable development practices. On the other hand, GIS applications will have an additional accurate source of information, allowing the improvement of city and land analysis and management use cases.

3. Objectives

The bSI/OGC joint initiative developed a roadmap that outlines specific actions to achieve consistent use of open standards in BIM and GIS data modeling and integration that supports users. The roadmap explicitly recognizes that the real-world business domains may be represented in multiple ways in BIM and GIS tools and that standards implementation in software tools may also be inconsistent. The roadmap places emphasis on the connection between different sources of data. It seeks to use the "best in class" standards, tools, and technologies available at any given time to solve user needs while constantly seeking to achieve greater levels of standardization and standards implementation. This user-driven and user-centric aspect of the roadmap is intended to ground the work in real needs of data users in the most standardized way practicable.

The primary objectives of the roadmap are:

- Solve impactful use cases that benefit from improved connection of BIM and GIS data.
- Provide standardized toolkits to advance use cases in real-world applications.
- Demonstrate the advantages of adopting open standards for data modeling and integration.
- Educate a new generation of data suppliers and users who are simultaneously adept at enterprise-scale BIM-GIS data and acutely aware of the use cases that demand continuity in information modeling.
- Engage the traditionally siloed BIM and GIS communities with a common purpose to foster a collaborative, harmonized, and consistent approach to information management across their ecosystems.

The development of the strategic roadmap was led by a group of committed professionals with a long history of BIM-GIS development. Several work sessions between October 2022 and December 2023 focused on leveraging existing knowledge bases, identifying challenges and opportunities, prioritizing actions based on desirable use cases, and creating a framework for sustained progress. This approach tried to ensure that the roadmap was grounded in practicality and addressed real-world challenges while paving the way for innovative solutions.

4. Business Domains and Use Cases

The roadmap recognizes that open data standards development, support in software applications, and subsequent adoption and use by all built asset industry stakeholders (e.g., facility owners, consultants, researchers, policy makers, administrators, etc.) vary by business domain and are guided by the urgency associated with use cases; that different data standards need to be developed for different business domains; and that adoption of standards and software support of these standards may also vary by business use and software applications within a domain. Therefore, to enable these agencies to efficiently connect data across BIM and GIS tools, it is important to start by identifying specific use cases in each of the business domains. Accordingly, the roadmap emphasizes the identification of high-value and urgent use cases from the bSI, OGC, and other allied communities as a first step in the campaign. These high-value use cases are expected to be selected from user stories, large and small, collected from business domain experts actively engaged within the bSI and OGC communities.

Figures 1 and 2 present example use stories in the buildings and highway infrastructure domains where BIM and GIS data need to be connected. It is expected that such stories, when sourced from the wider community of practice and used as a foundational building block, will drive sustained engagement, awareness, and interest in the roadmap's activities. They are the starting points for activities related to open data modeling standards, data exchange standards, data procurement standards, and software implementation pathways.

User Story	User Story Description	Epic
Develop Existing Conditions Model	**As** `architect`, **I want to** get existing site information on property line, surrounding streets, utility lines, zoning and other property related constraints, **so that** I can create ...	02-Design
Create Digital As-Built (Digital Twin) for Building	**As** `emergency responder`, **I want to** get information on Building Utility Connections, Building Inventory and Condition (including capabilities of damaged structures) and ...	08-Emergency ...
Create Maintenance Work Request	**As** `building occupant`, **I want to** find my building, room so that I can post a work request to facilities management...	06-Operations
Identify Critical Assets	**As** `facilities manager`, **I want to** know where my critical assets are located and review their information (e.g. room number/name etc.), **so that** I can take appropriate ...	06-Operations
Update Asset Inventory using Digital As-Built	**As** `facilities owner`, **I want to** get as-built data on new construction, **so that** I can update the asset inventory with information about the asset	05-Handover

Figure 1: Sample Business Use Cases in Building Infrastructure Domain.

User Story	User Story Description	Epic
Develop Statewide Transportation Improvement Program (STIP)	**As** `Planner`, **I want to** identify projects that can to be programmed in the Statewide Transportation Improvement Program (STIP), 5-year plan, 3-year plan using asset life ...	01-Planning
Update Asset Inventory using Digital As-Built	**As** `Asset Manager`, **I want to** get digital as-built data model from construction after the facility is open to traffic, **so that** I can update asset inventory system with information ...	05-Handover
Create Pavement Construction History Sections	**As** `pavement analyst`, **I want to** create pavement construction history sections, **so that** I can capture information about pavement layers, material, thickness, surface type and ...	06-Operations
Federal Reporting: ARNOLD, HPMS, MIRE	**As** `Road Inventory manager`, **I want to** maintain Highway Alignment (including Bridge Alignment), Stationing & Roadway Characteristics information, **so that** I can prepare and...	06-Operations
Create Intersection Model	**As** `traffic and safety analyst`, **I want to** create an intersection model with Intersection Roads, Approach, Alignment, Turn Lanes etc., **so that** I can perform Safety ...	06-Operations

Figure 2: Business Use Cases in Highway Infrastructure Domain.

5. Key Activities and Timeline

The BIM-GIS data (and related functions and operations on those data) connection challenges that need to be addressed and opportunities that could be leveraged in each business domain were divided into following themes:

A. Industry stakeholder adoption and implementation of standards, tools, and policies.

B. Development of data management standards that facilitate data integration, exchange, and sharing.

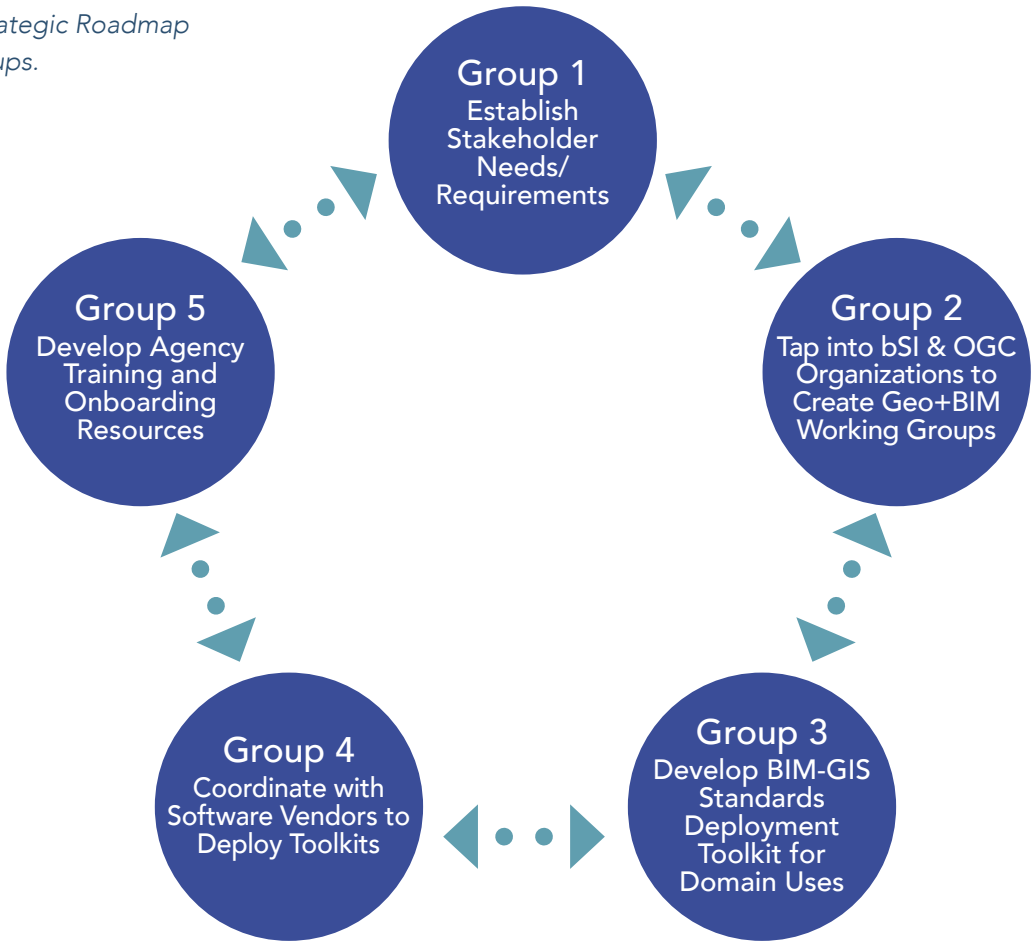
C. Collaboration with software vendors to develop tools and technology that support BIM-GIS connection standards.

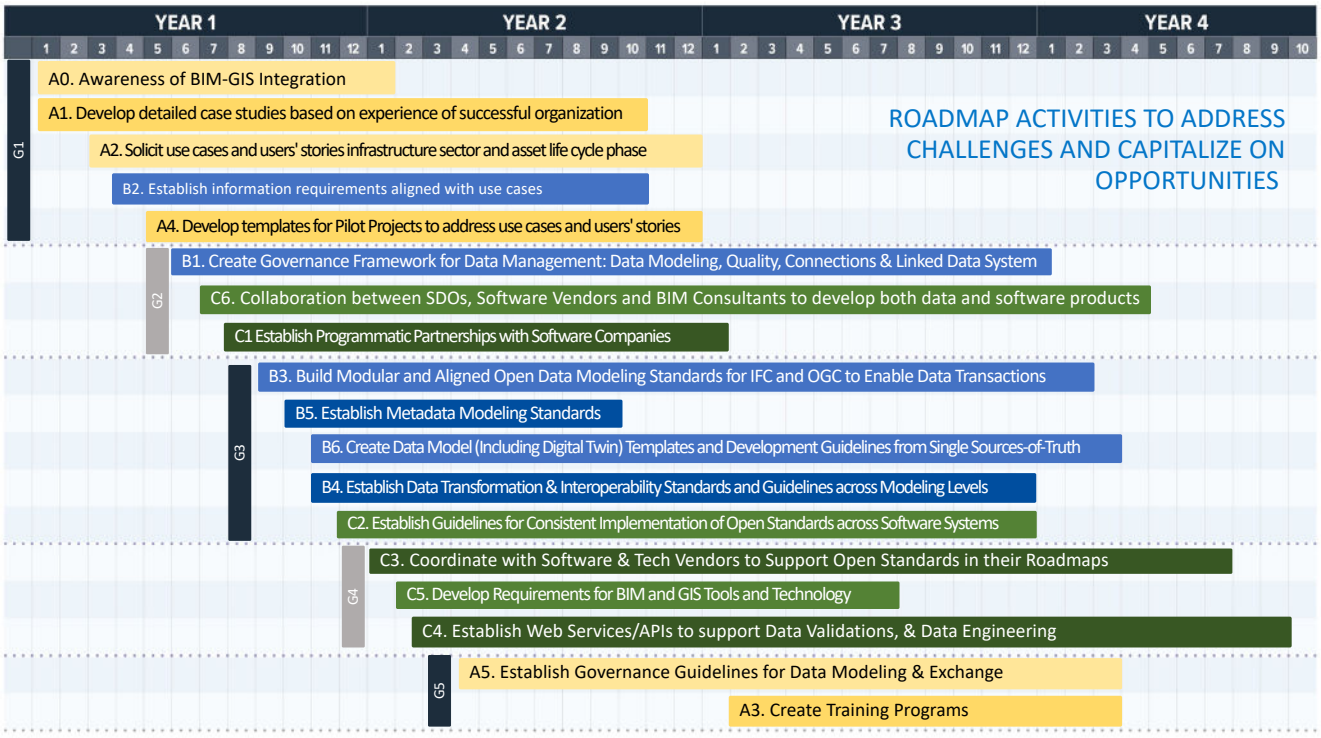
Some of the challenges and opportunities in these areas may be similar across business domains. The activities in the strategic roadmap were defined in a manner such that they can be executed to address challenges and leverage opportunities across all the domains.

Broadly, the strategic roadmap activities were divided into five key activity areas which are agnostic of business domains and use-cases. These key activity areas are shown in Figure 3. Figure 4 presents the activities in each group and the proposed implementation schedule. As shown:

- Activities in Groups 1 and 5 (highlighted in yellow) were defined to address challenges and opportunities associated with empowering built asset industry stakeholders to adopt and implement standards.
- Activities in Groups 2 and 3 (highlighted in blue) were defined to develop data management standards in coordination with bSI and OGC working groups, to facilitate data integration and exchange.
- Activities in Group 4 (highlighted in green) were defined to address challenges and opportunities associated with implementing standards in software applications through development of tools.

Figure 3: Strategic Roadmap Activity Groups.





A: Activities to enable adoption and implementation of standards and BIM-GIS integration at client organizations
B: Activities for development of standards for data management: modeling, integration, publication and use
C: Activities for tools and technology development for supporting standards in coordination with software vendors

Figure 4: Strategic Roadmap Activities by Activity Group and Challenge-Opportunity Themes

Group 1 Activities: Establish Stakeholder Needs/Requirements

As outlined in the section titled Business Domains and Use Cases, it is important to first identify the needs of stakeholders with regard to BIM and GIS data connections and to raise awareness around the priority use cases and business benefits of using standardized approaches to make these connections. To accomplish this, the following activities could be carried out within each business domain:

- A0. Increase awareness around BIM and GIS data integration.
- A1. Develop detailed case studies based on past efforts on BIM-GIS data integrations that have resulted in significant benefits realization.
- A2. Continually solicit use cases and user stories from business domains covering all life cycle phases and constantly prioritize them using user-driven criteria around performance benefits.

Group 2 Activities: Align OGC and bSI Working Groups and Create Geo+BIM Working Groups

Based on the identified priority business use cases and datasets in each domain, assess the readiness of available standards for data modeling and implementation in software applications. From a standards alignment perspective, during this process, it is important to take note of instances when multiple open data standards (e.g, IFC, CityGML) support standardized data modeling. This work would involve the following activities:

- B1. Create governance framework for data management: data modeling, quality, connections, and linked data system.
- C6. Collaborate across standards development organizations (SDOs), software vendors, and BIM/GIS consultants to develop both data and software products.
- C1. Establish programmatic partnerships with software vendors.

Group 3 Activities: Develop Data Standards Deployment Toolkit for Domain Business Group

Under this group of activities, data standards and associated software toolkits will be developed to pave the way for deployment of these standardized BIM-GIS data modeling and linking in software applications. The following standard development activities were identified:

- B3. Build modular and aligned open data modeling approaches for Industry Foundation Classes (IFC) and OGC data standards to enable data transactions.
- B5. Establish metadata modeling standards.
- B6. Create data model (including digital twin) templates and development guidelines from single sources of truth.
- B4. Establish data interoperability standards and guidelines across modeling levels.
- C2. Establish guidelines for consistent implementation of open standards across software systems via toolkits.

Group 4 Activities: Coordinate with Software Vendors to Incorporate Toolkit in Various Software Applications (by domain, business area)

After the development of software standards and associated toolkits, the next step is to find ways to enable adoption and use of these standards and toolkits. One way to do this is to support these tools in the software applications that are used by stakeholder entities. This involves working with software vendors to demonstrate how software applications can incorporate these tools for use by agencies in development of open-standard based connected BIM-GIS data models and data exchange processes. The following activities associated with software vendors were identified in the roadmap:

- C3. Coordinate with software and technology vendors to support open standards in their roadmaps.
- C4. Establish web services (e.g., Application Programming Interfaces or APIs) to support data validations and integration.
- C5. Develop requirements for BIM and GIS tools and technology.

Group 5 Activities: Develop Agency Training and Onboarding Resources

In addition to building support for the developed standards in software applications, it is also important to establish data modeling, exchange, sharing, and publication guidelines to enable relevant stakeholder entities to develop processes, policies, resource skill requirements, and business use protocols to implement the use cases with the help of the readily available software tools. Therefore, the following agency training and onboarding activities were identified to ensure that the developed standards can be taken stakeholder entities for incorporation into their processes:

- A5. Establish governance guidelines for data modeling and exchange.
- A3. Create training programs.

The roadmap activities presented in Figure 4 must be executed in an agile manner for each of the business domains and identified use cases in the domain. The agile approach involves documenting and prioritizing use cases across various business domains and building a catalog of use cases and identifying interdependencies across business use cases (as well as domains). This will ensure that the business use cases and domains that need work by the same standard development working groups on similar data standards can be combined and can be worked on together.

Using the backlog of use cases, a shorter sprint[1] backlog[2] can be created, in which each sprint spans a certain period (e.g., a quarter, six months). Activities across all groups could be performed during the sprint to ensure end-to-end assessment of the developed data management toolkits. This process should include stakeholder inputs and should also allow for updates to the backlog if additional development and deployment support tasks/needs are identified. Depending on the business domain and use case, the development of the toolkit can go through multiple such iterations over a 4-year roadmap period (as shown in Figure 4) to ensure that each iteration results in an improved version of the toolkits and that in each iteration the development and deployment feasibility of the toolkits is assessed in collaboration with stakeholders. Such an agile execution process ensures that all the roadmap activities are carried out in parallel within a single sprint and that each sprint provides inputs to the execution team on improvement opportunities. Incremental development and deployment feasibility assessment will also ensure that all stakeholders involved in the development process are growing together and are involved in planning for change.

[1]A sprint or an iteration refers to a set time period within which specific work needs to be completed and made available for review.

[2]List of tasks or priorities that need to be addressed.

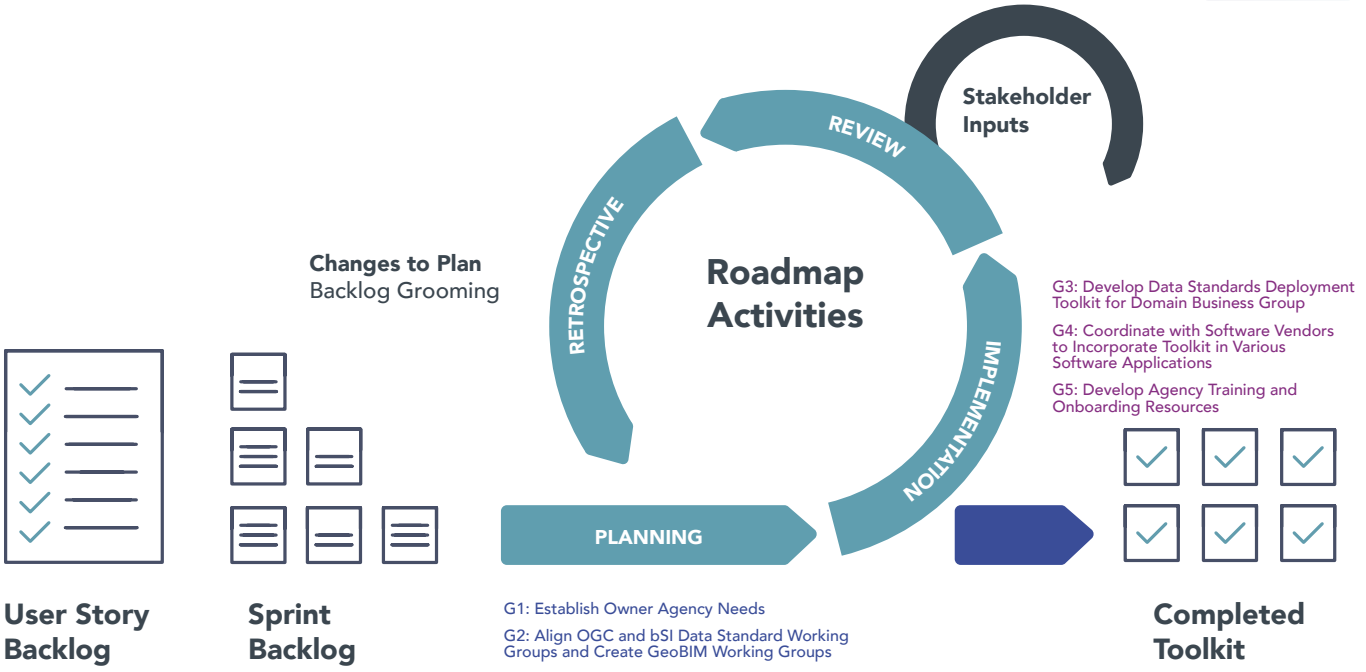


Figure 5: Iterative Execution of Roadmap Activities for Each Use Case Identified in a Domain.

6. Next Steps

As the initiative moves forward, the following steps have been recognized as being crucial for shepherding the roadmap's identified activities:

- Publish the roadmap for public review and comment.
- Form a steering committee to oversee the roadmap's implementation through facilitated meetings organized by bSI and OGC.
- Re-issue calls for pilot projects to test and refine the BIM-GIS data connection strategies for client-prioritized use cases.
- Enhance visibility and engagement of the roadmap's activities within the bSI and OGC communities to ensure widespread adoption and support.

7. Conclusion

The strategic roadmap toward BIM and GIS integration represents a forward-thinking, practical and results-oriented collaboration aimed at enhancing the digital ecosystem that fuses data modeled and linked at differing scales across various sectors. By prioritizing open standards and stakeholder engagement, this initiative lays the foundation for a more integrated, efficient, and sustainable approach to managing the built environment's lifecycle.

8. Public Notice

The roadmap development committee seeks public comments on the planned roadmap activities described in this roadmap. Please direct your comments on this document to the attention of:

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9. Acknowledgements

The roadmap activities described in this document were a result of contributions from the following members of the buildingSMART International (bSI) and Open Geospatial Consortium (OGC) communities:

Abhishek Bhargava, WSP

Clive Billiald, bSI

Christophe Castaing, Consultant

Michelangelo Cianciulli, ACCA

Marc Goldman, Esri

Leif Granholm, ex-Trimble

Ian Howell, bSI

Richard Kelly, bSI

Jagannath Mallela, WSP (Chairman)

Francesca Noardo, OGC

Kimon Onuma, Onuma Inc.

Dr. Erik Poirier, École de technologie supérieure

Michel Rives, Via-Nova

Greg Schleusner, HOK

Scott Simmons, OGC

Ingo Simonis, OGC

Daniel Soderlindh, Trafikverket