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EMPIRICAL VALIDATION OF BIM-TO-DIGITAL TWIN TRANSFORMATION FOR SMART MOBILE FACTORIES: A CASE STUDY

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Abstract

The BIM approach has become a standard in the construction sector, supported by improved data-sharing protocols across software and regulations promoting its extensive use in various countries. The Digital Twin concept is needed to fully use BIM at the dimension of Building Management). This transformation involves automatic and bidirectional data updates and data collection through sensors and actuators linked to the static BIM model. This article explores a real case study that tests an initial interoperability framework between BIM and DT.

Introduction & Motivation

The construction industry is undergoing continuous evolution, driven by the pursuit of emerging technologies and practices that enhance project delivery, streamline operations, and improve overall efficiency. In recent years, the sector has shifted significantly from traditional methods toward the adoption of Building Information Modeling (BIM) as a collaborative platform for building design, construction, and management (Mousavi et al,. 2024). However, as the industry's demand for more sophisticated digital solutions grows, the essentially static nature of BIM data can present challenges for effective application in dynamic site operations and maintenance (Sacks et al., 2020). These limitations can be overcome by enriching the BIM model with sensor data, evolving it into a Digital Twin. A DT provides a virtual representation of a physical asset—such as a building—drawing on real-time data from sensors, systems, and other sources (Sacks et al., 2020). This approach enables the monitoring, analysis, and bidirectional simulation of key performance parameters over the asset's entire life cycle. In the construction sector, a DT incorporates information ranging from architectural and engineering data to sensor inputs and building system specifications (Singh et al,. 2021), and it is typically realized through a combination of BIM, Internet of Things (IoT) devices, cloud computing, and data analytics (Eneyew et al,. 2022). The main objective of implementing DTs in construction is to deepen understanding of project characteristics and resources allocation, facilitate scenario-based simulations, optimize performance, and support data-driven decision-making across all project stages (Jiang et al. 2021). During construction activities, DTs enable architects, engineers, contractors, and facility managers to visualize the project, assess its operational behavior, identify potential issues, and make data-supported adjustments that enhance efficiency, sustainability, and safety (Mi et al,. 2021). With respect to building management and the activities carried out within facilities, the integration of real-time data and advanced analytics further enables predictive maintenance, fosters the integration of multiple systems, and supports effective resource management (Omrany et al,. 2023). A DT can also help in identifying and mitigating occupational risks, optimizing energy consumption, and improving overall operational performance (Zhang et al. 2024). By merging BIM with the DT concept, stakeholders gain access to a holistic and dynamic representation of built assets, enabling advanced monitoring, predictive analysis, and operational optimization (Alnaser et al,. 2024). This paper presents an empirical test to configure a BIM model in order to facilitate its subsequent evolution into a DT, illustrated by a real-world use case developed within the European SMF4INFRA project. Overcoming challenges such as data interoperability, real-time synchronization, hardware limitations, and user adoption is crucial to achieving seamless integration and widespread acceptance of BIM-DT solutions in the construction industry (Revolti et al,. 2024). The proposed approach is consistent with current research trends that advocate for semantic enrichment, middleware-based integration, and ontology-driven data modeling as key strategies to overcome interoperability challenges between BIM and IoT systems. In particular, the works of Zhou et al. (2022), Bilal et al. (2020), and Pauwels et al. (2017) underscore the importance of enabling seamless data exchange and real-time interaction between static digital models and dynamic physical environments. In line with these studies, the framework presented in this paper seeks to extend the applicability of BIM beyond the design and construction phases into active building management, facilitating bidirectional data flows and fostering a continuous, responsive link between virtual representations and real-world operations.

Research Methodology

An empirical test aims, through the creation of an initial working prototype, to collect information and observations thanks to which, at a later stage, systematic protocols can be deduced and the first validations of the theories hypothesized can be made (ter Beek et al,. 2022). To align more closely with case study research standards, future iterations of this prototype will adopt a structured methodological framework, including defined research questions, comparative benchmarking against existing DT implementations, and measurable outcome metrics such as system responsiveness, data accuracy, and user interaction performance. These additions will support the empirical validation and enhance the reproducibility and generalizability of the findings. The aim of this research work to be presented is to achieve an initial complete prototype for the evolution of a BIM model into a DT, even though it may not yet be fully standardized or automated. The discussion and conclusion sections will highlight the main results, limitations, and future research directions. The following development phases, summarized here, will be presented:

- Definition of the Use Case
- STEP1 - Preparation of the BIM model
- STEP2 - Porting Rules into Unity environment
- STEP3 - IoT Integration and Data Interaction

Empirical Test

Definition of the Use Case

In the following paragraphs, the various steps undertaken to develop this empirical use case will be described and explained in detail. The process begins with the creation of a BIM model based on a real construction project. This model is carefully prepared to facilitate its subsequent integration into Unity, a platform where data from real sensors installed in the construction site or work areas will be read and updated dynamically. The creation of the BIM model involves accurately representing the physical structure, systems, and relevant details of the construction, ensuring that it is not only true to the actual building but also optimized for digital transformation into a more interactive and data-driven environment. This preparation includes adapting the model to support the integration of real-time data streams and enabling bidirectional interaction between the physical and virtual environments. The article will also explain the specific types of sensors employed for this test case, including their purpose, placement, and how they contribute to monitoring various aspects of the construction process or building performance. Examples of sensors might include those monitoring environmental parameters (e.g., temperature, humidity, or air quality), structural health (e.g., vibrations or stress on key elements), or worker safety (e.g., proximity detection or hazard alerts). Additionally, the technological choices made to achieve this initial demonstrator will be examined. This includes selecting the appropriate tools, software, and hardware to ensure seamless integration and functionality. The use of Unity as a platform is particularly significant, as it allows for the creation of an interactive 3D environment where real-time sensor data can be visualized and analyzed. Unity's flexibility and compatibility with BIM models make it a powerful tool for creating dynamic DT and enhancing decision-making processes in construction management.

STEP 1 – Preparation of the BIM model

A standard BIM model typically originates from a design-oriented workflow, focusing on accurate geometry, material specifications, and fundamental data for construction documentation (Dallasega et al,. 2021). While such a model excels in supporting design visualization and coordination, it may not inherently contain the dynamic, real-time information required for operations and management tasks (Dallasega et al,. 2021). To transform this static BIM model into a resource capable of facilitating facility monitoring, performance analysis, and decision-making, one can integrate it into a real-time environment—such as Unity—to form a Digital Twin. Through this process, the BIM model's geometric and meta-information is optimized, exported, and enriched with sensor data and analytics scripts, allowing it to reflect actual conditions and operational states. Once in Unity, stakeholders can interact with the model to visualize live sensor readings, simulate various scenarios, and make data-driven adjustments, turning a conventional BIM project into a powerful tool for comprehensive building management (Saif et al,. 2024). The creation of new IFC property sets (pSets) within a BIM model is a pivotal step in facilitating sensor connectivity for Unity-based DT. Initially, the relevant IFC schema (e.g., IFC4 or IFC4.3) was consulted to determine whether standard pSets adequately capture the desired sensor attributes, such as measurement intervals, thresholds, or device calibration requirements. In cases where predefined pSets were insufficient, custom pSets were formulated to house these additional properties, ensuring that each building element or space references the appropriate sensor-related data. This enrichment process typically involves defining the pSet structure in the BIM authoring tool (e.g., Revit or ArchiCAD) and linking each property to an IFC-compliant parameter. Once created, these pSets are assigned to the corresponding building entities (e.g., IfcSpace, IfcWall, IfcBuildingElementProxy) according to their intended sensor placement or function. As a result, each element in the BIM model contains the metadata needed to interface with real-time sensor feeds in Unity, thereby supporting the seamless transition from a static model to a fully interactive DT capable of reflecting real-world performance and conditions. The initial phase of the empirical test involved the creation of a Building Information Model (BIM) as a foundational framework, designed not only for static project visualization but also for potential real-scale (1:1) construction. This approach allowed for the testing of connections and the automation of subsequent DT development. The opportunity to create a BIM model that extended beyond static project purposes was given by the European project SMF4INFRA (https://www.smf4infra.net/). This project focused on developing a prototype of a mobile factory for the localized production of prefabricated components along linear construction sites, such as those envisioned for the Hyperloop (Dallasega el al,. 2023). A real pilot site was established in Dübendorf, nearby Zurich, under the supervision of the Eurotube Foundation, a project partner (Fig. 1).

Figure 1: Eurotube FieldLab

The design hypotheses regarding the factory's forms and materials (Dallasega et al,. 2024), as well as the Life Cycle Assessment (LCA) analysis to optimize the environmental impact of the prototype and the movement of the factory, have been addressed in specific scientific articles (Ma et al,. 2024). Consequently, this article concentrates on presenting the pilot site and detailing the steps necessary to transform the BIM model into a DT. The so-called Eurotube's FieldLab includes the construction of a 120-meter linear tube segment infrastructure to test vacuum creation technologies and cabin high speed vehicle movement transport systems. The selected site is a decommissioned military airfield that will host additional buildings and laboratories for local Swiss universities and institutions ETH in the future. The construction of the hyperloop infrastructure will require the fabrication of concrete tube segments of 2 meters, which are then assembled in pipes of 20,00 meter length. These pipes include support bearings to be positioned on foundation piles and during installation, the pipes will be connected and made airtight with dedicated joints. The production of ring-shaped elements takes place on-site using two molds specifically designed for this purpose. The factory's workspace allows for the movement, curing, assembly, and final installation of these elements on the foundations. The developed BIM model comprehensively represents the factory, reflecting its real-world dimensions and volumes (Fig. 2).

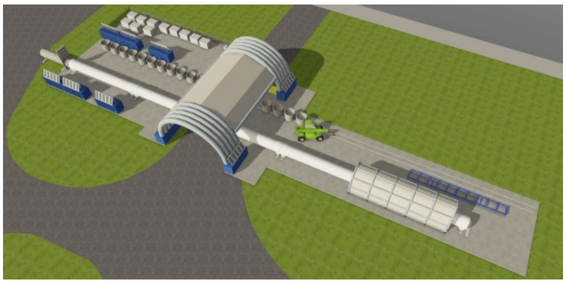

Figure 2: SMF BIM Model

Furthermore, all the dedicated machinery and systems involved in the operational phases of tube creation have been fully modeled (Fig. 3), with their power and capability characteristics.

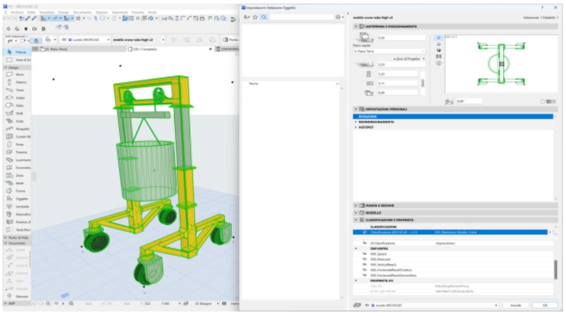

Figure 3: Mobile crane asset block

Particular attention has been paid to the design of access routes and the movement of objects within the factory to ensure an efficient workflow. To facilitate the transition of the BIM model to Unity for its evolution into a DT through the integration of IoT sensors, custom IFC properties and families were created within the model. The software used for this empirical test was Archicad 27, though the same procedure can be applied with other BIM software, such as Revit and Allplan. Specifically, a new IFC Property Set (P-Set) was developed to create a repository for updating IoT sensor data. The properties of the p-set are defined as follows:

Table 1: New IFC Property Set (P-Set)

Property Name	Data Type	Description
SensorID	IfcIdentifier (String)	A unique identifier for the sensor, e.g. "TempSensor-001".
SensorType	IfcLabel (String)	Type/category of the sensor, e.g. "Temperature", "CO2", "Motion", Etc.
MeasurementRange	IfcReal	Range of sensor measurement, e.g. 0-1000 (Unit).
MeasurementUnit	IfcLabel (String)	Unit of Measure, e.g. "C", "ppm", "m/s", "lux", etc.
Accuracy	IfcReal	Accuracy or tolerance of the sensor (e.g. +0,5 °C).
CommunicationProtocol	IfcLabel (String)	The communication method/protocol used by the sensor, e.g. "BACnet", "Modbus", "LoRAWAN", "ZigBee".
DataUpdateRate	IfcReal	The frequency or interval od data updates (e.g. every 60 seconds).
Manufacturer	IfcLabel (String)	Name of the manufacturer.
Model	IfcLabel (String)	Model number or ID of the sensor device.
LastCalibrationDate	IfcDateTime	Date/time stamp of the most recent calibration.
Status	IfcLabel (String)	Current operational status (e.g. "Active", "Faulty", "Maintenance Required").

In this instance, properties such as humidity sensors, temperature sensors, and CO_2 variation sensors were created and subsequently assigned to the relevant assets of interest. The creation of this P-Set represents an initial effort to standardize the bidirectional exchange of data between the physical model and its digital counterpart, paving the way for enhanced interoperability and real-time synchronization in DT applications (Fig. 4). The creation of custom Property Sets (P-Sets) within the BIM model was carried out following the logic and structure of standardized property sets defined by buildingSMART.

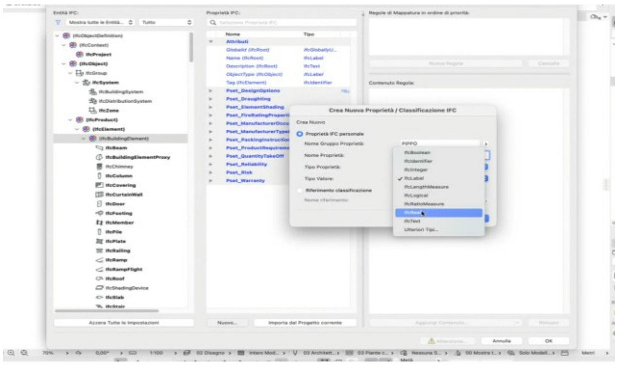

Figure 4: Pset Definition interface

These P-Sets were specifically developed to ensure compatibility with the IFC4/IFC4.3 schema and were assumed to conform to OpenBIM principles, ISO 16739-1:2018 (Industry Foundation Classes), and ISO 19650 (information management using BIM). This approach ensured that the enriched BIM model remained interoperable with existing industry standards while extending its capacity to accommodate real-time sensor data required for the implementation of the Digital Twin.

STEP 2 – Porting Rules into Unity environment

To begin integrating a BIM file into Unity for a DT application, the operator must first prepare and export the model into a Unity-compatible format, such as FBX or IFC. This preparation process is crucial for optimizing the performance of the DT in a real-time environment. It typically involves optimizing the geometry, reducing polygon counts, and consolidating materials to ensure that the model performs smoothly without sacrificing visual fidelity. The optimization ensures that the model can be rendered efficiently in Unity without causing excessive load on the system. Once the model is prepared, the operator can export it, ensuring that all necessary metadata, textures, and materials are included in the export. Unity provides a powerful development environment for integrating 3D models, and setting up the project appropriately is essential for smooth development. The operator can then import the exported files through Unity's "Assets" menu, ensuring that all accompanying textures, materials, and metadata are properly included. Unity automatically generates meshes, materials, and prefabs during the import process, which can be easily managed within the "Project" folder. Proper asset management is important for keeping the project organized, especially when dealing with complex models. Once the model is successfully imported into Unity, the visualization of the digital model is built into the Unity Scene view. This is done by dragging and dropping the prefab or main mesh of the model into the Unity Scene view. This allows the operator to visually place and position the model within the digital environment. At this stage, it is helpful to create an empty GameObject, such as "BIM_Root," which acts as a container for the building model's hierarchy. Nesting the imported meshes under this root object simplifies the process of manipulating, scaling, and referencing various parts of the model. By organizing the model in this way, it becomes easier to handle different components, such as individual rooms, HVAC units, or other possible subsystems. To establish a connection with the database containing real sensor data, the next task is to determine appropriate communication protocols. This step is crucial as it dictates how Unity will interact with the backend systems to retrieve and visualize the live data. Whether using a REST API, WebSocket, or another communication method, setting up this protocol ensures that the BIM model can dynamically reflect changes in real-time based on sensor inputs, providing a more interactive and responsive DT application. To facilitate these steps and achieve a working environment already calibrated for the needs of a complex BIM model, it is possible to use the following specific plugin and libraries:

Unity Reflect: This is an Autodesk Plugin that can directly connect with Revit and other BIM software. It allows live updates and smooth integration of BIM data into Unity.

IFC to Unity: Some tools and libraries can help import IFC files directly into Unity, like the IfcPlusPlus library or BIMserver.

Unity's interface provides an integrated workflow for managing 3D models, layers, assets, and coding. The Scene View allows direct manipulation of objects, while the Game View previews real-time execution. The Hierarchy Panel organizes GameObjects hierarchically, enabling structured scene management with layers and tags for rendering and physics control.The Project Window centralizes asset management, organizing 3D models, textures, scripts, and prefabs. The Inspector Panel dynamically displays properties, allowing real-time modifications. For coding, Unity integrates with Visual Studio, where C# scripts define behavior, while the Console Window helps debug issues. Unity's Scripting API provides access to physics, animations, and UI control (Fig. 5).

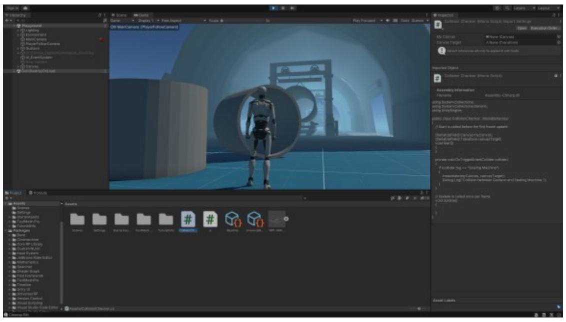

Figure 5: Unity Environment

Common approaches include REST APIs, WebSockets, or direct database connections via specialized plugins. For instance, if using REST APIs, create a C# script that periodically calls the endpoint to fetch sensor readings, parse the returned JSON, and update corresponding objects in the scene. If you opt for direct database access (e.g., MySQL or SQL Server), include the relevant .NET data providers in Unity's "Plugins" folder and write a script to open connections, execute queries, and retrieve results. Whichever method you choose, it is essential to map the incoming data to the correct elements of the BIM model (e.g., linking room temperature data to a specific IfcSpace). By placing these scripts on relevant GameObjects or controller scripts, Unity can continuously synchronize real-world sensor readings with the 3D environment, thereby enabling a true DT experience.

STEP 3 – IoT Integration and Data Interaction

For this empirical test, real sensors were used, embedded within the concrete molds (for temperature and humidity) or installed near the working areas (for carbon dioxide variation). The molds that were required for the casting process of the concrete rings are created in the BIM and connected to databases collecting the, real datasets from databases imported into the Unity environment. (Fig. 6).

Figure 6: Casting Area of the SMF

The sensor network has been designed with two objectives in mind: first, the network should be able to be dynamically increased or reduced, depending on the SMF size and the number of processes that are required for the construction; second, low cost highly available IoT sensors not only to leverage the possibility of scaling the system and have redundant data sources as required but also to allow to easily substitute sensors in case of malfunctioning. With this approach, the integration in the construction project becomes modular and requires minimal resources. The sensors used are easily available for just a few euros and the proposed IoT framework is easily expandable with any number of sensors and commonly used communication protocols, modifying the sensor type or repurposing the system across construction phases do not present any particular issues or additional requirements. (Fig. 7).

Figure 7: Temperature, CO_2, humidity Sensors

In this particular example, the focus was on temperature and humidity coming from the casting process, measuring these properties in the concrete pieces. Similarly, the environmental properties as well as the increase in carbon dioxide produced during the construction in the site is measured. To integrate this data with the local server (located at the Eurotube facility) hosting the BIM model in the Unity environment via SOAP APIs, a pipeline was developed to ensure data transfer, management, and visualization. The following list presents the schematic overview that was employed during the test:

1. *<u>Sensor Data Collection</u>*
   - Sensors: Collect real-time data (temperature, CO2, humidity) from physical sensors.
   - Data Storage: Data is stored in a Database (e.g., MySQL, SQLite, PostgreSQL).
2. *<u>Backend API (REST)</u>*
   - A RESTful API is built to allow communication between the Unity environment and the sensor database.
   - API Functions: The API exposes endpoints to retrieve real-time data from the database.
     - GET /sensor-data/temperature
     - GET /sensor-data/co2
     - GET /sensor-data/humidity
     - These endpoints return the latest sensor readings in JSON format.
3. *<u>Database (SQL/NoSQL)</u>*
   - Database Tables:
     - Temperature_Readings (id, value, timestamp)
     - CO2_Readings (id, value, timestamp)
     - Humidity_Readings (id, value, timestamp)
   - Database Query: When the API is called, it queries the relevant table for the latest sensor readings.
   - Example query: SELECT value FROM Temperature_Readings ORDER BY timestamp DESC LIMIT 1
4. *<u>API Server</u>*
   - The server runs the backend logic and serves the data to the Unity application.
   - Endpoints:
     - /sensor-data/temperature: Returns the latest temperature reading.
     - /sensor-data/co2: Returns the latest CO2 level.
     - /sensor-data/humidity: Returns the latest humidity reading.
   - The API is exposed over HTTP/HTTPS, allowing Unity to query for real-time data.
5. *<u>Unity Application (BIM Model)</u>*
   - Unity Project: The BIM model is imported and structured within Unity. It can represent physical objects like rooms, HVAC systems, or environmental elements.
   - REST API Calls: Unity uses HttpClient or similar libraries to call the REST API endpoints. To ensure secure transmission and management of sensitive sensor data, the system architecture incorporates data protection mechanisms aligned with best practices for industrial IoT applications. All REST API

communications are planned to be encrypted using HTTPS with TLS protocols, preventing unauthorized access or tampering during data transmission. Furthermore, access to sensor data and control endpoints will be regulated through authentication protocols and role-based access control (RBAC), ensuring that only authorized users and systems can view or modify information.

- Data Visualization: Based on the data received from the API, Unity modifies the BIM model in real-time. In the example tested, the temperature and humidity have direct impact in the time required for the concrete to develop the required strength for transportation and assembly. Similarly, the final quality of the concrete might be affected if sharp changes in environmental conditions during curing is recorded. If in the digital model the environmental conditions are triggered, the system send an alert to the operators.

- Data Updates: Periodically, Unity queries the API to get updated sensor data (using GET requests).

6. *Data Flow*

- Sensor Data: Sensors → DB (SQL/NoSQL)
- API Request: Unity → API → Database
- Data Response: API → Unity → BIM Model
- Real-Time Updates: Unity reflects real-time data in the BIM model by modifying elements or triggering events based on the retrieved data.

With the proposed strategy the sensors transmit the detected data to a microcontroller or gateway, which processes and sends the data to the server using SOAP APIs. These APIs, based on the XML protocol, require data to be formatted according to WSDL (Web Services Description Language) schemas, ensuring compatibility with the server. The server is configured to receive, process, and store data in real-time or near real-time in a relational database. Unity, using a scripting engine in C#, queries the database via REST APIs or specific SDKs to connect to the server, dynamically updating the BIM model and visualizing sensor data in real time through overlays or 3D graphics. Obviously, the data flow has been designed to be bidirectional, meaning it will allow commands (automatically once fully operational) to be sent to actuators in the real world. For the sake of completeness, the graphs made from the data collection are shown. The trend of the curves is perfectly in line with the drying times of the CLS (Fig. 8).

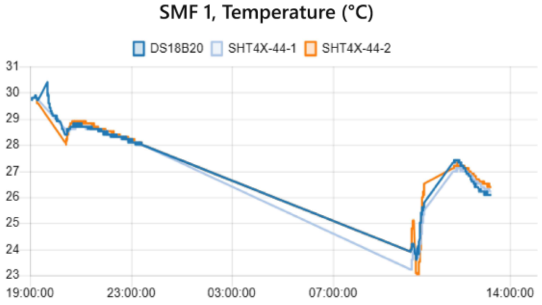

Figure 8: Temperature Graphs

Within the model, a digital avatar was used to interact with the DT and retrieve real-time sensor data from the physical molds. Although no automatic actuators have been activated at this stage, to ensure the validation of the process and the feasibility of its implementation, it is possible to manually trigger an alert signal to halt production or modify specific parameters of the manufacturing processes. The use of this avatar can subsequently be enhanced through the integration of virtual reality (VR) and augmented reality (AR) devices (Fig. 9). This will enable the operator to interact with or visualize data firsthand while navigating the model. Additionally, the operator will be able to open specific dashboards, carefully designed to provide interpretations and alerts regarding the progress of work and the working environments within the factory.

Figure 9: XR visualization of the DT

Discussion, Limitations, and Future Directions

This initial attempt at creating a functional DT for use during the operational phase of a building (an industrial one in this case) has yielded an encouraging initial success. The BIM model, specifically designed with the appropriate Property Sets (P-Sets) for the sensors used in the test, enabled a seamless connection between the real world and the digital world without the need for manual interventions. The process of porting the BIM model into Unity using the IFC format allowed the classifications and embedded data to be preserved without any loss of information, ensuring consistency and reliability in the transition. The integration of REST APIs facilitated a streamlined connection and efficient management of the local databases. As a result, it became possible to remotely visualize a digital model enriched with real-time data from the physical environment and make informed decisions to intervene and modify ongoing situations. This real-time interaction demonstrated the potential of the system to bridge the gap between physical and digital environments effectively. However, one of the key limitations of this test was that actuator interventions were not yet automated. The process still relied on manual inputs to trigger alerts or modify certain parameters. A follow-up article specifically addressing this topic is currently under preparation and will outline the steps required to automate the process fully, marking a significant evolution in the practical implementation of DTs. Another limitation was the relatively small number of sensors deployed during the test. While all the sensors used supported data migration via REST APIs, future applications may encounter scenarios where alternative API protocols or data transfer methods are required. The flexibility and adaptability of the system to handle diverse data migration protocols remain areas for further exploration. Lastly, not all possible file formats for importing BIM models into Unity were tested in this experiment. Exploring other formats might yield varying results regarding the retention of classifications and data integrity. This could open up additional opportunities for optimizing the BIM-to-DT transition process depending on the specific use case or software environment. Moreover, this work does not provide a comparative analysis against existing BIM-to-DT transformation methodologies. Incorporating benchmarking with state-of-the-art approaches will be essential to contextualize the advantages and limitations of the proposed framework in terms of interoperability, performance, and implementation effort. Additionally, while the current validation was conducted within a single pilot environment, future studies will need to assess the system's scalability and practical usability across varied construction scenarios and asset typologies to ensure broader industrial applicability. Despite these limitations, this test represents a significant starting point and lays the groundwork for future experimentation. It underscores the potential for evolving static BIM models into dynamic, automated Digital Twins. To complement the current technical validation, a more comprehensive assessment of system adoption and stakeholder engagement is planned for 2025 in collaboration with the EuroTube Foundation. This next phase will include the structured collection of qualitative feedback from field operators and technical personnel, alongside the development of a SWOT matrix to identify the system's strengths, weaknesses, opportunities, and threats in a real operational context. In parallel, the upcoming test campaign will introduce the use of key performance indicators (KPIs) to assess how sensor-derived data supports decision-making in construction workflows. KPIs will include metrics such as curing delay prevention, frequency of manual safety interventions triggered by environmental thresholds, and responsiveness of the system to real-time alerts. This combined technical-strategic evaluation will provide valuable insights into organizational readiness, integration barriers, and the operational benefits of a data-informed BIM-DT system, ultimately supporting its broader applicability and scalability. By addressing the challenges identified on this initial success, future developments could significantly enhance the integration and functionality of DTs in the industrial and construction sectors.

Conclusion

This paper aimed to present an initial empirical test of the implementation and evolution of a BIM model into a DT. To achieve this, a use case, the relevant technologies, and the sensor systems enabling the creation of a functional DT prototype were outlined. The Field Lab by EuroTube is the first real scale implementation of the BIM-Digital Twin system within a dedicated construction site. This implies the unique possibility to benchmark and, then, refine the proposed approach in the future, closing the gap between the research development and the construction industry. Despite its limitations, this article serves as a starting point for further research, which will contribute to the development of a procedural framework. This framework will be proposed as a potential contribution to the standardization efforts led by the Standards Committee Executive of the international association buildingSMART(www.buildingsmart.org/standards/organisation/standards-commitee-executive), the governing body responsible for defining future OpenBIM regulations. As part of this effort, custom property sets (P-Sets) for sensor data will be developed to ensure full compatibility with the IFC4/IFC4.3 schema and will adhere to the logic and structure of standardized P-Sets established by buildingSMART. The significant heterogeneity still present in both the construction of BIM models—already designed for future sensor integrations—and the frequent lack of proven interface and reliability between unspecialized IoT systems, each with its own protocols and functionalities, currently hinders the effective implementation and use of Digital Twins in the construction and O&M sectors. Therefore, there is an urgent need for the establishment of well-defined rules and clear, as open as possible, data exchange protocols. The testing setup presented in this article represents a first step towards providing a validation of this framework at the industrial level, allowing reliable, consistent and informative insights in complex construction sites in harsh conditions.

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