

buildingSMART International (2022)
358-ASSET Asset Management using openBIM



AbQOJKWe

ChorusLife: Creation and maintenance of an openBIM Digital Twin for asset management

Entrant details

Role or Job Title on the Project | Consultant/operations

Employer

| Engisis Srl, Rome, Italy

Employer Role | Other

Are you or your employer a member of buildingSMART? | Yes - Chapter Member

Entry details

Entry Details

By checking this box I understand and acknowledge that this awards program is to assess information about openBIM, and that openBIM is not only about the use of solutions. openBIM is about setting up an environment where every party in a team can work in the optimal way ("how they prefer") without putting limitations on others. It is about freedom to take control over your data and workflows, while keeping that freedom for others as

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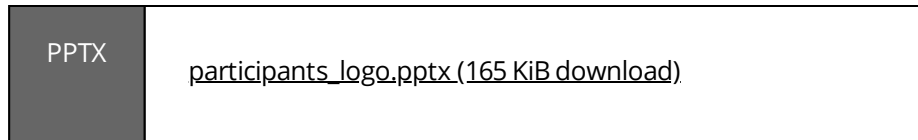
well. Full use of open standards is not mandatory for this mission.

Website | <https://chorus.life/en/home.asp>

Location

The ChorusLife smart city project is being developed in Bergamo, Italy. We worked with the group (COSTIM) that is responsible for the construction and for the asset management of the entire smart city that is being built. The group is based in Bergamo, Italy. We (Engisis) are based in Rome.

Submitting Party and Stakeholder Logos (compiled into one .ppt/pptx file for upload)



Entry Description

Chorus Life is an ambitious project aimed at creating a Smart District. This district is currently under construction, and it comprises around 70,000 square meters, with the following areas:

- Commercial area with retail, food court, service stores and others, restaurants,
- Parking spaces,
- A wellness center and a sport palace,
- A residential area with apartments,
- Hotels,
- An arena for concerts,
- A communal gym,
- A green surface area (park).

The Smart District allows users to interact with the surrounding environment so that they can fully benefit from it. This interaction enables a wide range of services, which are simple to use and environmental friendly. Examples of such services include the automatic reservation and payment of a parking slot, the monitoring of the energy consumption in the apartments, and the participation to events organized in the arena.

The idea is to offer **building-as-a-service**, through an integrated digital platform that will enable users to fully interact with the district itself.

COSTIM is in charge of both the construction and the maintenance of the whole district, including the platform needed to provide the associated services. This platform is called GSM: it is a digital environment that collects and transforms data provided by a set of technological solutions, such as the IoT systems, the hotel reservation application or the software (and hardware) for access control. GSM integrates the digital infrastructure and the plant engineering systems, favoring the exchange of information for the benefit of the individual and the community.

In order to provide some services, COSTIM needs the support of a **digital twin**, to be integrated in the GSM infrastructure. Thus, COSTIM has decided to use ChorusLife as a living lab to promote and experiment research and development activities on the digital twin. This development is aimed both at improving the processes themselves and at expanding and optimizing the "ChorusLife user experience".

To go forward with the living lab, **COSTIM engaged with IBN, Minnucci Associati and Engisis** to find a strategy to:

- understand the role played by the openBIM models in the creation of the digital twin of ChorusLife,
- maintain the digital twin over time, and
- define the asset information requirements for the delivery of the openBIM models for the digital twin.

openBIM was the strategic choice for several reasons.

- First, the BIM model needs to be integrated in several applications: a model viewer, a Building Management System (BMS), the Azure Digital Twin (ADT), a Computer-Aided Facility Management system (CAFM), and others. These systems share part of the information that is contained in the BIM models. If this information was in proprietary formats, specific integrations (and interpreters) needed to be developed, thus adding a cost to the project;
- Second, we had to find an approach that COSTIM could easily replicate in other projects. A closed approach would have limited the applicability of the solution to the same software context;
- Last, but not least, we needed a long-term approach, that would ensure the maintenance of the digital twin in 5 to 10 years. A closed approach would have not guaranteed such a timeline.

Thus, within the ChorusLife living lab we defined and tested an approach to develop a digital twin based on IFC:

- the asset information requirements were mapped to IFC;
- the BIM authoring tools were set so as to correctly export IFC;
- the IFC schema was used as (part of) the data model of the Azure Digital Twin;
- the IFC models (instances of the schema) were used to populate the Azure Digital Twin;
- the IFC models (instances of the schema) were used to populate the CAFM;
- the GUIDs of the objects in the IFC models were used as parameters of the webservices developed to integrate the IT systems.

The approach that we adopted consisted of the following **steps**:

1. We identified the scenarios and use cases that the customer wanted to implement;
2. We defined an holistic method to the set-up of the digital twin. This method included the analysis of homogenous information sets (containers) and a datamodel of the digital twin (which included the IFC data model);
3. We specified the Asset Information Requirements (AIR);
4. We tested 1, 2, and 3 through the development of a Proof a Concept (POC) that focused on one apartment of the campus and that implemented several use cases.**

The **challenges** that we successfully overcame are the following:

- We listed and described all the scenarios and the use cases that had to be supported by the digital twin. For each scenario, we defined if an openBIM model was useful (some scenarios didn't need BIM models at all).
- We understood and formalized the relationship between the information contained in openBIM models (mainly spatial structure, systems and elements) and the rest of the digital twin information (such as sensors data, maintenance activities, etc.)
- We tailored a Microsoft product (Azure Digital Twin) to IFC, and we tailored its APIs to retrieve and update the representation of the objects coming from the IFC models.
- We linked the IFC data model to other data models (such as the REC ontology).
- We identified the assets, mapped them in IFC, and defined in which use cases each asset was involved. This drove the path towards the definition of the AIRs in IFC.
- We defined several information containers (17 for each asset). For each container we understood which trigger events demanded its creation/update/visualization/archival, and which system was the master for that information container. For 8 information containers the IFC models were the master.

Overall, **COSTIM was very satisfied with the achievements of the living lab and thus further investments might fall in this direction.** In fact, COSTIM will be able to evaluate the procedures to be implemented, the necessary resources and the consequent advantages of integrating the operating methods with the use of the virtual model of the building, acquiring a broader vision of the potential of the latter and the importance of its update over time.

What stage of completion is the entry content representing?

Working Proof Of Concept (POC) of the system integration, developed during the Design Development phase

Stakeholder Statements

Ares Frassinetti, General Director of Impresa Percassi Spa, part of COSTIM group:

Through the lab and the proof of concept we have shown how openBIM is fundamental to revolutionize the way of managing assets, even large ones, such as a smart city. Surely we will reuse this approach in different business projects.

Ing. Jacopo Palermo, CEO of COSTIM:

The project for system integration for ChorusLife replies to the need of digitalization of the real estate industry and enables the users to enjoy all the services offered through the integrated platform.

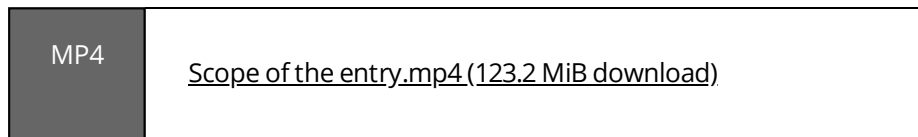
Ing. Ernesto Minnucci, Technical Director and Founding Partner, of Minnucci Associati s.r.l.

In order to face projects of such a huge size, interoperability is crucial, as it's the only way to ensure their correct management over time for the entire life cycle of the building. The usage of a Twin Model helps us to control the data flow by reducing the risk of data duplication and subsequent inevitable mistakes.

Costanza Benincasa, BIM Manager & R&D at ELMET GSM

Through this project we've deeply investigated the possibilities and the scenarios opened by the interaction between OpenBIM Models and the Digital data infrastructure made available through the GSM Platform. The most important lesson learned has been the importance of structuring a sustainable process and clear responsibilities for all the actors involved in the different stages for the development, the construction and the management of the asset, and the necessity to define structured scenarios and use cases to address with this tool. We strongly believe in the development of the Digital twin for the Building Management, and this PoC has set the basis for the current strategies and the future development of this tool and the related process inside of our GSM platform.

Upload a 2 minute video to show the scope of the entry.



openBIM Claim

Detailed description of openBIM used on the project or initiative

Within this project we have defined and tested an approach for the creation and the update of a digital twin based on IFC.

The openBIM based approach, in detail, consisted of the following steps:

- We defined the scenarios and the use cases that the customer wanted to implement in ChorusLife. Specifically, for openBIM, **we established if there was a need to visualize IFC models in each scenario.**
- We identified more granular use cases that were needed to implement the scenarios. **Westablished if each use case could be implemented starting from an IFC model (or from its visualization).** We also created a matrix that indicates if a use case is useful to the implementation of a scenario. The result was the understanding of the priority use cases.
- We listed all the type of assets that had to be represented in the digital twin of Chorus. We assigned to each asset type: an id, name, description, the system it belongs to, a PBS code, if it is an element/system/assembly, and if it needs to be included in the BIM model. **For the assets included in the BIM model, we also defined the IFC mapping (IFC Entity and TypeEnum).** We also created a matrix that indicates in which use cases each asset is involved.
- We organized the information containers, as sets of information that is homogenously managed in the platform. We understood in which trigger events (such as census, substitution, movement) each information container was

created/updated/archived/eliminated/visualized. Also, **for each information container, we defined if the IFC model was the master source of information.**

- **We defined the AIRs: for each IFC entity**, we defined the property sets needed for Chorus, and we defined which properties were part of which information container.
- **We invented an approach to incorporate IFC in the Azure Digital Twin (ADT).** This approach includes the creation of an ADT data model based on IFC and its connection to the REC (Real Estate Core) ontology. (<https://www.youtube.com/watch?v=g3p895vdrI8&list=PL3tG6f5UHC7ZcKUn8lKjk2YKLgyeW7vz> minutes 30.55-37.36)
- **We developed a Proof Of Concept (POC) to test this openBIM approach** based on a portion of ChorusLife.

Specifically, for the POC we did the following:

- We modeled a two-room apartment: we mapped all assets to IFC and we exported the BIM model both in proprietary (BIMx) and in an open (IFC) format. Note: the rest of the full ChorusLife IFC model was provided by the client prior to this activity;
- We created and instantiated the ADT Data Model (so-called creation of Digital Twin instances), based on IFC and the REC ontology.
- We prepared openMAINT (CAFM) by creating and instantiating the data model in the software, starting from the IFC model import;
 - We specified and developed integrations between the ADT with openMaint and BIMX, and integration between BIMX and openMaint. The GUIDs of the objects in the IFC models were used as parameters of the webservice developed to integrate the IT systems.
- We tested and documented the Integration, and we realized a demonstration video (provided in the Attachments section).

"We were able to innovate using openBIM."

We consider our approach as very innovative since it looks at IFC not only as a file format, but also as a common data model useful to integrate different solutions. Also, our approach implements IFC in software solutions that are not BIM tools (such as the Azure Digital Twin). Finally, it shows how IFC can be integrated in the wider digital twin ecosystem. Given the success and innovation of the approach, we are proud to declare that the customer, COSTIM, was very satisfied with the achievements. Further investments might fall in this direction.

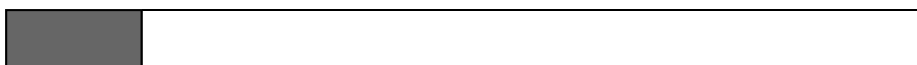
openBIM methods used	✓ IFC 4 ✓ IDM
Have you used bSDD to add additional extensions on top of IFC?	No
Level of Collaboration	✓ Multi-domain in two or more organizations

Information Requirements

PDF	AIR part 1.pdf (1.4 MiB download)
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openBIM Evidence

Software Ecosystem Map



PDF

[Software ecosystem map.pd... \(194 KiB download\)](#)

Process Maps

PDF

[POC Process Map.pdf \(1.3 MiB download\)](#)

openBIM Data Metrics Summary

PDF

[openBIM Data Metrics Summ... \(635 KiB download\)](#)

Additional openBIM Supporting Evidence

PDF

[Using IFC to create an Az... \(1.2 MiB download\)](#)

Lessons Learned

In conclusion, we learned that:

- Creating and maintaining a digital twin doesn't come for free: we had to analyze in detail the client's requirements for the use of the digital twin and recognize the cases where it was worth the investment. Also we had to recognize that not all the elements were worth to be included in the BIM models.
- We learned how to define a sustainable process to maintain the digital twin over time, in order to allow the client to manage the asset in the long run. This process is based on openBIM and on the identification of homogeneous information containers. As an example, some information is provided at the handover and will remain the same throughout the lifecycle, some other information is provided at the handover and will be updated during the operation phase, some other information is not provided at the handover and created during the operation phase, and finally some other information is not in the BIM models. Understanding how the IFC model had to be organized so as to incorporate the information containers was crucial.
- For the creation of the ADT data model and its instances, both the REC and IFC ontology were analyzed. We learnt that the REC ontology has limited semantics for the building part, and we decided to use as much as possible a consolidated standard already implemented by many solutions in the AEC sector: IFC. Thus, we kept from the REC ontology only what we could not derive from the IFC schema.

"We were able to identify where we need openBIM to develop further."

The POC needs to be extended to the whole ChorusLife district. Also, in the future, the approach might include the usage of bSDD for external classification and for the formal definition of the pSets included in the AIR.

Upload .ifc file(s) or other technical files to support validation of the research results.

<https://service.usbim.com/link/62a9e2b917de4eccc0f8514e>

Share any instructions for accessing the .ifc or other technical files for review.

The IFC model is in view only mode, as the download option in the ACCA platform was not available (It said "coming soon"). The use of the IFC models is only for the scope of the Awards. No other use is permitted at the moment, as specified in the document attached "Limited Use Disclaimer".

Use Cases

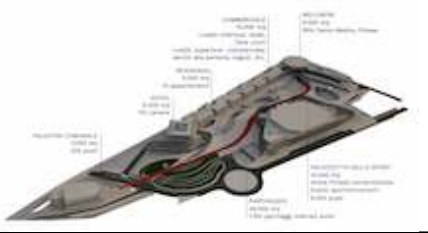
BIM Uses were defined on the project | ✓

BIM Uses formed an integral part to how the project was delivered | ✓

Documentation on use case(s) as a single file upload

PDF	use cases and scenarios.p... (1.4 MiB download)
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Log in to awards.buildingsmart.org to see complete entry attachments.


Type of attachment Image
CHL.PNG 1.4 MiB

PDF
Type of attachment Technical Documentation
AIR part 2.pdf 893 KiB

MP4
Type of attachment Video
POC ChorusLife... 516.7 MiB

PDF
Limited Use Discl... 377 KiB


Type of attachment Image
CHL-adt.PNG 1.2 MiB

