SATO

Self Assessment Towards Optimization of Building Energy

Deliverable 5.1

BIM-based interactive applications design

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Table of Contents

List of Figures

List of Tables

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SATO

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EXECUTIVE SUMMARY / ABSTRACT / SCOPE

This deliverable describes the design of the interactive assessment applications for the tertiary sector buildings end-users, based on the requirements and use cases identified in "T1.1. Analysis of actors, roles and interfaces related with A&O services" and "T1.4. Definition of use cases and operational test experiments". Innovative BIM-based interfaces will be used to allow projecting the building and equipment energy performance assessment directly into the building spatial 3D model. This task has been developed in parallel with "T 3.3. Development of BIM-based sensors placement assessment for desired level of SA&O of building and appliances" considering the requirements of the assessments during the design of the tool.

This deliverable presents the BIM environment and context in which Open BIM SATO tool will be developed, the users requirements (inputs and outputs) for the tool, the workflow with the SATO platform and finally, a preliminary design and idea of the tool that has been represented by a series of mock-ups.

1. Context analysis for BIM environment

Building Information Modeling (BIM) is a methodology for the Architecture, Engineering and Construction sector (AEC). BIM aims to create an ecosystem capable of connecting in a more efficient and cost effective way the different fields and phases of the design, construction and life cycle of a building. Therefore, BIM allows to bring together processes that in the past were carried out independently, as for example in the SATO project, the building design and the building monitoring.

BIM has brought new important concepts to the AEC sector as: Interoperability, Digital Twins, Internet of Things (IoT), Common Data Environment (CDE), Augmented Reality (AR), among others. These concepts and the respective technologies around them will enable the development of Open BIM SATO application.

Specifically for the context of SATO project, Open BIM SATO will allow users to display sensors in a BIM model of an existing building and retrieve information from the real sensors installed in the building, it also will allow users to create different assessment rules and apply them to the 3D model and data.

1.1. Open BIM

Open BIM is a methodology in which the importance of BIM lies in the capability of the software of exchanging information, and the possibility of accessing this information during the entire life cycle of the building, independently of the software program used to create the BIM model. The use of standardized formats ensures to the users the permanence and accessibility of the information generated in the project, and in this idea relays its importance.

SATO application will not only work in a BIM environment but in an Open BIM environment. The application will allow users to work in standardized formats (IFC, GLTF, JSON) instead of software proprietary formats, allowing cross collaboration among different software developers and permanence of the information.

1.2. State of the Art: BIM existing tools

There is a wide range of existing BIM tools addressing the different fields and problems of the AEC sector: from design, to energy efficiency, from structural calculations, to health and safety or IoT applications. Most of those applications are in continuous development and it can be said that most of them haven't reached its full potential. This section provides a brief overview of the available tools in the market regarding BIM modeling and BIM IoT.

1.2.1. BIM modeling

To work in Open BIM SATO application, it will be necessary to have created a BIM model which will be later loaded in the application.

Among BIM modeling solutions, we can find paid and free to use solutions, also some of the BIM modelers are based on proprietary formats, meanwhile other solutions are based in standardized formats. All the solutions presented in Table 1 in can work in an Open BIM environment, exporting the models in the International Foundation Class (IFC) format.

Table 1 - BIM modelling solutions.

LOGO	NAME	FREE/PAID	IFC	TOOL DESCRIPTION
	CYPE Architecture	Free	Yes	CYPE Architecture is the new CYPE tool for the design and 3D modelling of buildings. The aim of the program is to offer a 3D tool integrated into the Open BIM workflow via the BIMserver.center platform that allows users to model in a simpler and easier way. CYPE Architecture is free of use and is specially prepared to share information among the Open BIM programs connected to the BIMserver.center platform.
	Blender BIM	Free	Yes	Blender is an open source 3D modeling program that is completely free of use. Blender is capable of creating parametric designs easily in IFC4 and integrate with the Open BIM ecosystem. Blender BIM doesn't have a direct connection with BIMserver.center platform but output IFC files can be uploaded to the platform with IFC Uploader add-on.
	Revit	Paid	Yes	Autodesk Revit is a BIM modeling design software for architecture and engineering, which facilitates project design tasks and work processes. The most characteristic of this software is that everything that is modeled is through intelligent objects (parametric families) and obtained in 3D on the fly as we develop the project from the first floor to the upper floors. Revit has a plugin to connect directly with BIMserver.center platform and share information inside the Open BIM workflow.
	ArchiCAD	Paid	Yes	ArchiCAD is a BIM software that offers a very intuitive and clear design and interface, meeting all digital delivery requirements. As well as being able to manage all the information needed for construction, offering open collaboration, and to create all the documentation in an almost automated way. ArchiCAD doesn't have a direct connection with BIMserver.center platform but output IFC files can be uploaded to the platform with IFC Uploader add-on.

1.2.2. BIM IoT

BIM-IoT modules are currently in a stage of early development. There are not so many references available for the general public that embrace sensors and actuators from different companies, being most of the developments available with quite low TRL or for internal use of companies. Table 2 provides a short description of a BIM IoT module.

Table 2 - BIM IoT modules

NAME	DEVELOPER	TOOL DESCRIPTION
usBIM.IoT	ACCA	The application to integrate the BIM model with IoT systems and sensors, visualize sensor data on the model in real-time and get a dashboard with information synthesis and sensor control. With usBIM.IoT, it is possible to implement supervision and remote control of IoT devices directly from the BIM model, which thus becomes a dynamic system that reacts in real-time to events generated by IoT devices. This tool is a web platform that is currently under development.

1.3. BIMserver.center environment

BIMsever.center is CYPE's Common Data Environment (CDE) for BIM projects. BIMserver.center is a free web platform that works in standardized Open BIM formats as .ifc, .gltf and .json. The platform is in charge of managing the data of the BIM project and transferring information between Open BIM programs.

All the software that CYPE develops, including the one that concerns to this task Open BIM SATO, is capable of retrieving and sending information to BIMserver.center platform as main channel of communication and data repository.

Since BIMserver.center first version launched in 2018, the platform has grown steady in number of users (106.520 users) and projects (286.372 projects), positioning the platform as one of the most viable alternatives to work in Open BIM. In this way, BIMserver.center provides the general framework for the different users of SATO assessment application.

Some of the BIMserver.center capabilities that will be used for the aim of this project and task will be the following:

3D Visualization of the models

One of the main features of the platform is the capability of visualizing 3D models and information from BIM models from any device: computer, tablet or phone.

In SATO project, the 3D visualization will be used mainly from the end users perspective, which will be capable of retrieving information from the sensors and displaying it on their phones or tablets in a simplified and easy-to-read way.

Common Data Environment

The platform is a Common Data Environment (CDE) where users, projects and software meet. The cloud data storage allows the exchange information very easily and is a secure way to storage information during the entire lifecycle of the building.

In SATO project BIMserver.center CDE will provide the main source of information for BIM assessment tools and its users. BIMserver.center platform will store the information of the architecture and the sensors BIM models and will retrieve and store data of the sensor coming from SATO platform.

Sharing the project with the different users

BIMserver.center platform allows sharing the project with other users and giving them different roles and permissions to access the information available in the platform. BIMserver.center also allows to share the project in social media, through QR codes or embedded in your webpage

SATO project has different stakeholders that can be divided in: active users as building/facility managers and designers, they will be capable of adding information to the BIM model at different stages; and passive users, as residents that will be interacting with the application at specific moments to query data. More specifically the owners of the dwellings, should be able to access data of the BIM model and the sensors, and designers and building managers should be able to develop assessments and place sensors in the building. Designers and building managers will be active users (will be capable of adding information to the BIM model) meanwhile owners will be passive users (only capable of reading the BIM model and data coming from sensors)

Other BIMserver.center capabilities that could be explored during the SATO project development:

Notifications

BIMserver.center is a platform that allows notifications in your phone, tablet and mail. Notifications help to have a fluid communication among users in the project.

Notifications could be also explored in SATO project allowing users to be notified if certain limits in the sensors measurements are reached.

Mobile App and Augmented reality

BIMserver.center mobile app allows users to display models in Augmented Reality directly from its phone or tablet.

The use of the mobile app to access the BIM model and the data coming from sensors of the SATO project could be an interesting feature to explore. Mobile App allows also to see the model in Augmented reality helping to put together data and reality.

2. Identifying requirements of the SATO project.

Based on the outputs of the "Task 1.1 Role of Actors and Design of Stakeholder Framework" and "Task 1.2 Requirements of the self-assessment framework", the basic requirements of the users and for assessment have been defined. Those needs have been taken into account for the development and the design of Open BIM SATO a BIM-based interactive application.

2.1. User requirements.

Task 1.1. provided the Actors and Roles for the SATO project. For the purpose of this task they will be described briefly.

Occupants

Goal: visualization of BIM models and sensor data in portable devices and web-browser.

The objective is to allow occupants to visualize the BIM model of their building together with the last updated data of the real sensors in their dwelling, making easy the visualization and understanding of their sensor data in a 3D model. For the development of this objective the existing online viewer of BIMserver.center platform will be used.

Facility/Building Managers

Goal 1: visualization of BIMmodels and sensor data in portable devices and web-browser.

Goal 2: to develop assessments for the BIM model and sensor data.

The objective for this type of users will be twofold. On one hand, these users should be capable of visualizing the BIM model and data of the sensors together. This capability will provide them the ability of understanding the performance and state of their building in an easy way. For the development of this objective the existing online viewer of BIMserver.center platform will be used.

On the other hand, the facility/building manager will go one step further using Open BIM SATO during the building operation as they will be able of making assessments to the building model and sensor data during the life cycle of the building. The user interface of the program will ensure that non-BIM experts can easily use the software with minimum knowledge.

Architects/Engineers

Goal 1: make a forecast of sensors that will be later on installed in the building.

Goal 2: to develop assessments for the BIM model and sensor data.

The architects/engineers that are planning the building can be also a potential user for the program. The architects/engineers will be responsible to set up the initial visualization and assessment schemes based on the planned sensors making a forecast of the sensors that will be needed in the building during design phase. Later on, this will allow them to obtain a bill of quantities and cost estimation in other BIM software tools and a layout of the sensors for installation on the building. The architects/engineers will be also capable of making assessments in the design phase related to sensor position in the building.

2.2. Assessment requirements.

The assessment requirements are being developed in parallel with Task 3.3 which is also led by CYPE. The complete list of assessments will be available in deliverable 3.3. Mainly three types of assessments have been identified for the project purpose:

- **BIM model assessments:** those assessments will be directly pointing to the geometry of the BIM model and the sensor placement. Multiple assessments related to this issue can be done as for example: location of exterior sensors, location of sensors close to windows, maximum and minimum high to place sensors, link between sensors and specific zones, link between sensors and specific building systems, among others.

- **Sensor data assessments:** Those assessments will be done on the real data downloaded from the SATO platform. The assessments are related to sensor measurements as for example, asses set points for comfort temperature, humidity, CO_2, or compare the performance of different facades.

- **Combined assessments**: Those assessments will combine geometrical data of the BIM model and sensor data to obtain required information.

Table 3 - List of assessments of task 3.3.

	Assessment	Type	Input	Output
1	**Maximum/Minimum height of the sensors placed in walls**	BIM Geometry	Walls, Sensors	Verified/Failed
2	**Maximum/Minimum temperature of the building**	BIM Geometry and Sensor Data	Temperature data, sensors, spaces	Color maximum and minimum rooms red/blue
3	**Maximum/Minimum humidity of the building**	BIM Geometry and Sensor Data	Humidity data, sensors, spaces	Color maximum and minimum rooms red/blue
4	**Maximum/Minimum CO2 concentration of the building**	BIM Geometry and Sensor Data	CO2 data, sensors, spaces	Color maximum and minimum rooms red/blue
5	**Temperature set point by rooms**	BIM Geometry and Sensor Data	Spaces, temperature data	Colors by room (rainbow?)
6	**Humidity setpoint by rooms**	BIM Geometry and Sensor Data	Spaces, temperature data	Colors by room (rainbow?)
7	**CO2 setpoint by rooms**	BIM Geometry and Sensor Data	Spaces, temperature data	Colors by room (rainbow?)
8	**Installation of type of sensors by type of room (Habitable, non habitable)**	BIM Geometry	Spaces, sensors	For each room verified/failed
9	**Installation of type of sensors by type of room (Humid, not humid)**	BIM Geometry	Spaces, sensors	For each room verified/failed
10	**Detect necessities of sensors for plugs and appliances**	BIM Geometry	Furniture, Electrical Mechanism	Warning existing plug or appliance

2.3. Information workflow.

For the correct design of the Open BIM SATO application it is crucial to define the workflow for BIM data and Sensor data. Open BIM SATO application will be the tool that will put together the two sources of information, being capable of displaying in a BIM model the information coming from sensors and make assessments to it.
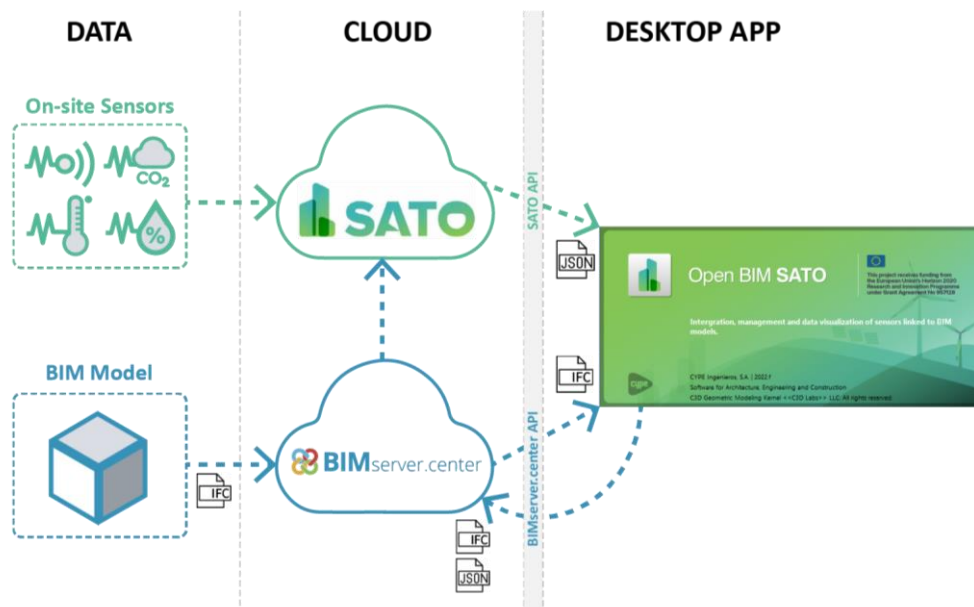

Figure 1. Open BIM SATO information workflow and file formats.

Open BIM SATO will retrieve data from two sources: the on-site sensors installed in the building, and the BIM model developed by the architect. On-site sensor data will be stored in SATO cloud platform, meanwhile, BIM model data will be stored in BIMserver.center cloud platform. As the application will work in Open BIM, the exchange of information among platforms will be held in standardized formats. The format chosen to exchange sensors data is .json, meanwhile the BIM models will be stored and exchanged in IFC format.

Open BIM SATO application will be capable of retrieving information from two different platforms through its open API's; in one hand, SATO platform will provide the information of the sensors; in the other hand, BIMserver.center platform will provide the BIM models.

Once the sensor assessment has been done, Open BIM SATO will be capable of sending the BIM model of sensors to BIMserver.center platform. The information will be visualized through BIMserver.center web viewer. CYPE lives open de possibility of storing sensor information in json in BIMserver.center platform.

2.4. Actors interaction with SATO A&O BIM services

For the correct design of the Open BIM SATO application, it is also crucial to define the actors interaction with the workflow. Table 4 presents different interactions with SATO workflow that have been designed for the different actors. This table is based on the users definition and requirements described section 2.1 of this deliverable:

Table 4 - Description interaction of users with different SATO services.

USER	SATO	BIMserver.center	Open BIM SATO
Occupant	✓ View and manage dwelling sensors data.	✓ Online 3D viewer for BIM model and sensor information.	x
Facility/Building Manager	✓ View and manage dwelling sensors data.	✓ Online 3D viewer for BIM model and sensor information. ✓ Storage of information for BIM models during life-cycle of the project.	✓ Develop assessments
Architect /Engineer	x	✓ Storage of information for BIM models during life-cycle of the project. ✓ Free and paid solutions for project design and development.	✓ Forecast of sensors for installation ✓ Develop assessments

On-site sensor data will be in charge of the building manager which will access all the information coming from the sensors and storage in SATO platform. The building manager will allow owners to access this information, sharing space in the SATO platform. Meanwhile the BIM model must be developed by an architect or engineer. The architect/engineer will be in charge of manages the BIM models of the building inside BIMserver.center.

Open BIM SATO is software for building managers, architects and engineers, owners will be capable of viewing the information generated by the program but will not use the program itself.

For Architects/Engineers the program could be used in various stages, first in the planning stage where they will develop the planning for the installation of sensors in the building the program will allow to obtain a list of quantities for each type of sensor. Secondly, and together with the building managers they will be capable of developing assessments to the model and data.

Finally, all the information coming from Open BIM SATO will be storage in BIMserver.center. Building managers and owners will be capable of viewing the Building BIM model, Sensors BIM model and sensor data together in the Web-viewer of BIMserver.center.

In the following image it can be seen the interaction between actors and different steps of the workflow:
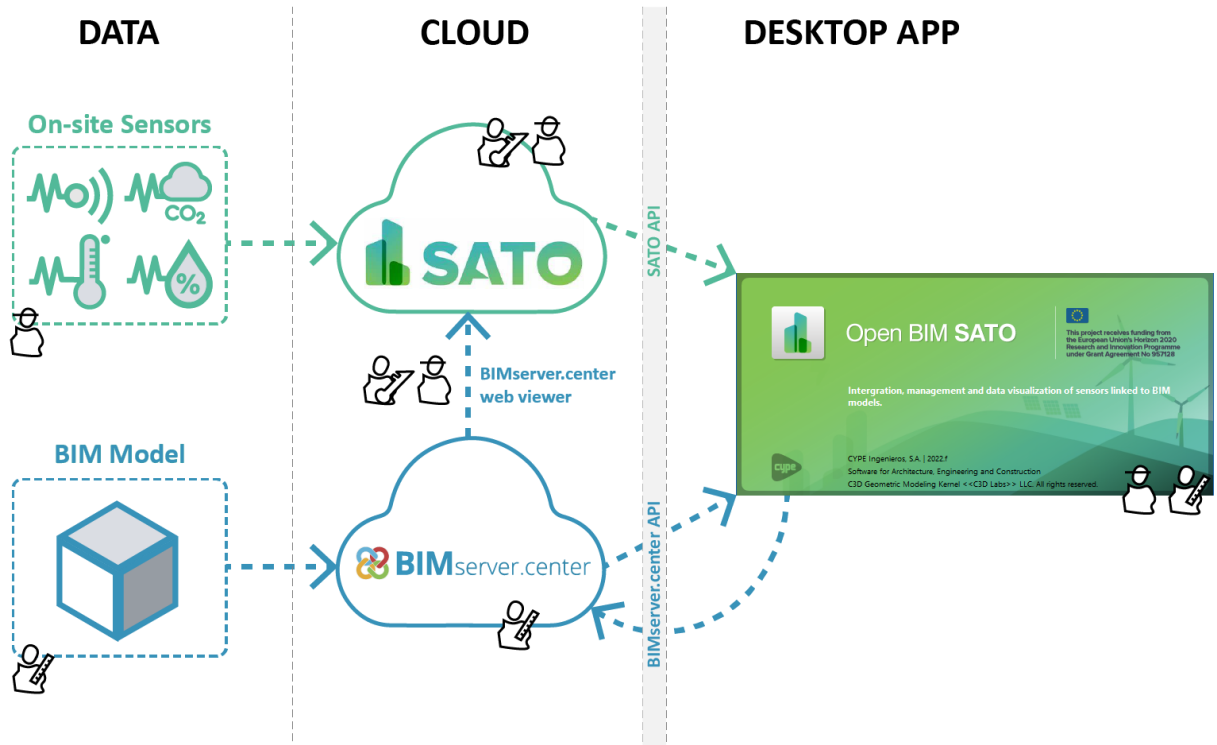
Figure 2. Open BIM SATO information workflow and users interaction.

3. BIM-based application design

3.1. Objective of the tool

Specifically for the context of SATO project, Open BIM SATO will allow users to display sensors in a BIM model of an existing building and retrieve information of the real sensors installed in the building, it also will allow users to create different assessment rules and apply them to the 3D model and data.

3.2. Tool Requirements

3.2.1. Inputs: sensors layer and BIM layer (IFC, GLTF)

As it has been said in the previous point, there are two main inputs for the tools: data coming from SATO platform and the BIM model coming from BIMserver.center platform. Respectively the agreed formats for exchanging information will be JSON for sensors and IFC for the BIM model.

During this task development and in order to agree with the way of transferring sensor data, examples of sensors specification in the JSON format have been exchanged among CYPE and FC.ID. These are shown in Table 5.

Table 5 - Examples of sensors in JSON format.

	EVENT	Code
1	**Door/Window sensor event**	(see code below)
2	**Smart Plug measurements event**	(see code below)

Row 1 — Door/Window sensor event:

```json
{
    "payload":{
        "cmd":{
            "sensingListData":[
                {
                    "sensingData":{
                        "state":"closed",
                        "timestamp":"2021-06-02T17:35:10.200+01:00"
                    }
                }
            ],
            "function":"sensingListData"
        }
    },
    "header":{
        "addressSource":{
            "feature":"0",
            "device":"dev_EA9E56543706543F11B69361D83366A0_a564e777-e1da-44e9-a2cd-1f91d1467777",
            "entity":"1"
        },
        "cmdClassifier":"notify",
        "specificationVersion":"1.1.1",
        "timestamp":"2021-06-02T17:35:10.200+01:00"
    }
}
```

Row 2 — Smart Plug measurements event:

```json
"payload":{
    "cmd":{
        "measurementListData":[
            [
                {
                    "valueType":"value",
                    "measurementId":"0",
                    "value":{
                        "number":"32"
                    },
                    "timestamp":"2021-06-02T17:34:40.078+01:00"
                },
                {
                    "valueType":"value",
                    "measurementId":"1",
                    "value":{
                        "number":"20290"
                    },
                    "timestamp":"2021-06-02T17:34:40.078+01:00"
                }
            ]
        ],
        "function":"measurementListData"
    }
},
"header":{
    "addressSource":{
        "feature":"0",
        "device":"dev_EA9E56543706543F11B69361D83366A0_1a07c872-8c5b-4039-b849-574b554e0010",
```

		`"entity":"1"`
		`        },`
		`        "cmdClassifier":"notify",`
		`        "specificationVersion":"1.1.1",`
		`        "timestamp":"2021-06-02T17:34:40.078+01:00"`
		`    }`
		
		`}`

3	**Smart Plug relay event**	`{`
		
		`    "payload":{`
		`        "cmd":{`
		`            "actuatorSwitchData":[`
		`                {`
		`                    "function":"on"`
		`                }`
		`            ],`
		`            "function":"actuatorSwitchData"`
		`        }`
		`    },`
		`    "header":{`
		`        "addressSource":{`
		`            "feature":"0",`
		`            "device":"dev_EA9E56543706543F11B69361D83366A0_1a07c872-`
		`8c5b-4039-b849-574b554e0010",`
		`            "entity":"2"`
		`        },`
		`        "cmdClassifier":"notify",`
		`        "specificationVersion":"1.1.1",`
		`        "timestamp":"2021-06-02T17:34:40.055+01:00"`
		`    }`
		
		`}`

Regarding the data of the BIM model the format chosen is IFC which can be exported by most of the BIM modelers that exist in the market including the ones described in this deliverable. These models will be uploaded to BIMserver.center platform from which Open BIM SATO will bring this information.

Open BIM SATO will be capable of displaying all the entities of the BIM models. The entities described in Table 6 are of special interest for Open BIM SATO tool development.

Table 6 - Relevant IFC entities.

	IFC entity	IFC Description	Open BIM SATO
1	**IFCSensor**	A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument.	This entity type is the main input of the software Open BIM SATO and its main contribution to the BIM model definition.
2	**IFCSensorType**	Defines a range of different types of sensors that can be specified.	Main type values that will be used in the program: CO2Sensor, HumiditySensor, TeamperatureSensor, NotDefined. Other type values that can be used in the program: LightSensor,

			MovementSensor, GasSensor, SmokeSensor, SoundSensor
3	**IFCSpace**	A space represents an area or volume bounded actually or theoretically. Spaces are areas or volumes that provide for certain functions within a building.	This is one of the main entities involve in the assessments of the models. It will allow the program to recognize the spaces where the sensors are located. IFCSpace can be colored to make the assessments visually available in the BIM model.
4	**IFCSpaceType**	Predefined types to define the particular type of space. There may be property set definitions available for each predefined type.	Predefined types will help the program to recognize types of spaces and develop assessment depending on their definition. For example, habitable/non habitable, humid/not humid.
	IFCBuildingEle mentProxy	The IfcBuildingElementProxy is a proxy definition that provides the same functionality as subtypes of IfcBuildingElement, but without having a predefined meaning of the special type of building element, it represents. Proxies can also be used as spatial place holders or provisions, that are later replaced by special types of elements.	This entity can allow detecting ventilation, heating, cooling or lighting systems among others. The information about the performance of this systems can be relevant to the building performance assessment in general.
	IFCTypeObject	The object type defines the specific information about a type. It refers to the specific level of the well-recognized generic - specific - occurrence modelling paradigm.	Predefined types will help the program recognize types of systems and develop assessments depending on the definition.

3.2.2. Functionalities

To fulfil the project requirements of users and workflow described in this task, the following main functionalities will be developed in the software. These functionalities are:

- **Sensors placement in the BIM model:** the objective of this functionality will be double, in one hand it will help architects/engineers to create a prevision of sensors for the building creating an BIM model of the sensors that will allow later on to obtain in other software solutions bill of quantities of installation plans.

- **Connection to BIMserver.center and SATO platform:** the program will be capable of retrieving information from both platforms and displaying it visually on the program. Open BIM SATO will use the open API of both platforms to create this connection.

- **Assessments of sensor data and BIM model:** the objective of this functionality is, after retrieving information from sensors and BIM models, allow to apply rules to both types of data. Examples of assessments are described in section 2.2 of this deliverable.

- **Mapping BIM sensors and real sensors:** the software will be capable of cross-referencing data from the real sensors installed in the building and the digital sensors of the BIM model.

All these functionalities are described in more depth in section 3.3 (Interface design), with text and image mock-ups.

3.2.3. Outputs

The program will be capable of producing output files with information of sensors and assessments developed. The output files that will be generated are the following:

- **IFC file:** main open format for BIM that contains geometry and data, the main input of this IFC file will be the sensors under the IFC schema with sensors and sensor assessment data.

- **GLTF file:** open format for quick visualization in any devices.

- **PDF List:** a list with the assessments an consider important information about sensors and sensor placement.

3.3. Interface design

The idea for Open BIM SATO tool and the mock-ups developed during this task had been created in an iterative process always taking into account the inputs from task 1.1 and 1.4 and the inputs of the consortium partners involved in the task.

3.3.1. Idea and Mock-up

The first step has been to put together the interface design, as shown in Figure 3. Open BIM SATO mock-up: general interface design. This design responds to the general design of interfaces in CYPE programs and is divided into three parts:

- The ribbon: here is where we can find the main functionalities defined for the program: sensors, connections, rules, edition tools and the connection to both platforms SATO Platform and BIMserver.center.

- Left side toolbar: where main tools for visualization of the BIM model are available. The toolbar is divided into two parts. The upper part "Views" allows to create views for the BIM model (top, section, elevation) to easily navigate it, and the bottom, where the visibility of the models available and its elements can be modified.

- 3D view: the model is display in the BIM model depending on the view selected in the left side toolbar. The view allows to input elements from the ribbon such as the sensors.

Additionally, functionalities of the ribbon were defined and the idea of each one has been described in more detail. The following images display the mock-ups for those functionalities.

Sensors

Sensors functionality, as depicted in Figure 4, will allow to display a prevision of sensors in the BIM model. The sensors will be classified into different types: temperature, humidity, CO_2, movement, lighting, or any other sensor that could be displayed as generic. Each type of sensor will be displayed in a different color to facilitate visual recognition. Each sensor will have a unique identification name (guide).

Also, an easy/automated way of inputting sensors in the BIM model has been planned. This functionality will allow to input the preferred type of sensors in the selected rooms of the BIM model automatically, helping to simplify the work for the end users.
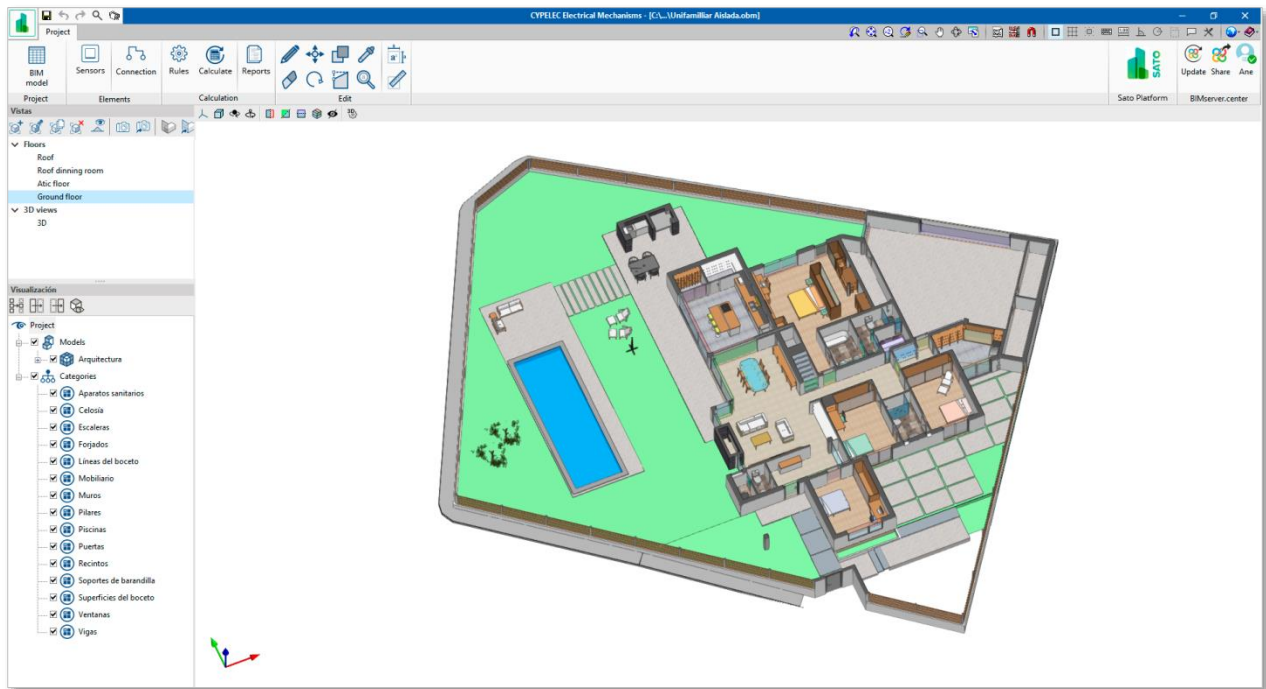
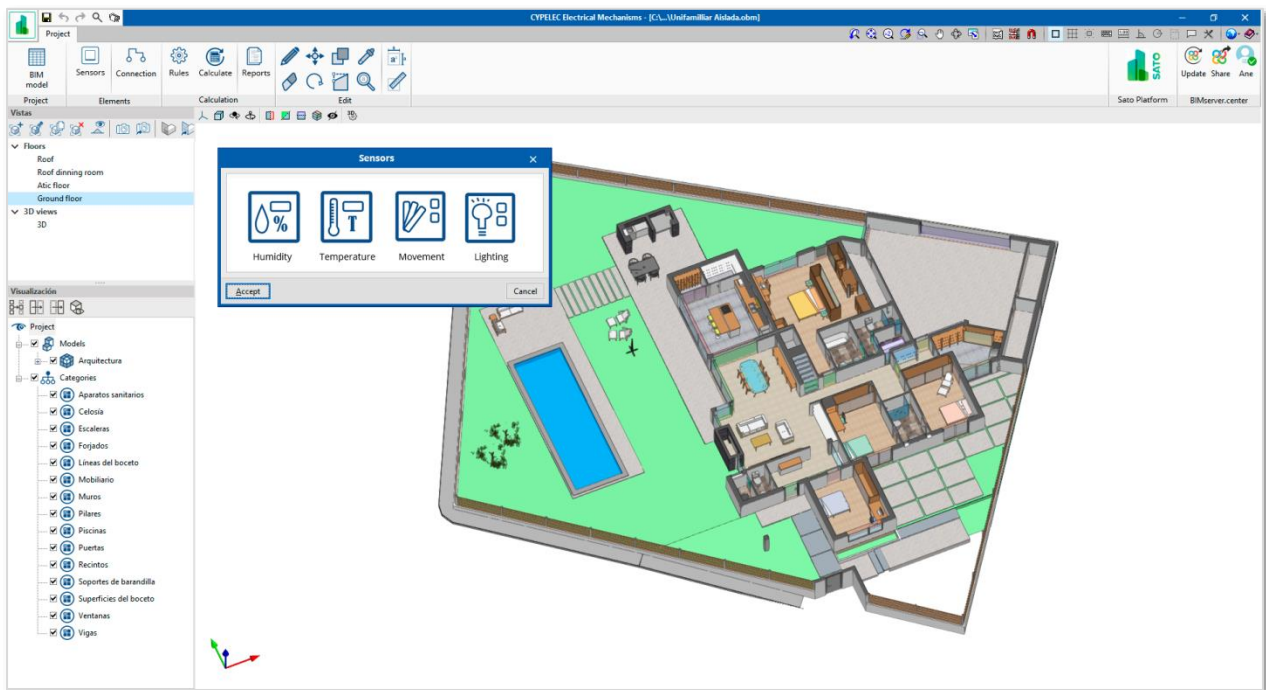Figure 3. Open BIM SATO mock-up: general interface design.

Figure 4. Open BIM SATO mock-up: sensor placement functionality.

Connections

This functionality, shown in Figure 5, is strongly related with the "sensors" functionality as it will allow to connect virtual sensors to the real sensors displayed in the building.

This functionality will allow mapping the real sensors to the virtual sensors, adding for each of the virtual sensors a correlated real one and linking in this way a virtual representation with real-time data. The list of real sensors available will be retrieve from the SATO platform, so to use this functionality, it will be necessary for the user to be previously connected to it.
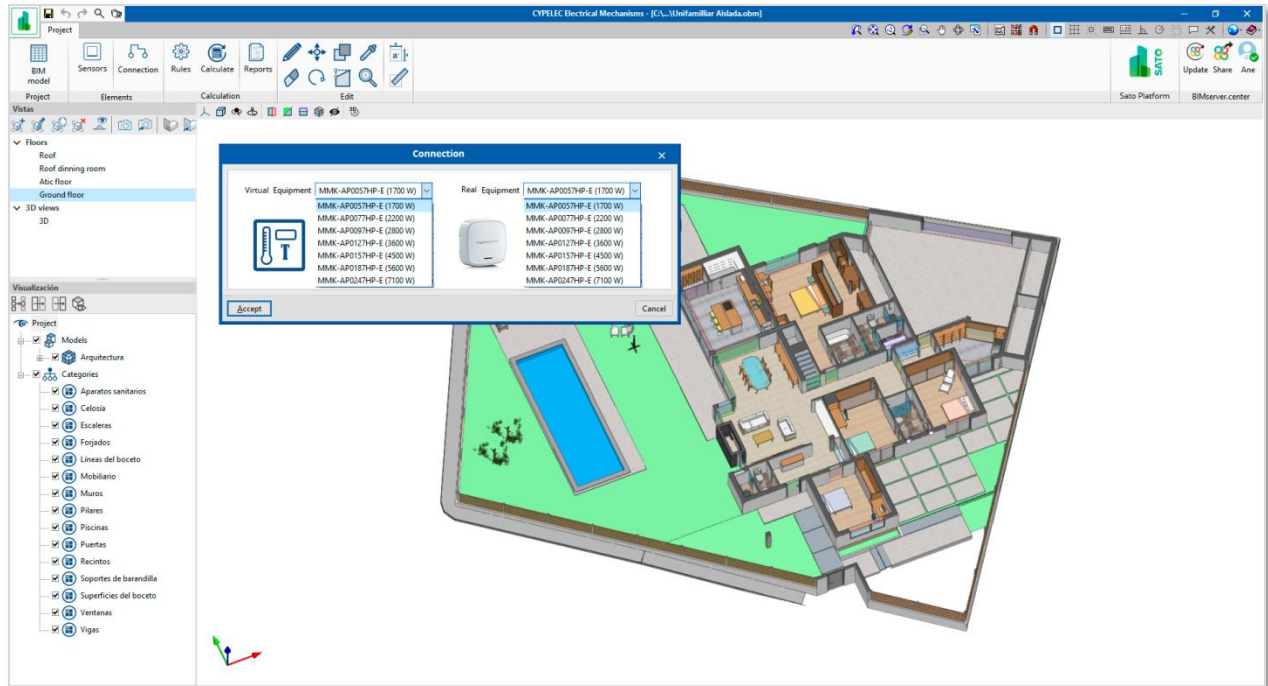

Figure 5. Open BIM SATO mock-up: connection of virtual sensor and real sensors.

In the mock-up shown in Figure 6 we can see that after the connection of both virtual and real sensors, the software will be capable of displaying real data for each of those sensors. Also, it will be capable of making assessments to this data.
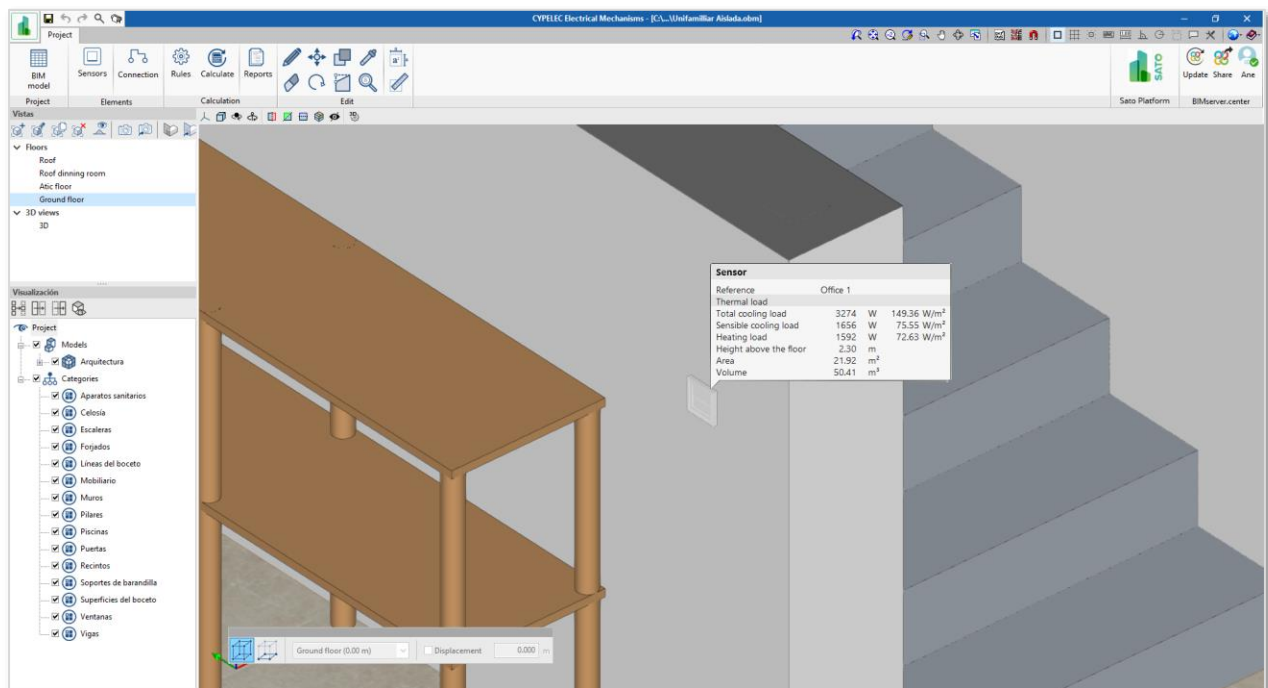

Figure 6. Open BIM SATO mock-up: sensor placement and sensor information.

Rules (Assessments)

Other important functionality for the program will be for the user to be capable of applying assessments to the BIM model and sensors data (Figure 7). A list of rules will be pre-defined in the Task 3.1. that has been developed in parallel of this task and is also led by CYPE.

The rules will be related to different assessments, for example, to check the minimum and maximum high of the sensor displayed in walls, or to check if any of the rooms surpass the temperature setpoints for each type of room.

For this part a functionality is also included to obtain a small report of the assessments developed.
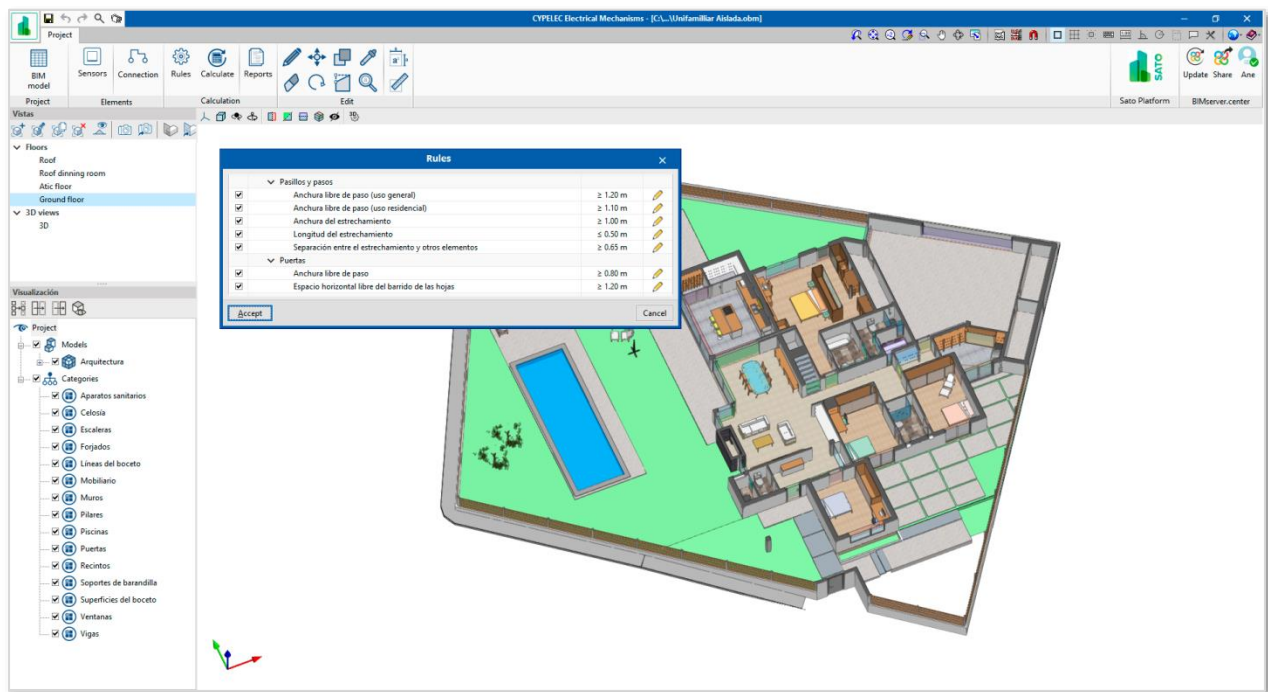

Figure 7. Open BIM SATO mock-up: rules assessment.

Connection between SATO Platform and BIMserver.center.

These are crucial functionalities for the software as it will allow to import the data necessary to use the program. In one hand BIMserver.center will allow to import any model that is stored in the platform in the standardized IFC format. On the other hand, SATO Platform will allow to import data from the real sensors installed in the building.

Both connections will be done through the platforms API's and will require a proper combination of authorization and authentication mechanisms.

BIMserver.center   open   API   is   available   in   the   following   link: https://developers.bimserver.center/en/info_desktop_api.
The SATO Platform API is currently under joint development with CYPE. Open BIM SATO software will serve as a testing tool for the correct functioning of SATO API.
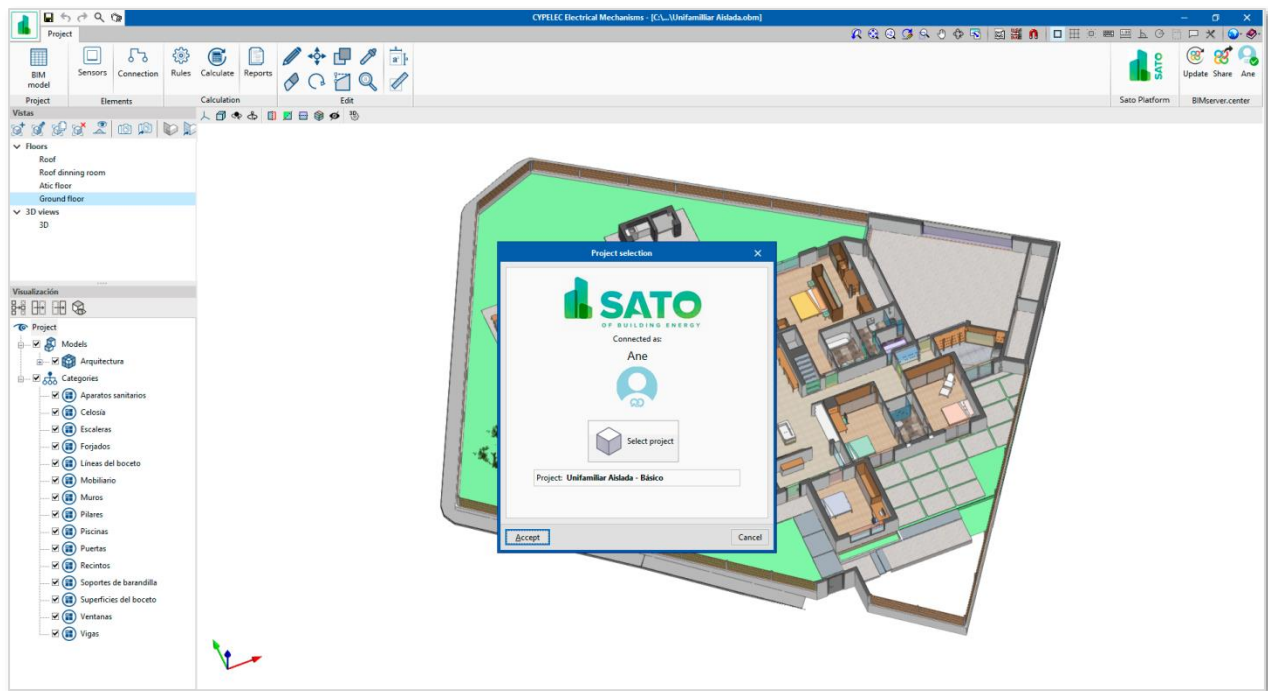
Figure 8. Open BIM SATO: connection with SATO platform.

4. Conclusions

During the development of deliverable 5.1, "BIM-based interactive applications design", the following work has been carried out: state-of-the-art of BIM and IoT solutions; definition of the main users, functionalities and types of assessments; definition of the workflow for BIM models and Sensor Data, development of mock-ups describing and summarizing the functionalities of Open BIM SATO application.

The objective of the task supporting the deliverable was to produce the necessary knowledge in terms of users experience and data structure to be later developed in task 5.3. "Development of BIM-based interfaces for SA&O services", setting in this way the baseline points for the Open BIM SATO software solution.