openDBL

Improving Buildings is Improving EU

D3.1

Evaluation Methodology and Planning

openDBL User Guide version 1.0

Disclaimer and acknowledgements

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1 Contents

List of Tables

List of Figures

Glossary of terms and acronyms used

Table 1 Glossary of terms and acronyms used

Acronym/Term	Description
AECO industry	Architecture, Engineering, Construction, Operations
AS BUILT	Every data, information and documentation available since the construction of the building and the relevant updates
BEP[1]	BIM Execution Plan
BIM	Building Information Modeling
EIR	Exchange Information Requirements[2]
FM	Facility Management
GA	Grant Agreement
KPI	Key Performance Indicator
WP	Work Package

[1] It is also known as BIM Implementation Plan

[2] Originally, EIR stood for "Employer Information Requirements" according to the PAS 1192-2 standard. However, with the advent of ISO 19650, it now stands for "Exchange Information Requirements".

2 Executive summary

***Subject of the deliverable**. This document is a deliverable of the openDBL project, which aims to create a digital building library (DBL) for the AECO industry.*

***Purpose**. To describe the evaluation methodology and deployment requirements for the pilot projects that will test and validate the openDBL platform and its functionalities as a reference guide for future deployments. The document has three main chapters after the introduction:*

1. *Requirements (**what** shall be digitized and uploaded into openDBL)*
2. *Key Performance Indicators (**why** are users digitizing?)*
3. *Go-Live (**how** shall be digitized and uploaded into openDBL?)*

***Summary of the work**. The document outlines the scope, objectives, expected results, data to be managed, key performance indicators (KPIs), and go-live steps for each pilot project. It also provides a checklist for planning, data collection, digitalization, sensor installation, and data management.*

***Main Conclusion**. The sustainability goals for the European industry emphasize the integration of sustainability into financial systems and corporate practices. Several EU directives[3] reflect the EU's commitment to integrating sustainability into various industrial sectors and contributing to the global efforts in achieving a sustainable future. Moreover, they aim to protect consumers from greenwashing and support the transition to a circular and green EU economy. This impacts of course also the AECO supply chain and building management.*

openDBL provides significant benefits for building management, such as improving efficiency, reducing costs, enhancing user comfort, and supporting the EU's circular economy and green policies.

As such, this document -to be intended as the first version of the definitive openDBL User Guide- supports users to pragmatically adopt openDBL as the tool of reference to monitor and optimize building performance, energy consumption, environmental impact, user comfort, and maintenance operations and costs.

[3] 1.Sustainability Risks and Factors, 2.Corporate Sustainability Reporting, 3.Climate and Energy Goals, 4.Ecodesign for Sustainable Products, 5. Green Claims Directive, 6.Sustainable Europe by 2030

3 Introduction

3.1 openDBL project summary

openDBL intends to integrate multidisciplinary know-how to cover the requirements of the Call and solve the issues of the current situation. The challenge of the project is to allow, through the development of openAPI, the disposal of openDBL in a unique standardized platform and create useful content, to simplify the workload of the AECO industry.

The project pursues 3 objectives: 1) create a DBL with useful content and functionalities, 2) ensure openDBL is usable and simple to use, reducing the time spent to upload, search and process the information and data to facilitate usage and gain wide adoption, 3) ensure attractive economics, through value propositions and convenient pricing. We'll provide any user with an integrated platform for their digitization needs; ensure that information and data conform to the latest trends and needs of our target clients and support the EU's circular economy and green policies; develop automatic classification systems and data standards; facilitate the operation and maintenance activities of the buildings. This will be achieved creating an Information Delivery Manual and a Data Model and further developing our existing platform used to create a DBL for an important Italian Public Contracting Authority. openDBL will support data matching with external databases and will integrate state of-the art technologies (AI, Blockchain, IoT and VR). Our ambition is to make openDBL the platform of reference for the monitoring of building consumption, transparencies of transactions and official documents, and the positive impact on maintenance and environment.

To reach its goals openDBL is divided into 6 WPs with different goals, tasks and deliverables. *[Guidance: complete the introductory section, describing the WP the deliverable is part of and its objectives; how this document support those objectives?]*

3.2 Mapping openDBL outputs

Table 2 openDBL work description

openDBL GA Component Title	openDBL GA Component Outline	Respective Document Chapter(s)	Justification
DELIVERABLE			
D3.1 Evaluation Methodology and deployment requirements	*Goal is to define the approach, requirements and KPI for the conduction of the pilot projects in the three municipalities and in the manufacturing company.*	*Section 3*	*This deliverable is a User Guide that describes the methodology on how to best adopt openDBL. It describes the evaluation methodology and deployment requirements for the pilot projects that will test and validate the openDBL platform and its functionalities as a reference guide for future deployments.*
TASKS			
T3.1 Evaluation Methodology and deployment requirements	*The document has three main chapters that deal with the major tasks:* *1. Requirements (**what** shall be digitized and uploaded into openDBL)* *2. Key Performance Indicators (**why** are users digitizing?)* *3. Go-Live (**how** shall be digitized and uploaded into openDBL?).*	*Paragraphs 4, 5 and 6*	*Paragraph 4 deals with task 1 (requirements). Paragraph 5 deals with task 2 (KPI) and Paragraph 6 deals with task 3 (The required activities to go-live)*

3.3 Deliverable Overview and Report Structure

openDBL is suited to manage different buildings information and data during their entire asset's life cycle, around the business processes of Design, Construction and Maintenance. However, each building has a different history so that the user of openDBL needs to know **what** is needed (requirements) **why** (KPIs) before starting the digitalization journey and **go-live.**

As such, this deliverable:

- is a **User Guide** that describes the methodology on how to best adopt and use openDBL for the management of their buildings[4]
- takes into high consideration the most recent sustainability targets defined by the EU in terms of Energy Performance of building(s)
- is based on the decisions taken and the know-how acquired by the Consortium partners during the conduction of the pilot projects.

Figure 1 summarizes the structure of this document.

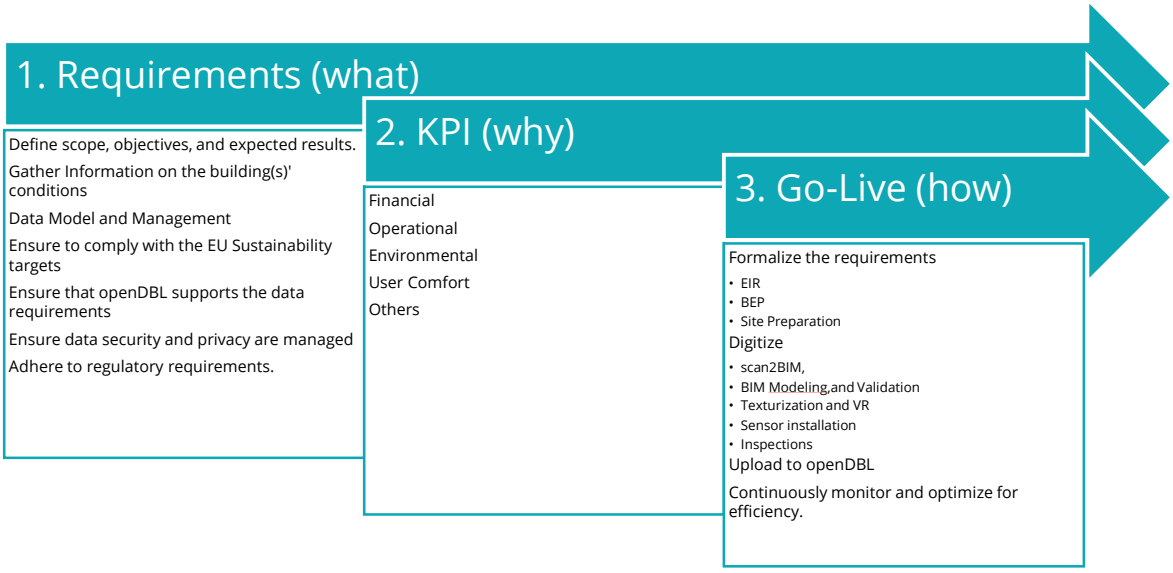

Figure 1: openDBL User Guide – Structure

The following three chapters describe the methodology to adopt openDBL.

[4] We retain the freedom to revise and update this User Guide until the end of the openDBL Project if the pilot projects in MIS, KIF, RUV and DOR and the technological solutions will provide new evidence and lessons learnt.

4 Requirements (what)

4.1 Define scope, objectives, and expected results

Digitalization starts with an activity that has a strategic nature: "what" shall and will be digitized and uploaded into openDBL?

It requires decisions on the followings:

1. **Digitalization scope**: which building(s)?
2. **Use cases**: which business processes must be supported by openDBL? (ie. construction management, H&S, operation, maintenance and ticketing, inspection reporting, product comparisons, compliance with regulations and standards, etc.)
3. **Data to be managed:** which data are needed? (ie. geometries, architectural plans, permits, facility condition index, maintenance records, inspection reports, technical sheets, replacement values, etc.)
4. **Historical comparisons**: which information and data are key for identifying long-term trends or recurring issues? For which periods (ie. Years, months, etc.)
5. **Real-time Updates:** which data needs to be collected and updated (ie. equipment, temperature, air quality, fire alerts, etc.) and in which frequency (monthly, daily, real-time, etc.?)
6. **Accessibility**: which users shall be able to access and work with openDBL (ie. building owners, managers, suppliers, tenants, etc.) and what are they allowed to do? (ie. only viewings, editing, administration, etc.)
7. **Integration with existing systems:** which external systems shall be linked to openDBL?
8. **Innovation**: Which of the emerging technologies are required to be integrated in a future version of openDBL? (ie. Blockchain, RFiD, AI and ML, etc)

Figure 2 provides the checklist users of openDBL shall have to structure their answers and rationalize their digitalization requirements.

Digitization scope:	which building(s)?
Use cases:	which business processes must be supported by openDBL?
Data to be managed:	which data are needed?
Historical comparisons:	which information and data are key for identifying long-term trends or recurring issues?
	For which periods
Real-time Updates:	which data needs to be collected and updated
	in which frequency
Accessibility:	which users shall be able to access and work with openDBL
	what are they allowed to do?
Integration with existing systems:	which external systems shall be linked to openDBL?
Innovation:	Which of the emerging technologies are required to be integrated in a future version of openDBL?

Figure 2: Planning Checklist

4.2 Gather information on the Building Conditions

Once the scope of information and data has been decided, basic information on the building(s) needs to be collected before the digitalization activities can start and a total budget can be quantified.

It is of foremost importance to state that openDBL will function during the entire lifecycle of any building, so that users shall register/update the status of their building(s) anytime, also enabling traceability of changes.

4.2.1 Information and supporting documentation

This step consists of collecting all information and documentation available since the construction of the building. Usually this is called “as-built” information and shall include any existing updates, including documents and certificates produced during the construction, commissioning and past renovation phases such as floor plans, quality control reports and permissions. If there is documentation available, it is very important to register the initial stage of the building as well as any change made in the building updates because it may explain current performance and issues.

The *basic information* to be collected is listed in Figure 3: a checklist that will be at the disposal of each openDBL user directly from the platform and/or the mobile app, so to structure and prioritize the information to be collected before digitalization can take place and later facilitate their seamless upload and update.

Name of Building	
Address of Building	
City, CAP, State	
Year of Construction	
Year of Renovation (if available)	
Description	
Info provided by	

Nr.	Categories	Information needed	Answers / Comments
1.	As-Is		
1.1	Cadastrial data	Data and Survey	
1.2	Dimension and Size	# Floors, sqm, etc	
1.3	DGW	Please send it if available	
1.4	Documentation	Please send it if available	
1.5	Photos	Please send it if available	
1.6	Overall State	Formulate a judgment on the state of the building, on its state of maintenance, on the general aesthetic effect (both internal and external)	
2.	Constraints	-	
2.1	Generic	Provide information about any generic constraints	
2.2	Technical	Are there particular constraints in adopting new technologies on the asset?	
3.	KPI	-	
3.1	Energy Management	Please indicate the KPI used	
3.2	Cost Reduction	Please indicate the KPI used	
3.2	User Experience and comfort	Please indicate the KPI used	
4	Detailed information	-	
4.1	Construction Structure	* Reinforced concrete * Mixed * Steel * Prefabricated	Mixed
4.2	Equipment typologies	Please deliver any equipment information available	
4	To-Be	-	
4.1	Vision	Why do you want to use openDBL for this building	
4.2	Future development	Is there a development plan for the asset	
4.3	Working team	Experts to be consulted	

Figure 3: Building Information Checklist

The checklist formalizes the required information on the as-built condition. Of course, each user has the possibility to add/delete some categories.

4.2.2 Inspections

Before proceeding with the digitalization activities, the building(s) needs to be inspected by the digitalization team.

There are two kinds of inspections:

1. scan2BIM
2. data verification

The first further details the digitalization needs of the building(s) and the BIM Uses pursued by owners especially when BIM Models are not existent. The second inspection verifyies that the information and documentation gathered corresponds with the building reality or its current status.

Scan2BIM inspection

Based on the information provided, the digitalization team can proceed with the inspection of the building(s) to provide a careful plan of the subsequent scan2BIM and BIM Modeling activities.

The inspection usually includes the building's structural components (ie. walls, floors, roofs, windows, stairs, doors, technical rooms, etc.), major equipment and systems (ie. plumbing, HVAC, electrical, etc.), as well as interior and exterior components (ie. finishes and fixtures).

Data verification inspection

The data verification inspection is a visual *walk-through survey* in which every building element is checked to confirm whether the information in the available documentation is up to date or need to be updated as well as to complete information that is not available in the existing documentation. Differently from the scan2BIM inspection, data verification inspections address non-geometrical data such as lighting power installed in every space, HVAC system features, circuits in electric panel boards, etc.

The openDBL mobile app will guide and support this inspection[5]. It is directly connected to the openDBL platform through its API and can be used during commissioning or operation to easily update information when building changes are identified during onsite inspections.

4.2.3 Data integrations and updates

As said, through its lifecycle each building(s) will require updates to its data and information. openDBL, and its mobile app, are interoperable with applications used

[5] The mobile app has been designed to address detailed data that should be verified for energy and sustainability audits such as walls, floors, roofs and windows layers and features (layer name, thickness, conductivity, etc.), cooling/heating generators (brand, model, heating capacity (W), cooling capacity (W), compressor power (W), nominal EER/COP, condenser type, evaporator type, etc), pumps/fans (type, brand, model, heigh, power, position, year of installation, status, etc), terminal units features (fan coils, radiators, floor heating, splits, etc.), infiltration flows and schedules, heat recovery, etc.

during onsite inspections that needs to record and/or update the information. Two examples:

1. the **mobile app** will guide and support quality control onsite inspections. These inspections are visual surveys to carry out an inventory of building damages such as cracks, landslides, etc. and document them for building diagnosis. The data collected in the quality control onsite inspections need to be recorded in the DBL.
2. openDBL will also be updated through real time data and information produced by the **meters and sensors** installed in the building(s).

4.3 Data Model and Management

Creating and managing their own data model is key for openDBL users.

It is therefore of foremost importance to define, collect, store, analyze and manage the relevant data through a well-structured Data Model.

Generally speaking, a Data Model includes several data categories such as:

1. **Location and Climate Data**: Data about site location, size, topography, zoning, traffic conditions, and climate. It also considers any future developments or changes to the site's surroundings.
2. **Design, Project and Construction**: Architectural, Structural, MEP, Building Permits, Energy classification, inspections, cadastral, building codes etc.
3. **Energy and Environmental:** Weather conditions, noise levels, air pollution, HVAC types, etc.
4. **Building Management and Maintenance:** Asset type, age, priority, facility conditions index (ie. Lighting and Electrical equipment, HVAC systems, Water connections, etc.)
5. **Space utilization:** occupancy, desk assignments, usage of common areas, etc.
6. **Cost and Financial:** maintenance, renovations, operational, replacement value of equipment, repair, etc.
7. **Structural and Safety:** obsolete structures, conditions, etc.
8. **User Comfort**: energy usage, occupancy patterns, indoor air quality, lighting levels, customer satisfaction surveys, etc.
9. **Others**

Figure 4 presents the Data Collection Checklist that openDBL will ingest and display to users[6]. It comprehends 9 categories, and it is not comprehensive of all data managed by openDBL. However, it provides most of the manageable data and the interfaces in regard to connection to external services.

Data Categories and Types	Measurement unit	Periodical data update	Data subject	Functionality	Data Source		
					BIM (from IFC)	Static (Manual)	Dynamic (from Sensors)
1. Location							
1.1 Site							
1.1.1 Quality of the site compared to the territory							
Non-relevant external areas	m2		Building			x	
Non-relevant Green external areas	m2		Building			x	
Presence of equipped parks within 1,000 m	yes/no		Building			x	
Presence of cycle path within 1,000 m	yes/no		Building			x	
Total dimension of the site	m2		Building		x		
1.1.2 Site quality							
Relevant external areas	m2		Building			x	
Relevant external green areas	m2		Building			x	
Presence of charging stations for electric cars	yes/no		Building			x	
1.1.3 Accessibility to public transport							
Distance from public transport - bus/tram	m		Building			x	
Distance from public transport - metro	m		Building			x	
Distance from public transport - train	m		Building			x	
1.1.4 Accessibility to services							
Administrative/postal	m		Building			x	
Commercial	m		Building			x	
Sports	m		Building			x	
1.2 Topography						Documentation	
1.3 Traffic conditions							
2. Design, Project and Construction							
2.1 Architectural details, drawings and layouts plans			Building		x	Documentation	
2.2 Structural details			Building		x	Documentation	
2.3 Technological details			Building		x	Documentation	
2.4 MEP systems			Building		x	Documentation	
2.5 Energy Classification			Building		x	Documentation	
2.6 Building Permits, Cadastral documents etc.			Building			Documentation	
2.7 Building Codes and Regulations			Building			Documentation	
Compliance with Regulations	yes/no		Building			Documentation	
3. Energy and Enviromental Data							
3.1 Weather Conditions							
Average temperature in the winter period	C°		Building			x	
Average temperature in the summer period	C°		Building			x	
3.2 Sunlight Exposure			Building			Documentation	
3.3 Noise Levels							
3.4 Air Pollution							
3.5 Physical Characteristics							
3.6 Lighting, Heating, Cooling types							
Main lighting type			Building			x	
Main heating system			Building			x	
Main cooling type			Building			x	
3.7 Energy Consumption							
Site Energy Use Intensity	kW						
Energy performance or Energy Use Intensity	kWh/m2						
3.8 Environmental Control							
3.8.1 Emissions							
for CO2 equivalent	KgCO2/year		Building			x	
for solid waste – paper	Kg/year		Building			x	
for solid waste – plastic	Kg/year		Building			x	
for solid waste – glass	Kg/year		Building			x	
for solid waste – organic	Kg/year		Building			x	
for solid waste – metals	Kg/year		Building			x	
3.9 Energy model							
Annual electric power consumption	kWh		Building			x	
Total use of renewable primary energy resources	%		Building			x	
CO2 production of energy supplies to buildings	kg CO2/kWh		Building			x	
Renewable energy produced for thermal uses	kWh/year		Building			x	
Renewable energy produced for electrical uses	kWh/year		Building			x	
Other	kWh/year		Building			x	

[6] We have marked in red those information and data that will not be supported in the first releases of openDBL.

Data Categories and Types	Measurement unit	Periodical data update	Data subject	Functionality	Data Source		
					BIM (from IFC)	Static (Manual)	Dynamic (from Sensors)
4. Building Management and Maintenance							
4.1 Lighting and Electrical Equipment							
Number of lightpoints	n°		Building		x		
Number of power outlets	n°		Building		x		
Number of internet access	n°		Building		x		
4.2 HVAC System condition				Maintenance tool		x	
4.3 Water use							
Total water consumption	m3/year		Building			x	
Drinking water consumption for irrigation	m3/year		Building			x	
Drinking water consumption serving the building	m3/year		Building			x	
Non-potable water consumption for irrigation	m3/year		Building			x	
4.4 Asset type, Age,Priority, FCI				Maintenance tool			
5. Space Utilization							
5.1 Total Occupancy (people counting, rates)	people		Building				x
5.2 Desk Assignments			Room		x		
5.3 Common areas usage			Room		x		
6. Cost and Financial							
6.1 Estimated administrative value							
Residual value (“book value”)	EUR		Building			x	
Annuity value	EUR		Building			x	
Return on Investment (ROI)	%		Building			x	
6.2 Estimated administrative cost							
Total Facilities Management Costs	euro/year		Building			x	
Total Energy cost	euro/year		Building			x	
6.2.1 Non-renewable energy costs							
Heating	euro/year		Building			x	
Cooling down	euro/year		Building			x	
Other	euro/year		Building			x	
6.2.2 Costs of energy from renewable sources							
Heating	euro/year		Building			x	
Cooling down	euro/year		Building			x	
Other	euro/year		Building			x	
6.3 Other administrative cost							
Ground	EUR		Building			x	
Tax	EUR		Building			x	
Design	EUR		Building			x	
Construction	EUR		Building			x	
Other acquisition costs	EUR		Building			x	
Administrative management	euro/year		Building			x	
Technical management	euro/year		Building			x	
Energy conduction	euro/year		Building			x	
Water conduction	euro/year		Building			x	
Waste management (taxes)	euro/year		Building			x	
Failure maintenance	euro/year		Building			x	
Scheduled maintenance	euro/year		Building			x	
Maintenance	euro/year		Building			x	
Renovation	euro/year		Building			x	
Operational	euro/year		Building			x	
Replacement Value of Equipments / Systems	euro/year		Building			x	
Repair	euro/year		Building			x	
Self diagnosis	euro/year		Building			x	
7. Structural and Safety Conditions							
7.1 Obsolete structures				Cemosa App	x	x	
7.2 Condition status				Cemosa App		x	x
7.3 Safety Incidents							
Track the number of incidents	n°		Building			x	
Track the types of incidents			Building			x	
8. User Comfort							
8.1 Energy Usage							
8.2 Occupancy Patterns							
Vacancy Rate (per Building type)	%		Room				x
8.3 Indoor Air Quality			Room				x
8.4 Lighting Levels			Room				x
8.5 Customer satisfaction surveys							
Tenant / User Satisfaction	%		Building			x	
9. OTHERS							

Figure 4: Data Collection Checklist

Managing data in a structured model also enables and facilitates **historical comparisons and benchmarks** on:

1. building(s) operations and equipment across several dimensions (ie. per building, user, city, etc.) to deepen knowledge about the building's status and performance
2. surveys, on the number of building permits given, buildings under construction, and buildings completed etc.

The type of data to be collected can differ **depending on the purpose of the scope defined above or on the KPIs to be assessed** (see next paragraph). For example, if one business use is to improve energy efficiency, users might need to collect data about the building's energy consumption and the efficiency of its HVAC system.

4.4 Ensure to comply with the EU Sustainability Targets

The European Union estimates that 75% of Europe's building stock is "energy inefficient". Buildings account for 40% of energy consumption and 36% of total carbon emissions.

The European Parliament voted on an amendment to the **Energy Performance of Buildings Directive** (EPBD), with the aim of modernizing building(s) of any type to significantly reduce the costs of home heating and hot water production, reduce electricity consumption and greenhouse gas emissions. This is a step that is intended to accelerate the achievement of climate neutrality in the European Union, as well as the transition away from fossil fuels. The amendment to the directive is a stage in the implementation of the assumptions of the REPowerEU.

This has big impacts on how building(s) must be managed:

- From 2030, all newly constructed buildings must be zero-emission (earlier -2028- in the case of public buildings). After these dates every new building occupied or owned by Public Authorities should be zero-emission.
- For residential and non-residential buildings, it is necessary to carry out **energy refurbishment** projects to reduce their demand for primary energy for heating, cooling, ventilation and air conditioning.
- residential buildings must reduce their average primary energy consumption of at least 16% by 2030 and at least 20-22% by 2035.
- non-residential buildings shall be renovated (16% of the total stock with the worst energy performance by 2030, and by 2033, 26%)

In addition, **Energy Performance Certificates** for buildings (EPC) will be introduced, and this will:

- contribute to the unification of standards and a consistent approach to energy classes
- will have a big impact on the valuation of real estate assets.

Hence, detailed data enabling reliable analysis and information about the condition of those buildings will become a mandatory tool for every owner or manager of a property.

Table 3 lists the most important impacts of the EPC classes to the buildings and the targets to be achieved according to the latest EU norms.

EPC CLASS	IMPACT on buildings	TARGETS to be achieved
A	Acceptable Status	
B		
C		
D	All buildings shall achieve these classes	By 2033 (residential) By 2027 (non residential)
E		By 2030 (residential) By 2030 (non residential)
F	Obligation to Energy Refurbishment	
G		Max 15% of total building per country can stay in this class

Table 3: Impacts and Targets of EPC of buildings

To effectively carry out the energy refurbishment projects and evaluate the EPC, minimum requirements for the energy performance of buildings (KPI) must be defined. openDBL enables users to achieve this goal, (see paragraph 5.3).

Moreover, information and data can also refer to **Recyclability and Circular Economy** targets. Such parameters can be applied to various types of raw materials and/or building components - e.g. plastics, glass, wood, etc. and have a big impact on the classification of the building(s) in terms of CO^2 emissions. The use of appropriate materials and products for the modernization of a facility is important and directly affects the final classification of the building(s) on the A-G scale.

Data in this area feed into the analysis of energy efficiency, decarbonization of buildings, and LCA analysis (see paragraph 5.3): kWh/m^2, Energy consumption, CO^2 emissions, and other data and information are useful inputs and openDBL enables

the collection, processing and analysis to provide the right basis for decision-making and formulation of recommendations.

4.5 Ensure that openDBL supports the data requirements

openDBL has an easy-to-understand interface to make sure that required data is not only collected but properly stored. It supports 4 types of building(s) information and data:

1. **Documental Information** (contained in documents, such as scanned and .pdf files and similar)
2. **Manually inserted data** (the smallest building block of an information, to be provided manually by a user)
3. **Dynamic data** (coming from sensors or external services, usually displayed as aggregated data, or directly ingested as such)
4. **Building asset data** (coming from .ifc files, pertaining to building elements)

This type of data and information can be uploaded or consulted in a specific section of the openDBL platform as described in paragraph 6.3.1.

4.6 Ensure data security and privacy are managed

Access to openDBL will preserve personal data in accordance with **European GDPR legislation** and will provide access to personal data through a specific authorization system within the platform, completely managed by users. Any sharing of personal or building data will be notified to users internally on the platform and will only be granted subject to explicit authorization from whomever is concerned.

The mobile app will address security and privacy according to EN ISO/IEC 27001:2023 Information security, cybersecurity and privacy protection.

4.7 Adhere to regulatory requirements

openDBL complies with ISO/IEC 27000[7], and ISO/IEC 27001[8].

- **ISO/IEC 27000**:2018 provides an overview of information security management systems (ISMS). It also provides terms and definitions commonly used in the ISMS family of standards. This document is applicable to all types

[7] EN ISO/IEC 27000:2020 Information technology - Security techniques – Information security management systems - Overview and vocabulary

[8] EN ISO/IEC 27001:2023 Information security, cybersecurity and privacy protection - Information security management systems – Requirements.

and sizes of organization (e.g. commercial enterprises, government agencies, not-for-profit organizations).

- **ISO/IEC 27001** has been prepared to provide requirements for establishing, implementing, maintaining, and continually improving an information security management system. The adoption of an information security management system is a strategic decision for openDBL.

As a result of this, each user has the guarantee that openDBL has a system to manage risks related to the security of data owned or handled in the platform and by each Consortium partner, and that respects the best practices and principles prescribed by International Standards.

5 Key Performance Indicators ("why")

Key Performance Indicators (KPIs) to manage building(s) performances are essential for identifying areas of improvement in terms of efficiency gains or cost reductions and often drive to better, data-driven, decisions.

In our pilot projects, Kifissia, Mislata and Ruvo, the Consortium partners have cooperated to identify KPIs relevant to their specific situations and have consolidated them into major categories. Each category can of course be enriched and expanded depending on specific user needs.

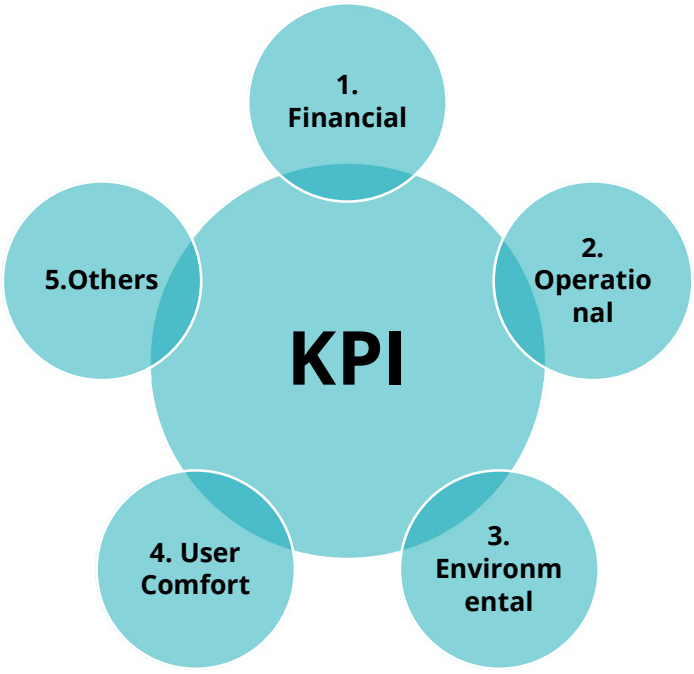

Figure 5: Building Management KPI

5.1 Financial

1. **Total Facilities Management Costs**: Overall cost of operating the building(s), including maintenance, utilities, staffing, and other expenses. There are different types of maintenance (preventive, planned, extraordinary, etc.) and these pursue standard goals to ensure that the assets and their services are in a safe condition and fit for use.
   - *Unit of measure: euro € or euro €/m*[29]
2. **Energy Cost:** Total energy costs (such as electricity, gas, water, etc.)
   - *Unit of measure: euro €*

[9] This data can either be stored in documents (such as energy invoices) or inputed manually in the relevant section, depending on the users' preference.

3. **Return on Investment (ROI):** calculates the financial benefits of specific projects or initiatives, such as energy efficiency upgrades.
    - *ROI = (Net Profit / Cost of Investment) x 100.*

5.2 Operational

1. **Facility Condition Index (FCI):** assesses and compares the relative condition of a group of facilities/equipment of building(s) [10].
    - *FCI= Total cost of needed repairs (Maintenance, Repair, and Replacement Deficiencies of the Facility) / Current Replacement Value of the Facility*
2. **Site Energy Use Intensity:** Total energy consumption for the site, and/or specific energy source (ie. electricity, gas, water, etc.)
    - *Unit of measure: Energy unit kWh – depending on the use case a different period of update might be necessary (i.e. yearly, monthly, daily etc.)*
3. **Energy performance of equipment:** Measures the energy use per selected equipment, typically in kWh. Sensors can provide real-time data on energy use for specific equipment.
    - *Unit of measure: kWh – depending on the use case a different period of update might be necessary (i.e. yearly, monthly, daily etc.)*

5.3 Environmental

As discussed in paragraph 4.4, openDBL supports the definition of minimum requirements to monitor and improve the energy performance of the building(s) managed in the platform.

All required information can be stored in documents or manually inserted as data.

1. **Energy Consumption:** This is the simplest and most important KPI and the basic parameter when determining the energy performance building class (A-G). It monitors energy use across different systems and identifies areas for improvement after energy-saving measures have been defined and implemented. Data and information related to the consumption of all types of fuels to produce energy supplied to the facility (electricity, heating, hot water) shall be converted to kWh according to official formulas. This allows a periodic estimation of kWh per m^2. Normally a yearly consumption of 50-60 kWh per m^2 indicates building(s) of EPC A.
    - *Unit of measure: kWh – depending on the use case a different period of update might be necessary (i.e. yearly, monthly, daily etc.)*
2. **Decarbonization of energy supplies to buildings:** As a complement to the above, it tracks data related to CO^2 emissions of the building in terms of:

[10] *Each building's FCI score reflects its current condition, categorized as: Good: FCI under 0.05, Fair: FCI between 0.05 and 0.10, Poor: FCI over 0.10*

- *Carbon intensity: Tracks emissions per unit of energy used (Unit of measure: kg CO^2/kWh) - this data can only be an estimate without extensive use of sensors and a completely transparent management from the energy provider.*
- *Emissions reduction: Tracks the percentage decrease in CO^2 emissions compared to the baseline*. Comparing changes over time will allow facility managers to assess the effectiveness of energy refurbishment steps taken in terms of the supply of all types of energy to the facility.

3. **Water Consumption:** it is also directly related to CO^2 emissions. Tracks the water use and identify leakages or wasteful practices. Water consumption has a negative impact on sewage and its efficient use saves the energy required to clean dirty water and related issues (by not wasting water, we do not waste the energy needed to heat it or the energy needed to purify sewage).
   - *Unit of measure: Liters or m3 – depending on the use case a different period of update might be necessary (i.e. yearly, monthly, daily etc.).*
4. **Total use of renewable primary energy resources:** This metric[11] measures the amount of energy directly generated from renewable sources, such as solar panels, wind, hydro, geothermal, and biomass. The renewable energy resources can be directly owned by the users[12] or acquired from third parties.
   - *Unit of measure: kWh produced with renewable resources (owned or from third parties) as a percentage of total energy production – depending on the use case a different period of update might be necessary (i.e. yearly, monthly, daily etc.)*

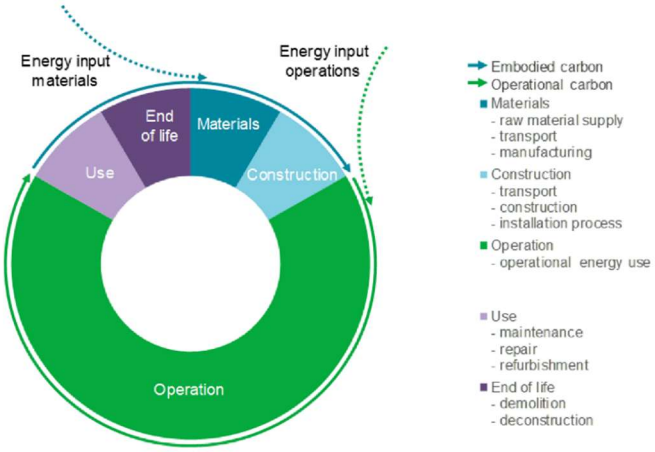

Figure 6: Whole-life carbon: Definitions[13]

[11] Information usually provided from energy supplier

[12] By 2030, photovoltaic installations should be gradually installed on public and non-residential buildings - depending on their size, as well as on all new residential buildings. The detailed conditions and deadlines will be decided by individual countries, depending on whether it is technically and economically feasible

[13] Adapted from European standard EN 15978 – IEA 2020. All rights reserved

5.4 User Comfort

1. **Tenant / User Satisfaction:** openDBL users can utilize a feedback tool to inform about malfunctions or unexpected behavior of openDBL. A notification system internal to the development team ensures the correct delivery of the user's feedback.
2. **Maintenance Request Response Time:** Tracks how quickly you respond to tenant / user maintenance requests. Aim for faster response times to improve tenants' satisfaction.
3. **Vacancy Rate:** Tracks the percentage of unoccupied space. Develop strategies to attract and retain tenants. This type of functionality is only possible (dynamically) with an extensive use of sensors and a custom service directly requested to the development team. Vacancy rate can be updated manually, if needed.
4. **Objective environment quality:** Tracks the indoor air quality and compares it to the reasonable indoor environment quality standards (temperature, humidity, CO^2 concentration, etc.). The adherence highly depends on the possible actuations needed to ensure that the environment quality does not degrade over time with active occupants. This type of functionality is only possible with the installation of specific sensors and limited to the area served by them.

The first version of openDBL will concentrate on the four KPI categories described above. However, for future releases and after the extensions of pilot projects additional criteria could be added and inserted into the development roadmap.

5.5 Additional criteria

1. **Compliance with Regulations:** openDBL allows users to upload documents related to building(s)' compliance to building codes and regulations for safekeeping and as an archive.
2. **Technology Adoption:** Tracks the adoption and effectiveness of technology solutions used in building management.
3. **Accessibility:** accessibility parameters can be uploaded in a document form in openDBL. Authorized users can access and consult them knowing that openDBL will not be accessible to people not directly invited to the project.
4. **Security:** Measures access control to the building(s) and counts people. This type of functionality is only possible with the installation of specific sensors and limited to the area covered and by them.
5. **Safety Incidents:** Tracks the number and types of safety incidents. Implements measures to prevent incidents and ensures a safe environment for occupants.

#	KPI categories	KPI	Unit of Measure	Description
1	Financial	1.1 Total Facilities Management Costs	euro or euro / mq	Track the overall cost of operating the building, including maintenance, utilities, staffing, and other expenses (euro €) There are three types of maintenance (preventive, scheduled, corrective) and these pursue some standard goals to ensure that the assets and their services are in a safe condition and fit for use (euro € or euro €/m2)
		1.2 Energy Cost	euro	Measures the total energy costs, such as electricity, gas, water, etc. (euro €)
		1.3 Return on Investment (ROI)	Net Profit / Cost of Investment x 100	Evaluate the financial benefits of specific projects or initiatives, such as energy efficiency upgrades (ROI = (Net Profit / Cost of Investment) x 100)
2	Operational & Safety	2.1 Facility Condition Index (FCI)	Total cost of needed repairs (Maintenance, Repair, and Replacement Deficiencies of the Facility) / Current Replacement Value of the Facility	Measures total site energy consumption, such as electricity, gas & water (Energy unit kWh)
		2.2 Site Energy Use Intensity	Energy unit kWh – depending on the use case a different period of update might be necessary (i.e. yearly, monthly, daily etc.)	Total energy consumption for the site, and/or specific energy source (ie. electricity, gas, water, etc.)
		2.3 Energy performance of equipments	kWh p. equipment (i.e. yearly, monthly, daily etc.)	Measures the energy use per selected equipment
3	Environmental	3.1 Energy Consumption	kWh/m2 (i.e. yearly, monthly, daily etc.)	Measures the building's energy use per unit area, typically in kWh/m2. Sensors can provide real-time data on energy use for specific equipment.
		3.2 Decarbonization of energy supplies to buildings	1.Carbon intensity: (kg CO^2/kWh) 2.Percentage reduction: % decrease in CO^2 emissions compared to the baseline	Monitor CO^2 emissions. Carbon intensity and Percentage reduction
		3.3 Water Consumption	Liters or m3	Track water use and identify leaks or areas of wasteful practices. Implement water conservation strategies
		3.4 Total use of renewable primary energy resources	kWh produced with renewable sources /total kWh	This metric measures the amount of energy directly generated from renewable sources, such as solar, wind, hydro, geothermal, and biomass.
4	User Comfort	4.1 Tenant / User Satisfaction	Qualitative results from the surveys	Conduct surveys or gather feedback to understand tenant / user satisfaction with the building environment and services. Use this data to make improvements
		4.2 Maintenance Request Response Time	Minutes	Track how quickly you respond to tenant / user maintenance requests. Aim for faster response times to improve occupant satisfaction
		4.3 Vacancy Rate	m^2 of unoccupied space / total m^2	Track the percentage of unoccupied space. Develop strategies to attract and retain tenants
		4.4 Objective environment quality	various (Celsius, humidity, CO^2, etc)	Tracks the indoor air quality and compares it to the reasonable indoor environment quality standards
5	Additional criteria	5.1 Compliance with Regulations	n.a.	Ensure compliance with all relevant building codes and regulations
		5.2 Technology Adoption	n.a.	Track the adoption and effectiveness of technology solutions used in building management
		5.3 Accessibility	n.a.	Access for people with specific needs, access to the building
		5.4 Security	# people / m2	Access control to the building and people counting
		5.5 Safety Incidents	# incidents per time-period (year, quarter, months, etc.)	Track the number and types of safety incidents. Implement measures to prevent incidents and ensure a safe environment for occupants

Figure 7: KPI Summary Checklist

6 Go-Live ("how")

Once that requirements and KPIs have been defined and validated by the relevant user/stakeholder a digitalization team needs to be put together. The team can be internal to our clients'/users' organizations or can be staffed with external contractors.

In all cases we suggest assigning the following roles and to staff them according to time and cost constraints:

- **One BIM Manager/BIM Coordinator**, responsible for the conformity to standards and validation of the BIM Model (.IFC)
- **One or more Laser Scan Expert(s)**, responsible for the survey of the building(s) and the point cloud production
- **One of more BIM Specialist(s)**, responsible for the creation of the BIM Model in the relevant categories (Architecture, Structure, MEP)
- **One or more VR Specialist(s)**, responsible for the translation, optimization and the mapping of the virtual reality BIM model (.GLB format)
- **One CDE Manager**, responsible for the data and information exchange of all stakeholders involved in the process.

This team will digitize the building(s) before being able to use openDBL at the full of its functionalities.

6.1 Formalize the requirements

6.1.1 Exchange Information Requirements

It is of foremost importance for every openDBL user(s) to define and detail the requirements in an **Exchange Information Requirements** (EIR) to ensure full compliance to their data and information need.

Th EIR serves as a pre-tender document that outlines the data and information to be delivered and the standards and processes to be followed during the digitalization delivery process.

6.1.2 BIM Execution Plan

Before starting the digitalization activities, it is important that openDBL users sign the **BIM Execution Plan (BEP)** with their contractor.

A **BEP** ensures that every player in the digitalization project knows and agrees on:

1. **Data Management**: how BIM data in actual files should be generated, managed, documented and shared.
2. **Roles and Responsibilities**: Agreed-upon roles within the BIM process.
3. **Deliverables and Milestones**: Strategy for key deliverables and vital project milestones.

4. **Execution**: Demonstrates when information will be prepared, who is responsible, and which protocols to follow.
5. **Adherence to standards**: File naming conventions, software usage, annotations, abbreviations, and symbols for BIM processes.

6.1.3 Site Preparation

After the signature of the BEP, the digitalization team can start with the activities. Based on the inspections realized in the requirement phase (par. 4.2.2) further details of the building(s) can be checked to determine the area to be scanned, the surveying details required, and safety precautions. Moreover, the site must be prepared, clear access to all spaces ensured and safety measures planned.

6.2 Digitize

6.2.1 scan2BIM

A laser scanner collects millions of points per second, creating a point cloud geometry that represents the building(s)' surface. The scanner captures complex geometries, irregularities, and details and the most recent models can capture photos of the building(s). This is a big help for the BIM Specialists in charge of the creation of the BIM Model.

The data post-processing phase is a critical step in any scan2BIM process. This involves refining the data retrieved from the laser scan devices into a standalone deliverable to remove "noise", align the clouds, and create a coherent 3D model.

After data processing, a so-called "cleaned" point cloud is produced and delivered to the BIM Authoring team. Modern laser scanners automatically deliver photos of the building(s) in addition to point clouds and this deliverable is of great importance for managing the building[14].

6.2.2 BIM Modeling and Validation

BIM Modeling

To convert the point cloud into BIM geometry (.ifc format), special software and advanced 3D modeling techniques are required, which are differentiated by disciplines: architecture, structure, and MEP (mechanical, plumbing, and electrical)

In the BIM team, the BIM Manager or the BIM Coordinator ensures that the three models are coherent so to proceed with the federation of the whole model.

[14] As a matter of fact to digitally manage building(s) during their lifecycle BIM Models are not the only digital representation that can be adopted. In many instances, also "simple" photos of the facilities can achieve the same facility management and environmental goals.

The federated model contains 3D objects with their information content. The model can help with visualization, quantification, and simulation of design, construction, and other tasks related to the building process.

Validation

Once the BIM Model is federated, the BIM Manager or the BIM Coordinator analyzes the 3D model to assess structural integrity, identify defects, and detect changes over time.

Quality assurance is the detection, correction, and validation of all project information to verify the model accuracy. This is an essential step to ensure the reliability of the BIM model.

Finally, the validation shall ensure that the BIM model is fully detailed and optimized for VR. This might involve simplifying complex geometries, removing unnecessary details, and ensuring the model is to scale.

6.2.3 Texturization and Virtual Reality

There are several software options available for converting BIM models to VR. The following activities need to be carried out:

1. data optimization
2. geometry clean-up and texturing
3. digital and interactive model creation
4. UI and UX Design
5. visualization test on web
6. integration support

The VR production team normally focuses on the correct use of advanced textures, on the geometry translation processes from the BIM model in GLFT o GLB format to be imported into special software packages such as Unreal Engine (a specific framework for VE productions).

The building model in IFC format is exported from BIM authoring software such as Autodesk Revit. The exported model is then imported into a linear modeling software such as Cinema4D. The next phase involves checking the model after its import for any data loss, incorrect translations, etc.. Once defects are identified, geometry optimization is performed, which will then be imported into a VR environment.

Typically, geometry optimization activity focuses on normalizing model tangents, correcting anomalies in meshes, etc. Once the geometry is optimized, the texturing or mapping phase follows.

Texturization process involves adding surface details to the BIM models to make them more realistic. This is done processing the photos taken during the laser scanning process. The

details added can include material textures, colors, and other visual properties that enhance the realism of the model.

Once the mapping phase is completed, the generated model is exported in .glb format[15] and then imported into a Virtual Reality (VR) software framework such as Unity3D. In this environment, features for navigating and inspecting the building model are implemented.

Using the Virtual Reality (VR) on BIM in pilots' buildings can provide numerous benefits:

1. **Training and Planning**: VR can be used for training purposes, such as safety training or equipment training.
2. **Error detection**: VR allows to view the 3D model and identify potential costly errors as well as security issues
3. **Increased accuracy and efficiency**: BIM and VR can improve the accuracy of maintenance projects and reduce costs by improving efficiency and collaboration

6.2.4 Sensor installation

The correct installation of sensors in building(s) requires a series of activities and responsibilities to be assigned. To ensure a smooth installation process there are some prerequisites which should be met.

6.2.4.1 Installation Checklist

Following decisions must be taken**:**

1. **Purpose of the Sensors**: Determine what kind of monitoring or control are needed on building(s). As indicated in Chapter 4, this could be temperature, humidity, occupancy, light levels, people counting, access control, etc.
2. **Purchasing criteria**: Based on the purpose, the appropriate sensors shall be procured and criteria like accuracy, range, power requirements, cost, and compatibility with BIM software shall be taken into consideration.
3. **Data exchange formats**: Sensor data shall be aligned to the ontologies supported by openDBL.
4. **Sensor Network**: How will sensors communicate with each other and/or with the central control system?. This could be through wired connections or wireless technologies like Bluetooth, LoRa or Wi-Fi. Then the placement of the sensors shall be planned (i.e. whether

[15] The GLB format is a versatile and widely used 3D file format that has gained significant traction in recent years. It is a binary file format that is essentially a container for various 3D assets and resources. These assets can include 3D models, textures, materials, and animations. The GLB format is based on the glTF (GL Transmission Format) file format, which is an open standard for the efficient transmission and loading of 3D graphic. GLB, a binary form of the glTF file, uses JSON (JavaScript Object Notation) encoding to detail these assets. The purpose of the GLB format is to provide a compact and efficient means for transferring and displaying 3D content across various platforms and applications. This makes it an ideal format for use in applications such as virtual reality (VR), augmented reality (AR), 3D modeling software, web applications, social media platforms, animations, and visual effects.

there is a need for 220V power connection) and the location where to fix them to the wall.

There is also a need for a secure Wi-Fi network (WPA2 Personal), which only requires the password, because most of the non-industrial devices are not able to connect to Wi-Fi that require username and password authentication. In addition, the internal network should be configured in such a way that it allows an outgoing VPN connection to the appropriate servers.

5. **Sustainability and LCA aspects of the project.** As indicated in par.5.3 openDBL environmental priorities must address:
    1. Heat waste monitoring through walls, windows or doors;
    2. Rainwater flow monitoring in the drains leading to the ground;
    3. Electricity consumption per floor/room/device;
    4. Others, such for example electromagnetic noise from equipment, radon emissions, etc.
6. **Integrate with Facilities Management**: The installed sensors are functional for many facilities management operations. The BIM Model with the sensors provides a visual model and database that can be used as a repository for all information, documents and data captured during the facility's life cycle.
7. **Test and Adjust**: After installation, the system shall be tested to ensure the sensors are working correctly and providing accurate data.
8. **Model sensors in the BIM model**: The sensor locations in the BIM model shall also be adjusted, if necessary, to be linked to their exact locations /rooms.

6.2.4.2 Type of Sensors

This is the most crucial activity related to sensor installation for every building.

The user shall choose from the following sensors' categories to be installed:

1. Temperature – degrees;
2. Relative air humidity –amount of water vapor present in air, expressed as a percentage of the amount needed to achieve saturation at the same temperature;
3. Atmospheric pressure – in metric units of pressure, bar;
4. CO2 concentration – in ppm (parts per million).
5. TVOC (total volatile organic compound) concentration – ug/m3. A concentration of 1 µg/m3 means that one cubic meter of air contains one microgram (10^{-6} grams) of pollutant;
6. People Counting – persons per room;
7. Access Control – authorization.

In addition to the previous list, other sensors are planned to be developed with usage of sensor fusion technology during the openDBL project so that this list can be further updated. Details are to be specified depending on the developments in T2.4:

1. Electricity consumption monitoring system;
2. Heat waste monitoring through walls;
3. Rainwater flow monitoring.
4. PM2.5, PM10 particles in the air;
5. Air Quality Index;
6. Light intensity;
7. Solar UV Index;
8. Air speed (indoor wind speed 0 - 7,2 m/s);
9. Proximity (up to 50 cm or up to 6 m);
10. Hand movement;
11. Gases related to food ripening or decay;
12. Soil moisture;
13. Ammonia concentration (NH3);
14. Beta, gamma and X-ray radiation;
15. Altitude, depending on pressure;
16. Water leaks;
17. Ozone concentration;
18. Light frequency sensor;
    a. Only for informational purposes, not for safety-critical applications) such as Gas leaks (NO2, H2, butane, propane, etc.), Seismic sensor (presence of earthquakes) and smoke and fire detection.

6.2.4.3 Step-by/step Installation Guide

The general workflow of the sensor installation can be described as follows

1. Unpack and remove all shipping materials;
2. Check for damage;
3. Attach the sensor board to the wall/ceiling, the pilot site should provide the place and drill any holes necessary;
4. Connect USB and power cables, power connection should be provided by the pilot site;
5. Check that the board boots up correctly – this can be checked by inspecting the LED blinking pattern on the startup and is device specific. Information provided together with sensors;
6. Take photos and pictures of the sensor placement;

7. Find and report the sensor location in the floor plan and mark the sensor number in it.

6.2.5 Inspections

At this stage some inspections can be carried out. They can verify data (same as in paragraph 4.2.2) or quality issues. In this case onsite tests and damage surveys can be carried out[16].

The **test pits** aims at identifying or verifying the composition and state of the construction elements (walls, pillars, floors, roofs, etc.) . The tests will be done with the support of the mobile app and the information collected will be automatically registered in openDBL linked to the building element tested.

The **damage survey** aims at carrying out an inventory of building damages such as cracks, landslides, etc. and document them for building diagnosis. The data collected will be automatically recorded in openDBL and linked to the corresponding building element.

The inspection will be carried out in all the demonstrators and will check:

- Construction elements types and materials: walls, ceilings, floors, roofs
- Windows and doors types and materials
- Floors geometry and spaces distribution
- Spaces: occupancy, lighting, equipment, infiltration, ventilation, terminal units (fancoils, radiators, splits, etc)
- Building systems: generators, distribution system (pumps, fans, etc.), renewable energy sources, building automation and control systems

6.3 Upload and Monitoring

Once the digitalization has been completed and the digital model of the building(s) produced (can be (BIM, Photos, VR, etc), users can upload it to openDBL.

6.3.1 Upload to openDBL

Users can create their virtual digital space, where different collaborators and stakeholders can work together and get informed about the project and the digital model(s)[17]. These virtual spaces are called “openDBL projects”.

Here how it works:

1. Whoever creates a project is automatically designated the **owner** of that project and has full access and control over it.

[16] This specific use case was carried out to test the connection and data interoperability between openDBL and any application for onsite inspections that needs to record and/or update data in open DBL. The advantage of our mobile app is that it will be directly connected to openDBL through its open API.

[17] Digital models are the visual complement to the full Digital Logbook of buildings: ie. point clouds, photos, BIM models, VR files, selected information and files, etc.

2. Any other user who gets invited onto the openDBL project is called **collaborator**. Each collaborator needs to be assigned a role.
3. Each **role** can be created by specifying a list of permissions and access to different functions. Depending on the role, collaborators can access different folders and upload any requested documentation. openDBL will not have a fixed "stakeholders list", but it will have numerous roles specified inside of the project. Each role is granted access to relevant data. This ensures perfect match with the client's expectations and prevents us from making mistakes when creating the stakeholders' rights.

The upload can be free (most likely in the case of the owner or property manager) or it can be requested through a "task" function, in which a collaborator has the task of producing or uploading a document in a specific folder, before a given date.

As anticipated in paragraph 4.4:

1. **Documental Information** will be uploaded, updated, and consulted mainly through the **document logbook** section. A collaborator with the correct role will be able to produce and upload a document requested to them via a Task created by a higher role. The document[18] can be uploaded directly from the task window, allowing easy of use, without active navigation to the right folder of the project. All roles with reading rights can then navigate to that folder to consult the document. Owners and property managers can always upload documents without needing a task, by simply navigating to the relevant folder.
2. **Manually inserted data** can be found in multiple areas of openDBL. General building(s) data (i.e. total yearly energy consumption, dimensions etc.) can be seen and edited, by the roles that have access to it, in the "building data" Section. The "Building data Editor" allows to integrate data from .ifc files or potentially edit them, transforming them effectively into manually inserted data. Project metadata (i.e. project name, description, location, etc.) can be manually inserted and edited from the "Project Register". Currently, the option to mass import manually inserted data via aggregation files (such as .json .xml .xlsx) is being evaluated.
3. **Dynamic data** can come either from sensors, in which case aggregated data from sensor can be accessed from the "sensor gateway" section, or it can come from external services (i.e. weather services APIs, Air pollution stations etc.). At the moment no connection to external services is planned or implemented. Some manually

[18] The tasks provide the file extension accepted for a given document (i.e. .ifc, .png, .pdf, etc.) and the relevant metadata for the various automated features of openDBL. Building(s) data coming from .ifc files can be passed through the openDBL **AI re-labeling service**, if the user wishes so.

inserted data can be substituted by dynamic data if the correct sensor is installed and implemented in the platform.

4. **Building(s) asset data** can be imported massively through ifc files (uploaded through tasks in the document logbook) and manually edited through the building data editor. The platform, once told the folder in which to search for the relevant .ifc file for a given system, is automatically able to recognize the latest version.

6.3.2 Optimisation

openDBL will receive constant update and improvement both during the pilots and once in full production, to guarantee seamless usage for openDBL clients. In case of issues during testing and validation of the results, openDBL and/or its applications must be improved, and any likely bugs must be fixed. On the one hand, this optimization will be of an exquisitely technical nature and will have an impact on the cloud infrastructure on which the entire openDBL platform will reside (the challenge is to have a fully autonomous scalable solution). On the other hand, the optimization will encompass the information objectives (ie. the ability of the system itself to become a source of aggregated data that is significant for the assessment of the environmental impact of buildings at European level). Additional goals relate to optimize the linkages of external applications and the improvement of the tools for collection and update of data.

6.3.3 Results Validation

Users and stakeholders will be able to provide feedback on the results of the pilots and draw up operative recommendations on how to improve and systemize our methodology, our tools and further development areas of openBIM.

The validation plan will rely on a quantitative and a qualitative evaluation and will comprehend:

- Evaluation KPI
- Baseline period
- Demonstration period
- Quantitative and qualitative evaluation

For that purpose, the demonstration period will have two phases. The baseline or reference period without openDBL and the demonstration period which is the period after openDBL deployment and when it will be in full production and used.

The quantitative evaluation consists of calculating KPIs such as:

1. **Time savings** to collect information with openDBL compared to manual process (5-10%),
2. **Correlation system** between the different entities of the Data Model (At least 5%),
3. **Cost reduction** (3-5% due to enhancement in data traceability), etc.

The qualitative evaluation aims to complete the quantitative evaluation by analysing aspects that are difficult to measure. For that purpose, a SWOT analysis will be done including internal aspects of the solution (strengthens, weaknesses) and external aspects regarding the solution (opportunities and threatens).

The final version of this BIM Guide will include the final version of the Optimization approach and the KPI that will be traced once in production.

6.3.4 Monitoring

The key to preventing bugs and optimizing open DBL on pilots' building(s) is the continuous monitoring, the regular maintenance, and making necessary adjustments based on the data collected.

This approach ensures that the building systems (ie. HVAC, lighting, etc.) operate at their peak efficiency, to reduce energy consumption and costs. It’s also important to keep openDBL capable to track these changes and their impacts over time. This will help in making informed decisions for future optimizations.

6.3.5 Archiving and Accessibility

openDBL will enable to store the digital products (ie. BIM Models or the full Digital Logbook) with its informative content and data for future reference, preservation, and research. Each step involves a range of techniques and tools, and the exact process can vary depending of the type of building on the project's specific requirements.

7 Conclusions

openDBL can provide significant benefits for building management, such as improving efficiency, reducing costs, enhancing user comfort, and supporting the EU's circular economy and green policies.

The recent EU Energy Performance of Buildings Directive (EPBD) aims to modernize building(s) and reduce energy consumption and greenhouse gas emissions, aligning with the EU's climate neutrality goals and the REPowerEU plan.

Building Owners and facility managers face severe impacts:

1. Zero-Emission Buildings: By 2030, all new buildings must be zero-emission, with public buildings required to comply by 2028.
2. Energy Refurbishment: Residential and non-residential buildings must undergo energy refurbishment to reduce primary energy demand for heating, cooling, ventilation, and air conditioning.
3. Reduction Targets:
    a. Residential buildings: Reduce average primary energy consumption by at least 16% by 2030 and 20-22% by 2035.
    b. Non-residential buildings: Renovate 16% of the total stock with the worst energy performance by 2030, and 26% by 2033.
4. Energy Performance Certificates (EPC): Introduction of EPCs will standardize energy classes and significantly affect real estate valuation.

These measures will require detailed information and data for reliable analysis and condition assessment, making it essential for property owners and managers.

As such, this document shall be intended as the **first version** of the definitive openDBL User Guide. Through its continuous use and updates, this Guide will guide and supports our clients to adopt openDBL in the monitoring and optimization of their building(s) performance, energy consumption, environmental impact, user comfort, and maintenance costs.

8 References

The Sustainability goals for the AECO industry, in line with EU directives, emphasize the integration of sustainability into financial systems and corporate practices.

Here are the key principles based on the EU directives:

1. **Sustainability Risks and Factors**: Management companies must consider sustainability risks and factors in their operations, aligning with the broader EU framework for a greener and more resilient economy[1].
2. **Corporate Sustainability Reporting**: The Corporate Sustainability Reporting Directive (CSRD) mandates that companies report on their sustainability actions, ensuring transparency and accountability[2].
3. **Climate and Energy Goals**: The EU has set ambitious targets for reducing greenhouse gas emissions, increasing renewable energy usage, and improving energy efficiency to ensure a competitive, secure, and low-carbon EU[3].
4. **Ecodesign for Sustainable Products**: The EU has proposed regulations to improve the circularity, energy performance, and overall environmental sustainability of products[4].
5. **Green Claims Directive** a proposed law by the EU Commission to ensure that environmental claims made by companies are reliable, comparable, and verifiable across the EU. Here are the key principles of the Green Claims Directive:
6. **Sustainable Europe by 2030**: The EU aims to use the UN's Sustainable Development Goals as a guide to transition towards sustainability, outlining scenarios for progress on these goals[5].

These principles reflect the EU's commitment to integrating sustainability into various industrial sectors and contributing to the global efforts in achieving a sustainable future, including the AECO supply chain. Moreover, they aim to protect consumers from greenwashing and support the transition to a circular and green EU economy.

(1) EUR-Lex - C(2021)2617 - EN - EUR-Lex. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=PI_COM:C%282021%292617.

(2) Directive - 2022/2464 - EN - CSRD Directive - EUR-Lex. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022L2464.

(3) 2030 climate and energy goals for a competitive, secure and low-carbon .... https://ec.europa.eu/commission/presscorner/api/files/document/print/en/ip_14_54/IP_14_54_EN.pdf.

(4) Ecodesign for Sustainable Products Regulation - European Commission. https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/sustainable-products/ecodesign-sustainable-products-regulation_en.

(5) A Sustainable Europe by 2030 - European Commission. https://commission.europa.eu/publications/sustainable-europe-2030_en.

(6) undefined. http://data.europa.eu/eli/dir/2022/2464/oj.

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