Technical study on the development and implementation of DBLs

Report on the feedback survey by the study team.
# Table of Contents

Introduction .................................................................................................................. 3
Profiles of respondents .................................................................................................. 4
Responses to the questions ............................................................................................... 6
Part 1: Building identifiers ............................................................................................... 6
  The INSPIRE principle .................................................................................................. 6
  DBL Data extraction .................................................................................................... 7
Part 2: Semantic Property sets ......................................................................................... 10
  Overall structure and organisation .............................................................................. 10
  Proposed building properties ..................................................................................... 12
  Smart district and built environment data .................................................................. 17
Part 3: Use cases ............................................................................................................ 19
  Relevant data for use cases ....................................................................................... 19
  Use case examples ..................................................................................................... 20
  Data extraction features relevant for use cases ......................................................... 21
  Relevance of property sets across the building life cycle ......................................... 22
Part 4: Semantic modelling ............................................................................................. 24
  Implementation formalisms ....................................................................................... 24
Part 5: Data management ............................................................................................... 28
  Use of blockchain ....................................................................................................... 28
  Frequency of data provision/updates ........................................................................ 29
  Data verification .......................................................................................................... 31
  New databases ........................................................................................................... 33
Part 6: Data sharing and licensing .................................................................................. 34
  Licensing of public-sector data ................................................................................. 34
  Privacy and authorisations ......................................................................................... 36
  Rights of data providers ............................................................................................. 37
  Costs of developing a DBL .......................................................................................... 38
Part 7: Technical guidelines overview ............................................................................. 41
Annex A – Open answers ................................................................................................. 43
Annex B – Question 27. What aspects (property sets) of a national DBL as defined in an earlier question would be relevant for this use case, and in which stage of the building life cycle (multiple choice)? – per use case .................................................................................................................. 50
Introduction

The development of Digital Building Logbooks (DBLs) supports the digitalisation of the construction ecosystem. It serves as a means to connect stakeholders along the value chain and throughout the lifecycle of a building by facilitating the collection, storage, exchange, sharing and updating of data.

To support the development of DBLs, the European Commission (DG GROW) launched a study, which Ecorys carries out with TNO, Arcadis and Contecht. The result should be a framework with protocols for DBLs combined with guidelines to implement DBLs at the national level, facilitating harmonisation and sharing of building data.

The feedback survey launched in April aimed to help us i) to collect feedback on our work so far, and ii) to receive input on the potential costs and/or benefits of the implementation of DBLs and related activities.

This survey report provides an overview of stakeholder feedback received on:

- Building identifiers;
- Semantic property sets;
- Use cases;
- Semantic modelling;
- Data management;
- Data sharing and licensing; and
- The outline of the technical guidelines.

Should you have any questions or comments on the presented findings, please contact us at buildinglogbook@ecorys.com.

Disclaimer: The findings presented in this intermediate report are the collected opinions of stakeholders as well as the reflections of the study team. They do necessarily reflect the official opinion of the European Commission.
Profiles of respondents

In total, we received 80 responses, out of which 28 (35%) reached the end of the survey. Because the feedback survey covered a broad scope, respondents were allowed to skip questions and focus on areas within their realm of expertise. Therefore, the response rate varies between questions. The number of total respondents is indicated for each question by the letter ‘N’.

The majority of responses came from business associations and consulting companies, followed by private companies and academic institutions. Local public authorities did not participate in the survey.

Figure 1 Breakdown of responses by stakeholder type (N=80)

Respondents came from 28 different countries, both within and outside the EU. The largest group of respondents worked for organisations that were active in all or most EU countries. In addition, many respondents came from Spain, Belgium, Italy, the Netherlands and countries outside the EU. There were no responses from Estonia, Greece and Malta.
We also observed a wide coverage in the fields of activity of respondents (participants could give multiple answers). Most responses came from organisations in the fields of digital, followed by respectively environment, energy, and decarbonisation.

Figure 2 Breakdown of respondents by country (N=78)

We also observed a wide coverage in the fields of activity of respondents (participants could give multiple answers). Most responses came from organisations in the fields of digital, followed by respectively environment, energy, and decarbonisation.

Figure 3 Breakdown of participants by organisational activity (N=77)
Responses to the questions

Beyond the identification questions, our questionnaire was divided into seven parts:

- Part 1: Building identifiers;
- Part 2: Semantic property sets;
- Part 3: Use cases;
- Part 4: Semantic modelling;
- Part 5: Data management;
- Part 6: Data sharing and licensing; and
- Part 7: Technical guidelines overview.

The following sections summarise the responses to the questions under each of these parts.

Part 1: Building identifiers

In this part, we asked participants different questions about the proposed system of decentralised IDs which contains a hyperlink that provides access to a document (or a webpage) with structured information about one specific building.

The INSPIRE principle

First, we described the structure of INSPIRE links: Decentralised building identifiers mean that local authorities can create their own localid for a building, e.g. 123456789. The identifier is made unique by prefixing a code for the municipality and region, the type of authority, the classification system or DBL manager and a country code. The local building ID should in principle not change over time and therefore for example not include a code for the building as the purpose might change over time.

When asked, three out of four respondents to this question fully or partially agreed with the INSPIRE principle (see Figure 6).

Figure 4 Question 6. Would you agree with the principle described above of following the structure of INSPIRE links? (N=57)

Do you agree with the INSPIRE principle?

Participants were also given the opportunity to elaborate on their given answers. Here we observed a few participants emphasising the importance of decentralised building IDs and the advantages of the INSPIRE principle while a few others highlighted the need to standardise the structure of the identifier across the EU. Two respondents commented that the building ID should also be unique across other sources than the DBL. Another respondent mentioned that due to similarities of DBL with
product passports also compliance with ISO 23387 should be aimed for and compatibility of INSPIRE with this norm should be assessed.

In our view, Member States could regulate that various other sources must use the ID given to the building in their national DBL. We discussed standardisation discussions in our separate Semantic Data Model document and aim to also explain how our interacts with BIM and product data in the Technical Guidelines.

Annex A provides all the open answers given to question 6.

**DBL Data extraction**

Participants were next asked to state their preferences on data extraction methods for the DBL. The first two questions were about **functional vs. data link** and **push vs. pull**. While there is no clear preference between direct data extraction (functional) and hyperlinks to data, there is a clear preference for data to be extracted whenever the end user requests them (pull), rather than receiving periodic updates (push).

*Figure 5 Questions 8 and 9. What would be your favourite mode of data extraction from the DBL? (N=50)*

Next, participants were asked whether they prefer to have a local copy (where the end user can download data) or to have remote access (where the end user can only view the data). The

---

1 Functional means that data is extracted directly from DBL; data link means the user is provided a hyperlink to another data source.

2 Push means that the DBL sends relevant data to users whenever they are updated; Pull means that the DBL collects data from the source after the end-user completes his search on the DBL.
participants that expressed their opinion were equally distributed between local copies and remote access, however, we also observe a high percentage (40%) of indifference between the two options.

Figure 6 Question 10. What would be your favourite mode of data extraction from the DBL? (N=50)

Those who responded with ‘local copies’ were also asked about the management of data timeliness. Participants could choose more than one answer. Multiple ways of informing about the timeliness of data are in demand, most prominently on the frequency of updates (see Figure 7).

Figure 7 Question 11. How should timeliness of data be managed (multiple choice)? (N=13)
Finally, all participants were asked about their preferences regarding the interaction between national DBLs and data providers. Here a **periodical update is preferred** over extracting data from data providers after every search.

*Figure 8 Question 12. Assuming interoperable data formats, what interaction between a national DBL and data providers would work technically better in your view, for example in terms of version management, data security and authorisation control. (N=45)*

![DBL-data interactions](image)

Participants were asked to elaborate on their responses to **data extraction**. Some highlighted their preference for decentralised systems with version control, checksum validations and API access. Another respondent argued that there is no need to copy data to national databases as long as minimum data requirements are defined in DBLs. However, others highlighted that still, **local copies of data should be possible but timestamps** as a central copy of all relevant data can make it easier and more efficient to access the necessary information so that users do not need to search for and access data from multiple sources. Another respondent flagged also that a **central copy is needed to secure data** if a provider goes offline.

Regarding **updating of data**, one respondent highlighted that they prefer periodical updates, but not through updating the whole dataset, but the different content between source and copy based on audit logs. Such an approach can be replicated from other database applications. Another respondent preferred that data remains at its source and is updated only on demand, while another respondent argued that data should be “pushed” by providers whenever they do something in a building so it is dynamically updated and remains reliable. However, one respondent highlighted that this would require trusted providers and even if they are trusted, there can be multiple problems. Finally, two respondents stressed that this should not be an either/or-question as a **distinction could be made between data that needs to be updated periodically and data with longer lifespans**. Such periodic updates can then be scheduled and communicated by data providers.

The full list of open remarks is provided in **Annex A**.
Part 2: Semantic Property sets

Overall structure and organisation

In this part, we introduced to the participants a proposed structure of three branches (cadastral parcel, building and building unit) and seven proposed property sets (building identification, general, legal and financing, dimensions, performance, structure and material, and building services). Participants were asked a set of questions regarding this proposed set-up.

When asked whether they agreed with the set-up, we observed an overall high level of agreement with the three proposed branches. In addition, there was agreement that for details on rooms users would be referred to BIM models or technical drawings.

Figure 9 Question 14. Do you agree with the set-up with three branches (cadastral parcel, building and building unit) and that DBL users would be referred to BIM models or technical drawings (if available) for further details about rooms? (N=39)

Do you agree with the set-up?

- Yes, fully., 26
- Yes, partly., 9
- I don't know, 3
- No, 1

In our view, although remote access to source data better ensures that information is up-to-date, this also places higher demands on the digital infrastructure and the use of the same semantic model. It therefore could be advisable to start working with central copies only. However, even with remote access to source data, a central copy is needed in case a data provider gets offline.

If at all, users may only make local copies of open data, if the data owners authorise that. While allowing users to make local copies of data is user friendly, it comes with the risk of different versions of data circulating. If data on the national DBL are meant to represent the official version of data, that would place high demands on data verification. This would be an argument to not allow users to make local copies until the digital infrastructure is complete to automatically extract and verify data from data providers.

As opposed to building data, the EU core ontology will be open data and downloadable by users, with a time and version stamp.

Our proposal for data update frequencies is to use different update frequencies and to communicate the applicable update frequency for every data aspect.
We collected open answers from respondents to further clarify their responses.

Regarding the three branches of the DBL, several respondents suggested extensions such as for sub-buildings on university campuses, the LADM (Land Administration Domain Model), and for “critical points of interest” for compliance with fire, elevator and balcony safety, inspection certificates, maintenance contracts, etc., that need to be individually monitored for large objects such as hospitals or shopping malls. According to the respondent on critical points of interest, this list could include systems that have already harmonised obligations to monitor (e.g. boilers, chiller units, sprinkler and fire alarm systems, defibrillators etc.), arguing that users of these kinds of buildings already use IT support tools (e.g. Enterprise Asset Management Systems, Computer Aided Facility Management or Computerised Maintenance Management Systems), from which this information can be linked through API to reach the full potential of the DBL.

Two respondents highlighted that for the building unit branch, there should be no individual or individualizable personal data and consideration regarding GDPR rules need to be made.

Many responses focused also on the idea to link the DBL to BIM models and technical drawings for providing more details about a building. One respondent urges to reconsider the necessity of having these details linked in the DBL as it would require these models to stay up-to-date, which would be quite a burden. Another respondent argued that for room details we should not rely on BIM models or technical drawings as there should be a faster and more effective way of defining these details with a predetermined methodology so users or data providers can introduce comparable information. Finally, one respondent flagged that the connection to BIM is important and that data between DBL and BIM should be harmonised, while another cautioned to respect ownership rights on BIM models.

One respondent stressed following existing norms and standards, i.e. that DBL is part of the LOIN principle of EN 17412 (purpose, milestone, actor, classification of buildings) and that definitions of data sets and properties follow international standards based on EN 23386 and 23387.
With regard to the branches: the proposal of three branches for cadastral parcel, building and building unit relate to the core ontology. Member States or users can add branches such as sub-buildings, building complexes, floors or real estate (an element of the Land Administration Domain Model – where real estate is land with human additions that are not necessarily buildings such as fences or a pavement). Our central idea is to distinguish between owner, floor area, parking space etcetera between multiple branches.

With regard to critical points of interest, it is important to distinguish between a private DBL and a national DBL. Facility managers need to monitor elevators etc. individually because they break down at different moments. However, elevator inspectors will likely assess all elevators at the same time and the number of elevators and the date and results of the last inspection may suffice. In other words, a national DBL is not a facility management tool but certain DBL data such as validity certificates and inspector remarks could be input for such a tool.

With regard to links to BIM models in the DBL, this would always be optional. Such a link avoids replicating these models with the DBL, while giving the possibility to link to these richer and more detailed models. We however, will consider how to ensure to keep these in synch or flag that information is possibly outdated (e.g. through timestamps in the metadata).

The full list of open remarks is provided in Annex A.

**Proposed building properties**

Next, participants were asked to indicate whether they agreed with the proposed organisation of building properties. The majority of respondents either fully or partly agreed with the organisation of building properties and only two of the respondents indicated disagreement.
Regarding the seven proposed property sets, respondents provided additional information. Generally, some respondents agreed in principle but said more information in their details is required as well as whether these are all mandatory to fill in or whether some are optional. One respondent suggested focusing on building identification, performance, structure and material as property sets, while another proposed that construction and further interventions should follow the built object life-cycle.

Two respondents raised concerns regarding GDPR, arguing that information like user profiles is relevant enough to risk GDPR problems. However, in our model user profiles refers simply to types of users, for example, a student accommodation, and does not contain information about individuals. Another shared that in the building logbook, they are working on they added a layer of GDPR-sensitive data, particularly in the case of social housing.

One argued that the grouping does not matter and recommends the LOIN approach. Another wondered whether ‘building components’ are included and isolated as their properties and relationships are of importance for deconstruction.

Finally, one respondent made several suggestions, which we intend to consider for the technical guidelines as potential extensions or updates:

- To separate “Structure” and “Material” into different categories as their content is distinct and more intuitive if separate.
- For “Structure”, there should be a separation between the structural function of rooms and relations between spaces with a predetermined but flexible way of introducing the data to make it comparable between different buildings and easy to introduce the information.
- To not include information about security systems such as alarms as this is not relevant, which is also our intention.
- To reorganise “General” and “Legal and financing” as it would be more intuitive if the topics related to “Administrative”, “Financial” and “Use” are separated.

3 To respond, at least building IDs are needed as otherwise there is no information, however apart from that the full core model is optional and properties depend on data availability in Member States. Member States can decide on restrictions as well as extensions.
The historical and cultural value of a building should be included as it is important information.

In addition, the social dimension is another important element to consider.

The parameter of “building occupancy” should be included as well, since it influences other aspects such as energy performance.

There should be a transversal category of “Documents” simply to provide supplementary documents.

Finally, the “Placement” property set should be reintroduced.

With regard to data fields being optionally or mandatory filled in, we argue for keeping most data fields to be optional, and only the building ID should be mandatory. The reason is that for existing buildings even partial information is already useful.

With regard to user profiles: this was meant to refer to certain types of buildings such as student homes or senior homes. Perhaps “building purpose” is a more appropriate term. After consulting legal experts, such information would not violate the GDPR.

With regard to following the lifecycle: the DBL framework includes fields on the date of change, as well as the life-cycle status of data: “As-required”, “As-designed”, “As-built” and “As-used”.

The core ontology combines structure and material because at the core, a DBL only needs to include the type of materials used for structural parts of the building. However, a DBL may provide links to Building Materials Passports (besides links to BIM models and environmental data).

We agree that information on security systems such as alarms should not be public information and indeed they were not included in the indicative list of types of properties.

We will keep organisation of property sets as it is, because the property set under which a property is organised does not constitute a formal relationship in the ontology (as opposed to a building unit being a part of a building, for example).

With regard to Documents, after long discussions we decided to make documents an item field for every relevant building aspect, with legal documents organised under for example sales data, tenancy data and data on other transactions.

With regard to Placement – this term was changed to the less abstract term Dimensions and certain aspects such as address and geo coordinates were moved to General.

The full list of open remarks is provided in Annex A.
Respondents were then given the opportunity to indicate whether they would prefer a different organisation for some of the properties or whether they thought certain properties were missing. Half of the respondents of these questions indicated that they were missing some properties while almost a third of them would group some of the properties differently.

Figure 11 Question 18. Would you organise certain properties differently or do you miss certain properties (multiple choice)? (N=37)

In their open responses, some respondents referred to comments already made for the previous questions, while others added further insights.

One respondent suggested giving more visibility under “Performance” to the “Documents” as EPC is mentioned, but there are also other technical inspection reports such as electrical or gas inspections which are key for building safety aspects. This could be a separate property set on technical reports. Similarly, another respondent suggested that elements related to the Directives on waste and safety and health on construction sites provide aspects that should be part of the DBL. In addition, DBL and Level(s) should be compatible. Currently, our semantic data model provides a property on circularity performance, providing a placeholder for Member States to add circularity indicators which should be based on Level(s). One more respondent argued that “Accessibility” must be in the DBL, which is true, but already covered under the ‘Function’ property. Finally for item 3c (documents under ‘Legal and Financing’), one survey respondent suggested adding “public land register/cadastre” behind “sales deed”. They also shared that most of the information in item 4a regarding “Lengths, gross and net areas & volumes” (under ‘Dimensions’) is information contained in the German cadastrales.

Another respondent argued that for building services a link to BIM would be helpful to provide further details. Another respondent wondered however whether some aspects such as lifecycle costs, annual maintenance costs, or building services would be useful extensions of typical BIM models but should remain outside of the DBL model. One respondent highlighted again to use for the definitions of the data templates under EN 23387 following also the LOIN principle (EN 17412).

Finally, one respondent provided detailed suggestions based on the DBL proposal and their work. They developed a new organisation of twelve categories and properties. New elements in the categories below are marked with an (*).

1. **Building Identification:** - Building ID - Building Unit ID - Cadastral parcel ID - Online Link ID
2. **General information:** - Address, placement indicators like geo coordinates - Dates of permits, construction, renovation, etc - (*) Building type (single-family, multi-family...) - Use function (principal) - (*) Number of Building units - (*) Building historical/cultural value

3. **Placement & urban data:** - Public transport - Connectivity - (*) Public services - Internet connectivity - Video street surveillance (question if necessary, possibly to remove) - Street lighting - (*) District Heating - (*) Urban supply services - Traffic speed metres - Flood risk - Noise levels - Climate data - (*) Access to green spaces or parks – climatic shelters and contact with nature - (*) Air pollution - (*) Other eco-systemic services?

4. **Dimensions:** - Lengths, gross and net areas & volumes - Requirements such as max height, minimum distance from boundary etc. - Documents: BIM model, technical drawings - Linked geometric representations (0D, 1D, 2D, 3D) - (*) Simplified geometrical model that represents the dimension’s data that are introduced, so that the user can easily understand it.

5. **Structural function:** - Number of / breakdown in zones, floors, spaces/rooms, elements, components, products, materials - (*) Spaces/rooms area and relations -Requirements such as min/max number of parking spots etc.

6. **Construction & Material:** - Components, products, materials for each element - U-values for various element types - (*) Building materials inventory - (*) Embodied resources & carbon. - Year of latest materials inspection, asbestos check etc. - Certain materials as asbestos (Y/N) for authorised DBL users only - (*) Building structure type, status and inspections

7. **Building Services:** - Types of energy (gas/electricity/solar/thermal/city heating, ...), production and consumption installations - Requirements such as heat pump (Y/N), prohibition of gas connection (Y/N) etc - Solar surface potential and actual - Type of ventilation system - Type of water and sewerage installations - Number of elevators, balconies, swimming pools etc. - Types of building automation (temperature control system, automatic lighting etc.) - Types of security (locks, alarms etc.) for authorised DBL users only (I'm not sure if this is necessary) - Type of telecommunications connectivity - Planned and recorded dates of connections, installations and repairs - Compliance status with fire, elevator and balcony safety, salmonella free status of swimming pools etc.

8. **Performance:** - Functionality offered incl. connection to utility services (Y/N), indoor health & comfort levels - Accessibility to people with a movement or visual disability, etc. (Y/N) - (*) Building occupancy (useful for energy performance) - Actual energy and water consumption and production level - Energy performance label (e.g., A-G), circularity label, energy and water use label, CO2 and N2 emissions label, smart readiness indicator value etc.

9. **Social - User profiles:** (*) age, income - (*) Local entities, communities and other social organisations linked to the Building - (*) Building owners, tenants... - (*) Property administrator - (*) Building occupancy (useful for the community structure)

The full list of open remarks is provided in Annex A.
Aspects of electrical and gas inspections are indeed good additions to the EU core ontology, because periodical inspections of these are mandatory in multiple EU countries. In the proposed framework, documents are part of the data on various aspects.

The core ontology currently does not include Level(s) concepts such as building materials quantities and costs, building emissions, comfort levels (indoor air quality, thermal comfort), climate change risks, and life cycle costs. For some aspects such as costs the reason is that a national DBL is primarily a concept for data extraction, and commercial tools may use such data to developing cost calculator tools. For other aspects the reason is that the national DBL is a concept for aggregate data such as the energy performance level and metadata such as the norm system on which the performance classification is based, and not for the underlying data. And environmental data such as climate change risks (floods, average temperature, sun hours etc.) should remain in specialised datasets to which a national DBL can provide links. Any data from the Level(s) concept would thus be an extension of the framework for the core ontology.

With regard to certain aspects such as lifecycle costs, annual maintenance costs not belonging in a DBL: we propose to keep data aspects optional in general, and will address both arguments for and against including such data in a national DBL. An advantage of such data in a national DBL is that it allows to analyse costs for different types of buildings at a national level. A counterargument is that costs change over time – as we saw with the spike in energy prices in 2022.

With regard to other data templates: the DBL as concept contains more aggregate data than a BIM, and for this reason we aligned more with the INSPIRE terminology than with norms such as EN 23387 and EN 17412 which are developed for BIM.

With regard to suggestions for additional building data aspects to be included in the core ontology: we will address those in the Technical Guidelines as useful extensions. However, it should be noted that smart city data should be stored at other data sources to which a DBL can link to avoid duplication of information and discrepancy between data sources.

**Smart district and built environment data**

In this section, we presented the idea of a DBL linking to smart district and built environment data but not having it directly integrated. Most participants either fully or partly agreed with the principle that a DBL should only link to smart district and built environment data and not integrate it directly.

---

4 The main reason being that these data are not specific to a building, and are typically available on geographic maps. Transforming geographic data into building-specific data would be an investment and generates pseudo-accuracy.
As there was general agreement with the proposal, there are not many open comments, however, a few respondents provided additional details:

- One respondent remarked that a high information load would make data handling more difficult, while another even considered linking to smart district indicators as too impractical for actual use;
- Another respondent taking an incremental and multi-level perspective agreed that the DBL should provide and receive data from the surroundings and city level but should not go beyond its level, which is the building/land parcel where it is built.
- One respondent suggested linking smart district and environmental data to a building through reference mappings in DBLs, e.g. on buildings’ IDs in GIS systems.
- Finally, a respondent agreed that there would be a pseudo-accuracy due to the difference in scale and level of detail between the urban data and the building data, but argued that the building’s surroundings directly affect its habitability, and for this reason, data on this should be a category in the DBL to facilitate a holistic understanding of the building and its surroundings.

The inclusion of smart district and environmental data in the core ontology was long discussed in the project team. Our conclusion is that such data would only be used for very specific purposes. A user may be expected to search for information from different sources. A DBL should facilitate the search for such information, by providing an up-to-date hyperlink to such data. In our view, a national DBL should unlock the potential to combine building data with already existing environmental data through facilitating access to building data. The user can then combine the building location with those data or commercial companies may develop tools to do that job. The majority of responses agreed with this view.
Part 3: Use cases

A use case describes for which purpose users will use a website (or other product) and how they interact with it. In this part, we asked about potential use cases for participants’ organisations and presented some generic use cases from different user perspectives.

Relevant data for use cases

Out of the 38 participants that responded to this part, 20 of them were part of an organisation that produces data that could be useful to the DBL. Those participants were asked about the type of data that their organisation’s primary process produces and whether they would see a benefit in sharing this data in the DBL. We received a wide range of responses on the types of data useful for a DBL:

- Performance data (assessment, simulation, certification) and data related to EPC (Energy Performance Certificate) and SRI (Socially Responsible Investing);
- Data addressed to the energy renovation of the residential stock at a district or municipality scale to inform and prioritise renovation interventions; in Spain, a tool called urbanZEB integrates cadastral data, construction data, climate data and data on energy costs, renovation costs etc. to develop intervention scenarios (see full comment in the footnote);\(^5\)
- Life cycle assessments: e.g. impact databases used in calculations;
- Material inventories;
- Product data for the whole product life cycle to increase the awareness of building owners about the construction components of the building;
- Manufacturers of HVAC (Heating, Ventilation, and Air Conditioning) systems give information in the standardised format of EN ISO 16757. This could be used for facility management and other purposes;
- Generic information regarding obsolescence of electrical installations and rate of fires from electrical sources. Fire rates are not specific to a given building but describe a general situation;
- Complete digital inventories for food retail stores (from material items to energy meter data);
- Information models of buildings and BIM models;
- Data related to risk management;

Two respondents provided also comments otherwise relevant comments:

- Building smart is developing a standard for the digital handover of data and documentation;
- A respondent works on a DBL implementation for residential buildings that include an analysis of the data types that could be defined and how they could be implemented. These include tenant data, energy labels, fire evaluations, data on building composition (vision of buildings

\(^5\) Based on that 3D model, urbanZEB runs an building-by-building energy simulation (with Energy Plus) to define the expected consumption results, costs of intervention, etc. for an energy renovation of the buildings addressed. The potential users are public administration, construction companies, urban planners or Energy Services Companies (ESCO) among others. This data should be included in the DBL, as a first energy diagnosis of the building, and could be complemented and refined with the data available in the DBL.
as banks of materials) and more aspects. It also reflects on how to structure this to enable a Digital Twin and collect data from utilities (e.g. water, electricity, etc.).

Use case examples

Next, participants were asked to, if possible, define a use case where a DBL would be helpful for their daily work process. In general, respondents feel that DBLs and the availability of consistent and reliable data can contribute to better design, construction and management of buildings, improved market information, creation of innovative services and business models, as well as more effective policymaking. In this context, one respondent from a business association highlighted that a common European approach covering the entire lifecycle and comprising all relevant building information could increase learning and enable synergies, data consistency and information exchange.

Below we list the examples of use cases provided by survey respondents, which we have structured as follows:

Government use:
- **Structural inspections** of buildings because many buildings have no information about it.
- **Fire safety evaluations** are done by public authorities at the building and city levels.
- Storing, accessing and reviewing **assessments and certifications**.
- **Research** by providing verified and standardised data on the building stock that facilitates comparisons. This could include data from economic or energetic simulations, surveys etc.
- **Transparency** by bringing relevant building data together and providing access.
- **Defining norms** and building cases.

Construction and renovation:
- **Design and engineering**, the DBL could provide information not available elsewhere.
- **Enabling the Renovation Wave and circularity** in the construction and building sector.
- **Renovations**, since construction SMEs could use the DBL to access information on existing buildings. They could use the DBL to quickly access information about the building’s structure and materials, such as the year it was built, the type of insulation used, and any previous renovation work that has been done.
- **Replacing obsolete electrical installations** which are more than 30 years old. They are not ready for the energy transition as they cannot accept high loads and are potentially dangerous. Typically, targets are buildings from 1993 and older that have not been renovated. If the DBL integrates those two parameters (age and date of renovation, ideally electrical renovation), it becomes possible to identify these buildings.

Facility management:
- **Remote monitoring**, identification of energy efficiency opportunities, improving the energy performance of buildings, remote maintenance, reporting, management and similar activities. This could facilitate the maintenance of a building, optimise the operation and enable better-informed decision-making.
- For **business models**, such as identifying potential clients and suitable solutions for their building. For example, real estate developers could assess opportunities for investments.
Companies working in the field of building performance could integrate more data to improve the quality of their models by refining indicators and adding new indicators\(^6\).

**Data extraction features relevant to the use cases**

The next question was about ranking the usefulness of data extraction features in a DBL relevant for national DBL portals (and in the long term an EU portal).

‘Typing an address to search a building’ was the most frequently chosen option as most useful, followed by ‘Clicking and zooming on a map to search a building’. Meanwhile, ‘Option to view or download earlier versions of the data’ was most often rated as the least useful feature, followed by ‘Option to extract aggregate data on buildings meeting certain criteria’. A noteworthy observation in this question is that several participants noted that all of the above features are relevant and that it is neither necessary nor relevant to rank them.

Using a total score approach where the highest-ranked feature received a score of 10 (a score of 100% is obtained if all respondents rank an item at the top) down to a score of 1 for the lowest ranked feature, summing the scores over all respondents and dividing the result by the theoretical maximum score of 280 (based on 28 respondents), the ranking of features becomes:

*Table 1 Final ranking based on total score (N=28)*

<table>
<thead>
<tr>
<th>Total score</th>
<th>Data extraction feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>76%</td>
<td>A query feature to select all buildings meeting certain criteria</td>
</tr>
<tr>
<td>76%</td>
<td>Typing an address to search for a building</td>
</tr>
<tr>
<td>66%</td>
<td>Menu-browsing to select relevant data items for buildings</td>
</tr>
<tr>
<td>61%</td>
<td>Option to extract aggregate data on buildings meeting certain criteria</td>
</tr>
<tr>
<td>58%</td>
<td>Clicking and zooming on a map to search for a building</td>
</tr>
<tr>
<td>51%</td>
<td>Top-down searching for an address (province, city, city area, street)</td>
</tr>
<tr>
<td>49%</td>
<td>Option to link to local portals that are relevant to the building (e.g. the relevant city map, zoning documents etc.)</td>
</tr>
<tr>
<td>43%</td>
<td>An Excel / csv / html file with full data for all selected buildings</td>
</tr>
<tr>
<td>38%</td>
<td>Separate documents with full data for each building</td>
</tr>
<tr>
<td>30%</td>
<td>Option to view or download earlier versions of the data</td>
</tr>
</tbody>
</table>

\(^6\) Two specific example provided was a use case for public administration and one for construction companies. For the first, the company could identify more precisely the buildings in a municipality that are more vulnerable and thus, would require more subsidies to decarbonise them. This information would enable the municipality to link policies with valuable data and prioritise the interventions in private buildings paid with public funds. For the second, they could identify buildings where the intervention is more cost-efficient and thus could be more profitable for both the neighbours and the company or for an ESCO and where the intervention provides higher energy reductions.
Relevance of property sets across the building life cycle

The next question asked participants to indicate the relevance of the seven property sets across the stages of a building life cycle, i.e., design, construction, operation, maintenance, renovation, and demolition, in the use case they presented in a previous question. The following tables present the results for three use-case examples.

- For **structural inspections**, there is a clear distinction between the need for dimensions and legal and financial documents during the design and construction stage, and all other building data during later stages.

- For **replacing electrical installations**, general, legal and finance and dimension data are relevant in the design stage. Data on building identification and the installations themselves are relevant during the operation and maintenance of the buildings, with performance data becoming relevant during renovations data.

- For **renovations** in general, it is important to have data from throughout the life cycle, and performance data from the operational stage in particular.

The rest of the results are presented in Annex B – Question 27. What aspects (property sets) of a national DBL as defined in an earlier question would be relevant for this use case, and in which stage of the building life cycle (multiple choice)? – per use case.

---

Table 2 Question 27. What aspects (property sets) of a national DBL as defined in an earlier question would be relevant for this use case, and at which stage of the building life cycle (multiple choice)? (N=31)

<table>
<thead>
<tr>
<th>Use case: Structural inspection</th>
<th>Design</th>
<th>Construction</th>
<th>Operation</th>
<th>Maintenance</th>
<th>Renovation</th>
<th>Demolition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building identification</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legal and Finance</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure and material</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Building services</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use case: Replacing electrical installations</th>
<th>Design</th>
<th>Construction</th>
<th>Operation</th>
<th>Maintenance</th>
<th>Renovation</th>
<th>Demolition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building identification</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legal and Finance</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Structure and material</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Building services</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

7 As introduced at the beginning of Part 3: building identification, general, legal and financing, dimensions, performance, structure and material, and building services.
One respondent commented on the report containing the use cases and found the figures on the aspect models useful to visualise the information flow for each persona. In addition to the four groups presented in the use case report (construction industry, financial institutions, governmental agencies and building owners), a suggestion was to consider that building users (i.e., tenants), who do not necessarily own the building, can provide information about their real experience in the building (such as thermal comfort, acoustic comfort, functional quality, the existence of a community or associations, etc.) and might want to consult the information about the building they live in.

On the use cases report, one respondent said that the information management standards should be used, while another shared a relevant website with more use cases.

Based on our case study report, we asked respondents to elaborate on their proposed use case, outlining the Persona, User Journey, and Aspect Model as well as the data users would retrieve or provide to a DBL. The use cases are presented in the Table below.

<table>
<thead>
<tr>
<th>Persona (i.e. user)</th>
<th>Customer journey</th>
<th>Aspect Model (information needs)</th>
<th>Other information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Administration Owner</td>
<td>Advice &amp; Permit for Renovation</td>
<td>Information on what is needed to improve EPB, to comply with EPB norms and on what has been done</td>
<td>All data to evaluate the EPB</td>
</tr>
<tr>
<td>3 University</td>
<td>Facility Management</td>
<td>Construction Product data</td>
<td>Sensor data</td>
</tr>
<tr>
<td>4 Public authority and building owners</td>
<td>A process-based framework for digital building logbooks</td>
<td>Design (bill of materials forecast, building dimensions, fire safety analysis) Construction (Final BoM, fire safety compliance checking on handover, datasheet regarding fire safety indicators to become part of the city level visualisation) Operation (traceability of changes, building accidents/events registry)</td>
<td>N/A</td>
</tr>
<tr>
<td>5 Public administrations</td>
<td>Elaborating a strategy to identify</td>
<td>Information about: Identification, Performance (energy and CO2),</td>
<td>N/A</td>
</tr>
</tbody>
</table>

8 https://ucm.buildingsmart.org/.
In our view, the government should decide which information should be public, including to building users. This applies especially to data obtained in building permit procedures. For other data, permission of the data owner is generally needed. Authorities may require such consent for subsidies or for buildings that are being publicly procured.

**Part 4: Semantic modelling**

Part 4 included a set of questions based on a technical document with coding outlining the linked data ontology implementation. Participants not familiar with the subject matter had the option to skip these questions. The number of respondents is therefore lower in this part.

**Implementation formalisms**

The implementation formalisms were not clear to everyone.

*Figure 13 Question 31. Are the used implementation formalisms clear (syntaxes like Turtle and JSON-LD and languages like SKOS and RDFS)? (N=12)*

<table>
<thead>
<tr>
<th></th>
<th>Clarity of implementation formalisms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No, they are not clear at all.</td>
</tr>
<tr>
<td></td>
<td>Yes, they are all clear.</td>
</tr>
<tr>
<td></td>
<td>I don’t know</td>
</tr>
<tr>
<td></td>
<td>No, they are only partially clear.</td>
</tr>
</tbody>
</table>
Participants who responded with a ‘No’ were asked to elaborate on what is not clear about the implementation formalisms. We received 3 responses. One of the respondents stated that the formalisms depend on a common language whereas another respondent indicated that “the industry is not working with these software languages but with IFC open standards”. The third respondent had never heard of the formalisms.

The second question referred to a proposal in the technical document related to a language-binding of DBL elements, where respondents were asked if the proposal is clear. Most respondents found it to be clear (see Figure 14).

All four participants that responded with ‘No’ or a ‘partial no’ elaborated on what was unclear. One respondent did not understand the link between DBL and ontology. Another respondent seemed to suggest that a unique ontology would be ideal. A third respondent argued that “all these dictionary terms are not known by the vast majority of the industry” and another one that “the language, syntax and semantics were defined by international norms and standards and that there is no reason to reinvent the wheel.”

Figure 14 Question 33. Table 1 of the document proposes a so-called language-binding of DBL elements, which maps DBL terms (concepts and properties) to specific language-constructs available in the concrete SKOS and RDFS languages. Do you find this clear? (N=12)

Our philosophy behind the ontology and formalisms is that our proposed W3C Linked Data/Semantic Web approach acts as a ‘glue’ joining the worlds of BIM, GIS and DBL while respecting their formalisms such as the STEP technology of buildingSmart International (bSI), XML, LD and JSON. We will not recommend the one formalism over the other, but we will use one formalism to illustrate how the semantic model can be used in the technical guidelines.

For the terms in our dictionary we had to choose which “wheel” to use and we based the terms on INSPIRE and CEN/TC442.
Next, participants were asked about the clarity of the Uniform Resource Identifier (URI). Similarly to the previous question, most respondents found the URI to be clear.

*Figure 15 Question 35. Is the use of the Uniform Resource Identifier (URI) clear? More specifically, in regards to the use of one base URI about a building property and different namespace URIs within the base URI for the ontology, the dictionary and metadata? (N=12)*

One of the two participants who responded with a ‘No’ answered the open question and asked to explain “why we should use different types of URIs”. Further explanations will be provided in the Technical Guidelines, but in short, there are different roles for URIs as there are not only URIs for things that are being described but also for things describing them (e.g. Graph URIs).

The next question was about ‘helper’ ontologies used to develop an ontology for buildings and whether participants foresaw any other relevant ones being developed. Most of the respondents in this question indicated unawareness (‘I don’t know’). One respondent provided an example of such a ‘helper’ ontology.\(^9\)

*Figure 16 Question 37. Several ‘helper’ ontologies have been developed that could be used to develop an ontology for buildings, such as qudt (quantities, units, dimensions and types), foaf (friend of a friend, describing persons, activities and relations), sml (semantic modelling and linking standard). Do you know or foresee other relevant ‘helper’ ontologies? (N=12)*

Participants were then asked to indicate their view on the usefulness of extended modelling possibilities that allow the addition of constraints to an ontology. Similarly to the previous question, most respondents indicated unawareness (‘I don’t know’), however, there was a slightly higher number of participants who responded positively.

Figure 17 Question 39. Certain graphs such as OWL (Web Ontology Language) and SHACL (Shapes Constraint Language) allow the addition of constraints to an ontology. Do you think the addition of such optional extended modelling possibilities to add constraints would be useful for the future? (N=12)

No further comments were provided by respondents regarding this question.

Next, the survey asked participants whether they foresaw the need for the given interfacing capabilities. The most popular answers were JSON and XML.

Figure 18 Question 42. Do you foresee the need for the following interfacing capabilities (beyond linked data)? (multiple choice) (N=11)
The two respondents who responded with ‘Other’ indicated CAD files, BIM models, SHP and IFC as options. None of the respondents chose the option ‘No, linking to other data suffices’.

Finally, participants were asked to indicate whether they considered an intermediate ‘secure data space’ layer necessary. All of the respondents agreed with the necessity of such a layer, for multiple reasons (see figure below). The ‘other’ response emphasised that security is a must-have, and an ‘insecure data space’ cannot be envisioned.

Figure 19 Question 43. Do you consider an intermediate ‘secure data space’ layer necessary (multiple choice)? (N=10)

As part of our approach to the DBL EU and national DBL gateways we will describe how such a secure data space layer can be developed in the short and long term.

Part 5: Data management
Use of blockchain

The first section of this part referred to the use of blockchain in a DBL – we propose that a DBL is not implemented with blockchain but can provide a link to data that are generated by blockchain.
When asked, most participants indicated their agreement, either in full or partially, with our proposal that **DBL only links to blockchain-generated data**.

*Figure 20 Question 44. Do you agree with the proposal that a DBL should only link to blockchain generated data? (N=28)*

Respondents that agreed with the proposed solution and provided open answers, explained that there is a *need for centralised responsibility and management of data* in DBLs and that they do not see a need for blockchain because of the long-term view of building data and the lack of need to keep open ledgers for public data.

The responses we received when asking respondents about the usefulness of blockchain for other types of DBL data included data on *‘the change of ownership’*, and *‘fundamental data’* which however needs to be first identified.

**Frequency of data provision/updates**

This next section introduced our study’s proposal that **building data should be updated only during moments of change**, i.e. when an owner sells their building unit or when interventions such as renovations or inspections take place. Most respondents agreed with this suggestion, either in full or partly. In general, we foresee most data in the DBL to be static that will be updated at these moments of change, real-time data, monthly billing data or energy consumption data we do not see as relevant for national DBLs, while also creating potential data protection issues.
In the open responses, one respondent that responded to the previous question with ‘I don’t know’ reflected that ‘data should be provided anytime upon request’. Two respondents argued that all changes covered by the DBL should be introduced ‘as built’ as soon as possible, however, such data should only be publicly accessible for specific reasons, for example when the owner wishes to sell the building. In contrast, one respondent who did not agree with our proposal, clarified that updates need not be in real-time and that periodical updates suffice (e.g. weekly, monthly).

In addition, several respondents who (partially) agreed provided additional inputs:

- A stakeholder from the engineering sector that agreed with our proposal further argued that the responsibility of updating data should be limited to public organisations such as building permit authorities rather than the private sector.
- Someone representing construction products and material companies, highlighted that moments of change are good triggers points but others can be considered too, for instance, the validity of a technical assessment report: If an electrical installation has not been inspected for 10 years it is recommended (by CEN-CENELEC) to carry out a check. The same applies to gas for which regular inspections are strongly encouraged. However, if the owner or the tenant lived in the place for a long time, there is no chance for these inspections to happen despite there being safety reasons to do so.
- A respondent from a research or technology institute added that they classify data in DBL as static, quasi-static and dynamic. Based on this classification, some data might need to be updated monthly (e.g. water billing) while others less regularly. However, the respondent clarified that they come from the perspective of Digital Twins. Therefore, if we consider a moment of change as receiving new data related to performance, they tend to agree more with the principle. In our case, data will likely be static or quasi-static.
- Finally, a consulting company agreed that moments of change are one of the major drivers to provide new data related to the building or building unit. However, this driver does not always match with the provision of data related to the users of the building (in particular for residential buildings). Data might be required in certain moments of the operation phase of the building while there is not a major change, i.e. a certain user wants to access subsidies...
and is requested to provide specific information. Another user data is the occupancy of the dwelling which can vary significantly but is not related to a major change. This data, provided by the user and not necessarily the owner of the building, is in general more sensitive, i.e. energy consumption, housing income, and number of occupants. User-related data is variable over time, like energy consumption or energy bills, and must be updated regularly to be realistic and profitable.

Respondents were then asked to identify other appropriate moments of change as well as the responsible actors for data provision, which are good suggestions to be included in the data management plan of the DBL:

- The initial set-up of an initial DBL, so it can be used;
- Change in building ownership;
- Change in occupancy;
- At the 'reception' of the building or major renovation;
- After completion of renovation or repair works (contractor);
- When changes are made to the building energy systems (owner);
- When there are changes in building regulations (authorities);
- After inspections;
- Validity of technical assessment reports expires;
- After the Energy Performance evaluation, but it is not only the owner who is responsible for data provision.
- Other events such as a fire, earthquake, etc.

Finally, one respondent highlighted that they consider it important to clarify whether the data is static or dynamic, and in that case, analyse its updating periodicity. This concept of periodicity should be considered when providing data.

We are grateful for all suggested moments of change to update the DBL and will include them in our recommendations for a data management plan. With regard to the distinction between static and dynamic data, our view is that each data aspect should have a field for the update frequency, with “never” implying static data.

Data verification

This section introduced our approach to data norms and verification. In our view, the DBL manager should define data norms, i.e. the format in which data need to be provided. The data norm should provide precise terms and definitions and mutually exclusive sub-categories, e.g. not “number of floors” but “number of above-ground floors” and “number of below-ground floors” etc. to avoid confusion without needing to check metadata (at the cost of more detail). The data norm should provide that these numbers need to be natural numbers.

When asked, most participants expressed their agreement with the above concept.
One of the respondents that answered with ‘I don’t know’ clarified that it is crucial to share harmonised data, but cautioned that standards do not always describe all the necessary information and that locally defined data which are not necessarily defined by harmonised standards should be maintained.

A respondent who partially agreed elaborated that this is the core of the solution which must be based on a data dictionary (already containing definitions from technical standards) linked to ontology vocabulary. In their view, this is the only way to govern a DBL with standards (international and national). The respondent stressed that there is a framework ready based on EN standards and encouraged to implement it in DBL.

Other respondents that fully agreed, provided further details. One pointed out that the data 'norms' should be driven by related standards, while another responded that dealing with versioning is essential. Finally, one respondent from a consulting company provided a more detailed response. They highlighted that due to the great variety of agents intervening in developing a DBL for a specific building, data norms need to be clear before entering the data. Therefore, they suggest complementing these norms with specific training for developing a DBL, as a great understanding of the tool will be required before using it. They have the experience of extracting data massively from the Spanish cadastre and human error is evident when analysing the data. Thus, if the data gathered in the DBL is expected to be reliable and of great quality, the professionals responsible for entering the data have to be well-trained.

With regard to using standards for a data dictionary there are many different existing standards – we have chosen to the INSPIRE terminology and linked data that underly technical standards. In the long term, machine readable data inputs and automatic updates are preferred, but this places a high demand on the digital infrastructure. In the short term, central copies of data that are semi-automatically integrated in the DBL may be advisable.
New databases

Regarding the future development of building-related data, participants were asked to express their opinion about which new data services or datasets they foresee being developed or becoming more available in their countries in the next five to ten years (see table below). In particular respondents from Belgium expect new services to become available and for more buildings, whether public or private and free or paid. However, most respondents expect a wide range of already existing services to become available for more buildings over time. Most respondents expect that private actors and public actors are both likely to develop new services, although respondents consider sensor data to be more likely developed by the private sector. A majority of respondents expect sensor data but also data from drone inspections to become available for pay only. In contrast, respondents generally expect that building permit data will become freely available for more buildings.

Table 3 Question 52. In regard to the future development of building-related data, what new public or private, free or paid data services or datasets do you foresee in the next five to ten years to be developed or become available for more buildings in your country? (N=24)

<table>
<thead>
<tr>
<th>Data service/dataset</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>New and/or More available</td>
</tr>
<tr>
<td></td>
<td>New</td>
</tr>
<tr>
<td>DBL-like services containing general building data</td>
<td>AT BE CZ ES</td>
</tr>
<tr>
<td>Sensor data</td>
<td>BE NL</td>
</tr>
<tr>
<td>Circularity aspects data</td>
<td>BE CZ ES NL PT</td>
</tr>
<tr>
<td>Building permit data</td>
<td>BE CZ</td>
</tr>
<tr>
<td>Construction product data</td>
<td>BE</td>
</tr>
<tr>
<td>BIM data, 3D data</td>
<td>BE CZ LU PT SE</td>
</tr>
<tr>
<td>Inspections by drones</td>
<td>BE ES PT SE</td>
</tr>
</tbody>
</table>

| Public and/or Private                         |                          |                          |
| Public                                        | Private                  |
| DBL-like services containing general building data | AT BE CZ ES IT           | BE CZ DE ES IT NL PT    |
| Sensor data                                   | AT CZ PT SE              | AT BE CZ DE ES IT LU PT SE |
| Circularity aspects data                      | AT BE CZ ES LU PT        | AE BE CZ DE ES PT       |
| Building permit data                          | AT BE CZ DE ES NL PT SE  | AT ES IT LU PT          |
| Construction product data                     | BE CZ DE ES NL PT        | AT BE CZ DE ES IT LU PT SE |
Part 6: Data sharing and licensing

Licensing of public-sector data

In this section, we described our study’s approach to licensing public-sector data. We propose that DBL data owned by public authorities should be licensed with the requirement that users may only share these data for free. Thus, if for example, publicly owned DBL data include that the energy performance label of a particular building is “C”, an engineering company creating a renovation cost calculator must provide the energy label for free, but may charge a fee for the calculation of renovation costs using the energy label. In addition, we propose that the license conditions of the DBL provide that all service providers using public DBL data to generate new data must provide the newly generated data under an “Attribution-NonCommercial-ShareAlike” creative commons license, or a license that grants more free access.

We then asked participants whether they agreed with the following principles:

- Publicly owned data should always be free; and
- Public authorities should not need permission to use newly generated data building on publicly owned DBL data.

Figure 23 presents the results showcasing that the majority of survey respondents agreed fully or partially with our proposal.
Figure 23 Question 53. Do you agree with the principles that (a) publicly owned data should always be free and (b) that public authorities should not need permission to use newly generated data building on publicly owned DBL data? (N=28)

<table>
<thead>
<tr>
<th>Agree with public data principles?</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, fully</td>
<td>15</td>
</tr>
<tr>
<td>Yes, partly</td>
<td>9</td>
</tr>
<tr>
<td>No</td>
<td>3</td>
</tr>
<tr>
<td>I don’t know</td>
<td>1</td>
</tr>
</tbody>
</table>

Furthermore, respondents were asked whether they agreed that the recommended *creative commons license* protects private companies’ rights. Here again, the vast majority agreed.

Figure 24 Question 54. Do you agree that this type of creative commons license appropriately protects the rights of private companies that use public DBL data? (N=28)

<table>
<thead>
<tr>
<th>Agree with creative commons license?</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, fully</td>
<td>15</td>
</tr>
<tr>
<td>Yes, partly</td>
<td>7</td>
</tr>
<tr>
<td>I don’t know</td>
<td>5</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
</tr>
</tbody>
</table>

One respondent that agreed fully with the previous two questions added that they think that the DBL should be accessible to all users and agents and its information should be available depending on the agent, so that it becomes a useful tool, respecting, of course, the privacy rights. But having the right to access the information would not necessarily mean that it is for free. Another respondent fully agreed, saying that “creative commons licenses provide a flexible system which should be able to comfort most constellations”.

European Commission
Another respondent that fully agreed with Q53 and partially with Q54 argued that the free licence is very important but for trusted data, there must always be full transparent responsibility for who is inputting values into the DBL and when they are inputting it. This requires a transparent and well-defined governance structure. Meanwhile, a respondent that partially agreed with Q53, but fully with Q54, added that access should be granted upon necessity.

Finally, a respondent representing a public authority agreed with both statements partially but pointed out that data owned by public authorities may be personal data which are neither public nor free.

**Privacy and authorisations**

Next, we explained that we would propose that all publicly owned building-specific data that are not protected by licence or contract and are not in any way privacy sensitive should be available to all civilians including those from abroad. This includes data that might affect the sales value of the building such as the year of construction or the energy performance label.

However, data that (1) are privacy sensitive such as the name of owner or tenant, actual energy use, fire incidence etc., (2) make a person more vulnerable such as quality of locks or burglar alarm, or (3) from which private data on health or income may be inferred, such as the presence of asbestos, leaking roof etc. should be accessible only to the owner of the building or building unit and their legal representatives and to authorised persons of certain authorised organisations such possibly the housing association, police, fire services, and municipal building control.

Most respondents agreed that publicly owned data should be accessible to all civilians and that a DBL should include privacy-sensitive data only if appropriate authorisation procedures are in place.

Respondents were invited to share further thoughts on these aspects related to privacy. One respondent, who selected ‘I don’t know’ for the second question wondered whether such data should be in a DBL at all. Seeing how major providers of platforms just leave the choice to accept their rules or not to use their platform, they worry that such a phenomenon could develop also for DBL. Therefore, if such types of data are not foreseen for DBL, then this risk would disappear.

Another respondent that partially agreed, argued that the DBL should include links to data (not the data itself) and allow access to the data via the links on an as-needed basis. Similarly, a representative for SMEs highlighted that access should be granted upon real necessity. A respondent that fully
agreed with both statements added that access to this private data should be defined according to the agent’s privacy rights.

Finally, one respondent that did not agree with the first question raised the issues of national security.

Asking about what other data one could consider privacy sensitive and should have restricted access to, one participant mentioned social aspects, such as age and gender, and income data to be privacy-sensitive information.

The concern whether a DBL should contain privacy sensitive data at all, even if only accessible to relevant authorities, is valid. However, some privacy sensitive data such as the names of owners and tenants are necessary in case of civil disputes or to know who to contact when safety concerns about a building arise. The GDPR (General Data Protection Regulation) does not prohibit the inclusion of privacy sensitive data in public databases, as long as the purpose is legitimate and communicated to the data subject (the person about whom data is collected) and certain other data protection principles. We recommend that Member States make their own assessment of which public authorities need to access privacy sensitive data in which circumstances.

Rights of data providers

In our study, we propose that any data provider or owner should have free-of-charge access to view the DBL data that he provided directly for the DBL. For example, a building owner, but also the construction company, real estate manager etc. providing data should have free access to the energy performance label, soil conditions report, sales deed etc. if that is available in the DBL, even if the same data is not freely accessible to others. The reason is that the data provider should be able to verify the data in the DBL and propose changes.

As depicted in the figure below, most participants agreed with this proposal.

*Figure 27 Question 60. Do you agree with the principle that data providers and owners should have free-of-charge access to their data in the DBL? (N=28)*
One respondent from a national authority agreed partially arguing that owners should have free data access, but not providers. Similarly, a consultancy elaborated that every owner should be able to access for free all data and private providers should have free access to the data they provided, but not to the rest. They suggest that there could be a fee according to the aim of the provider. However, public providers, due to their common public goals, should have free access.

One respondent coming from a standardisation organisation disagreed with our proposal and argued that the maintenance of a data dictionary has a cost that needs to be paid to maintain the reliability of data.

We are grateful for the further clarification that data owners and providers should only have free access to the data they own respectively provide, not necessarily to the rest of the data in the DBL. In our view dictionaries of public national DBLs should be open and free, as any data provider needs to know the definitions of data they are asked to provide. Collecting, updating and verifying data indeed has a cost. It makes sense to charge a fee to frequent users of the DBL. However, allowing data owners and providers free access to their own data should reduce those costs and/or increase the timeliness and accuracy of data.

Costs of developing a DBL

Next, we asked participants to rank the following costs of developing a DBL from highest to lowest:

- Developing a semantic model;
- Developing a dictionary;
- Agreement about data norms with stakeholders;
- Collecting data on existing buildings;
- Verification of data;
- Development of an online platform;
- Costs for licensed data;
- Other.

The majority of respondents ranked ‘Collecting data on existing buildings’ and ‘Developing a semantic model’ to be the highest costs, followed by ‘Verification of data’ and ‘Collecting data on existing buildings’. ‘Costs for licensed data’ was most often ranked as the lowest cost. ‘Preparing and implementing the necessary legal framework’ was also suggested as a cost by one of the participants in the ‘Other’ option.

A total score was assigned to each option from score 8 for the highest ranked cost (a score of 100% is obtained if all respondents rank an item at the top) to 1 for the lowest ranked cost. The scores were summed across all respondents and divided by the theoretical maximum score of 160 (based on 20 respondents). From the total score, it becomes evident that the collection of data on existing buildings was generally ranked among the most costly activities.

<table>
<thead>
<tr>
<th>Score</th>
<th>Type of cost</th>
</tr>
</thead>
</table>

Table 4 Final ranking based on the total score (N=20)
Next, participants were asked to give an estimate of lead time in months, man-days and/or outsourced costs for each of the above costs. The table below presents the estimates provided by up to four respondents.

From the response of one respondent, who reported the total lead time from initiation of activities to completion of the initial development, it appears that few activities can run in parallel. Collecting and verifying data can take up to 5 years, although in that case collection and verification can likely take place largely in parallel. The lead time for collecting and verifying data depends of course also on the ambition level for the completeness of coverage of existing buildings. Developing a dictionary, a semantic data model and an agreement with stakeholders on data norms each takes 6 to 12 months, and the development of an online platform takes one to two years. The minimum reported lead times add up to 3 years, but this assumes that all activities are completed in the minimum reported times. Assuming that a DBL with partial building coverage goes live after one year of collecting data and another year for verifying those data, the sum of average and maximum reported lead times add up to 6 and 7 years respectively. This corresponds to the lead time of 6 years estimated by one respondent.

In terms of man-days, the sum of minimum reported values is 350, and the sum of maximum reported values is 8,000. The one respondent who estimated the total man-days involved, estimated a total of 1,800 man-days. Even at a relatively conservative estimate of EUR 500 per man-day, a total of 1,800 man-days corresponds to a labour cost equivalent to EUR 9 million.

For out-of-pocket costs, the sum of minimum reported values is EUR 52,000. Leaving out the cost of collecting data on existing buildings which one respondent estimated at EUR 1 billion (the other two respondents reported EUR 1,200 and EUR 25,000 respectively), the sum of out-of-pocket costs vary between 50,000 and EUR 150,000 with an average of EUR 100,000.

Table 5 Question 64. Can you give an estimation in terms of lead time in months (the time between the initiation and completion of initial development), man-days, or of outsourced costs (minimum - average - maximum)?
<table>
<thead>
<tr>
<th>Activity</th>
<th>Range 1</th>
<th>Range 2</th>
<th>Range 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing a dictionary</td>
<td>6 – 8 - 12 (N=3)</td>
<td>100 – 450 - 800 (N=2)</td>
<td>0 (N=1)</td>
</tr>
<tr>
<td>Agreement about data norms with stakeholders</td>
<td>12 – 12 – 12 (N=3)</td>
<td>0 – 350 - 800 (N=4)</td>
<td>0 – 25,000 – 50,000 (N=2)</td>
</tr>
<tr>
<td>Collecting data on existing buildings</td>
<td>0.5 – 30 - 60 (N=4)</td>
<td>6 – 500 – 1,200 (N=3)</td>
<td>1,200 – 300M – 1B (N=3)</td>
</tr>
<tr>
<td>Verification of data</td>
<td>0.5 – 27 - 60 (N=4)</td>
<td>2 – 800 – 2,000 (N=4)</td>
<td>400 – 22,000 – 45,000 (N=2)</td>
</tr>
<tr>
<td>Development of an online platform</td>
<td>12 – 15 – 24 (N=4)</td>
<td>200 – 800 – 2,000 (N=3)</td>
<td>50,000 (N=1)</td>
</tr>
<tr>
<td>Costs for licensed data</td>
<td>0.5 (N=1)</td>
<td>2 (N=1)</td>
<td>400 (N=1)</td>
</tr>
<tr>
<td>Total</td>
<td>72 (N=1)</td>
<td>1,800 (N=1)</td>
<td>165,000 – 15M – 30M (N=2)</td>
</tr>
</tbody>
</table>

Finally, participants were asked the following question: “Which costs would have been incurred or do you expect to incur even in the absence of developing a DBL as a platform for collecting and sharing data?”. The collection and verification of buildings are reported most often as unavoidable activities.
This result indicates that the greatest value of a DBL is seen as a storage facility of verified building data, with the distinction that a DBL makes building data digitally accessible as opposed to paper documents. In addition, half of the respondents indicate that they would incur costs to harmonise building data – presumably to compare data on different buildings.

Given also that the highest ranked desirable feature of a DBL is a query feature to select all buildings meeting certain criteria, facilitating a comparison of data on different buildings meets another need that is in high demand.

Part 7: Technical guidelines overview

In this final part, we described the purpose of the technical guidelines, which is to support Member States in setting up and operationalising digital building logbooks under an EU framework. This means for example not only describing the dictionary as a deliverable, but also guidelines on the steps needed to use and further develop it. The guidelines also will discuss the main reasoning for a digital building logbook, benefits for Member States and other end-users and suggestions for the implementation strategy.

As such, we foresee the following outline for the technical guidelines:

1. **Introduction**: Description, definition, scope and purpose of digital building logbooks.
2. **Benefits of the building logbook**: In terms of better building and data management and EU harmonisation.
3. **Political and social implementation**: Awareness and acceptance, key players, potential barriers, enforcement strategy, feedback loops.
4. **Technical implementation**: Concept explanation (architecture, dictionary, semantic model)
5. **Platform guidelines**: Back-end and front-end setup of Member State platform.
6. **Required resources**: Community, financial, technical.
7. **Risks inventory:** e.g. legal / privacy, data security, incorrect or falsified data.

We asked participants to indicate whether they were missing any relevant, important parts from the above outline. 11 out of 22 respondents felt it was complete. However, 7 participants responded that it was incomplete (the other 4 participants responded with ‘I don’t know’). Some of the participants that responded with a ‘Yes’ provided some further feedback on what they were missing.

Their answers included the following suggestions:

- ‘cost-benefit analysis’,
- ‘case studies of existing DBLs’,
- ‘articulation with existing legal frameworks at the EU and national levels’,
- ‘clarification of what is private and what is public, i.e. what should be in a government DBL’,
- ‘the structural health of the buildings’.

Another participant also suggested that an ‘impact evaluation on societal benefits in terms of efficiency of processes, data processing, and identification of issues’ could be interesting.

Finally, participants were given the opportunity to make additional comments regarding the technical guidelines. We received three responses asking for the establishment of a clear differentiation between the compulsory and voluntary data within the DBL, the customisation of the Open Source Software (OSS) approach and the OSS DBL framework/template for local implementation at a reasonable cost, and a clear explanation of how DBLs use EN and ISO standards for data dictionaries and LOIN principle and classification systems.

The technical guidelines will include cost estimates but will indicate benefits only qualitatively. Existing DBLs will be briefly discussed. The guidelines will discuss potential legal barriers and the formulation of regulations that establish existing national DBLs.

We will make no recommendations on which information should be public or private. In our view, a national DBL can include both public and private data, where private data owners may set conditions for access and pay.

Also, in our concept a DBL is a tool for extracting data. Using building data, other tools may be developed to calculate the structural health of a building, energy efficiency performance, renovation costs, renewable energy potential (suitable surface for solar panels), environmental risks to the building (floods, fire etc.) etcetera.
### Annex A – Open answers

#### Question 6. Would you agree with the principle described above of following the structure of INSPIRE links? – Please, clarify your opinion in your own words.

- **“Developing and using unique building identifiers to tag and aggregate data is the preferred way to develop logbooks.”**

- **“I think this way sounds good but the details need to be clear. Furthermore, this issue must be coordinated with other relevant initiative in order to publish consistent information on different levels.”**

- **“The following sentence is not clear ‘The great advantage of such a set-up would be that an EU portal or a commercial tool can link the user to data on an individual building. If a national authority combines data from multiple sources in that document, the end user needs to view one document only.’ If INSPIRE links define the building resource as URI, all the linked resources (other URIs, links, Documents, etc.) are just a reference to this building. Thus, is needed just a list of Buildings INSPIRE IDs (read only) with the related list of References (editable) that points to.”**

- **“EU should force to have a unique ID for a building and only regulate the standardised organisation of data common data environment and a standardised digital library.”**

- **“INSPIRE has the advantage to exist and avoids having to create another system for DBL. In addition, it combines a European approach with the freedom of the national/ local level to develop their specific building identification system.”**

- **“Yes, we use CIM (city information modelling) for integrated data shared sources.”**

- **“In my perspective the link between INSPIRE and DBL is critical to implementation. However, INSPIRE development might not had in mind all requirements that presently are being placed. DBL is not so different from a Product Passport, meaning that compliance with ISO 23387 should be seek. In this respect it seems that future research needs to set to see how compatible is INSPIRE with ISO 23387 assumptions.”**

- **“Security and possible threats related to this table listing IDs and corresponding addresses should be clarified.”**

- **“We agree that a system of decentralised building IDs is suitable to link building information within the country and the EU framework, making use of the hyperlink to access the document. The IDs should be related to the corresponding addresses and geo coordinates and also with the cadastre ID which is, at least in Spain, the current system to store the building data. Regarding the structure of the identifier, it should be discussed how to normalize it, in order to have a common information across the different MS. The information to construct the identifier should be available in every MS, i.e.: Country (2 digits) + Region (2 digits) + Municipality (3 digits) + ? In Spain, we find a different structure to construct the ID between the national cadastre and the Basque cadastre, using different information to construct so it is expected that this will also happen among the 27 MS.”**

- **“I fully agree with the decentralized data model which is more sustainable for responsible users. This model is killer dependent on unique identifiers to avoid duplicates. That is the crucial bottleneck of this architecture always. In my 25 years of software development, I trust only GUIDs.”**
I’m sorry but I don’t have time to study in detail Annexe H (above 120 pages), so if there are guaranteed unique IDs, which I assume, that is all fine.”

“Easy to find the characteristics of some building.”

“We prefer universal unique identifier (uuid).”

“An unambiguous identification of buildings is necessary for the public sector.”

“No objections on principle provided that the access to the data is managed by the owner of the data itself. So decentralised storage of the data is preferable.”

Question 13. Following the questions on DBL Data extraction, timeliness of data and interoperable data formats – Please, clarify your opinion in your own words.

“You would need to have trusted providers to retrieve the data at every search and even if trusted they can have various problems.”

“The question is not clear. It should not be an either/or question. A distinction could be made between data that will need to be updated periodically and data which have a longer lifespan.”

“In this case the homogeneous data structure could be managed.”

“The best solution could be a mix of both types of interaction. Some kind of data versions could persist more than other (no changes in years) than a periodic update can be a good solution (and might be scheduled and communicated by data providers\consumers). Other kind of data can be updated more than once in a year, and can be retrieved in real time from the providers. Technically this kind of data can ben cached based on common search stats to retrieve fast results. A central copy (even if decentralized in terms of dataset redundancy) is needed to secure the data if provider goes offline (i.e. is very common that some interesting Linked Data providers goes offline for different reasons).”

“Having a central copy of all relevant data can make it easier and more efficient to access the necessary information, as the user does not have to spend time searching for and accessing data from multiple sources.”

“The DBL needs to be dynamically updated in order to be reliable. It means that each provider has to push its data when he does something in the building.”

“Only retrieval after every search ensures up-to-date data.”

“DBL as ID of Building/Building Unit & basis for Data Exchange  data retrieved from sources on as needed basis.”

“Data remains at source and is only actualized on demand.”

“It is not possible to retrieve all the data on real time from the sources because some of them are not interoperable, but it would be desirable.”
“I would avoid creating a novel huge central repository somewhere. Decentralised systems better suit the scattered sources of information (even amongst gov agencies).”

“We are uncertain on the last few questions, but in general favour decentralised systems with version control and checksum validations along the way, with an emphasis on API access to data.”

“I prefer periodical updates but not all data content but just update the difference content between source and copy based on audit logs. There are already validated replication scenarios from other database applications, no need to invent something new.”

“Easy to manage.”

“We prefer direct access and loose coupled system.”

“Technically, there is no need to copy data to national databases as long as minimum requirements are defined for data in DBLs.”

“Local copy should be possible (otherwise, what’s the use of DBL...) but with a timestamp.”

Question 14. Do you agree with the set-up with three branches (cadastral parcel, building and building unit) and that DBL users would be referred to BIM models or technical drawings (if available) for further details about rooms? – Please, clarify your opinion in your own words.

“The connection to BIM is important to combine and harmonised the data between different initiatives.”

“How are building units and rooms managed in terms of privacy data?”

“Referring to BIM models or drawings for the rooms would need them to stay up-to-date, which may be a burden without providing useful information. The necessity of having these details needs to be reconsidered.”

“For building units, it should be ensured that no individual/individually personal data are collected/used in a way which would be an infringement of GDPR rules. Wherever possible, BIM data should be used, obviously respecting ownership rights.”

“Agree on what you propose, but that’s not enough and you should consider LADM as mentioned previously.”

“The data traceability requirement implies that all this data needs to be compatibilized. Inspire and CoBIE as example provide a significant part of this systematic. Yet, due to personal experience on practical implementation of this, there are several bottlenecks on the realisation of what a BIM model must be.”

“We’ve been already confronted to building composed of (sub)buildings (especially in campuses or large organisations). This should be considered as well.”

“For further details about rooms, we shouldn’t only rely on BIM models or technical drawings. There should be a faster or more effective way of defining these details about a building’s”
functional program. The methodology for obtaining this information could be predetermined so that the users or agents can introduce comparable information.”

“This is a crucial principle of the DBL to be a part of the future. DBL is just part of the LOIN principle based on the EN 17412 series (purpose, milestone, actor, classification of the buildings). And the definition of any sets and properties must go under the data dictionary international standards based on EN 23386, 23387. Dismissing and not well implementing those and more standards will cause a silo solution with enormous additional costs when governing data and their updates. Here I'm repeatedly offering you my huge knowledge and practical experience from the national level and from standardization as well.”

“Only rooms according to class: rooms according to city GML.”

“CRITICAL point: I am strongly convinced that these 3 levels are not sufficient if we want to collect detailed 'live' information about individual systems and critical components (see. Building Services group of properties: - Compliance status with fire, elevator and balcony safety, salmonella free status of swimming pools / - Documents: elevator and fire safety inspection certificates etc., maintenance contract, utilities contracts). For large objects such as a hospital building or a shopping center (e.g. IKEA), in which there are many technologies and devices, it is not possible to report their compliance status and all issued safety inspection certificates at the Building or Building Unit level. Therefore, it should be possible to create the 4th level: Critical Point of Interest and record the above information directly for this device. I do not mean to create an overview of all windows in the building and monitor their U-value, but to define, for example, TOP 10 types of critical point of interests and monitor information about them individually. This list should include especially those systems for which there is already a harmonized obligation to register, such as Boilers checks in relation to the EPBD, Chillers because off European F-Gas regulation, Sprinkler system - very important for every insurance company, Fire Alarm System, Evacuation Elevators, Defibrillator, etc.. Today, users of such buildings already use IT support tools such as EAMS (Enterprise Asset Management System), CAFM (Computer Aided Facility Management) or CMMS (Computerized Maintenance Management System), which contain all this information and documents stored and attached to a specific device/system. In addition, the status of this information changes frequently, as it is subject to regular inspections often, such as monthly or quarterly. If we really want to effectively link information between the building owner/operator, insurance companies and authorities (e.g. Fire Brigade dept.), we need to be able to link information from these CAFM/CMMS systems online via API. If we wanted to record all this information and documents at the Building or Building Unit level, it would not be sustainable. Please believe me, during my more than 20-year professional career, I had the opportunity to work (also thanks to my employment at Bureau Veritas as Head of FM dept.) on exactly these topics for many multinational corporations from the field of Retail (METRO Group, IKEA, Hornbach, Decathlon, Adidas, Nike, ...) Food industry (Nestlé, Orkla foods, SABMiller, Asahi, Legardere, ...) Automotive (Jaguar Land Rover, Johnson Controls, Magna, ...) Hotel industry (Hilton, Accor, ...). Without this 4th level and the ability to record this data effectively, the potential of DBL will NEVER be fulfilled.”

“In a building, a DBL should exist for every owner. In a multi-ownership, several DBLs exist for the specific units.”

Question 16. Do you agree with the proposed organisation of building properties in the seven property sets? – Please clarify your opinion in your own words.

“In principle ok, but the details must be discussed.”
“The grouping does not really matter. The level of information need approach is recommended.”

“This is the standard organization, if needed the property sets can be extended or customized.”

“This organisation doesn’t respect at all the ISO and CEN organisation ISO 41 000 ISO 55 000 and IFC 2.3 and 4.”

“I wonder whether items such as in 2d, 'user profile like students, seniors, asylum seekers etc.' is important enough for DBL purposes to risk problems with GDPR.”

“All you propose is OK but more might be needed.”

“It seems that there might be several constraints on this implementation due to the design and construction deliverables organisation. I don’t think this should go to general. On the other hand, construction and further interventions should build upon the built object life-cycle. In the DBL layers that I’ve been setting I consider GDPR data sensitive layer, namely if it is the case of social housing. I have several questions on how the organisation will work namely in terms of points 4, 5, 6 and 7.”

“We have some considerations and opinions in this matter: 1. We would separate “Structure” and “Material” in different categories, because we consider that their content is distinct and it’s more intuitive if they are separate. 2. About “Structure”: as we said in an earlier question, the structural function of rooms and relations between spaces should have a predetermined way of introducing the data, so that it could be comparable between different buildings and it’d be easier to introduce more detailed information. We understand that this predetermined data for an architectural or functional structure should be flexible enough, so that every architect or technician could describe it satisfactorily. 3. We doubt if it’s really necessary that the information about security (alarms, locks) is a part of the DBL. 4. We think that the categories 2. General and 3. Legal and financing could be reorganized. It could be more intuitive if the topics related to “Administrative”, “Financial” and “Use” were separated. 5. Based on the case study that we are going to develop, as Ander explained in our last meeting, we think that the historical and cultural value of a building is an important information to consider, so it should be included. 6. From our knowledge and the projects, we had the pleasure to develop, we think that the social dimension related to a building is a very important element to consider. 7. It could be good to add the parameter “building occupancy”, not only as a social dimension but as something that influences other things, like the energy performance. 8. We think that it should exist a transversal category named “Documents” only for providing and consulting documents. Then, the data available in them, would be related and available too in the other categories, where it could be suitable for the data to be. 9. The “Placement” category should be recovered.”

“We suggest property sets nr 1, 5 and 6.”

“We would like to see some more explanation on the properties as to also understand why it is necessary to put each property information in the logbook. Will this information be required to be filled in or is all info provided optional...?”

**Question 18. Would you organise certain properties differently or do you miss certain properties?**

– Please clarify your opinion in your own words.

“Especially for building services it will be difficult to use abstract information therefore a link to BIM would be helpful for further details.”

“E.g. Classification is missing or linking mechanism to entities not stored and managed by the DBL, etc.”

“ Seems complete, but this kind of questionnaire is not very user friendly to check.”
In 5. Performances, a clearer visibility shall be given to the 'Documents', EPC is quoted but other technical inspection report exist like electrical or gas inspections which are key for safety reasons inter alia: a section dedicated to technical reports shall be considered, ideally a new property set.

“There is a mismatch between properties, performance and reliability of data: this is organised in the IFC model.”

1. Perhaps I missed 'accessibility' for access to, moving in, leaving a building, but that aspect must be in DBL. 2. I wonder whether some aspects, e.g. 'lifecycle cost', 'annual maintenance cost' or item 7 'building services' are not typical parts of BIM data. 3. In general, I wonder whether BIM has the key position for providing data which I would give it. 4. In item 3c, I would add 'public land register/cadastre' behind 'sales deed'. 5. Most of the information item 4a 'Lengths, gross and net areas & volumes' is contained in the cadastres in Germany (I do not know how that is in other countries).

“You might miss some aspects. You apparently assume that dwellings are contained in a single building which is not the case.”

Aspects related with the Directives on waste and safety and health on construction sites must be overviewed as they provide aspects that should be part of the DBL. DBL and Level(s) should be compatible and support each other organisation. I question to what extent is this being considered.

“Based on your proposal and our work, we have developed a new organisation of twelve categories and properties, that we will show you below. First of all, we propose to add: building type (single-family, multi-family, church...), number of building units, historical / cultural value, public services, urban supply services, access to green spaces / parks / nature, air pollution, spaces / room surface and relations, building materials inventory, embodied resources & carbon, building structure type and inspections, building occupancy, local entities / communities / other social organisations, building owners / tenants, property administrator, environmental awareness level. You will find these new elements in the categories with an (*). 1. Building Identification: - Building ID - Building Unit ID - Cadastral parcel ID - Online Link ID 2. General information: - Address, placement indicators like geo coordinates - Dates of permits, construction, renovation, etc - (*). Building type (single-family, multi-family...) - Use function (principal) - (*) Number of Building units - (*) Building historical / cultural value 3. Placement & urban data: - Public transport - Connectivity - (*) Public services - Internet connectivity - Video street surveillance (is it necessary?) - Street lighting - (*) District Heating - (*) Urban supply services - Traffic speed metres - Flood risk - Noise levels - Climate data - (*) Access to green spaces or parks – climatic shelters and contact with nature - (*) Air pollution - (*) Other ecosystemic services? 4. Dimensions: - Lengths, gross and net areas & volumes - Requirements such as max height, minimum distance from boundary etc. - Documents: BIM model, technical drawings - Linked geometric representations (0D, 1D, 2D, 3D) - (*) Simplified geometrical model that represents the dimension’s data that are introduced, so that the user can easily understand it. 5. Structural function - Number of / breakdown in zones, floors, spaces/rooms, elements, components, products, materials - (*) Spaces/rooms area and relations - Requirements such as min/max number of parking spots etc. 6. Construction & Material: - Components, products, materials for each element - U-values for various element types - (*) Building materials inventory - (*) Embodied resources & carbon. - Year of latest materials inspection, asbestos check etc. - Certain materials as asbestos (Y/N) for authorised DBL users only - (*) Building structure type, status and inspections 7. Building Services: - Types of energy (gas/electricity/solar/thermal/city heating,...), production and consumption installations - Requirements such as heat pump (Y/N), prohibition of gas connection (Y/N) etc - Solar surface
potential and actual - Type of ventilation system - Type of water and sewerage installations - Number of elevators, balconies, swimming pools etc. - Types of building automation (temperature control system, automatic lighting etc.) - Types of security (locks, alarms etc.) for authorised DBL users only (I’m not sure if this is necessary) - Type of telecommunications connectivity - Planned and recorded dates of connections, installations and repairs - Compliance status with fire, elevator and balcony safety, salmonella free status of swimming pools etc. 8. Performance: - Functionality offered incl. connection to utility services (Y/N), indoor health & comfort levels - Accessibility to people with a movement or visual disability, etc. (Y/N) - (*) Building occupancy (useful for energy performance) - Actual energy and water consumption and production level - Energy performance label (e.g., A-G), circularity label, energy and water use label, CO2 and N2 emissions label, smart readiness indicator value etc. 9. Social - User profiles: (*) age, income - (*) Local entities, communities and other social organisations linked to the Building - (*) Building owners, tenants... - (*) Property administrator - (*) Building occupancy (useful for the community structure.)”

“For the definition must be used data templates under EN 23387 with LOIN principle as well (EN 17412).”

“Especially property sets nr 1 and 7. We want to exclude cadastral information in set nr 1.”
Annex B – Question 27. What aspects (property sets) of a national DBL as defined in an earlier question would be relevant for this use case, and in which stage of the building life cycle (multiple choice)? – per use case

<table>
<thead>
<tr>
<th>Use case: Design and engineering</th>
<th>Design</th>
<th>Construction</th>
<th>Operation</th>
<th>Maintenance</th>
<th>Renovation</th>
<th>Demolition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building identification</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legal and Finance</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure and material</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building services</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use case: Renovation of buildings/EPB</th>
<th>Design</th>
<th>Construction</th>
<th>Operation</th>
<th>Maintenance</th>
<th>Renovation</th>
<th>Demolition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building identification</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>General</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Legal and Finance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Dimensions</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Performance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Structure and material</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Building services</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use case: Facility management</th>
<th>Design</th>
<th>Construction</th>
<th>Operation</th>
<th>Maintenance</th>
<th>Renovation</th>
<th>Demolition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building identification</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use case: Fire safety evaluations</td>
<td>Design</td>
<td>Construction</td>
<td>Operation</td>
<td>Maintenance</td>
<td>Renovation</td>
<td>Demolition</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------</td>
<td>--------------</td>
<td>-----------</td>
<td>-------------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>Building identification</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>General</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Legal and Finance</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Dimensions</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Performance</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Structure and material</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Building services</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use case: Enabling Renovation Wave and circularity</th>
<th>Design</th>
<th>Construction</th>
<th>Operation</th>
<th>Maintenance</th>
<th>Renovation</th>
<th>Demolition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building identification</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legal and Finance</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure and material</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Building services</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
### Use case: Research purposes

<table>
<thead>
<tr>
<th></th>
<th>Design</th>
<th>Construction</th>
<th>Operation</th>
<th>Maintenance</th>
<th>Renovation</th>
<th>Demolition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building identification</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>General</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Legal and Finance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Dimensions</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Performance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Structure and material</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Building services</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

### Use case: Storing general information

<table>
<thead>
<tr>
<th></th>
<th>Design</th>
<th>Construction</th>
<th>Operation</th>
<th>Maintenance</th>
<th>Renovation</th>
<th>Demolition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building identification</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>General</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Legal and Finance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Dimensions</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Performance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Structure and material</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Building services</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

### Use case: Public administration – identifying buildings of interest

<table>
<thead>
<tr>
<th></th>
<th>Design</th>
<th>Construction</th>
<th>Operation</th>
<th>Maintenance</th>
<th>Renovation</th>
<th>Demolition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building identification</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>General</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Legal and Finance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Dimensions</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Performance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Structure and material</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Use case: Defining norms</td>
<td>Design</td>
<td>Construction</td>
<td>Operation</td>
<td>Maintenance</td>
<td>Renovation</td>
<td>Demolition</td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------</td>
<td>--------------</td>
<td>-----------</td>
<td>-------------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>Building identification</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>General</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legal and Finance</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure and material</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Building services</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use case: Business models – identifying clients and solutions</th>
<th>Design</th>
<th>Construction</th>
<th>Operation</th>
<th>Maintenance</th>
<th>Renovation</th>
<th>Demolition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building identification</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>General</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legal and Finance</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structure and material</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Building services</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use case: Real estate business models</th>
<th>Design</th>
<th>Construction</th>
<th>Operation</th>
<th>Maintenance</th>
<th>Renovation</th>
<th>Demolition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building identification</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>General</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legal and Finance</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Structure and material</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Building services</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>