DEFINITION OF THE DIGITAL BUILDING LOGBOOK

Report 1 of the Study on the Development of a European Union Framework for Buildings' Digital Logbook

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CHAPTER 1: BACKGROUND

Data concerns almost every aspect of the built environment: from how individuals and businesses use and interact with properties, to how a building's energy consumption and construction details are recorded and analysed to support informed decisions about construction and real estate processes. Data is used for benchmarking and progress tracking of performance improvements and energy use, business planning, internal and external reporting, risk assessment and financial underwriting. The availability of consistent and reliable data can contribute to better design, construction and management of buildings, improved market information and transparency, creation of innovative services and business models, as well as more effective policymaking.

Studies suggest that the construction sector[1] is underdeveloped in terms of overall digitalisation and data applications in comparison with other industrial sectors.[2] Building-related data (such as data of physical building characteristics, environmental performance information and real estate transaction data) continues to be scarce, of unreliable quality and limited accessibility.[3] The lack of a common data repository amount to additional costs and inefficiencies, stifle innovation, increase risk and undermine investor confidence.

The current study on the "EU-wide Framework for a Digital Building Logbook (DBL)" aims to support the widespread use of DBLs across Europe.[4] It also encourages data transparency and increased data availability to a broad range of market players, including property owners, tenants, investors, financial institutions and public administrations. In addition, the DBL will contribute to a number of high-profile policy initiatives including the strategy "A Europe fit for the digital age", the "European Green Deal" and its Renovation Wave, the new Circular Economy Action Plan and the forthcoming Strategy for a Sustainable Built Environment.

Several European countries have developed and implemented DBL-type initiatives over the last years, including, for example, the Woningpas in Flanders (BE), the private initiative BASTA in Sweden and the PTNB in France. All these initiatives share a common objective to increase data availability and transparency to a broad range of market players. The existing DBLs however differ in terms of focus (e.g. on energy efficiency or materials), data handling and digital solutions employed. While paper-based logbooks do exist, it is widely accepted that to reap the most benefits of such tool digital features are required. A common European approach covering the entire lifecycle and comprising all relevant building information could increase learning and enable synergies, interoperability, data consistency and information exchange.

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[1] For the purpose of this report, construction sector includes the following sectors of the NACE Rev.2 Statistical classification of economic activities in the European Community: Construction (Section F), Real Estate Activities (Section L), Architectural and Engineering Activities (Section M, Division 71).

[2] McKinsey (2016) Digital Europe: Pushing the Frontier, Capturing the Benefits, European Commission (2019) Supporting digitalisation of the construction sector and SMEs & BPIE and i24c (2016) Driving Transformational Change in the Construction Value Chain

[3] Hartenberger et al. (2019) The Building Passport as an enabler for market transformation and circular economy within the built environment: SBE19 Conference Series paper and RICS (2017) Global Trends in Data Capture and Management in Real Estate and Construction

[4] Another frequently used term is "building passports"

Project outline

Figure 1 presents the four main tasks carried out by the study on the EU-wide Framework for a Digital Building Logbook:
- Task 1: Conceptual definition of DBL,
- Task 2: State of play and review of national & sectoral initiatives promoting the use of building logbooks,
- Task 3: Gaps analysis,
- Task 4: Recommended EU Commission actions.
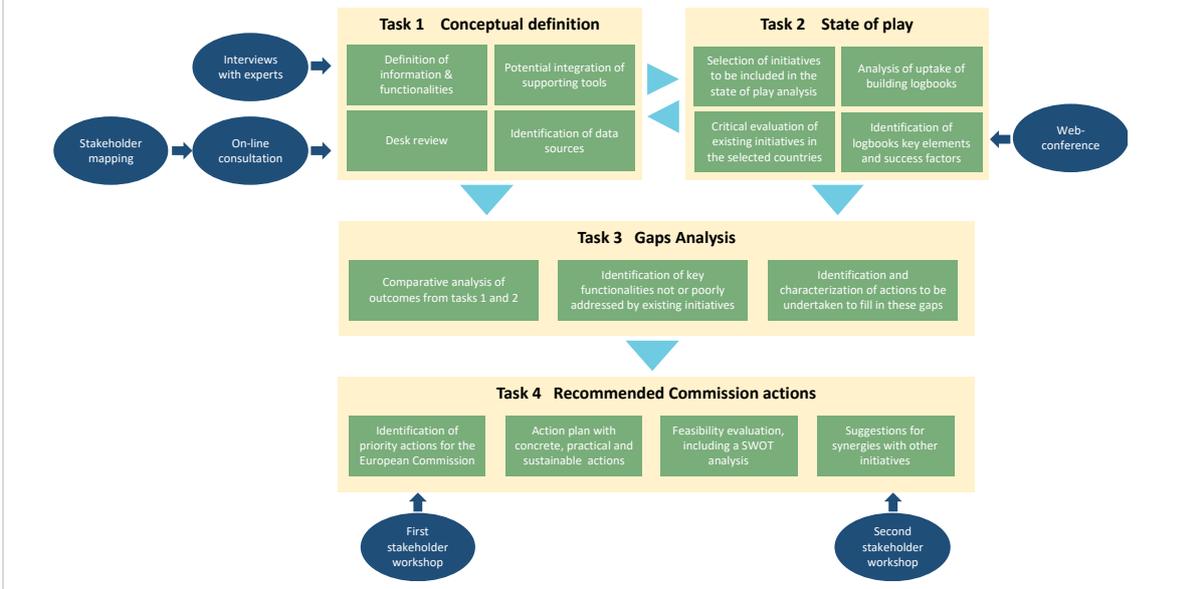
Figure 1. Overall approach and organisation of work

The present report aims to present a definition of a DBL, building on a state-of-play analysis and stakeholder input from across Europe. The report outlines the potential role and scope of an EU-supported DBL, including the central features of the instrument, as well as data handling and governance issues.

CHAPTER 2: RESEARCH APPROACH

The report builds on a thorough review of existing literature, consultation with over 30 experts through semi-structured interviews, as well as quantitative input received through an online survey (93 respondents).

The **desk research** explored existing studies and projects carried out on the topic of DBLs. The literature has been identified through a snowball method, where additional literature has been discovered based on a few central studies[5], as well as stakeholder input (see bibliography for the full list of literature). These include, but are not limited to, national and local initiatives promoting the use of a DBL (e.g. Woningpas in Flanders and PTNB in France), as well as private initiatives (e.g. Eigenheim Manager in Germany and Passeport Efficacité Énergétique in France). The desk research also covered academic articles (e.g. Lützkendorf et al, 2019 and Hovorka et al, 2012), industry publications and other relevant studies (e.g. RICS, 2017). Finally, the desk-based research was extended with a review of existing logbook schemes and initiatives. These include, but are not limited to, national and local initiatives promoting the use of a DBL (e.g. Woningpas in Flanders and PTNB in France), as well as private initiatives (e.g.Eigenheim Manager in Germany and Passeport Efficacité Énergétique in France).

The **online survey** gathered stakeholder views and input regarding the type of information to be included in the DBL, functionalities it could incorporate, as well as data governance issues (see questions in Annex A).

Semi-structured **interviews** were held with 32 experts to collect more in-depth insights. The interviewees were selected based on their field of expertise to gather a wide range of perspectives.

Table 1. Metadata of the consultations

Online survey	
Number of respondents	93
Survey time	15-20 mins. (estimate)
Number of EU countries represented	19
Stakeholder groups represented	Demolition industry [1], building owners [2], finance [3] architects [4], digital services [4], engineers [4], contractors and craftspeople [7], construction material and products [13], public authority [18], research [30]
Interviews	
Number of respondents	32
Interview time	30-80 mins. (average around 50 mins.)
Number of EU countries represented	9
Stakeholder groups represented	Building owner representatives [3], construction industry and manufacturers [2], suppliers of energy efficiency solutions [1], digital and data services providers [4], building automation and control [2], finance [1], real estate developer [1] and researchers [3]. Eight respondents have experience of implementing a version of a DBL, as a private [5] or public [3] initiative.

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[5] Most notably: Ganter, M.; Lützkendorf, T (2019) Information management throughout the life cycle of buildings - Basics and new approaches such as blockchain, Daniotti, B; Gianinetto, M & Della Torre, S (2020) Digital Transformation of the Design, Construction and Management Processes of the Built Environment & Virta, M.; Hovorka, F.; Lippo, A. (2012) Building Passport as a Tool to Evaluate Sustainability of Building

Consultation findings

The views of experts and stakeholders have been gathered to get additional input regarding the type of information to be included in DBL and to identify the key features of the instrument. The consultation also provided insights on barriers and enabling conditions for the development of DBL. The main findings are presented in this chapter.

Interview findings

Who participated in the interviews?

- 30 interviews and 32 interviewees
- 9 EU Member States
- 56% men and 44% women
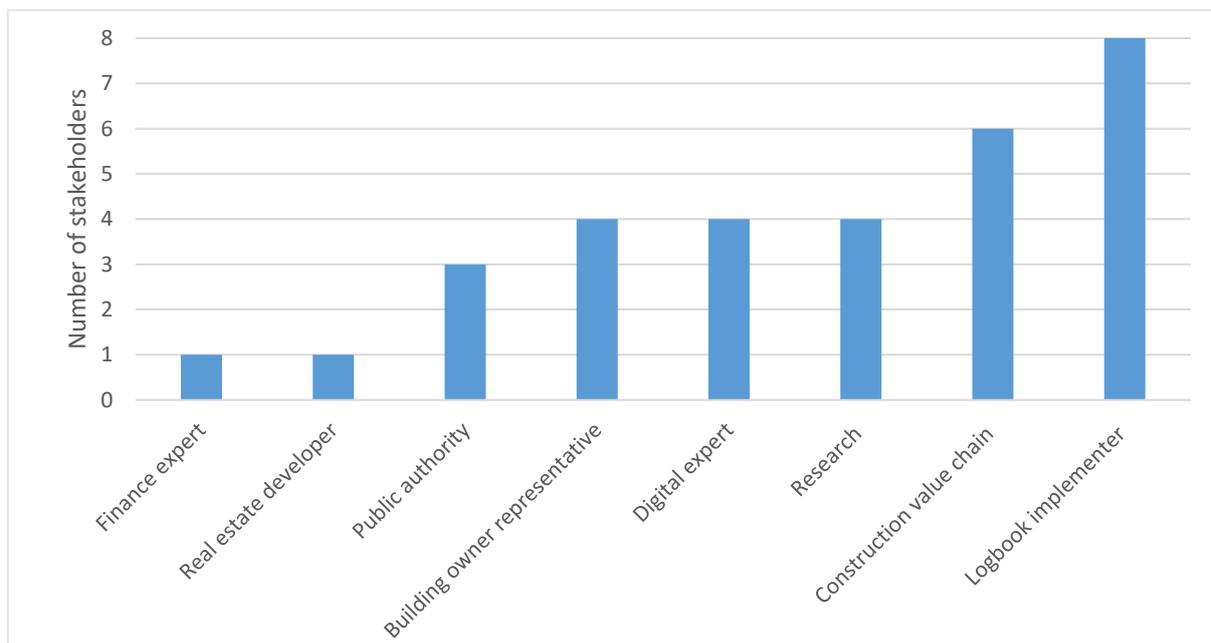
Figure 2. Number of interview participants according to the field of work

What is a digital building logbook?

- The interviewees described the DBL as a "repository for (all relevant) building data", or some version of this.
- There is a broad spectrum of ideas of what the DBL could be and what it should be able to do.
- The most common purpose mentioned in relation to the logbook is that it can enable a reduction of energy/carbon use and mitigate the sector's climate and environmental footprint (throughout the building's life cycle).
- Other common answers are: support the construction value chain and provide benefits to the building owner.

Which functionalities should the DBL include?

- It should allow for easy storage and access to information while being able to provide different data for different actors and purposes.
- The DBL must be "easy to understand, accessible and reliable".
- The DBL ought to systematically log and store existing data and information.
- It should contribute to an increased awareness of the building's energy performance, material use over the lifecycle, sustainability performance, indoor environmental quality, potential energy and cost savings etc.

- Several interviewees from the construction value chain argued that it must enable traceability of materials and chemicals over the building's lifecycle.
- Building owner representatives and existing logbook implementers argue that the DBL should provide services to the building owner and store information, access premiums, compare energy consumption (w. neighbours and/or future consumption) or find contractors etc.
- Digital experts and researchers highlighted the need to integrate BIM/digital twins.
- Digital experts and existing logbook implementers said that the DBL must contribute to the harmonisation of data, making sure different data types can be linked and matched in a reliable and time-efficient way.

What type of data should be collected?

- A common understanding is that it is sufficient to incorporate existing data sources.
- The digital experts pointed out that the future will open up opportunities to collect data (e.g. sensors, real-time energy use), which will come with new possibilities and responsibilities (in terms of data privacy and security).
- It was also highlighted by several interviewees that the DBL could be linked with existing policy and market instruments, such as the Smart Readiness Indicator, Energy Performance Certificates, LEVEL(s) and material passes /passports.
- A wide range of data sources was mentioned by the interviewees, including administrative, building characteristics, energy performance data, operational, maintenance, financial data.

Where should the data be stored?

- The interviewees think the data should be stored either by public authorities or continue being stored where it is currently being held. Only a couple of interviewees think it is a good idea to store and centralise data on the EU level.
- A common argument was that the data needs to be up-to-date and reliable to be useful.

On-line survey findings

Who participated in the survey?

- 93 respondents.
- 19 EU MS (+UK and "outside EU").
- 71% of men and 26% of women.
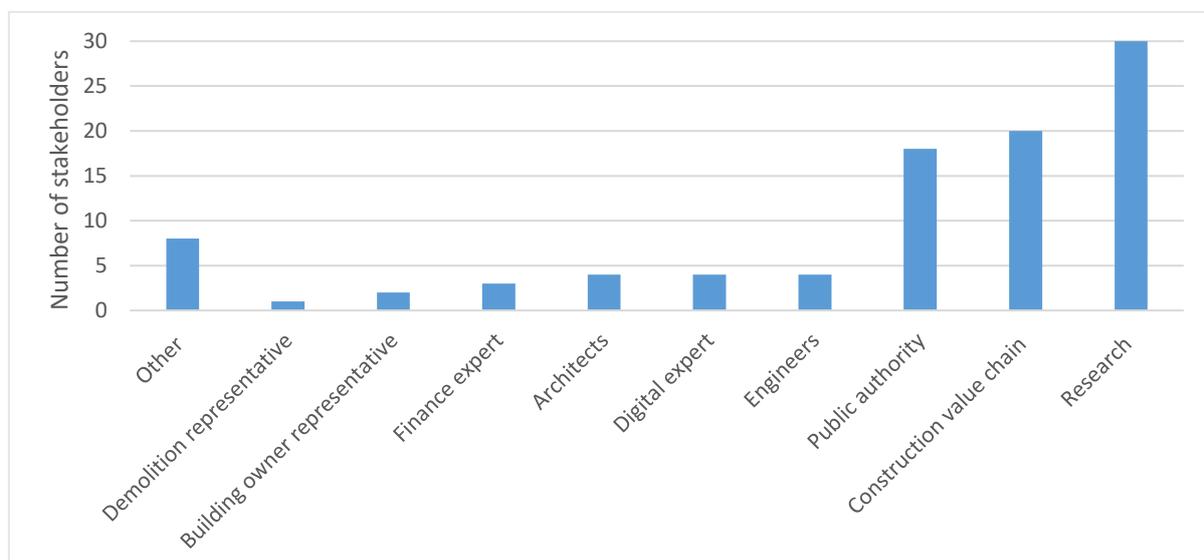
Figure 3. Number of survey participants according to the field of work

How important do you consider the following functionalities in a DBL?

The majority of survey respondents think that all listed functionalities are, at least, somewhat important. The most popular functionality is the "automatic input of data from 3D/BIM model", where 64% say it is very important and just 8% think is not important. The benefits linked to the most popular functionalities are very clear and straightforward, as they exist to some extent today. The benefits related to "valuation and due diligence" and "authorisation to 3rd parties" might be more difficult to grasp for non-experts.
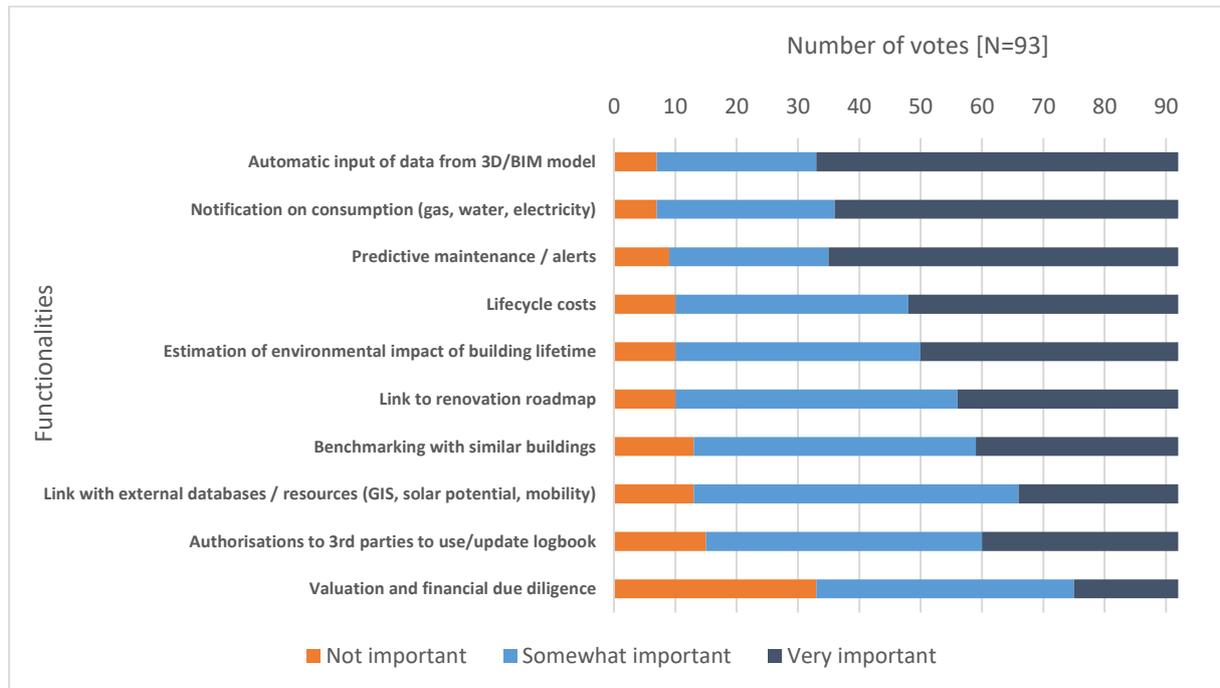
Figure 4. Survey - DBL functionalities

What type of data do you think should be collected in the DBL?

The majority of survey respondents think that all listed data types are, at least, somewhat important. The most popular data type is the "building description and characteristics", where 87% say it is very important and just 5% think is not important or should not be included. As with the functionalities, the most popular data types are traditional data types, description of the building, the equipment and materials. The benefits related to the least popular data types are less straightforward and more difficult to grasp for non-experts.
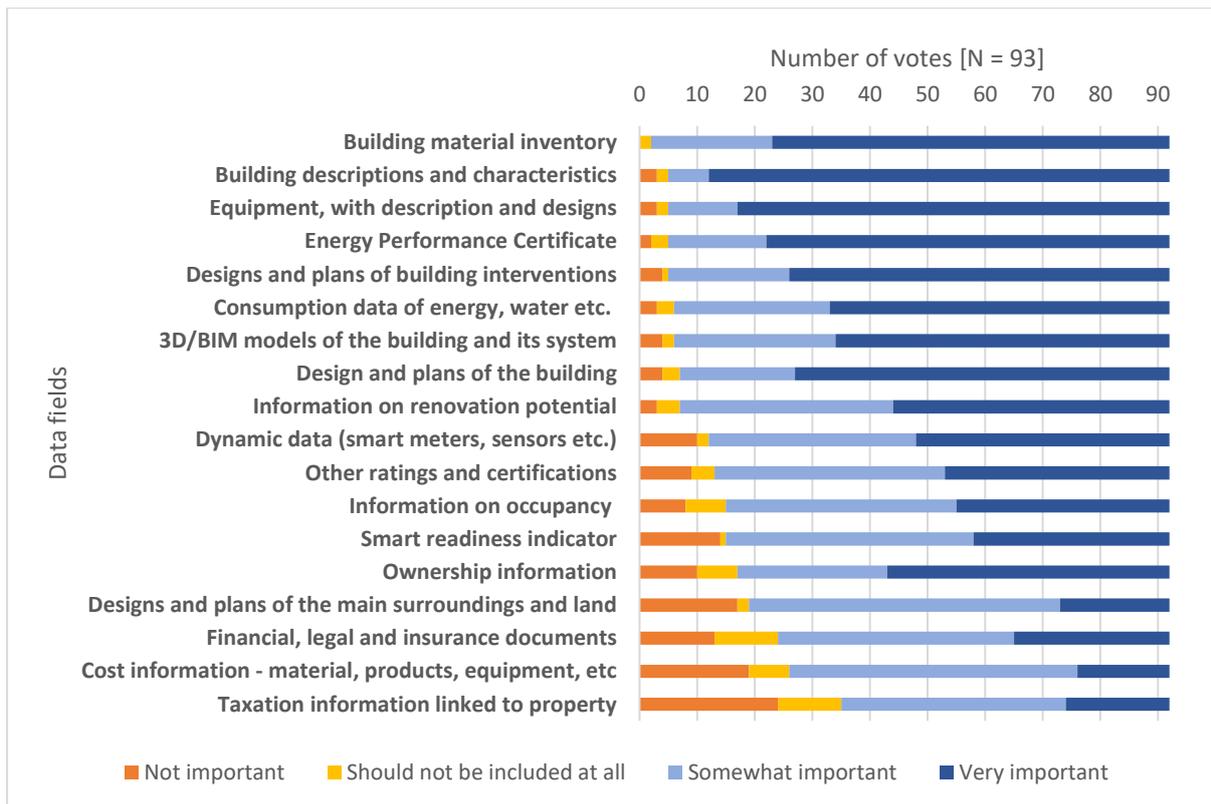
Figure 5. Survey - data fields

In your opinion, who should be responsible for data ownership and liability?

The respondents suggested a wide range of actors and constellations, yet two of them were recurring rather frequently:

- 59% (47 out of 79 respondents) suggests the building owner, either alone or together with a public authority.
- 34% (27 out of 79 respondents) refers to the public authorities, either alone or together with other actors. The main reason provided is to ensure data quality and reliability.

Who should have access to the DBL data?

The respondents were also asked to answer a question on data accessibility for the three main user types: building owners, public authorities and 3rd party actors (actors in the construction value chain, utility companies etc.). 75% (65 out of 87 respondents) think that building owners should have full access to the data stored in the DBL about their building. 52% (44 out of 85 respondents) think that 3rd party actors should have access to "individual project data". 54% (47 out of 87 respondents) think public authorities should have "limited access", while 36% (31 out of 87 respondents) think they should have "full access".
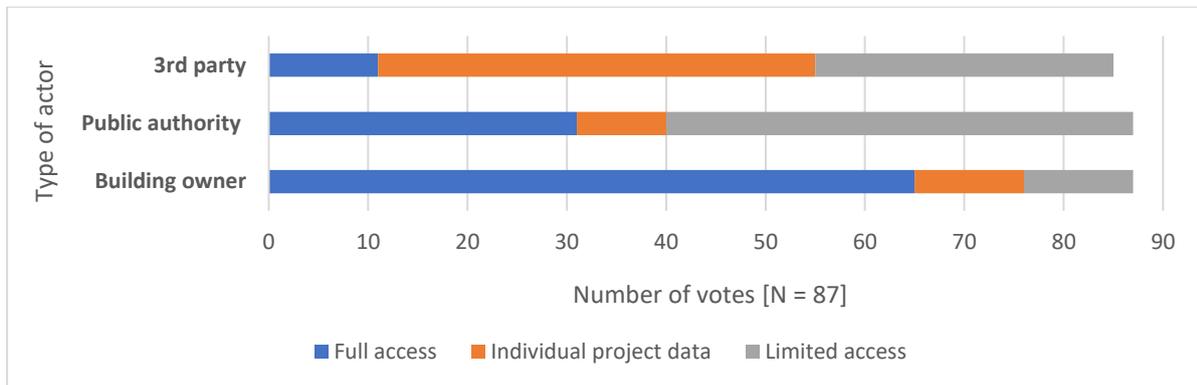
Figure 6. Survey - Data access

How often should the DBL be updated?

Almost half of the respondents (45 out of 92) think the DBL should be updated "any time the building undergoes intervention work", followed by "other" (22 out of 92) and "on a recurring basis" (21 out of 92). Only a handful of the respondents suggested the other listed trigger points including "point of sale" and "change of tenants".
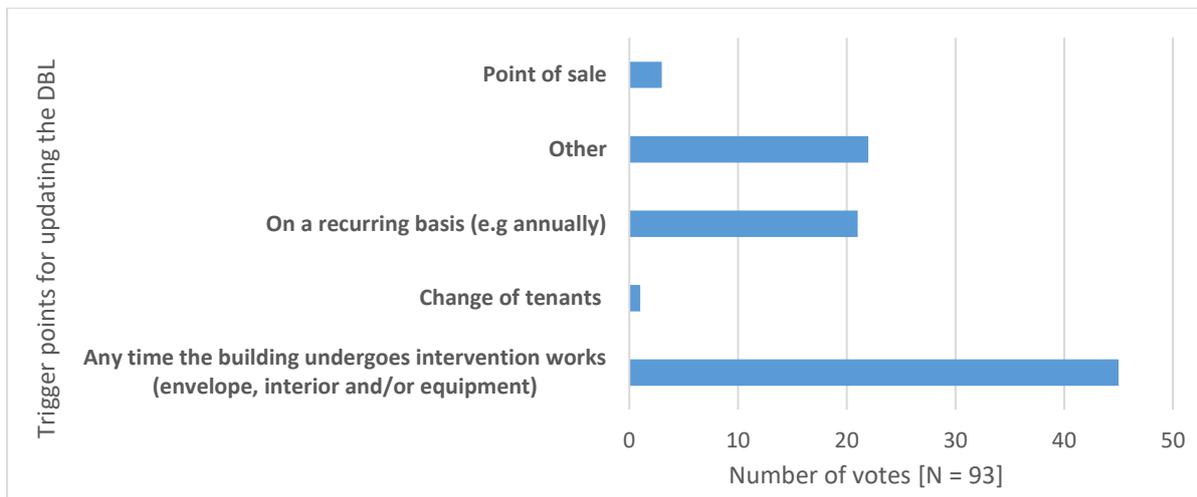
Figure 7. Survey - Data update

How are the consultation results referenced throughout the report?

- The relevant survey results are presented in a footnote adjacent to a specific finding or statement.
- The interview findings are used throughout the text with a reference to the specific interviewee. Each interviewee has been assigned a code based on their field of expertise (e.g. BU stands for building owner representative). The number next to the interviewee ID indicates the exact interviewee, which is kept anonymised in this report.

Interviewee type ID:

- BC – Building automation and control expert
- BU – Building owner representative
- CO – Construction value chain
- DI – Digital expert

- PA – Public authority
- R – Researcher
- LB – Logbook implementer
- RED – Real estate developer
- F – Finance expert

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Overview of existing building logbooks

While a common European framework for whole lifecycle digital repository for buildings does not yet exist, various logbook ideas and initiatives have been around for a while. Desk research and exchanges with stakeholders have indicated a large number of existing and past initiatives. Almost all of these initiatives can be considered "partial" logbooks as they tend to be driven by one focus area and do not take a comprehensive and all-encompassing whole-lifecycle oriented approach. Some examples are listed below:

- In **Ireland**, the architect prepares a safety file, a record of information outlining health and safety risks, which is handed over to the building owner when the project is completed. Architects and developers in many countries (see e.g. Sweden and Germany) are required to produce similar building commissioning handbooks which not only describe technical systems and performance, but also sustainability, health, comfort, productivity, safety and security aspects.
- Private initiatives in **Germany** (Eigenheim Manager) and **Sweden** (MinVilla) are offering building owners the possibility to store all building-related information in a digital repository.
- In **France**, the national authorities have launched a testing phase of different logbook concepts.[6]
- In **Sweden**, it is common to log the products and materials used during construction and renovation works to prove compliance with environmental requirements and certificates.
- Public authorities in **Portugal and Flanders** (Belgium) are embedding the energy performance certificate databases and related renovation roadmaps into a DBL.[7]
- In the **United States,** several initiatives collect detailed data on non-residential buildings for benchmarking purposes.
- In the **United Kingdom**, building owners are entitled to be provided "with summary information about a new or refurbished building, its building services and their maintenance requirements in a building logbook".[8] Facility managers in most countries have a long tradition of developing maintenance plans and logs.

Figure 8 maps a selected number of existing logbooks based on the level of digitisation and the number of intrinsic functions. Digitisation is the conversion of analogue to digital, or from hardcopy logbooks to fully digital versions. The Irish safety file is one example of an analogue document that needs to be handed over to the building owner after the finalisation of a project. Most of these types of documents are still paper based.[9] The Flemish Woningpas is an example of a fully digitised logbook, where all the information is stored digitally. It is clear that the digitised data, with the help of digital technologies, enables additional functions to be added to the logbook.

During the mapping of the existing initiatives, the project will analyse the state of play and uptake of digital logbooks including the identification of key elements, success factors and perceived benefits. Based on a set of criteria, digital logbooks will be analysed and benchmarked against a pre-defined evaluation matrix. The forthcoming report will also review the different approaches to data capture, data management, quality control and data sharing. The results of the analysis will be reviewed by a stakeholder group for the identification of perceived benefits and barriers of each initiative.

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[6] Initiatives organised in the framework of PTNB – Plan de Transition Numérique du Bâtiment.

[7] See Casa+ and Woningpas.

[8] CIBSE has developed a logbook template. this.

[9] They are considered as paper documents even if it is now common to provide this information as an email attachment.
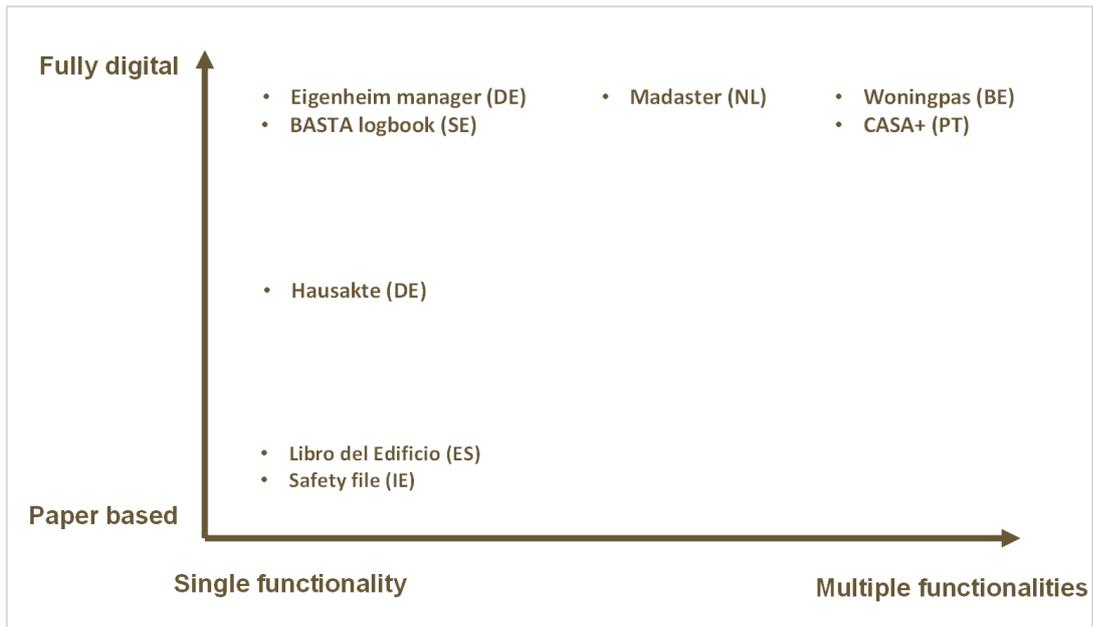
Figure 8. A mapping of a few existing logbooks

CHAPTER 3: THE ROLE OF DIGITAL BUILDING LOGBOOKS

The built environment and construction sector are notoriously complex and involve large numbers of stakeholders (with often conflicting interests) who have different information needs, use data in different ways and for different purposes. Most information is not available in one place and a systematic approach to organising and managing it is largely missing. As mentioned above, one of the main challenges concerns data sharing which is about overcoming the fear of losing out to competition and automation, but also technological roadblocks in the form of a common data repository, data standards and interoperability.

Mapping of data flows between the construction value chain, building owners, financial sector and local authorities has shown that very little information is transferred integrally from the beginning to the end of the supply chain[10]. Some information stays with particular professionals or suppliers, some of it needs to be re-created several times for transaction, certification or refurbishment purposes, and typically only a fraction of it ends up with those who would use data and information[11]. Whatever data may exist, it often remains static and not updated. Data and building documentation, which is generated and kept in paper format, remains inaccessible to most users.

This situation adversely influences project costs and timelines, quality of works, allocation of resources and environmental impacts. The extent of these consequences is even more notable as buildings represent high value, but also high risks. Better information flows are necessary to improve the quality assurance system for buildings and the construction industry overall. Lack of information and transparency increases risk and undermines investor confidence. Therefore, systematised and optimised capture and processing of information also support investment decision-making and create opportunities for innovation and uptake of energy efficiency and sustainability measures, processes and designs.

Hardcopy versions of building-related information (audit results, permits, retrofit records, certificates etc.) have been produced for a long time. While many building owners have collected and stored this information, much of it has been done in an inconsistent and unsystematic way, so that very little of this information is useable and transferable across the building lifecycle and the construction value chain. Non-digital storage of data has multiple shortcomings: the data is partial and not up to date; time-consuming to access; cumbersome to use for multiple indicators and subsequent reporting; and may be tampered with or lost. On the other hand, hard copies are easier to secure and may better protect against data security abuse and privacy concerns.

As digitalisation continues to advance, it is likely to create increasing amounts of data about buildings, their use, and their users. At the same time, opportunities to derive practical knowledge from this data are on the rise. If it will be possible to systematically compile and analyse data from all relevant aspects, then entirely new applications for designing, constructing, operating, leasing, financing and purchasing real estate will come into being.

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[10] See e.g. RICS (2017) Global Trends in Data Capture and Management in Real Estate and Construction

[11] Depending on the lifecycle stage of the building, stakeholders along the construction value chain can be users and/or providers of data and information.

Definition of a digital building logbook

A digital building logbook is a common repository for all relevant building data. It facilitates transparency, trust, informed decision making and information sharing within the construction sector, among building owners and occupants, financial institutions and public authorities.

A digital building logbook is a dynamic tool that allows a variety of data, information and documents to be recorded, accessed, enriched and organised under specific categories. It represents a record of major events and changes over a building's lifecycle, such as change of ownership, tenure or use, maintenance, refurbishment and other interventions. As such, it can include administrative documents, plans, description of the land, the building and its surrounding, technical systems, traceability and characteristics of construction materials, performance data such as operational energy use, indoor environmental quality, smart building potential and lifecycle emissions, as well as links to building ratings and certificates. As a result, it also enables circularity in the built environment.

Some types of data stored in the logbook have a more static nature while others, such as data coming from smart meters and intelligent devices, are dynamic and need to be automatically and regularly updated. A digital building logbook is a safe instrument giving control to users of their data and the access of third parties, respecting the fundamental right to protection of personal data. Data may be stored within the logbook and/or hosted in a different location to which the logbook acts as a gateway.

The different aspects of the proposed definition will be described throughout this report. The definition will also be further discussed during the stakeholder exchanges which are part of this study.

How the digital building logbook can contribute to EU policy goals

The EU Commission work programme 2020 communication sets out a targeted agenda to implement six priorities and the key initiatives that support them. The work programme focuses in particular on the opportunities that can be generated by 'the twin ecological and digital transition'. The two most relevant priorities in this regard are the European Green Deal and A Europe fit for the digital age. The DBL can greatly enhance these goals by playing a role in relation to the following policy initiatives:

- **A deeper and more digital single market (New Industrial Strategy for Europe)** – improved data availability, common data protocols and collaboration within the value chain will contribute to the development of an EU data economy and common European data spaces. Clarification of data governance issues and data sharing models can protect intellectual property rights and strengthen the legal framework for a single market in digital services.

- **More resilient and climate-proof buildings (European Green Deal and the announced 'Renovation Wave' initiative)** – the DBL and connected digital features can accelerate and maximise the impact of policies that deal with climate change and protect the environment. Availability of granular performance and maintenance data in addition to the Energy Performance Certificate (EPC) and Smart Readiness Indicator (SRI) could provide a more robust and reliable indication of energy performance and reduce performance gaps. The DBL is instrumental to gain a better overview of the building stock at all levels, to better assess the effectiveness of energy efficiency measures on a larger scale, tailor support measures, set benchmarks and strategies, monitor progress towards climate goals. Comprehensive information about buildings means that DBL users and value chain actors can make better decisions about how and when to renovate buildings.

- **Supporting the construction industry towards climate neutrality and building a more circular economy (Circular Economy Action Plan and Strategy for a Sustainable Built Environment)** – information about construction and building materials (type, quantity/amount, origin, carbon footprint, recycled content, as well as the end of life dismantling, reusing and recycling possibilities) facilitates source separation and increases recycling quantity/quality, prevents waste and closes loops. The DBL can vastly contribute to improve the general transparency and efficiency of construction and real estate markets as well as empowering building owners to play a more active role in the circular economy.

- **Data privacy and security (European Data Strategy)** – A "European way to digital transformation" which enhances open data, respects fundamental rights, and contributes to a sustainable, climate-neutral and resource-efficient economy.

- **Construction Product Regulation (CPR) review, Sustainable Product Policy and Digital Product Passports** – The forthcoming European Circular Dataspace aims to mobilise the potential of digitalisation of product information, introducing for example digital product passports which can closely interact with DBLs. Similarly, the revision of CPR may include recycled content requirements for certain construction products, whereas the DBL and traceability of construction products can support the increase of recycling content and value from the recycling of materials.

Stakeholders use of the digital building logbook

A number of benefits could be linked to the DBL, applicable to stakeholders across the entire construction and built environment value chain, such as greater overall sectoral transparency, value chain integration, innovation and circularity. DBLs could also offer stakeholder-specific benefits, which are important to keep in mind for the successful market uptake of the tool. Articulating clearly these benefits will help market actors realise the actual value of information and, conversely, the risk of incomplete or unreliable data. Focusing on the benefits – and the DBL functionalities that help to realise the benefits – is key to build support among market players who would otherwise perceive the DBL as an additional administrative burden. Annex B of this report gives a detailed overview of benefits and main concerns anticipated with the widespread introduction of DBLs.

Table 2. Mapping of stakeholder-specific benefits
(green = very relevant benefit, yellow = less relevant benefit)

Stakeholders/ benefits	Access to information	Reduced risk	Trust, reliability, accountability	Better decision-making	Reduced administrative burden	Operation, use & maintenance	Resource optimisation, circularity	Regulatory compliance	Innovation	Value chain integration	Benchmarking
Landlords and owner-occupiers	green	green	green	green	green	green	green	green	green	green	green
Tenants	green	green	green	green	green	green	green	yellow	green	green	green
Designers	green	green	green	green	yellow	green	green	green	green	green	green
Developers	green	green	green	green	yellow	green	green	green	green	green	yellow
Construction contractors	yellow	green	green	green	green	green	green	green	green	green	green
Investors	green	green	green	green	green	green	green	green	green	green	green
Banks and insurers	green	green	green	green	green	green	green	green	green	green	green
Material suppliers	yellow	yellow	green	yellow	green	green	green	green	green	yellow	green
Facility and building managers	green	yellow	green	green	green	green	green	green	green	green	green
Demolition contractors	green	yellow	green	yellow	green	green	green	green	green	green	yellow
Utilities	yellow	yellow	green	green	yellow	green	green	yellow	green	green	green
Real estate agents	green	green	green	green	yellow	green	green	green	green	yellow	green
Lawyers, solicitors, conveyancers	green	green	green	green	yellow	yellow	green	green	green	green	green
Valuers	green	green	green	green	yellow	green	yellow	green	green	green	green
Certifiers	green	green	green	green	green	green	green	green	green	green	green
Research	green	yellow	green	green	yellow	green	green	green	green	green	green
Public authorities & policy makers	green	yellow	green	green	yellow	green	green	green	green	green	green

CHAPTER 4: THE BUILDING BLOCKS OF A DIGITAL BUILDING LOGBOOK

This chapter describes the main building blocks of the DBL, including a) data and information, b) features, functionalities and benefits and c) data governance.

Data and information

The capturing and maintenance of data and information is the backbone of the DBL, as consistently emphasised by the interviewed and surveyed experts.

A systematic, well-organised and standardised scheme for data gathering and storage would alleviate several deficiencies of the current practices. Firstly, due to the absence of a systematic approach to capturing, storing, analysing and organising it, valuable data and information are lost. Secondly, the storage of data is fragmented and scattered across several organisations (and even departments within the same organisation). Thirdly, data that is collected and stored by one individual actor is not necessarily accessible and available to other actors in the value chain.

Lifecycle approach and users of a digital building logbook

The different stages of the building lifecycle[12] present various opportunities to collect data but also different needs of data use. Market participants along the building value chain need access to accurate data which can seamlessly be integrated into each aspect of the lifecycle. For the construction sectors to leverage the power of structured data, the information will need to be transferred and available integrally from the beginning to the end of the cycle. Figure 9 displays a simplified building lifecycle including the following stages: design and planning, construction, sales/leasing, operation and refurbishment and repurpose or demolition. The acquisition and permission phase is not detailed here but can be considered as the start of each new cycle. During each of these phases, a large number of different actors interact with the building.

a) The **design, planning and construction phases** represent the best opportunity to gather data on the building's physical characteristics, including information on materials in the building and where they are located. In addition, a building information model (BIM) or *digital twin[13]* of the building can be developed in this phase, while the review of existing cases shows that this could be useful and improve collaboration and liability of works. A construction project management function of the DBL can simplify the information sharing between different actors. The collected data can also be used to prove compliance with certain building regulations or certification schemes. The main actors in this phase are designers, architects, developers, contractors and material suppliers.

b) In the **sales/leasing, operation and property management phases,** data can be gathered on the building's operation, use and performance (maintenance, ownership transfer, change of use etc.). The information can, for example, be used to identify maintenance and renovation needs, adapt behaviour and/or fulfil administrative requirements. The data is also critical for financing and transaction underwriting and execution. The main users include building owner, tenants, facility managers, utility companies, real estate service providers, energy auditors, contractors and the financial sector.

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[12] Several interviewees highlighted the role the DBL couple play in enabling circularity in the building and construction sectors (CO1, CO2, PA2, PA3, PA4, BU3, LB4, LB7). Similarly, 82 out of 92 survey respondents thought functionality, "estimation of the environmental impact over the building's lifetime", was, at least, somewhat important.

[13] IET (2019) Digital Twins for the Built Environment

c) In the **repurpose or demolition phase**, the gathered data on the building, its composition and materials can be used to support decision making whether to refurbish/repurpose/demolish or to optimise/extract the most value from the recycling of materials. The main users include building owners, demolition companies, product maintenance service companies and recycling companies.
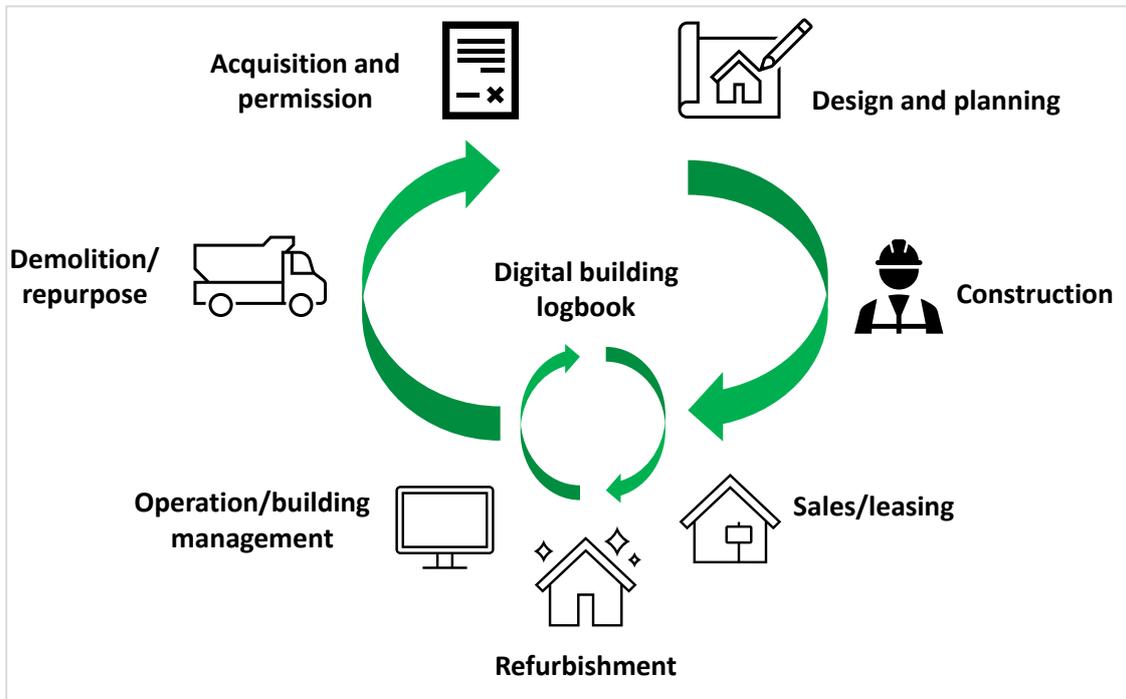
Figure 9. Lifecycle of a building

Data syncing and matching[14]

The DBL, as defined, gathers different types of data from multiple sources. These can include legacy systems, but also (smart) equipment connected to a building. The latter can take on a variety of applications ranging from those installed and running on the premises of the building to cloud-based platforms exchanging massive amounts of data in real-time between different stakeholders. The data from these different sources must be able to "communicate" for the DBL to reach its potential. Connecting all these data sources and users requires common 'languages' - interfaces and protocols - to enable interoperability, data consistency and information exchange. Several interviewees have highlighted the problem of "data matching" as one of the main obstacles [CO1, CO2].

The data architecture underpinning the DBL will not be described in this report as it concerns the technical solutions and operational/functional infrastructure of individual logbooks, rather than the conceptual definition of the DBL. Given the complexity and fragmented nature of the construction sector, it becomes clear that the data architecture will need to place special emphasis on data source diversity and the technical interoperability and connection to legacy systems as well as state-of-the-art, 3rd party data processing tools and sources. A number of European non-proprietary data formats,

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[14] Data matching is the task of identifying, matching and merging records that correspond to the same entities from several databases or even within one database.

standards and/or frameworks can be considered and cross-referenced, including e.g. SAREF4BLDG[15], INSPIRE, Level(s)[16] and the EU Building Stock Observatory.

Building typologies

The review of existing cases[17], as well as the interview findings, suggest that a separate DBL for different building typologies should not be pursued. Different building types may have different data needs, i.e. large commercial buildings can be documented in a more complete and granular manner, whereas a DBL for a smaller residential property will have fewer data entry points and records, simply because it is a less complex building with fewer data gathering opportunities (see Table 3). A common DBL and data template could work across all different building types. A common DBL for the entire building stock is, in fact, desirable and would avoid fragmentation and unnecessary market confusion.

Type of information

The information stored in the DBL can be broadly divided into two types: static and dynamic information.

- **Static information** is information with little or no change (e.g. the address of the building). Most commonly it relates to the building's construction, its administrative status and permits, and past renovations (e.g. property identification, building plans and licenses, energy performance certificates, yearly consumption of water and energy, executed works and reparation, installed equipment, etc.).
- **Dynamic information** is automatically and regularly updated, meaning it changes over time as new information becomes available. The dynamic information enables a better understanding of a building's performance over its lifecycle (e.g. monitoring of resource consumption and renewable energy generation).

The DBL can be considered a living document as the data it contains must be continuously updated to ensure it is relevant, useful and reliable. The expert opinion is that this should happen as often as changes have been implemented (49% of survey responders) or on a recurrent basis (23% of the survey responders). One expert noted "the data must be automatically generated and updated. It won't work if it's manually updated" [DI4]. This is especially the case for dynamic data stored in the DBL.

Data fields

Table 3 displays an indicative selection of data fields structured according to eight information categories: administrative, general, building descriptions, operation and maintenance, building performance, material inventory, smart readiness and finance. The data presented in the table is not an exhaustive list but a compilation of some of the most relevant data fields according to the result of the desk research and the mapping of existing initiatives. The relevance of certain data fields will inevitably be different for different users depending on the business area and lifecycle stage. Some other information will have more universal pertinence. To be relevant, data fields and scope of data capture should be linked to particular functionalities and benefits.

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[15] SAREF4BLDG is a community developed open-source extension to the "Smart Appliance Reference ontology and semantics" published as a technical specification by ETSI.

[16] Level(s) reporting framework, by incorporating a standardised data template to enable a simplified process of sharing relevant building data for an easier, quicker and more consistent environmental assessment and reporting of buildings.

[17] While most of the existing cases focus solely on residential buildings, they also have a more limited scope than what is being pursued with the DBL.

The table also gives indicative answers to some questions as presented below. Note that the answers are indicative and that many of them depend on the situation in different Member States.

- a) where is the data stored today?
- b) is the data essential to the DBL?
- c) is the data field more relevant for a certain building type?
- d) when in the lifecycle can the data best be collected? (new or existing buildings?)
- e) what type of data is it? (static or dynamic)?
- f) how easily can this data be collected?

The development of this table draws from the existing initiatives, as well as the work done by the Global Alliance for Buildings and Construction.

Table 3. An indicative selection of data fields

Data category	Data field	Type of data	Where is the data stored today?	Core data?	Building typology (single-family residential = S, multi-family buildings - M, Office = O)	New (N) or existing (E) building?	Static (S) or dynamic (D)?	Ease of collection (1 - easy, 3 - difficult)
Administrative information	Unique building identifier	Alfa-numerical code	Public registry	X	All	N	S	1
	Address	Text	Public registry	X	All	N	S	1
	Building owner	Name and contact details	Public registry	X	All	n/a	S	1
	DBL prepared by	Name and contact details	New data	X	All	n/a	S	1
	When was the DBL last edited	Date	New data	X	All	n/a	S	1
	Ownership type	Descriptive	Building owner, public registry		All	n/a	S	1
	Tenancy agreement	Linked data	Building owner		All	E	S	2
	Utilities contracts	Linked data	Building owner, utility companies		All	E	S	2
	Maintenance service contact	Linked data	Building owner/service contractor		All	E	S	2
	Insurance documents	Linked data	Building owner, insurance company		All	E	S	2
	Maintenance log	Linked data	Facilities manager	X	O & M	E	S	2
	Licenses	Linked data	Building owner		All	N	S	1

General information	District heating access	Linked data	Public registry		All	N	S	2
	Year built	Date	Public registry	X	All	N	S	1
	Solar potential	Linked data	Openly available		All	Both	S	1
	Soil/terrain	Linked data	Public registry		All	N	S	2
	Climate information	Linked data	Openly available	X	All	N	S	1
	Physical accessibility	Descriptive	Audit		All	N	S	2
	Safety manual	Descriptive	Audit		All	N	S	2
Building descriptions and characteristics	Design and plans of the building	Linked data	Developer	X	All	N	S	1
	Building information model	Linked data	New data/ developer	X	All	N	D	1
	Floor area	M2	Building owner		All	N	S	1
	Heated floor area	M2	EPC	X		N	S	1
	Number of floors	#	Building owner		All	N	S	1
	Façade types	Descriptive	Developer, Audit		All	Both	S	1
	Roof type	Descriptive	Developer, Audit		All	Both	S	1
	Windows and door types	Descriptive	Developer, Audit		All	Both	S	1
	Heating systems and related energy carriers	Descriptive	Developer, Audit		All	Both	S	1
	Cooling equipment	Descriptive	Developer, Audit		All	Both	S	1
	Lighting systems	Descriptive	Developer, Audit		All	Both	S	1
	Ventilation systems	Descriptive	Developer, Audit		All	Both	S	1
	Technical building systems	Descriptive	Developer, Audit	X	O & M	Both	S	1
	Renewable energy systems	Descriptive	Developer, Audit	X	All	Both	S	1
	Domestic water	Descriptive	Developer, Audit	X	All	Both	S	1
	Sewer systems	Descriptive	Developer, Audit	X	All	Both	S	1
	Rainwater drainage	Descriptive	Developer, Audit	X	All	Both	S	1
	Fire Safety Plan (evacuation plans, sinalisation, alarms etc).	Descriptive	Public registry	X	All	Both	S	1
	Building surroundings	Descriptive	Public registry		All	Both	S	1
	Historical context (blueprint plans or heritage of the building and municipality)	Descriptive	Public registry		All	E	S	1
	Expected lifetime	Years	Calculation		All	Both	S	2

Category	Name	Type	Source					
Building operation and use	Number of occupants	Number	Building owner	X	All	E	S	1
	Functions	Descriptive	Building owner	X	All	E	S	1
	Measured heating consumption	kWh/year	Utility company	X	All	E	D	2
	Measured electricity consumption	kWh/year	Utility company	X	All	E	D	2
	Measured hot water consumption	Litres/year	Utility company	X	All	E	D	2
	Dynamic heating consumption	kWh/year	Smart meter		All	E	D	3
	Dynamic electricity consumption	kWh/year	Smart meter		All	E	D	3
	Renewable energy production	kWh/year	Smart meter, utility company	X	All	E	D	2
	Behavioural insights	Descriptive	Smart meter, sensors, survey		O	E	D	3
Building performance	EPC rating	Alphabetical (or scale)	EPC rating	X	All	Both	S	1
	Building envelope (u-value of different components)	U-value	EPC/audit	X	All	Both	S	1
	Total calculated heating consumption	kWh/year	EPC	X	All	Both	S	1
	Total calculated electricity consumption	kWh/year	EPC	X	All	Both	S	1
	Tailored renovation recommendations	Descriptive	BRP/audit	X	All	E	S	2
	Climate resilience potential	Descriptive	Audit		All	Both	S	2
Building material inventory	Material 1 - Type	Descriptive	Developer/installer	X	All	N	S	2
	Material 1 - Location	Physical	Developer/installer	X	All	N	S	2
	Material 1 - Volume	Physical	Developer/installer	X	All	N	S	2
	Material 1 - Weight	Physical	Product/material manufacturer		All	N	S	2
	Material 1 - Embodied carbon	Physical	Product/material manufacturer		All	N	S	2
	Material 1 - Life span	Physical	Product/material manufacturer		All	N	S	2
	Material 1 - Fire resistance class	Rating	Product/material manufacturer		All	N	S	2
	Material 1 - Waste category	Code	Product/material manufacturer		All	N	S	2
	Material 1 - Certificate 1	Linked document	Product/material manufacturer		All	N	S	2
	Material 1 - Chemical declaration	Linked document	Product/material manufacturer		All	N	S	3
	Material 1 - Global Trade Item Number	Linked document	Product/material manufacturer		All	N	S	3

Smart readiness	SRI result	Rating	Audit		All	Both	S	2
	Charging infrastructure for E-mobility	Yes/no	Building owner		All	Both	S	1
	Smart district potential	Descriptive	Public registry		All	Both	S	2
	Demand response potential	Descriptive	Audit		All	Both	S	3
Finance	Annual rent	EUR	Building owner	X	All	E	D	1
	Annual property tax	EUR	Building owner, public authority	X		E	D	1
	Annual maintenance costs	EUR	Building owner, maintenance company	X	All	E	D	1
	Property value	EUR	New data, broker/building owner		All	Both	D	3
	Valuation date	Date	Valuation firm		All	n/a	S	2
	Valuation method	Descriptive	Valuation firm		All	n/a	S	2
	Valuation conducted by	Name	Valuation firm		All	n/a	S	2
	Valuation document 1	Linked document	Valuation firm, building owner		All	n/a	S	2
	Property yield	%	Calculation		All	Both	S	2
	Annual electricity cost	EUR	Utility company	X	All	E	D	1
	Annual water cost	EUR	Utility company	X	All	E	D	1
	Annual heating cost	EUR	Utility company	X	All	E	D	1
	Other costs	EUR	Building owner		All	E	D	1

The features, functionalities and benefits

The main purpose of the DBL is to develop a better understanding of the building throughout its full lifecycle, thus also improving transparency and trust while providing the basis for informed decision-making and actions. The main requirement of the DBL is to gather all building-related data and to provide this through a smart and user-friendly interface, potentially available and accessible to different users. Most notably building owners and occupants, the construction and real estate value chain, financial institutions and public authorities. Permission should be granted under specific conditions, depending on who will be considered the 'owner' of the DBL or upon the consent of the owner. To achieve this, the DBL should be equipped with some key features and a number of functionalities.

The *features* of the DBL are the intrinsic elements that make the instrument work in a simple yet effective way for the users, while the *functionalities* are services built around the DBL (and its features). The *benefits*, in turn, are the added value gained from the new and improved functionalities.

A common view among the interviewees is the focus on the DBL infrastructure; "information should easy to access" with the help of a "smart interface", "it ought to be automatically updated", and the structure should be "modular and layered". In short, the DBL should be flexible to make the right information available to the right actor at the right time.

The most relevant features identified are:

   a) digital interface,

   b) interoperability,

   c) data syncing/matching,

   d) storage of data and information and

   e) user-friendly navigation and visualisation.

These five key features are the requisites of every DBL design.

Functionalities refer to the services built around the DBL and the above-mentioned features. Functionalities have corresponding benefits or sets of benefits for the user. The number and type of functionalities determine the scope, quality and type of information that the DBL covers. To offer maximum value and successful market uptake, DBL functionalities must be prioritised effectively ensuring that it is responsive to the real needs of the construction and real estate industry. The first step in setting up a DBL is to develop a robust structure getting the main features and just a few functionalities right (e.g. digital safe for key documents) while keeping open the possibility of adding further functionalities in a modular fashion.[18] Annex C outlines the main functionalities and indicates the applicability for the different building typologies.

The type of information stored in the DBL should evolve over time with additional data fields and related functions. A common understanding among the experts is that a DBL should be launched with a limited number of essential data fields and functions. This was the case with the Flemish Woningpas, which allows all homeowners to consult building-related information such as the energy performance certificate, urban planning, solar energy installation potential, availability of public transport, etc. Over time, more functionalities will be included, such as information exchange with third parties, and alerts for and an overview of executed maintenance.[19]

Benefits represent the additional value delivered to DBL users. Rather than being limited to specific types of features and areas, such as energy or materials, the DBL has the potential to bring a wide range of benefits to different actors. Table 4 captures the most often quoted benefits during the expert interviews; as such, it is not an exhaustive list.

While Table 4 outlines the most relevant benefits, Figure 10 identifies which functionalities activate each of these benefits. The functionalities have been derived from the views of the experts interviewed and surveyed.

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[18] According to experience from existing cases (e.g. Woningpas) and the view of several interviewees [PA1, BC1, D3, BC2]

[19] Such functionalities may also very well go beyond the boundaries of the building. For example, EDF in France plans to develop a DBL including several repositories with different access rights. In the case of individual owners, the personal repository ("safe") can also be used to store personal documents that are not related to the building, such as tax notices, pay slips, etc.).

Table 4. List of the most relevant benefits that have been identified by the experts and stakeholders

Code	Benefits	The specific benefit was mentioned in these interviews
A	Enhanced access to information	PA1, PA2, PA3, PA4, R1, R2, LB1, LB2, LB3, LB4, LB6, BU1, BU2, BU4, BC1, BC2, CO1, CO2, CO3, D2, D5, R3,
B	Consumer protection and reduced associated risk of purchasing a property	PA1, LB1, LB5
C	Reduced time to fulfil administrative requirements as all information is accessible in one place	PA1, PA2, LB1, LB5, LB6, BU1, BU4,
D	Increased trust and reliability	PA1, PA2, LB1
E	More accurate risk assessment and mitigation	F1, PA4, LB1, LB5,
F	Better informed decision-making (including energy and environment aspects, financing, investment, etc.)	PA1, PA2, PA4, R1, LB1, LB2, LB7, F1, D2, BU4,
G	Improved real estate value and value preservation of sustainable/energy-efficient buildings	F1,
H	Increased awareness of energy use and saving potential, health, accessibility, adaptability, flexibility and resilience; extending the useful life of the asset	PA1, R1, D2, LB1, LB5, LB6
I	Optimised operation, use and maintenance	PA1, D2, PA3, BU2, LB5, LB6
J	Better use of resources across the whole life of the building	R2, CO2, D2, PA4
K	Synchronising maintenance cycles with renovation needs	D2, PA3, PA4, BU2,
L	Enabling demand response	BC1, BC2,
M	Possibility to trace components	CO1, CO2, PA2, BU3, LB4,
N	Circularity in construction and buildings through deconstruction, reuse and recycling of materials	CO1, CO2, PA2, PA3, PA4, BU3, LB4, LB7
O	Checking compliance with certification	PA1, LB2, CO1, LB4, LB5
P	Accountability and quality assurance of construction and building works	LB2, LB5, PA2,
Q	Innovation through digitalisation, the creation of new business models and improved productivity	BC1, D5,
R	Streamlining the management of construction projects; possibility to supervise construction works and ensure quality levels	LB5, D4,
S	Overcoming sectoral fragmentation by value chain integration and coordination among different trades/professions	LB1, LB5,
T	Enabling public authorities to develop more effective and targeted policies	LB2, LB7, BC2, PA2,
U	Monitoring building stock compliance with long-term energy and climate objectives	LB1, LB2

Benefits

Functionalities

Functionality	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
Digital repository to store key documents (incl. design plans, certifications, proof of installations etc.)			X	X				X				X						X	X		
Easy access to all relevant building related information according to different level of users & stakeholders	X	X	X		X													X	X		X
Operation, monitoring and maintenance plan (incl. notifications)				X	X	X					X	X	X			X	X				
Overview of building performance (whole life resource consumption, resilience, adaptability, flexibility, health etc.)	X	X		X	X		X				X			X	X	X	X				
Building renovation passport (renovation roadmap)	X	X		X	X									X	X	X	X	X			
Indicate the smart readiness of the building	X	X		X	X										X	X	X				
Traceability of building materials	X			X	X			X	X												
Integration of BIM			X								X	X									X
Construction project management tools (assign roles, KPIs, accountability and liabilities during the different phases)			X		X	X	X														
Value chain integration, aggregation of project and marketplace of services			X							X						X					
Links to financial incentives											X										
Visualise future energy/cost saving potentials and life-cycle costing											X	X	X	X		X	X			X	
Benchmarking, reporting and links to various certification and assessment schemes	X	X	X				X									X	X				
Overview of the building stock	X	X					X														

Where benefits A–U are:

- A: Enhanced access to information
- B: Reduced associated risk of purchasing a property
- C: Reduced time to fulfil administrative requirements as all information is accessible in one place
- D: Increased trust and reliability
- E: More accurate risk assessment and risk mitigation
- F: Better informed decision-making
- G: Improved real estate value of sustainable buildings
- H: Increased awareness of energy use and saving potential
- I: Optimised operation, use and maintenance
- J: Better use of resources across whole life of the building
- K: Synchronising maintenance cycles with renovation needs
- L: Enabling demand response
- M: Possibility to trace components
- N: Circularity in construction and buildings
- O: Checking compliance with certification
- P: Accountability and quality assurance of works
- Q: Innovation through digitalisation
- R: Streamlining the management of construction projects
- S: Overcoming fragmentation by value chain integration
- T: Enabling public authorities to develop better policies
- U: Monitoring building stock compliance with climate objectives

Figure 10. Functionalities and linked potential benefits

Data governance

Data governance refers to the process, organisation and standards implemented to ensure the effective and efficient storage and access to information. The DBL concept is a response to "the lack of a universal system that would facilitate access, storage, update and transfer of building-related data and information in a standardised format along the value chain." [20] But benefiting from the DBL requires settling a series of questions around data ownership, access, storage, privacy and security.

While the benefits of DBL are undisputed, concerns over privacy, confidentiality, and control of data can be a limiting factor to the market uptake of DBLs. The DBL, and generally, open access to data, is riddled with challenges related to data protection, competitiveness, confidentiality, liabilities over the accuracy of the data as well as business models built on the premise of withholding data rather than sharing data. One of the most contentious questions the DBL should clarify is the responsibility of holding, maintaining and updating all the – often sensitive and private – information.

Data ownership

Most stakeholders consulted agree that the building owner should be the principal owner of the information contained in the DBL.[21] However, certain information should be made available to third parties with the building/data owner's consent.[22] In this sense, the access to DBL can be tiered according to different stakeholder categories and the purpose of data access. A data access layer can further clarify who has access to the data and who has the right to amend or delete records. For example, pubic authorities could have given access to information[23] that is considered non-sensitive and non-intrusive.[24] Public authorities and the research community could be granted privileged access to aggregated and anonymised data for more effective policymaking and a better overview of the building stock. Other stakeholder categories such as building professionals or financial institutions can gain access with the consent of the owner.

Storage

The lack of a centralised storage location, with data often scattered across many organisations and departments, has been confirmed as one of the most significant challenges faced by all stakeholders.[25] While there is no easy and "one size fits all" solution to the data storage question, three main approaches are being considered by current initiatives:
- DBL as a *database* which physically stores all the information related to the building
- DBL as a digital *gateway* to which data and information can be linked via a unique building ID. The advantage of this approach is that information can be collated from various sources (both public and private) and the information is up to date whenever data is being updated 'at source'
- *hybrid* versions which are a combination of the above two approaches.

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[20] RICS (2017) Global Trends in Data Capture and Management in Real Estate and Construction

[21] 12 out of 20 interviewees (the number that answered this question) argued that the building owner should be the owner of the data. The others argue that the ownership should be divided among several actors or "the same as today", or that it should be the role of the manufacturers/contractors to keep the information updated and accurate. 75% of the surveyed experts say the building owners should have "full access" to the stored data.

[22] 65% of the surveyed experts think third parties should have either "full access" (13%) or access to "individual project data" (52%).

[23] 36% of the surveyed experts think public authorities should have full access to the data, while 54% think their accessibility should be "limited". Several interviewees argue that public authorities can have access to overall building data as long building owners' data privacy is safeguarded.

[24] What is "non-intrusive" varies greatly across the EU and should therefore be defined by Member States.

[25] RICS (2017) Global Trends in Data Capture and Management in Real Estate and Construction

Another key issue is the trustworthiness of the data source which is as important as the availability of data itself. Data originating from public authorities are generally considered more reliable which would suggest that public bodies ought to be responsible for setting up a central DBL. Commercial DBL initiatives seem however to be more in tune with market needs and offer functionalities catering for the flexibility and extensive requirements of commercial real estate actors. Aligning these different frameworks will be one of the main purposes of the common EU DBL to avoid market confusion and the situation whereby despite the growing number logbooks available, stakeholders continue to keep data in their private silos and large proportions of information still not being accessible to stakeholders.

Finally, liability, quality assurance and validation mechanisms will also need to be improved and enforced, to support the usability of the DBL (LB4, LB5, LB6, CO1].

Data privacy and security

Data security will have a decisive impact on the success of the DBL. Data privacy and security were also themes consistently picked up by interviews. The experts think it is essential that these requirements are fully addressed, and that the best actors to ensure this are the public authorities.

One of the key challenges finding the right arrangement for data privacy and security is given by the fact that both (1) EU data protection provisions are being modernised and constantly adapted, as well as (2) technology is developing fast providing new data-gathering opportunities but also challenges. DBLs will need to make sure they are compliant with the General Data Protection Regulation (GDPR). Consequently, cyber risk and privacy must be at the forefront – with collaboration from the construction value chain, operators, IT companies, public authorities and active engagement of the public to ensure the security of the data in the DBL. One interviewee argued that "we need to put in place a code of conduct" for how to deal with these issues [DI4].

Building user privacy can be considered as the main concern due to all the data that sensors collect. The DBL should contribute to making buildings more user-friendly; that means only building users should access personal data especially in commercial or public buildings with multiple tenants. On the other hand, some of the functionalities built in the DBL can function effectively even with anonymised data and other legal restraints. Additional interdisciplinary research is needed to assess the potential and risks offered by innovative solutions (e.g. blockchain [CO1, DI1]) to preserve data privacy and security.

All these indicate that there may not be easy and one-size-fits-all solutions. Setting a balanced agenda that would equally benefit citizens, markets and the public good will be an ongoing process and will likely require the following elements:[26]
- *Public engagement*: wider public awareness campaigns about the benefits and risks of sharing data based on evidence and "success stories." Developing an ongoing dialogue with the construction sector, public and policymakers will inevitably be a long-term process as it implies building trust and understanding the benefits and risks of data sharing
- *Clarity and transparency*: clarity and transparency over the terms of use of data including regulation and enforcement to limit any fragmentation of the data protection framework
- *Training and education*: construction sector stakeholders, professionals and building owners need to be better equipped with digital and ethical skills to take full advantage of the DBL and single data space.

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[26] The EC (2019) Communication of data protection rules as a trust-enabler in the EU and beyond – taking stock recommends the further development an EU data protection culture and make full use of the tools provided for in the GDPR, as well as the continuation of awareness-raising activities and engagement with stakeholders.

CHAPTER 5: NEXT STEPS

The barriers, gaps and recommendation for the DBL will be further explored and discussed in the subsequent reports of this study.

Multiple ongoing initiatives in Europe are testing different DBL concepts. This study is also exploring the design, purpose and status of existing and discontinued initiatives, yielding additional insights about the key ingredients of a successful DBL.

The research carried out so far shows that the DBL needs to be adapted to the diverse local contexts, with different needs, culture, processes (e.g. what type of data is gathered differ from country to country), as well as capacity and market readiness. The next part of the study will analyse the gaps that still have to be addressed at EU, national, regional and sectoral levels to ensure widespread use and efficient functioning of DBL for each building type.

The interviews with logbook implementers [LB1-LB7] made it clear that the successful implementation of a DBL takes time. Developing and implementing a DBL, including the listed features, require substantial planning and testing. In addition, stakeholders ought to be consulted and engaged from the outset to make sure the instrument is adapted to the needs of the users. Recommendations for how a DBL could be implemented will also be further explored later on in this study.

ANNEXES

Annex A. Interview and survey questionnaires

Questions for the semi-structured interviews

Expected time per interview: 30 mins - 1 hour

BACKGROUND QUESTIONS

Question 1: Tell me about your background and expertise?

Question 2: What is a building digital logbook in your view?

Question 3: Are you aware of any building logbook or similar initiative? (Is the example in the national, regional or sectoral level?) Is the example you have in mind replicable? Which aspects of it?

QUESTIONS ON THE POTENTIAL ROLE OF DBL(s)

Question 4: What are the potential benefits of introducing a DBL?

Question 5: In your view, what functionalities should the DBL comprise?

Question 6: What type of information should, and could, be collected?

Question 7: How, and where, could the data be stored? Who would be responsible at national and EU level?

Question 8: Who are the main users/beneficiaries of a DBL?

Question 9: How would you address challenges linked to a lack of available data?

Question 10: Who should have access to which kind of data? How can we deal with data security and privacy?

Question 11: How to ensure stakeholder engagement/approval?

WHAT ROLE SHOULD THE EU PLAY?

Question 12: What do you think the role and scope of the DBL at EU level should be?

Question 13: Do you see a need for an EU-wide DBL?

Question 14: What do you think the role of the EU should be in developing/promoting a DBL? Should the EU even have a role?

NEXT STEPS

Question 15: Which action(s) are most important to facilitate the deployment of DBLs (on different levels)?

Survey questionnaire

It was conducted using the EU Survey tool.

This project establishes the background information necessary to create a European-wide building digital logbook. The project objectives are to create a European-wide definition of a buildings' digital logbook, carry out an overview of relevant initiatives, conduct a gap analysis and produce 3-4 key recommendations for implementation by the end of 2020.

An integral part of the process is taking into consideration the input from relevant stakeholders and understanding the needs of the end-users. Therefore, we have established a stakeholder community in order to collect the best possible information regarding existing initiatives and relevant information. Two stakeholder meetings will take place during the project, one in June 2020 and one in November 2020.

Thank you in advance for your participation in the B-LOG process.

1. Please select which category best describes your organisation:

Drop down from our list of stakeholder groups

2. Name of organisation:

Open field

3. Position:

Open field

4. In what country/region do you work?

Open field

5. Which of the following building digital logbook related initiatives are you familiar with?

A dropdown of all existing cases we have identified (not familiar - somewhat familiar - very familiar)

- *AU – L2 Logbook*
- *BE – Dossier d'Intervention Ultérieure*
- *BE-FL – Woningpas*
- *BE-W – ImmoPass*
- *DE – Gëbaudepass*
- *DE – QDF Hausakte*
- *DE – Hausakte (discontinued)*
- *DE – LGA Gebäudepass*
- *DE – Gebäudepass Sachsenhaus*
- *DE – AKÖH-Gebäudebrief*
- *DE – immobilien-klose*
- *DK – Bedrebolig*
- *ES – Libro del Edificio*
- *FR – Plan Transition Numérique du Bâtiment (Évolution du logement de l'aménagement et du numérique)*
- *FR – Passeport Efficacité Énergétique*
- *FR – ELAN – Bouygues*
- *FR – Carnet numérique du logement*
- *FR – Mon carnet logement*
- *FR – Homebook*
- *FR – Wiki-habitat*
- *FI – Building passport green building council*

- *FI – Ilmastoviisaat Taloyhtiöt (Building passport green building council)*
- *FI – Real estate service manual*
- *Iceland - Property Register*
- *GR – electronic building ID*
- *IT – Fascicolo del fabbricato*
- *NL - Platform CB'23*
- *NL – Opleverdossier(discontinued)*
- *NL – Nibe TWIN-Model*
- *NL – Madaster*
- *PT – EPC and CASA+*
- *SE – Klimatdeklaration*
- *Switz Building and dwelling register*
- *UK – CIBSE TM31*
- *UK – Cornwall Building Logbook*
- *USA – UBID*
- *Open field for additional ones*

6. Have you been involved/are you currently involved in any related building digital logbook initiatives?

Yes/No

    a. If yes, what project:
    b. Website:

In what capacity?

- *Steering*
- *Development team*
- *Data provider*
- *Open field*

7. How important are the following data fields in a digital building logbook?

(has a rating next to it: not important – somewhat important – very important)

- *Ownership information*
- *Energy performance certificate*
- *Smart readiness indicator score*
- *Building descriptions and characteristics (i.e. age, construction type, walls, windows, roof, etc)*
- *Equipment included (for heating, cooling, control of interior environment) and data/certifications on their maintenance*
- *consumption - energy, water, gas and other resources*
- *dynamic data (smart meters and sensors, such as real energy consumption)*
- *building material inventory*
- *Material cost information*
- *Building documentation: permits and plans (i.e rental status, état des lieux, authorisations, renovation/improvement works, etc)*
- *Information on previous works and renovation potential (such as a building renovation passport)*
- *financial, legal and insurance documents, including building costs/value (annual rent, annual maintenance charges, property value, etc)*
- *Information on occupancy (i.e. current use and past uses), lease terms*
- *Open field*

8. How important are the following functionalities in a digital building logbook?

(has a rating next to it: not important – somewhat important – very important)

- *Predictive maintenance and alerts*
- *Notification of energy performance*
- *Renovation roadmap*

- *environmental impacts over lifetime (including deconstruction and re-use of materials)*
- *valuation and financial due diligence*
- *Enable smart energy services (demand response, dynamic pricing etc.)*
- *link with external databases and resources (e.g. soil pollution, public transport, solar panel potential)*
- *indoor environment quality*
- *Connect to 3rd party actors (e.g. real estate, financing institution, construction professionals) to use the logbook (with consent of the owner)*
- *other*

9. **What are the potential sources of information and what data could they provide?**

- *building owners – what data can they provide? open field*
- *public authorities (land registry, town hall, energy agencies)*
- *EPC databases*
- *building experts (architects, engineers, surveyors, FM, valuers, etc.)*
- *financial institutions*
- *other (energy agencies)*

10. **In your opinion, who should be responsible for data ownership and liability? (e.g landlord/owner, public authority, professional body, etc)**

Open field

11. **Who should have access to the data?**

(individual project data, full access, limited access)

- *Only the building owner*
- *Building owner and public authorities*
- *Building owner, public authorities and 3rd parties (e.g building professionals)*

12. **How often should the logbook be updated?**

- *Annually*
- *Point of sale*
- *Change of use*
- *Any time the building undergoes intervention works (envelope and equipment)*
- *Open field*

13. **How should data quality assurance be handled, ensuring it is reliable and kept up to date? (e.g. random audits and surveys, input data control, range analysis etc.)**

Open field

14. **What role should the European Commission play in promoting/designing/implementing the Digital Buildings Logbook?**

Open field

15. **What action(s) would best facilitate the deployment of and EU digital building logbook? Do you think of specific actions in Member States, local and sectoral level?**

Open field

16. **Would you be interested in participating in a stakeholder meeting to further discuss this project?**

Yes/No

17. **If yes, please enter your email:**

Open field

Annex B. Stakeholder mapping – Description of main benefits and concerns

Table 5: Stakeholder mapping – Description of main benefits and concerns

Stakeholders	Potential benefits	Main concerns
Landlords / owner-occupiers (including prospective buyers and sellers)	• Increased consumer awareness, knowledge and protection as the end-user generally carries all of the risks of a purchasing decision • Speeds up and eases due diligence processes; provides better security and guarantees during the transaction process • Proper documentation of the building may ensure a lasting and higher value • Reduced sick building syndrome; lingering issues are not overlooked as owners/occupiers/ facility managers can inform themselves on previous cleaning, maintenance and defects • Proper documentation can lower insurance premiums • Enables better portfolio management, better-planned maintenance and refurbishment works (renovation roadmap) and maintains the quality of use • Connects to a marketplace of services (e.g. one-stop-shops, tailored financing, turnkey renovation solutions) and aggregation of projects • Visualising future energy/cost saving potentials and smart readiness • Better information about the flexibility, adaptability and circularity of the building and its products	• Data ownership and privacy; building owners should be the sole owner and data only stored/shared upon consent • The overall interest from building owners might be limited as benefits are perceived as minor or intangible • The unwillingness of data provider to guarantee for data accuracy, e.g. upon transaction • Cost/benefits ratio for small residential owners is only positive if it can bring benefits at "low or no-cost, and a minimum additional burden" • Not all building owners are keen on allowing more transparency of the building's actual quality/performance, as it can influence the value of the building • Lease terms and tenant-landlord relationships (often more adversarial than collaborative) can complicate data sharing and disclosure
Tenants	• Well-documented buildings instil confidence and trust in the quality of the building • Information on indoor environmental quality could be a relevant factor to consider for potential tenants • Potential services related to energy consumption (such as demand response) could enable cost savings	• The extra (administrative/ cost) burden could lead to an increase in the rent. • Data ownership and privacy, especially when it comes to monitoring user behaviour (real energy consumption) • Lease terms and tenant-landlord relationships (often more adversarial than collaborative) can complicate data sharing and disclosure

Designers	• Encourages integrated and collaborative design • The setting of quality targets creates incentives to meet targets in construction projects • Access to comprehensive information in case of renovation/extension • Design information will be better maintained and accessible overtime to support decision-making over the whole lifecycle • Potential for integration with BIM	• Limited incentives to update the DBL after work is finished • May create exposure of design/engineering decisions in case of disputes on building performance
Developers	• Proper documentation and transparency may increase the value of the building, e.g. by providing an audit trail of who did what during the construction phase) • Simplifies the planning process and reduces red tape • Information regarding the flexibility and adaptability potential of the building could also increase the value of the building since it supports multiple uses/functions and extends the useful lifecycle of the asset • The DBL can be used to demonstrate regulatory compliance and provide links to various certifications and ratings	• Need for additional documentation, which entails more work/higher cost
Construction contractors	• In case of renovation/extension, information can be easily accessed about existing building structure/materials • Potential for integration with BIM • Enables end-of-life recycling, while increasing safety for the contractors	• Need to properly document works implies additional efforts
Investors	• More reliable and transparent information on building performance supports transaction due diligence, informed decision-making, risk assessments and certainty, CAPEX planning and tenant recruitment/retention • Accessible data lowers costs of voluntary and regulatory reporting (e.g., energy use/GHG emissions; climate risk etc.) • The material inventory can increase the residual value of the asset and encourage responsible investment practices (e.g. impact investing)	• Tenant buy-in, data access and quality management, which are often outside of the control of landlords and investors
Banks and insurers	• Increased transparency concerning financial instruments • Supports lenders with reliable data and may potentially increase the value of energy-efficient and sustainable real estate asset collateral • Enables the 'green' tagging of loans that could be packaged as asset-backed securities and refinanced by green bonds • Tracking the financial performance of energy-efficient/green loans relative to traditional financial products • Potentially lower risk and better capital treatment	• Any data collection required beyond initial due diligence at the time of underwriting creates additional costs • Adapting business processes and loan service agreements to reflect heightened data collection requirements and due diligence • Banks are often too many steps removed from the assets, e.g. tenant buy-in, data access and quality management

Stakeholder	Opportunities / Benefits	Challenges / Requirements
Material suppliers (incl. urban miners)	• Enables circularity in construction and buildings through deconstruction, reuse and recycling of materials • Improved traceability of materials and chemical substances • Innovative business models and value definition such as the leasing of construction materials or building elements	• Need to provide additional information on their materials
Facility and building managers	• Helps to monitor and reduce operational energy use and fuel bills • Improved building performance, occupant comfort and indoor environmental quality • Improved maintenance and use of buildings; extended asset life • Monitoring KPIs to support organisational goals	• Need for additional documentation • Needs to be easy to use and aligned with existing practices • Needs to be compatible with smart meters, sensors and intelligent devices in order to support the capturing and integration of big data
Demolition contractors	• Supports circular economy practices by providing information on the type, amount and location of materials used in the building, and their potential for re-use and recycling	
Public authorities & policymakers (e.g. urban planners)	• Enables better policymaking and enforcement • Access to reliable building data for monitoring of process towards climate targets • Development of better-tailored support schemes • Provides evidence about the effectiveness of policy measures	
Real estate agents	• Transparency and trust as a sales/marketing argument • Shortens and simplifies transaction processes	• Increased transparency might limit flexibility during the sales/letting process • Upskilling and capacity building to understand and communicate the wide range of data
Research	• Gives access to updated data on large parts of the building stock, significantly increasing the accuracy of building stock models	
Utilities	• Access to a wider scope of data facilitating the understanding of customer profiles and customer services • Facilitates smart energy use and energy demand reduction strategies • New business models, such as energy efficiency services	• Data privacy rules
Certifiers	• Significantly reduces the effort to generate certificates • Potential for semi-automatisation of certificates	• The potential loss of business volume due to automatisation

Lawyers, solicitors, conveyancers	• Speeds up and eases transaction and due diligence processes 35	
Valuers	• Significantly reduces the effort to generate valuation reports • Potential for semi-automatisation of reports • Availability of data and information from safe sources in a time and cost-saving way • Improves the accuracy of valuations by taking into account the many factors impacting the overall quality of buildings	• Change of business models and value additions due to extended use of automated valuation models (AVMs)

Annex C. Digital building logbook functionalities according to different building types

Table 6 depicts the most likely functionalities of a DBL and illustrates its applicability to different building types. The X:es indicate for which building type this functionality can be useful for. It also indicates the main benefit and beneficiary per described functionality.

Table 6. Functionalities and applicability

The blue X:es indicated new buildings while the orange X:es indicate existing buildings.

Functionalities	Building typology			Main beneficiaries
	Single-family house	Multi-family building	Office	
Digital repository to store key documents (incl. design plans, certifications, proof of installations etc.)	X X	X X	X X	Building owners
Easy access to all relevant building-related information according to the different level of users & stakeholders	X X	X X	X X	Multiple actors
Operation, monitoring and maintenance plan (incl. notifications)	X X	X X	X X	Building owners/ facility managers
Overview of building performance (whole life resource consumption, climate change resilience, adaptability and flexibility, health and safety, accessibility)	X	X	X X	Building owners
Building renovation passport (renovation roadmap)	X	X	X	Building owners
Indicate the smart readiness of the building	X X	X X	X X	Building owners
Traceability of building materials	X	X	X	Multiple actors
Integration of BIM	X	X	X X	Designers / developers
Construction project management tools (assign roles, KPIs, accountability and liabilities during the design, development and construction phase)		X	X	Construction value-chain
Value chain integration, aggregation of project and marketplace of services	X	X	X	Construction value-chain
Links to financial incentives	X	X		Building owners
Visualising future energy/cost saving potentials and lifecycle costing	X	X	X	Building owners
Improved overview of the building stock	X	X	X	Public authorities
Benchmarking, reporting and links to various certification and assessment schemes	X	X	X	Financial institutions

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- The Global Alliance for Buildings and Construction - Building Passport Task Force. Information is not publicly available but has been shared with the consortium.

- The iBRoad Project has developed a digital logbook (energy-oriented) for replication. The research also includes surveys and pilot tests. Reports include:

- The Concept of the Individual Building Renovation Roadmap (2018)

  – Understanding Potential User Needs (2018)

  – The logbook data quest (2018)

  – Database structure and programming core of the roadmap and logbook (2018)

  – The iBRoad Concept in practice (2018)

  – Test driving the Individual Building Renovation Roadmap and Logbook (2019)

- The ALDREN project is developing a digital logbook (energy oriented) for non-residential buildings. Their work is especially interesting when it comes to standards and indoor environmental quality. Reports include:

  – Overview of the Available Knowledge for the Data Model

  – Definition of a Building Renovation Passport for Non-Residential Buildings: The ALDREN Project Experience

- The BAMB project has developed an "electronic Materials Passports" with the aim to be a one stop shop for material information. Reports include:

  – BAMB pilots – "Feasibility study + Feedback report" (2017)

  – BAMB "Material Passports – Best Practice" (2019)

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