Demo Blog

REPORT ON DBL STATE OF PLAY

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June 30, 2023

TUD

This project has received funding from the European Union's Horizon Europe research and innovation programme, under grant agreement No. 101091749

Co-funded by the European Union

Grant Agreement No.	101091749
Start date of Project	1 January 2023
Duration of the Project	48 months
Deliverable Number	D3.1
Deliverable Leader	TUD
Dissemination Level (PU, SEN, CI)	PU

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History of Changes

Version	Change made	Date
1	First draft submitted for internal review	7 June 2023
2	Final draft for submission	30 June 2023

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ABBREVIATIONS

AI	Artificial Intelligence
API	Application Programming Interface
B2B	Business-to-Business
B2C	Business-to-Consumer
BE	Belgium
BMBBW	Bundesministeriums Für Verkehr, Bau-Und Wohnungswesen
BNDB	French National Database of Buildings
CEAP	Circular Economy Action Plan
CPR	Construction Product Regulation
DBL	Digital Building Logbook
DE	Germany
DNO	Distribution Network Operator
EC	European Commission
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performing Certificate
EU	European Union
FR	France
GUI	Graphical User Interface
HEC	Home Energy Check
HVAC	Heating, Ventilation and Air-conditioning
IoT	Internet of Things
KPI	Key Performance Indicator
LTRS	Long-term Renovation Strategies
MS	Member State(s)
OVAM	Public Waste Agency of Flanders
R&D	Research and Development
RLBA	Residential Logbook Association
SAP	Standard Assessment Procedure

SRI	Smart Readiness Indicator
TRL	Technology Readiness Level
UK	United Kingdom
UK-SCT	Scotland
UPRN	Unique Property Reference Number
UX	User eXperience
VEKA	Flemish Energy and Climate Agency

EXECUTIVE SUMMARY

The project on the ***Development and Demonstration of Digital Building Logbook (Demo-BLog)*** aims to challenge the 'conventional' purpose of a DBL. It sees to convert the data collected into actionable information for relevant stakeholders across the construction market value chain, principally the decarbonisation of the European existing building stock. The project further aspires to develop a decision support tool that enables local initiatives to identify optimal sustainability transition pathways that is steered by clustered digital building logbook (DBL) data, supported by a demonstration on how this data can monitor and process the evaluation of climate and other energy transition actions implemented by local governments. The project brings together the **Woningpas** (Belgium), **CIRDAX** (Netherlands-Belgium), **CLÉA** (France), **CAPSA** (Germany) and **Chimni**, (the United Kingdom) DBLs to cultivate four diverse functionalities that addresses growing key societal challenges in the built environment.

This report provides the foundation for all future studies within the scope of the Demo-BLog project, by reviewing the state of play of the five DBLs in relation to the wider market across Europe. It is designed as an encyclopaedia that contains the fundamentals of the five tools, the perspectives of the respective markets, as well as future goals and the underlying prerequisites thereof, which should serve as a common ground for all subsequent collaborative studies. This report builds on the following three reports previously submitted to the European Commission (EC) on the development of a European Union (EU) framework for DBLs, and can be perceived as a succeeding product of the studies.

1. Definition of the digital building logbook: report 1 of the study on the development of a European Union framework for buildings' digital logbook (2020);
2. Building logbook state of play: Report 2 of the study on the development of a European Union framework for buildings' digital logbook (2020); and
3. Study on the development of a European Union framework for digital building logbooks: Final report (2021).

INTRODUCTION

Today's construction market, the renovation market in particular, is notoriously fragmented and lacks a clustered approach; a fundamental constituent in establishing a sustainable built environment and to achieve the renovation wave. Local energy transition initiatives, driven by governments, housing associations or energy communities need proper tools to develop neighbourhood-based approaches to integrate renewable and digital solutions and create zero-energy districts, where consumers become prosumers selling energy to the grid. Efficient use of new and existing data sources effectively managed and accessed via digital building logbooks (DBLs) can improve resource efficiency, enhance planning, better target incentives, and so forth, to benefit local governments, the construction sector, financing institutions, homeowners, and tenants.

1.1 The Need for Digital Building Logbooks

Data touches on every aspect of the built environment. Data benchmarks and tracks the progress, performance, and energy use of a building, assesses improvements in business planning and (internal and external) reporting, and is crucial in risk assessments and financial underwritings. Essentially, data can be seen as the medium for interaction between human stakeholders and the built environment. The consistent availability of reliable data thus implies good building practices: from holistic ideas, concepts and designs to better construction and management of buildings, in addition to improved transparency in market information and the founding of novel business models, services and effective policies.

Yet, it appears to be universally agreed between policymakers and value chain stakeholders that the availability, reliability, and storage of building data are the recurring impediments in achieving a low carbon and circular built environment. It is thus suggestive that transparency and information accessibility are the two fundamental constituents for both energy efficient and sustainable buildings. Limitations in information sharing due to the absence of a systematised approach to data collection and the lack of a universal repository naturally increase costs and inefficiencies throughout the building cycle. A significant issue is that data and information management, as well as the subsequent transfer and evaluation, are mostly inadequate. The predicament now is that if information is available at all, it is often outdated, out of context, one-off, (very) partially covered and/or has adopted a questionable research methodology. These constraints make the existing available data redundant in the sense that limited to no value is transferred to the succeeding studies, and the same data collection process would have to be reiterated on a different set of parameters. Retaining a log and the capacity to store the added volume of information is therefore of significance to curb this mundane process for the better.

The Circular Economy Action Plan[1] recognises DBLs as circularity enablers, while the Renovation Wave[2] affirms that they are anticipated to integrate all relevant data generated and/or tabulated from (upcoming) building renovation passports, smart readiness indicators, Level(s) and energy performance certificates (EPC). The strategy Annex includes a proposal, due in 2023, on *Building Renovation Passports and [the] introduction of a single digital tool unifying them with Digital Building Logbooks*[3]. Several European countries have developed and implemented DBL inspired initiatives in recent years, with examples including *Woningpas* (Flanders, Belgium), CLÉA (France), CAPSA (Germany) and CIRDAX (the Netherlands). While every such initiative is founded on the common goal to increase data availability and transparency to a wider and more inclusive range of stakeholders, they each are unique in focus, data governance schemes and digital interfaces.

1.2 Project Introduction

Our current project on the ***Development and Demonstration of Digital Building Logbooks (Demo-BLog)*** aspires to achieve a common European approach that embraces the complete lifecycle of buildings in Member States (MS), demonstrating the capturing, integrating and storing of building data, whilst simultaneously enabling synergies, interoperability, data consistency and information exchange. Demo-BLog aims to further challenge the 'conventional' purpose of a DBL. It aims to convert the data collected into actionable information for relevant stakeholders across the construction market value chain, principally the decarbonisation of the European existing building stock.

To that, Demo-BLog brings together (1) five different DBLs with a total of 4.5 million registered units and a wide variety of target groups —homeowners, public authorities and building professionals such as architects and contractors to name a few— offering scale and diversity; (2) four diverse functionalities addressing key societal challenges, ranging from 'quick wins' —renovation and advice and (community driven) decarbonisation pathways— to complex industrial transaction objectives including circularity; (3) partners, frontrunners in research and development (R&D), market implementation and policymaking in highly visible platforms over the last five years; and (4) substantial opportunities to build and leverage parallel projects and activities focussed on evolving and/or scaling the participating DBLs.

The five DBLs at study are ***Woningpas*** in Belgium, **CIRDAX** in the Netherlands and Belgium, **CLÉA** in France, **CAPSA** in Germany, and **Chimni** employed in the United Kingdom (UK). This State of Play report seeks to evaluate said tools against several best practices that are active in Europe, to understand the present and prospective capacities of the tool. Key stakeholders and functionalities will be identified, followed by the validation of benefits, and prerequisites for optimal DBL performance thereafter.

1. See https://ec.europa.eu/newsroom/growth/items/690184 for more information on new circular economy action plan (CEAP) adopted by the European Commission (EC) in March 2020.
2. See European Commission (2020).
3. See annex to European Commission (2020).

1.3 Report Structure

This report aims to communicate several key takeaways that are necessary to accelerate the decarbonisation of the European building stock, building on a state-of-play analysis and stakeholder input from selected best practices. The report outlines the potential role and scope of the tool, including the central features, as well as data handling and governance issues. Figure 1 illustrates the structural approach of this report:

1. Chapter 2: Definition of DBL and an overview of best practices;
2. Chapter 3: Conceptual framework of the Demo-BLog initiative and the mapping of key stakeholders;
3. Chapter 4: Identification and validation of key functionalities, benefits and prerequisites;
4. Chapter 5: Evaluation of optimal DBL performance and discussion on key takeaways;
5. Chapter 6: Conclusions of the study.

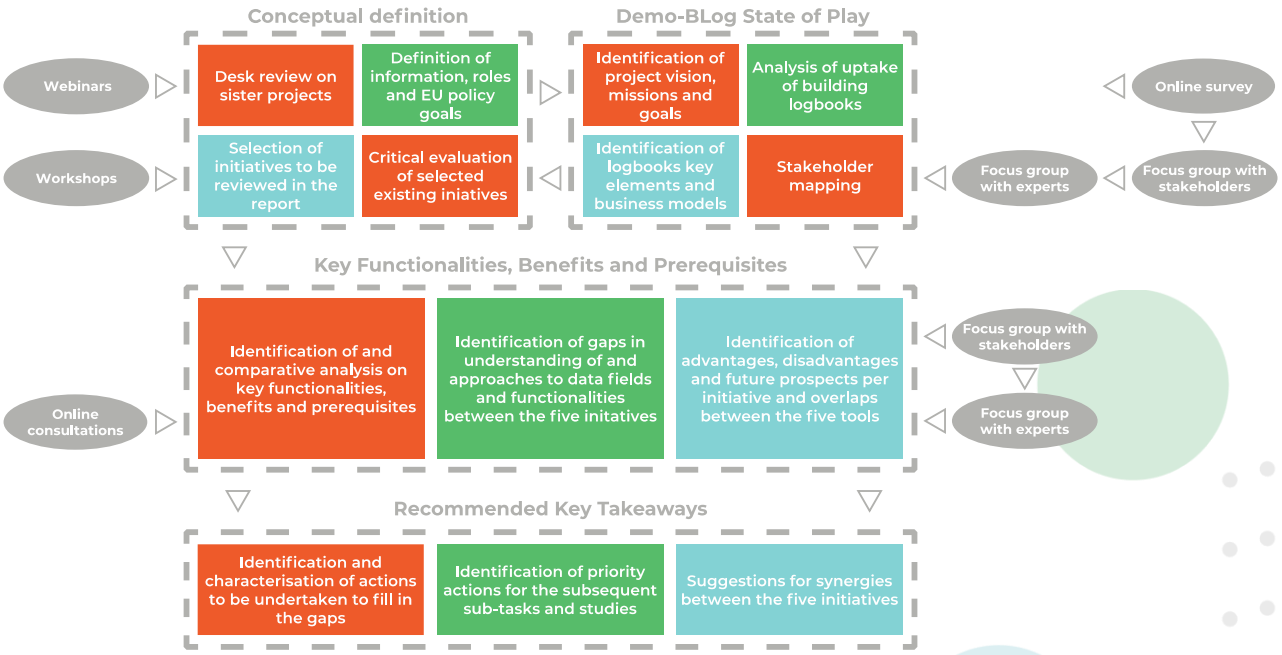


Figure 1: Overall structure and research approach of report.

1.4 Research Methodology

The report builds on a thorough review of existing literature, consultations with over 30 experts through focus group sessions and personal contact, as well as quantitative input received through an online survey questionnaire (65 respondents) and supplementary focus group sessions with approximately 20 key stakeholders from the regions at study.

1.4.1 Comparative Analysis of Best Practices

Demo-BLog aims to study the five previously introduced initiatives (see section 1.2) for the purpose of evaluating key success factors and barriers to the implementation of the DBLs in the respective areas: four are from EU Member States, and one from the UK. This report also assesses best practices from DBLs outside the Demo-BLog consortium, some of which have been previously reviewed by the European Commission et al. (2020b) in their report, *Definition of the digital building logbook: Report 1 of the study on the development of a European Union framework for buildings' digital logbook*. It aims to re-evaluate the development of the DBLs reviewed in the recent three years since the publication of the report.

Each building logbook is analysed using an evaluation template which covers several aspects:

1. Description of the initiative;
2. Type of initiative: public or private, paper or digital, mandatory or voluntary;
3. Identification of key stakeholders;
4. Data fields and functionalities included;
5. Applicability over different building typologies and usage by various stakeholders; and
6. Validation of key functionalities, benefits and prerequisites for optimal DBL performance.

1.4.2 Identification of Key Stakeholders

Key stakeholders are identified from both literature and contact with DBL owners and/or managers. A survey has been conducted among those stakeholders —including but not limited to building professionals, building owners, data owners, government agencies— to identify the requirements, functionalities and benefits that are relevant to the stakeholders; for instance, data, equipment and technology, standards, and benefits such as decarbonisation, cost efficiency, resource allocation and access to trusted and traceable information. The optimal DBL performance is thereafter studied through four focus group sessions in Belgium, France, Germany and UK-Scotland.

1.4.3 Validation of Key Functionalities, Benefits and Prerequisites

The key functionalities and their benefits for key identified stakeholders in 1.4.2 are validated to be used in forming an evaluation framework for the demonstration cases in later phases of the project. For this, the preliminary approach to data characterisation has been discussed with DBL experts and practitioners, in addition to the link with other datasets, innovative data collection methods, data governance and barriers and opportunities. Validation took place via discussions with DBL experts through a series of three focus group sessions.

DIGITAL BUILDING LOGBOOKS (DBLs)

DBLs are designed to be the central digital data repositories for building related data in the (future) built environment. Such ambition calls for the following prerequisites: (1) the possibility to automatise the process of importing data from various data sources; (2) the possibility to digitally interpret, complete and process said data; (3) the capacity to assess its quality and propose corrections on conflicting data and/or perceived errors; (4) the capacity to grant intuitive data governance for data owner; and (5) the possibility to link external functionalities and/or services via third party access upon authorisation by building owner. These prerequisites serve as benchmarks when evaluating the current state of play of DBLs and as orientation points for the future steps the project would take in the subsequent phase(s).

2.1 Definition of a DBL

The European Commission (EC)[4] defines a DBL as follows:

- 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.

This State of Play report aims to evaluate the various aspects of the EC's definition within the framework of Demo-BLog, through discussions with key stakeholders identified in the later chapters of this study. The definition will be revisited with the conclusions drawn from this study (see Section 5.2).

4. See Executive Summary of European Commission et al. (2021) for more information on DBL definition.

2.2 The Role of DBLs and EU Policy Goals

The built environment and construction sector are traditionally multifaceted with the immense numbers of stakeholders involved. These stakeholders often have conflicting interests; the difference in information needs, use of data and purposes is inevitable. Data that is relevant and of value to every stakeholder involved is often unavailable in one place and a systematic approach to organising and managing it is largely missing. A DBL can therefore be registered as a safe medium that grants users control over both their data and third-party access, respecting the fundamental right to the protection of personal data.

The role of DBLs, however, do not end at the user level. The *EU Commission Work Programme 2020*[5] sets out a targeted agenda to implement six priorities and several key initiatives that support them. The work programme places significant emphasis particularly 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. DBLs can greatly enhance these goals by playing a role in relation to the following policy initiatives:

Role of DBL	Relevant EU Policy Goal	Remarks
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

5. See https://commission.europa.eu/publications/2020-commission-work-programme-key-documents_en

		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.
Mobilising the digitalisation of product information	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.

Table 1: The roles of DBLs in achieving EU Policy Goals.

2.3 Overview of Existing Best Practices

The identification of existing best practices is grounded on *Building logbook state of play: Report 2 of the study on the development of a European Union framework for buildings' digital logbook* (2020a), which identified 34 initiatives across various maturity levels: 31 from EU Member States, one from Iceland, one from the United States of America (USA) and one from Switzerland[6]:

Maturity Level	Name of initiative (Country)	
Under development (6)	Building Passport GBC	Finland
	Ilmastoviisaat Taloyhtiöt	Finland
	Electronic building ID	Greece
	Platform CB'23	The Netherlands
	PAS-E	Spain
	Klimatdeklaration	Sweden
Tested (5)	Homebook	France
	Le carnet numérique du logement	France
	Mon carnet logement	France
	Passeport Efficacité Énergétique	France
	Wikihabitat	France
	Dossier d'intervention ultérieure	Belgium
	Woningpas	Belgium
	Bedrebolig	Denmark
	Real estate service manual	Finland
	Eigenheim Manager	Germany

6. See Chapter III of European Commission et al. (2020a) for more information on the best practices identified.

Operational (21)	Hausakte	Germany
	Gëbaudepass	Germany
	QDF Hausakte	Germany
	Property Register	Iceland
	Fascicolo del Fabbricato	Italy
	Madaster	The Netherlands
	Opleverdossier	The Netherlands
	Livro de obra	Portugal
	Home report	Scotland
	Libro del Edificio	Spain
	BASTA Loggbok	Sweden
	Min Villa	Sweden
	Produktkollen	Sweden
	Federal Register	Switzerland
	CIBSE TM31	UK
	Arc platform	USA
Discontinued (2)	ImmoPass	Germany
	Home Information Pack	UK

Table 2: Previously identified existing best practices in relation to maturity levels.

The identification of the initiatives started with the re-evaluation of the initiatives in Table 2 and expands further to include more active tools. Every new addition has been analysed in the following aspects, as was done in the preceding report[7]:

1. Description of the initiative;
2. Data fields and functionalities included;
3. Type of initiative: public or private, paper or digital, mandatory or voluntary;
4. Data management approach; and
5. Applicability over different types of buildings and usage by different stakeholders.

Table 3 illustrates an updated overview of 31 initiatives that are currently in-place and operational in Europe[8 & 9]:

7. See Chapter II of European Commission et al. (2020a) for more information on research methodology.
8. Note that this table merely provides examples of best practices that have been studied in this report and does not reflect every initiative that is active in every MS of the EU and the UK.
9. Disclaimer: Part of the information in the table reflects the findings from the previous study in 2020 (European Commission et al., 2020a). Please note that not all information may still stand in 2023.

Country	Name of Initiative	Name of Managing Institution(s)	Public (PU) or Private (PR)	Mandatory (M) or Voluntary (V)	Single-family home (S) or Multi-family home (M) or Others (O)	Paper (P) or Digital (D)
Belgium	Dossier d'intervention ultérieure	Belgian Federal Government	PU	M	S / M	P
	Woningpas	Flemish Energy and Climate Agency (VEKA), Public Waste Agency of Flanders (OVAM), Environment and Housing Departments Flemish Government	PU	M	S / M	D
Denmark	Bedrebolig	The Danish Energy Agency	PU	V	S / M	P
	Ilmastoviisaat Taloyhtiöt	Green Building Council (GBC) Finland	PR	V	S / M	D
	Real estate service manual	Government/Ministry of Environment	PU	M	All	P
France	CLÉA	Qualitel	PR	V	S / M	D
	Homebook	Urmet France	PR	V	All	D
	Le carnet numérique du logement	Bureau Veritas	PR	V	M	D
Germany	CAPSA	Chillservices	PR	V	All	D
	Eigenheim Manager	Eigenheim Manager	PU	V	All	D
	Gëbaudepass	Bundesministeriums Für Verkehr, Bau-Und Wohnungswesen (BMBBW)	PU	V	S	D
	Hausakte	BMBBW	PU	V	S	D
Greece	Electronic building ID	Technical Chamber of Greece	PU	M	All	D
Iceland	Property Register	Registers Iceland	PU	M	All	D
Italy	Fascicolo del Fabbricato	Regional Government based on national requirement	PU	M	O	P
Netherlands	Madaster	Madaster Foundation	PR	V	All	D
	Opleverdossier	Ministry of Internal Affairs	PR	V	S / M	P
Netherlands & Belgium	CIRDAX	Re-Use Materials	PR	V	All	D
Portugal	Livro de obra	Ministry of Environment, Territorial Planning and Regional Development, and Ministry of Public Works, Transportation and Communication.	PU	M	All	P
Scotland	Home report	Scottish Government	PU	M	S	P
Spain	Libro del Edificio	Regional Government based on national requirement	PU	M	S / M	P
Sweden	Basta	BASTA non-profit company	PR	V	All	P

	Klimatdeklaration	Prodikt	PR	V	All	D
	Min Villa	Villaagarnas Riksforbund	PR	V	S	D
	Produktkollen	ProduktKollen AB	PR	V	All	D
Switzerland	Federal Register	Federal Statistical Office (FSO)	PU	M	All	D
UK	Chimni	Chimni	PR	V	S / M	D
	CIBSE TM31	Chartered Institution of Building Services Engineers	PU	M	O	P
	GBuilder	Group Builder Ltd	PR	V	M	D
	The National Deeds Depository	The Deeds Depository Limited	PU	V	S	D
	Spaciable	Spaciable	PR	V	M	D

Table 3: Overview of best practices that are currently operational.

DEMO-BLog

Demo-BLog brings together: (1) five different DBLs with a total of 4.5 million registered units and a wide variety of target groups —homeowners, municipalities, building professionals and architects to name a few— offering scale and diversity; (2) four diverse functionalities addressing key societal challenges, ranging from 'quick wins' —renovation and advice and (community driven) decarbonisation pathways— to complex industrial transaction objectives including circularity; (3) partners, frontrunners in research and development (R&D), policymaking and market implementation in highly visible platforms over the last five years; and (4) substantial opportunities to build and leverage parallel projects and activities focussed on evolving and/or scaling the participating DBLs.

3.1 Project Vision and Mission

The decarbonisation of the European building stock needs a considerable push to achieve climate-neutrality by 2050, as the pace of transformation remains slow with the deep renovations rate at a trivial 0.2%.[10] To achieve its climate goals, the EU must utilise all available policy instruments, such as EPCs, building renovation passports and the long-term renovation strategies (LTRS). Member States' LTRS will provide the main framework for the overhaul of the building stock; they should define what is required for each building segment to become 2050-compliant, including, among others, "policies and actions to stimulate cost-effective deep renovation of buildings, including staged deep renovation, and to support targeted cost-effective measures and renovation for example by introducing an optional scheme for building renovation passports".[11]

The Energy Performance of Buildings Directive (EPBD) recast proposal introduces the requirement for MS to develop by the end of 2024 a scheme for renovation passports. The proposal defines the renovation passport as "a document that provides a tailored roadmap for the renovation of a specific building in several steps that will significantly improve its energy performance".[12] Given that an accelerated rate of renovation is likely to increase consumption of resources and generation of waste, the Renovation Wave also proposes measures to improve circularity and resource efficiency, such as the review of material recovery targets and supporting the internal market for secondary raw materials. Against this policy background, Demo-BLog brings together five front-runner DBLs with a wide variety of target groups, demonstrating four key functionalities addressing societal challenges (see Figure 2). The diversity in legal and market backgrounds, including both public and private led logbooks, different levels of maturity, core functionalities and target audiences will ensure the potential for wider replication and long-term sustainability of logbooks.

10. See European Commission & Directorate-General for Energy (2019).
11. See Article 21 of Directive 2018/844/EU.
12. See amendment 2010/31/EU (adapted) in European Commission (2021).

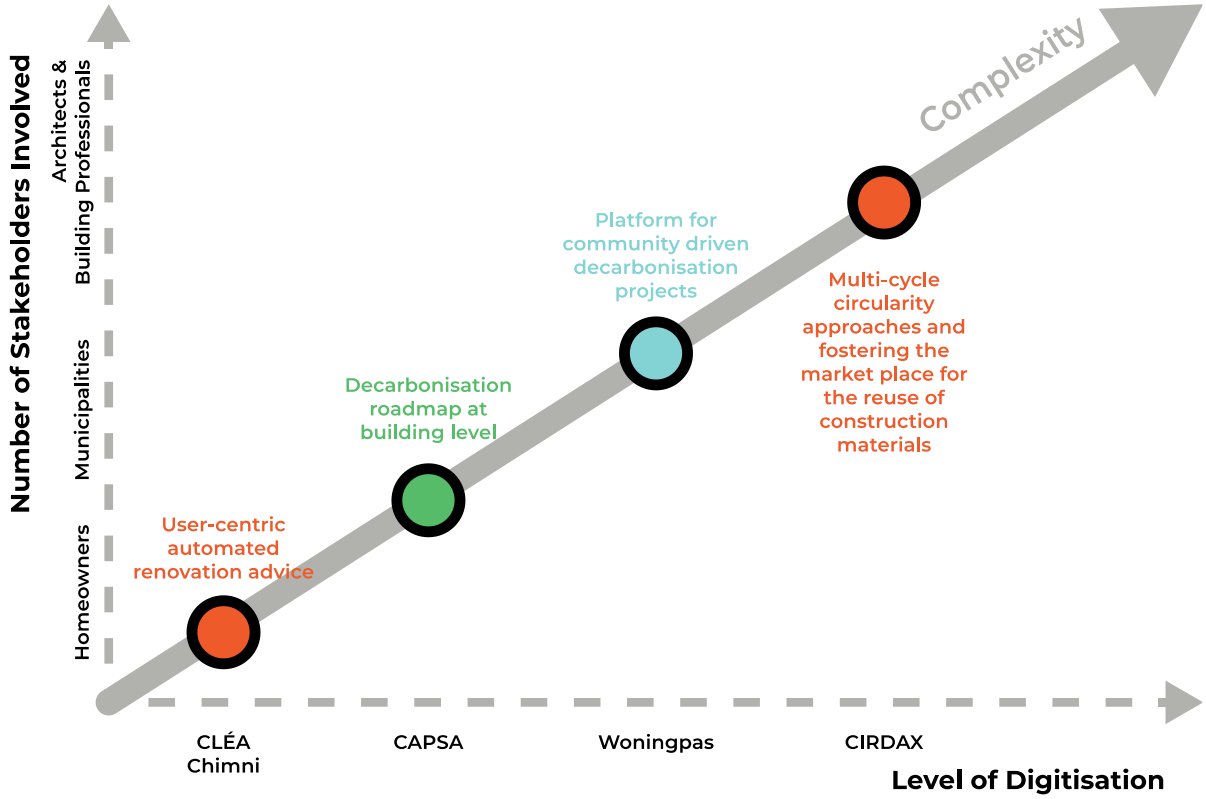


Figure 2: The Demo-BLog ecosystem.

3.2 Project Goal: The 4 Key Functionalities

Demo-BLog will demonstrate four key (related) functionalities addressing the main barriers to a fully decarbonised and circular built environment: (1) a user-centric automated renovation advice; (2) decarbonisation roadmaps at building level; (3) platform for community driven decarbonisation projects; and (4) multi-cycle circularity approaches, fostering a marketplace for construction materials reuse.

Key Functionalities	Description
User-centric automated renovation advice	A tool to engage homeowners by providing an initial set of recommendations for building retrofit improvements based on existing datasets, particularly EPC databases. The functionality will build on existing automated advice tools and the novelty is the integration of these tools into a logbook functionality. The automated renovation advice is a potential trigger that could open a dialogue with building owners and prompt further engagement and action. Therefore, functionality integration within building logbooks offers the potential to improve these tools regarding user experience (UX), customer journey, advice quality and potential links to renovation one-stop-shops.
Decarbonisation roadmaps at building level	While the automatic renovation check is usually a quick and light touch assessment, the roadmap functionality takes a further step to give a more detailed overview based on additional data collected on-site. Equally, while the automated renovation advice is based on a snapshot of the property, the decarbonisation roadmap presents a renovation journey over time, for instance, a staged deep renovation. It helps building owners gain a complete overview of when they will have to do what to their homes. The decarbonisation roadmap

	will consider local energy infrastructure and regional long-term renovation strategies. It can be updated as new measures are installed.
Platform for community driven decarbonisation projects	Moving on from functionalities targeting individual buildings and building owners, this tool will make use of the logbook data to unlock the potential of energy communities, positive energy neighbourhood, collective RES sharing, sustainable co-housing projects and neighbourhood renovations through economies of scale, pooling of finance and expert advice. The functionality will be designed to support community-led projects aimed to aggregate local demand, such installing measures on several properties in the same street. The functionality will provide a platform for community engagement and connecting to building and/or energy services and stakeholders, including service providers, utility companies, local governments, a building retrofit value chain. This tool will also be relevant for local authorities to identify trends and better plan and/or design renovation programmes.
Multi-cycle circularity approaches, fostering a marketplace for construction materials reuse	The scope of this functionality will go beyond the operational energy performance and use phase carbon emission mitigation to consider whole lifecycle environmental impacts. The functionality will create building material and component inventories to conduct whole life carbon assessments and indicate the potential future reuse of building materials and components. Transparency in the data of components and materials used in buildings will be used to calculate the financial and environmental impact of buildings at the material and component level, and this information can be leveraged in the marketplaces for reused and/or recycled components. This functionality should create new opportunities for circularity and make it viable. It will enable building professionals to better assess building sustainability performance and choose accordingly. It could also help identify which building components pose a threat to health, safety and environment and incentivise their replacement.

Table 4: The four key functionalities in study.

3.3 The 5 DBLS

3.3.1 Woningpas

Woningpas launched in December 2018 for residential building-units and is targeted to single-family houses or units in multi-family housing complexes. It is owned by bodies of the Flemish Government, namely the Flemish Energy and Climate Agency (VEKA), Flemish Public Waste Agency (OVAM), Wonen-Vlaanderen and Departement Omgeving.

Woningpas is designed to be automatically available for building owners, be it natural persons and/or housing companies. It includes data and status of the dwelling, plot and surroundings: information on energy performance including EPC label, renovation roadmaps and real energy use, insulation, installations, solar potential, soil, sewage system, water supply, flood sensitivity, building permits, mobility and overall dwelling quality. Data is linked with external data platforms through APIs, and it has a digital safe for attestations, plans, relevant documents with the possibility to update renovation works and a check-tool on dwelling quality. As of 2022, it features the possibility to share individual *Woningpas* with authorised third parties and the wider public. The passport will be expanded to all non-residential buildings by the end of 2023.

3.3.2 CIRDAX

CIRDAX launched in 2016 as part of the InterregNWE project *IT Digital Deconstruction* that explores the Circular Building agenda and private (real-estate) organisations as a business support module for maintenance and renovation. It is owned by Re-Use Materials, a data and consulting firm that focuses on making the demolition, construction and management of buildings circular. Clients of Re-Use Materials are mainly large real estate owners, governments and (semi-)public authorities.

CIRDAX is a digital materials database which stores all kinds of information on building components and materials. Data in CIRDAX is provided via an inventory of components and materials, partly obtained by 3D-scanning and manual additional services. CIRDAX offers a dashboard with information on building components and materials, which includes market value, CO_2-value and dismount ability. CIRDAX is linked to blockchain to provide unchangeable and/or verifiable information on the materials ownership, giving future transactions with materials and liability concerning the (future) use of material a legal framework.

3.3.3 CLÉA

CLÉA launched in October 2020 for residential building-units and is targeted to building owners and tenants, either as a direct customer or via real-estate managers. It is owned by Qualitel, a French certification body.

CLÉA is deployed across 50,000 dwellings: 45,000 business-to-business (B2B) transactions of privately-owned (mostly new) multifamily buildings and 5,000 business-to-consumer (B2C) transactions of individual dwellings and/or single-family houses containing core functionalities and features. CLÉA has multiple functionalities: (1) general dwelling information with data retrieved from cadastre through API; (2) a documents module for documents including minutes of general assemblies, invoices and house rules for the multi-family complexes; (3) an equipment module that includes user guides for heating, ventilation and air-conditioning (HVAC) and devices, with maintenance alert functions; (4) news-blog curated by Qualitel; (5) an energy monitoring module with API for French smart meters Linky and GASPAR; and (6) the use of algorithm to show energy split per use, in accordance to the French thermal regulation. CLÉA's UX can be customised according to the dwelling and the user such as the interface for 'Syndic'. CLÉA's current utilisation rate when sold via B2B is 28%, against 90% for B2C.

3.3.4 CAPSA

CAPSA launched in 2021 and is applied in Germany on 50,000 dwellings and in smaller test cases in Scotland, Netherlands, and Italy, and has a focus on decarbonisation roadmaps. It is owned by Chillservices, a commercial company providing building logbooks for large food retail stores since 2016. Chillservices builds its business by one-time data collection fees, license fees for tools needed for the documentation of maintenance visits and energy reports.

CAPSA consists of a smartphone app and a cloud-based data (building logbook) platform. The app functionalities focus on enabling non-experts to conduct robust data collection by focusing on primary data without assumptions on site. Data collection is supported by geo-

positioning and picture recognition features. Data is then checked, merged with external data sources, interpreted and complemented with synthetic data where necessary. The functionalities centre around the calculation of energy performance, surface area, asset management support and the (semi-) automated calculation of decarbonisation roadmaps.

3.3.5 Chimni

Chimni is a UK based digital logbook which specialises in the residential sector and has users across the UK and Ireland. Chimni is a free logbook service that has been running since 2021.

Approximately 250,000 homes in the UK have a DBL provided by across seven commercial companies. The Demo-BLog project will integrate the Chimni logbook with Energy Saving Trust's home renovation advice tool called Home Energy Check (HEC). The logbook allows users to store and categorise documents about a building, for instance maintenance information, floor plans and sales information. It can also currently be connected to a limited amount of publicly available data sources. The current version also allows people to record building projects and allows users to keep a record of their smart devices. The Home Energy Check is an online home renovation advice tool, created by Energy Saving Trust in partnership with Solstice Associates and the Association for Decentralised Energy. The Home Energy Check requires users to input information about their home and the occupancy profile, for example, the size, the year of construction, number of occupants etc. Based on the information provided, the HEC offers homeowners a list of suitable energy efficiency measures, as well as the potential energy, carbon and cost savings if the homeowner chooses to install these. The tool allows householders to see the best improvement measures for them and their budget. The HEC is consistent with full Standard Assessment Procedure (SAP) 2009 methodology and the 'Inference Engine' populates SAP assumptions based on available information about the home, and using Energy Saving Trust's assumptions.

3.3.6 Summary

	Owning bodies	Active region(s)	Current capacities	Targeted goals
Woningpas	VEKA, OVAM, Wonen-Vlaanderen and Departement Omgeving	Flanders (Belgium)	Data on the status of the dwelling, plot and surroundings are currently linked to external data platforms through APIs. The platform provides a digital safe for attestations and/or plans to be updated with renovation works and has a check-tool that assesses the dwelling quality.	Capability to develop enhanced energy-communities and pioneer a collective approach in the renovation process that is driven by the DBL.
CIRDAX	Re-Use Materials	The Netherlands and Belgium	Basic and generic information on building components and building materials to investors and real estate owners indicating component and material characteristics of (mainly) existing office and	Capability to demonstrate an enhanced legal and data driven approach in the construction process with focus on circular design by architects and re-application of components and materials driven by the DBL in the Belgium market,

			utility buildings in the Dutch market.	sharing data with third parties.
CLÉA	Qualitel	France	Basic and generic (non-tailored) advice to stimulate homeowners to refurbish their home.	Capability to demonstrate automated renovation advice with a strong focus on UX design and inclusivity by making links with the upcoming BNDB.
CAPSA	Chillservices	Germany, Scotland, the Netherlands, and Italy	Decarbonisation roadmaps are currently done (semi)-manually. Roadmaps have been created manually and with partially external tools as proof of concept for interested building owners on a case study scale	Capability to demonstrate automated decarbonisation roadmaps for 50,000 units in Germany, including links to (green) finance.
Chimni	Chimni	UK	Currently offers homeowners the feature to manage information about their home through an online platform. The Home Energy Check is an existing home renovation advice tool that gives tailored recommendations. The technology solution to integrate the advice tool and the logbook will be developed through this project.	Demonstrate the concept of user-centric automated renovation advice by connecting EST's Home Energy Check tool to a building logbook and pre-populating it with logbook data

Table 5: Section 3.3 summary.

3.4 Comparative Overview

A data template was created to identify a common data language and/or categorisation method that can be applied to all five DBL initiatives studied in this project (see Annex 8.1). Table 5 provides a preliminary indication of how the initiatives differ in terms of operational nature:

		Woningpas	**CIRDAX**	**CLÉA**	**CAPSA**	**Chimni**
Data owner	Homeowner (**H**); DBL owner (**D**); Governing body (**G**)	**H; D; G**	**D**	**H**	**H**	**H; G**
Access to data	Homeowner (**H**); Authorised third parties (**A**); Public sharing (**P**)	**H; A; P**	**H; A**	**H**	**H; A**	**H; A**
Initiative	Public (**PU**); Private (**PR**)	**PU**	**PR**	**PR**	**PR**	**PR**
	Mandatory (**M**); Voluntary (**V**)	**M**	**V**	**V**	**V**	**V**

Service fee	**YES** or **NO**	**NO**	**YES**	**YES**	**YES**	**NO**
Building typology	Single-family home (**S**); Multi-family home (**M**); Others (**O**)	**S; M**	**M; O**	**S; M**	**S; M; O**	**S; M**

Table 6: Comparison in characteristics.

The initial categorisations as indicated in the template and in this report is the result of studying every functionality and data field employed across the five initiatives, with the terms and scope generalised thereafter to encompass the varying features into one universal table. The map of the data fields included in each building logbook (see Annex 8.1) shows that data mostly present across the building logbooks are related to general administrative information, together with building characteristics and information on building operation and use. It is interesting to notice that CIRDAX deviate most as the nature of the tool propels more towards that of a material passport than a building logbook.

Data Field	**Functionality** (x = Yes; / = In the future)	**Woningpas**	**CIRDAX**	**CLÉA**	**CAPSA**	**Chimni**
Information Storage	Digital repository to store key documents *(i.e. design plans; certifications; proof of installations)*	x		x	x	x
	Easy access to all relevant building-related information according to the different level of users and stakeholders	x	x	x	x	x
	Storage of maintenance and operation plans *(may incl. predictive maintenance; notifications and alerts)*	x	x	x	x	x
	Traceability of building materials and/or material passport	/	x		/	
	Digital repository to store past renovations *(may incl. design plans; certifications; proof of installations)*	x	/	x	x	x
Data usage and (links to other) tools	Monitoring of building performance *(may incl. whole life resource consumption; climate change resilience; adaptability and flexibility; health and safety; accessibility)*	x			x	/
	Monitoring of indoor environment quality				/	
	Monitoring of environmental impacts over lifetime *(i.e. demolition and re-use of materials)*		x		/	
	Visualising future energy/cost-saving potentials and lifecycle costing		x	/	x	/
	Integration with construction project management tools for planning and financing *(To assign roles, key performance indicators (KPIs), accountability and liabilities during the design, development and construction phases)*					
	Enabling integration of BIM				x	/
	Indication of the smart readiness of the building					
	Enabling integration with smart energy services *(i.e. demand response; dynamic pricing)*				x	
	Building renovation passport or renovation roadmap	x	/	/	x	/
	Provision of automated renovation advice	x		/	x	/

Benchmarking, reporting and links to similar buildings, various certification and assessment schemes	x	/		x	
Provision of overview of the building stock				x	
Option to consent for third party use of data *(Third parties may include (prospective) buyers and tenants, real estate, financing institution, construction professionals & governing bodies)*	x	x		/	x
Links to financial incentives	x		/	x	
Estimation of environmental impacts of building lifetime		x		x	
Enabling integration with asset management tools		x		x	

Table 7: Functionalities in place.

The analysis of the functionalities confirms what is shown for the data fields: among the initiatives currently in place, building logbooks are mainly used as collector of administrative and construction information together with operational maintenance and use. Two of the more 'advanced' functionalities —integration with construction project management tools for planning and financing, as well as indication of the smart readiness of the building— can be seen as yet a challenge to all the initiatives at study.

3.5 Stakeholder Mapping

The identification of key stakeholders is built on *Definition of the digital building logbook: Report 1 of the study on the development of a European Union framework for buildings' digital logbook* (2020b) [13], which identified 17 stakeholder groups across the entire construction and built environment value chain:

1. Landlords and owner-occupiers
2. Tenants
3. Designers
4. Developers
5. Construction contractors
6. Investors
7. Banks and insurers
8. Material suppliers
9. Facility and building managers
10. Demolition contractors
11. Utilities
12. Real estate agents
13. Lawyers, solicitors, conveyancers
14. Valuers
15. Certifiers
16. Researcher
17. Public authorities & policy makers

3.5.1 Identification of Key Stakeholders and Their Roles

This report builds on this list with an online survey (see question 1 in Annex 8.2) and a series of focus group sessions with key stakeholders and DBL experts (see Annex 8.3) to further identify stakeholders relevant to the five initiatives at study, and define their significance thereof. The categorisation of key stakeholders is largely two-part: (1) distinguishing the role of a stakeholder as a data user and/or provider and (2) identifying the phase(s) in the building lifecycle in which the stakeholder is engaged (see Figure 3). The phases in the

13. See Chapter III of European Commission et al. (2020b) for more information on key stakeholders.

latter were first defined through desk research on the operational aspects of the five tools, refined later with the inputs from the focus group studies.

The definitive list of (potential) data users and providers of the five tools in order of importance as concluded from the qualitative studies is as follows:

1. Owner-occupiers *(27 counts)*
2. Architects and designers *(17 counts)*
3. Construction contractors *(15 counts)*
4. Certifiers *(14 counts)*
5. Public authorities *(14 counts)*
6. Policy makers *(27 counts)*
7. Facility and/or building managers *(13 counts)*
8. Landlords and/or leaser *(10 counts)*
9. Researcher *(10 counts)*
10. Banks and/or insurers *(10 counts)*
11. Utilities providers *(8 counts)*
12. Building material suppliers *(8 counts)*
13. Developers (Real-estate) *(7 counts)*
14. Tenants (Lessees) *(7 counts)*
15. Valuers *(6 counts)*
16. Data companies (Inventories and registering) *(5 counts)*
17. Demolition contractors *(4 counts)*
18. Energy experts *(4 counts)*
19. Lawyers, solicitors and/or conveyancers *(4 counts)*
20. Real estate agents *(4 counts)*
21. Investors *(4 counts)*
22. IT providers *(3 counts)*
23. Local authorities (*3 counts)*
24. OVAM material information (*3 counts)*
25. Distribution network operators (DNOs) *(2 counts)*
26. Guarantee bodies *(2 counts)*
27. Renovation advice providers *(2 counts)*
28. Service designer (UX) *(2 counts)*
29. Service providers (retrofit) *(2 counts)*
30. Social housing providers *(2 counts)*
31. Surveyors *(2 counts)*
32. Building safety regulator *(1 count)*
33. Competent Person Schemes *(1 count)*
34. Energy data providers *(1 count)*
35. Energy suppliers *(1 count)*
36. Funding party *(1 count)*
37. Maintenance contractor *(1 count)*
38. International organisations *(0 count)*

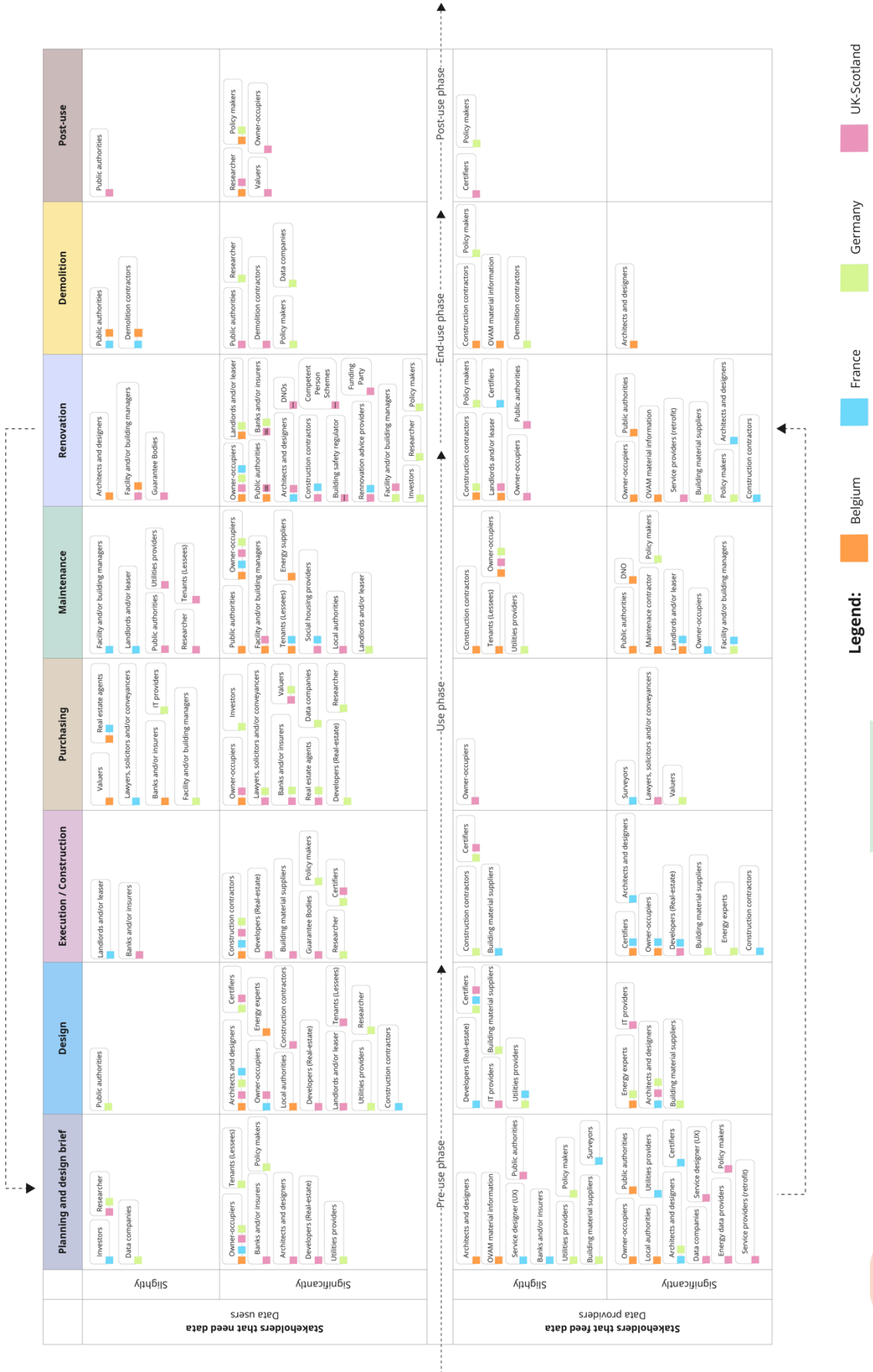


Figure 3: Results of the stakeholder mapping with key stakeholders, validated with DBL experts.

3.5.2 Validation with DBL Experts

Conclusions drawn from the stakeholder mapping exercise (Figure 3) during validation largely orbit around a common observation: there is less overlap between the tools than was hypothesised. A flaw to the methodology of the study recognised from the discussions is the inconsistence in the stakeholder groups that were engaged in the preceding focus group sessions. Not only did the sample sizes differ, but the representation of stakeholder groups differed as well. This may have been the leading cause to the misinterpretation of the tools and the involvement of various stakeholders.

Two other common reservations to the findings of this study surround (1) the actual reflection of the usage of the tool and (2) the terminology used. Several experts commented that the mappings include personal aspirations of how the tool could add further value rather than reflect how the DBLs are currently used at volume. Identifying the gaps between the terminology between active regions was yet another challenge observed. It was brought to attention that there are indeed differences in the way the names of the stakeholder groups were interpreted by experts from different countries due to variations in the operational stages of the entire construction and built environment chain and the roles of the stakeholders. While the map is useful in understanding how the tools are currently perceived by respective stakeholders, key takeaways from the exercise are as follows:

1. A balance between the developers, users and external third parties should be a constant in future studies.

2. Walking through the user journey per initiative and comparing the findings is highly recommended to understand the differences in the phases of a building lifecycle and terminology.

3. Identifying exactly how the key functionalities are employed per initiative at which stages in the phase and the leading actors thereof should be the next step.

KEY FUNCTIONALITIES, BENEFITS AND PREREQUISITES

4.1 Market Overview: Results from Survey

The online survey gathered 65 stakeholder views and input regarding the value of information DBLs provide and the data fields employed therein, functionalities (that could be) incorporated, as well as individual views on data governance issues (see questions in Annex 8.2).

4.1.1 Respondent Demographics

Stakeholder groups included but were not limited to building professionals, owners (and owner-occupiers), tenants, data owners, public authorities, investors, certifiers and researchers (see Figure 4). Approximately 50% of the respondents are and/or have been involved in the management and/or development of a DBL initiative as researchers and developers (44%), DBL managers (30%), data providers (19%) and tertiary bodies (6.9%).

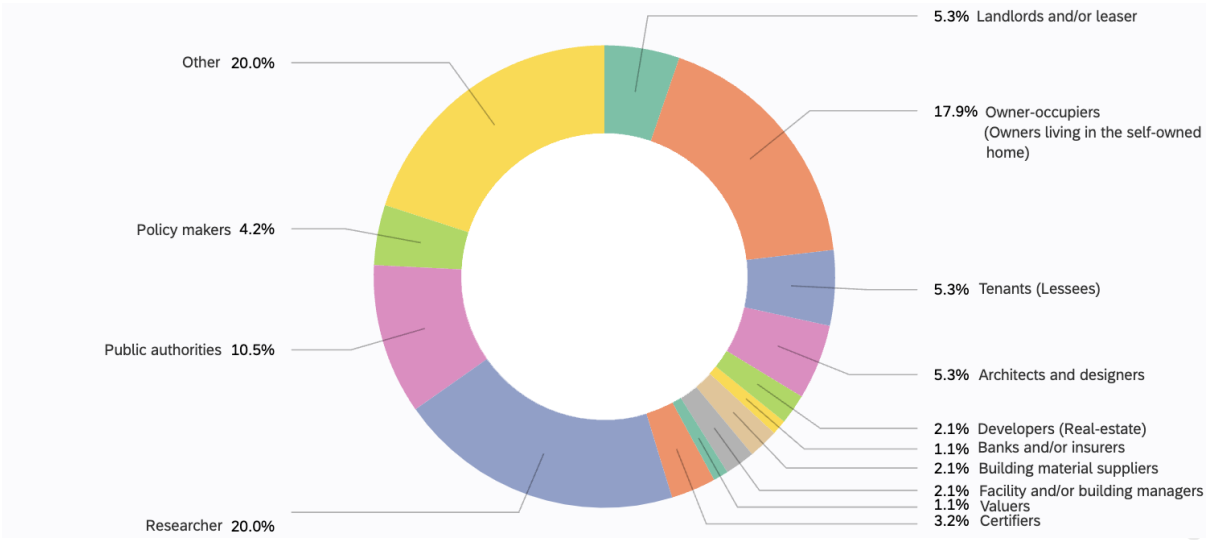


Figure 4: Breakdown of stakeholder groups (survey participants).

The familiarity of the five initiatives studied within the Demo-BLog consortium, as ranked in sequence of most counts, is as follows:

1. **Woningpas**, Belgium (29 responses representing 16.57%)
2. **CLÉA**, France (21 responses representing 12%)
3. **CAPSA**, Germany (14 responses representing 8%)
4. **CIRDAX**, Netherlands-Belgium (11 responses representing 6.29%)
5. **Chimni**, the United Kingdom (7 responses representing 4.00%)

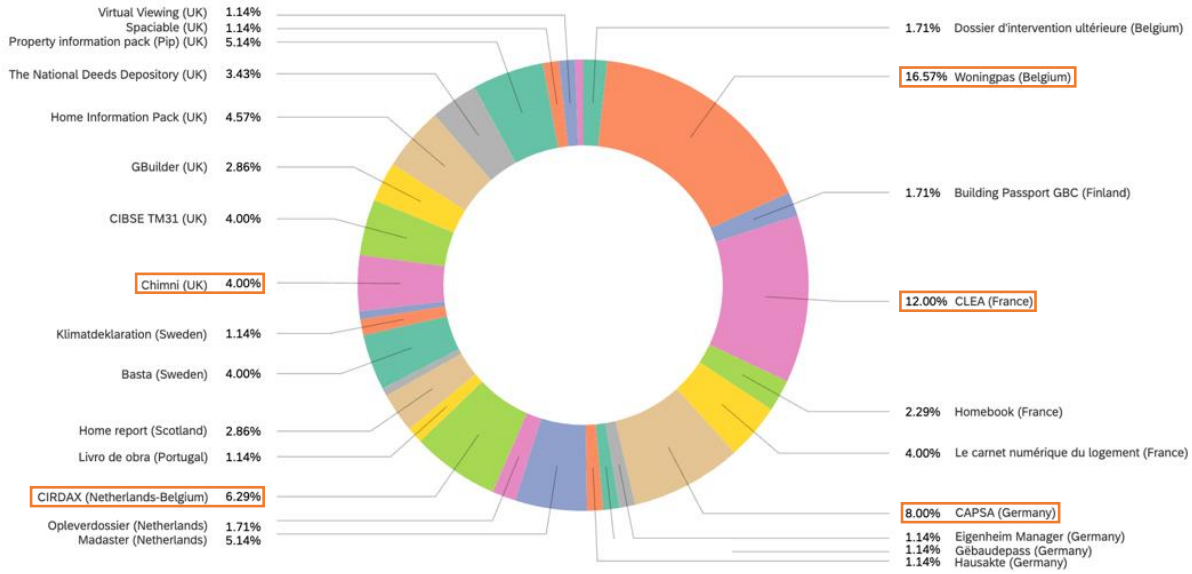


Figure 5: Familiarity of the five tools in comparison to other best practices.

The demographics indicate that the responses collected via the survey illustrates a much larger overview of the state of play of initiatives across the EU and the UK, beyond that of the five tools studied by the project. Conclusions drawn here can therefore be seen to have built the foundation for the discussions in 4.2 and 4.3.

4.1.2 Functionalities and Data Fields

The map of data fields included in the five initiatives (Figure 6) shows that the data stored in the DBLs that is of significance to the key stakeholders are mostly related to general administrative information and those of building characteristics, as well as information on building operation and use. Information on the equipment included in homes including the relevant maintenance manuals is ranked as most important at 83%, while the importance of data on the consumption can be better improved from the current 60%.

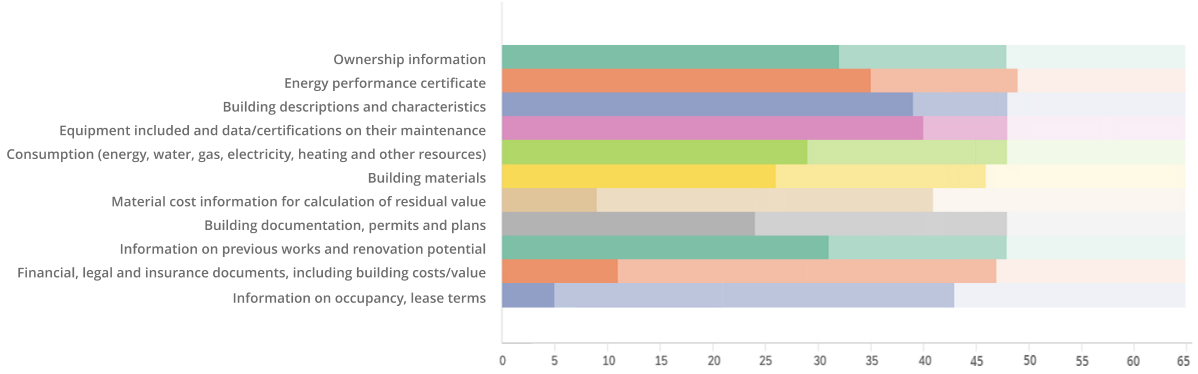


Figure 6: Data fields and their significance; from very important (darkest) to not at all important (lightest).

The analysis of the functionalities (Figure 7) confirms what is illustrated by that of the data fields: among the initiatives currently in place, building logbooks are perceived as more valuable as a repository of administrative and construction information, as well as those on operational maintenance and use. It is observed that there is a larger value placed on third party access to data including the provision of building stock overviews for relevant third

parties, than for more 'advanced' functionalities surrounding smart energy services and smart readiness indicators.

Figure 7: Functionalities and their significance; from very important (darkest) to not at all important (lightest).

On the collection of data on energy consumption, it is interesting to note that the importance of having additional functionalities relating to visualising future energy and/or cost-saving potentials and lifecycle costing is moderate at 36%, and the functionality to enable integration with smart energy services is likewise moderate at 41%. Contrastingly, the inclusion of fields such as consumption —including but not limited to energy, water, gas, electricity, HVAC and more— is deemed to be very important at 62%.

Currently, there are three recognised DBLs that include advanced tools to assess the options on renewable energy, storage and energy sharing for public buildings. Examples of data sources include the cadastres in the Netherlands, the BNBD in France for EPCs, and data provided by public authorities that is linked to smart meters for the measurement of accurate energy consumption measures in Belgium. The linking of smart meters to be already integrated in the design phase could include a broader overview of building materials and maintenance needs beyond the energy systems that is crucial for future updates; it can be viewed as a criterion to ensure interoperability and coverage of information that is beyond that of energy in the future. Other key benefits may include the provision of information to users to provide them the levers to optimise the use of their homes —such as but not limited to energy, taxation and renovation— as well as finances and/or subsidies.

On the question of the 'adequate' frequency of updates for data fields, the large majority of the respondents (29.79%) voted for 'whenever the building undergoes intervention works' and 'real-time', indicating the necessity for a much faster paced update frequency. However, the following reservations maintain:

1. The frequency of updates should be defined per data point. While data fields such as energy consumption and the quality of the indoor environment should be updated real-time, data with regards to renovation works can be updated at points of interventions;

2. The frequency of updates can differ between data types, but should generally be linked to moments of change, including the change of ownership, renovations, permit requests and inspections;
3. Real-time links to data fields and/or reminders for update should be included at moments where there are changes made to the building material; and
4. May differ per building type.

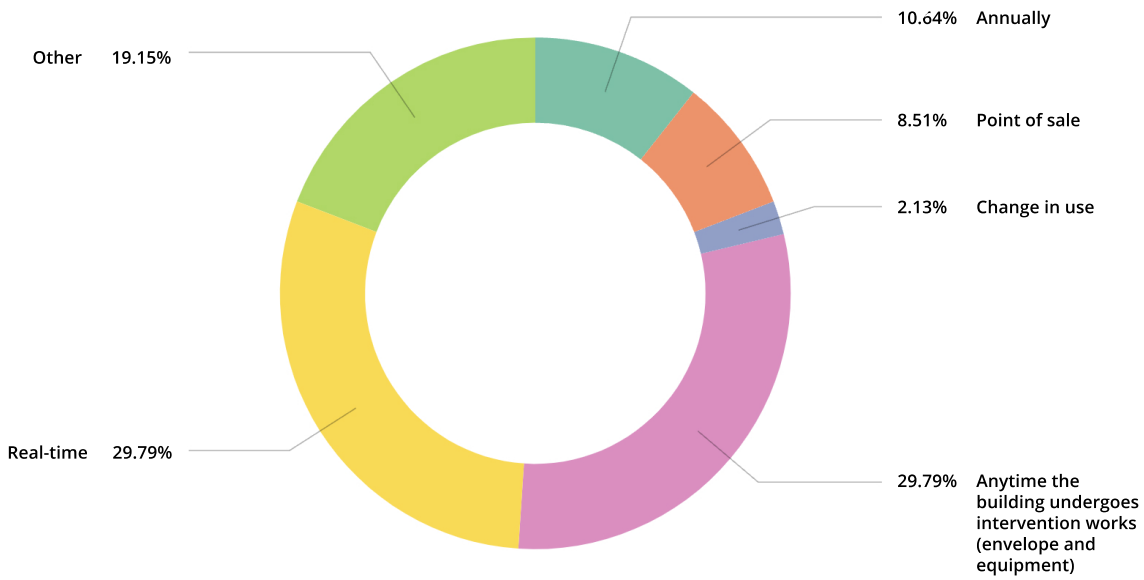


Figure 8: Update frequency.

It has also been pointed out that existing DBL initiatives can further improve their tools by targeting the quality of data within an up-to-date scenario. Notes on this include: the implementations of (1) confirmation checks at every update of the DBL, ideally with a block chain authentication method and (2) a centralised automated data source, though it is yet a challenge to employ a single way of prioritising data inputs between different data sources with the (growing) number of data providers for DBLs. A better solution here is (3) to collect a standard set of metadata fields alongside each data point that track information such as data source, date collected and method of collection, while (4) ensuring that the DBL is easy to read to minimise risks of misinterpretation, guaranteeing everyone, when granted the right, can access the data and understand the information therein.

In conclusion, it can be deduced that the use of both static and dynamic data appears to be most functional for a wider spectrum of key stakeholders. It is likewise clear that links to smart meters that can log real time data should be a given to all future developments of DBLs.

4.1.3 Data Accessibility, Source, Ownership and Liability

Building on the findings of 4.1.2, the survey identified (Figure 9) a list of third parties that could and/or should be granted access to (part of) the data a DBL holds. Several stakeholders raised here include buyers, architects, energy advisors, notaries, suppliers (for

renovations), estate agents, property lawyers, enterprises, financers, assurers, housing advisors and service providers. It can be deduced from this list that stakeholders across the entire construction and built environment value chain should orbit around the DBL, for the benefit of greater overall sectoral transparency, value chain integration, innovation and circularity.

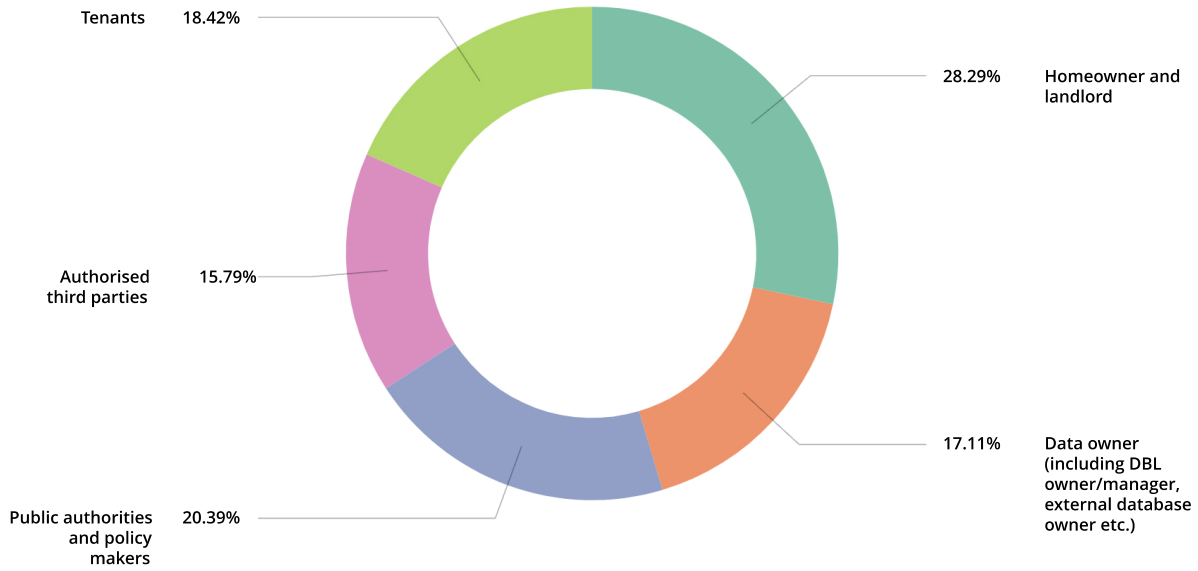
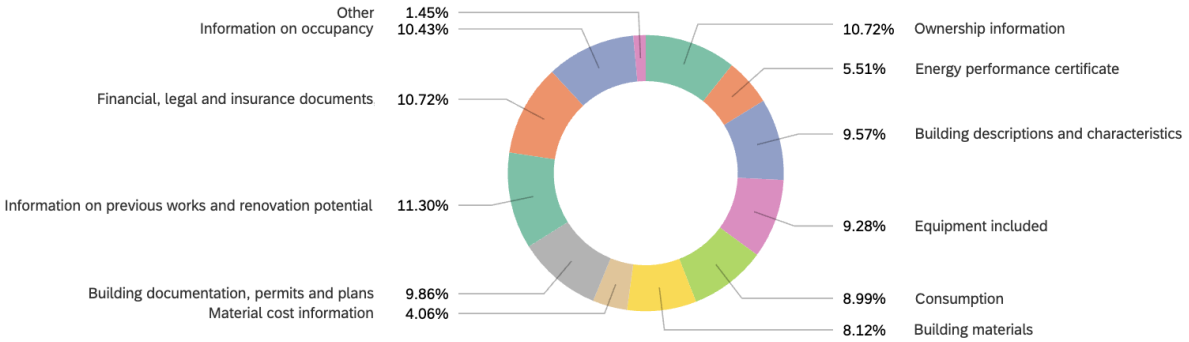


Figure 9: Breakdown of stakeholders that should be granted access to data.

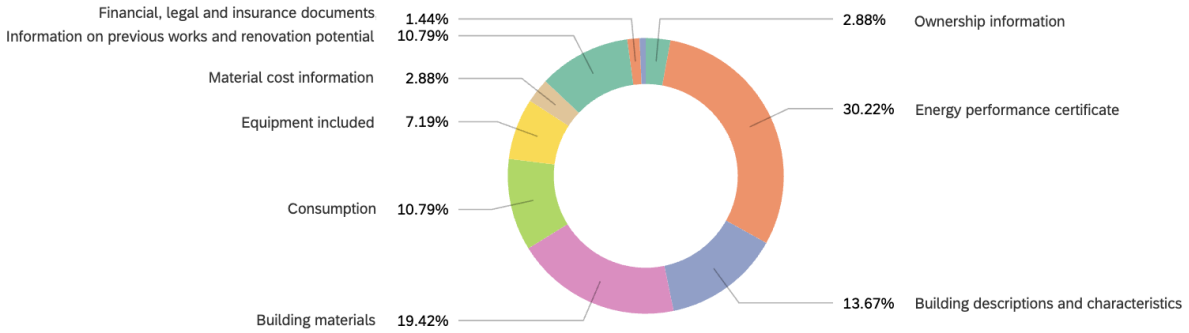
While stakeholders can benefit as users of the tool and the data therein, they can simultaneously play the role of data providers. Figure 10 explores the roles of seven stakeholder groups as (potential) sources of the 11 data fields that have been explored in 4.1.2. While the level of responsibilities across the data fields may differ, building owners, public authorities, building experts, financial institutions, and both public and private registers are perceived as equally active (potential) data providers for the efficient collection and regular revisions of building data. It is also noteworthy to highlight the capacity in the role of EPC databases as data sources, which suggests a more dynamic and active role as a key stakeholder across the building lifecycle.

Subsequently, the question then propels towards to whom does the responsibility and liability for data ownership lies. The respondents suggested a wide range of actors and constellations, and Figure 11 provides a general overview. Other stakeholders suggested in the survey are the owners of the dataset and tenants. Notable comments on the former include “logbook is [merely] a gateway”, as well as “different sources should account for different responsibilities”.

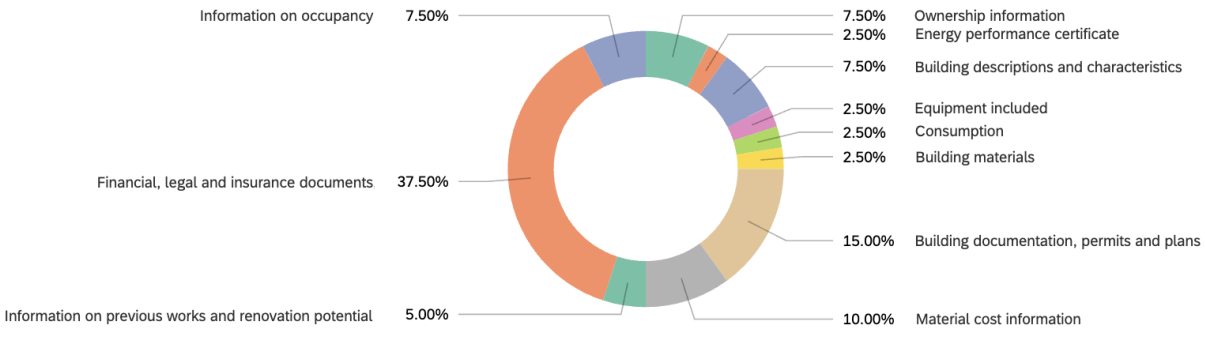
Building owners



Energy Performance Certificate (EPC) databases



Financial institutions



Land and ownership registers (public and private)

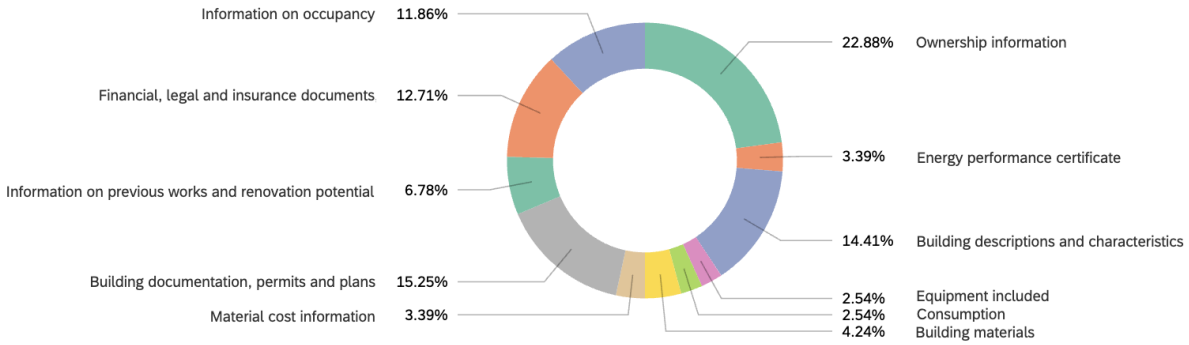


Figure 10: Breakdown of (potential) data sources.

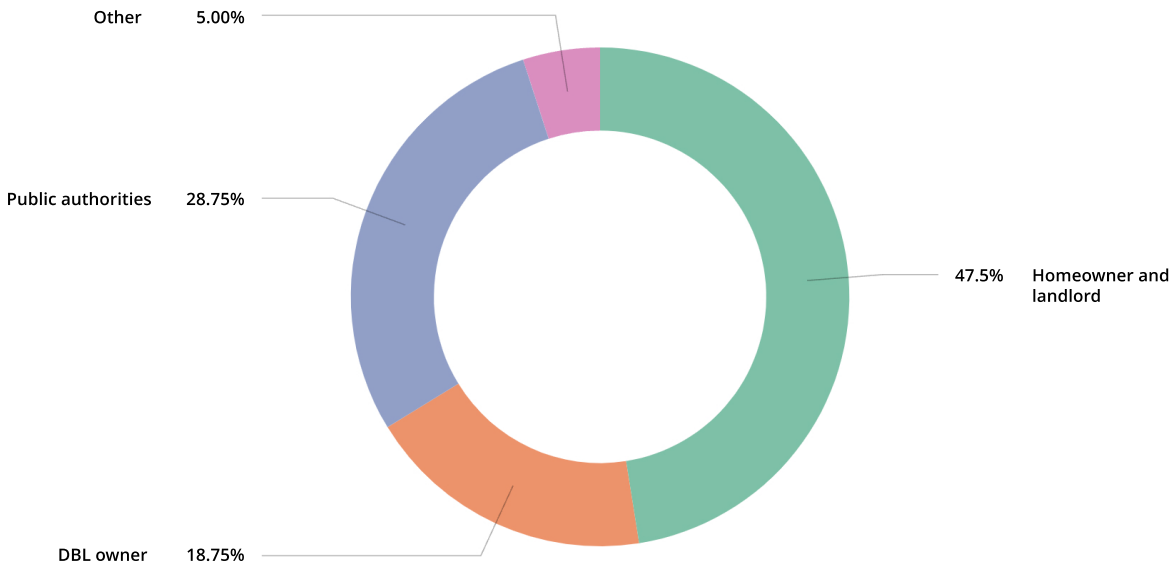


Figure 11: Data ownership and liability.

4.1.4 On the Roles of the EC

When defining a DBL and the roles of the EC, it has been stressed in the survey that a DBL needs to first be recognised as a digital asset that relates to a property and therefore should be viewed as belonging to whomever owns the particular property. A DBL should also be regarded as a medium to reduce information asymmetry between buyers and sellers for secondary materials, and as an enabler for process innovation with regards to future changes for the build environment. The EC should correspondingly (1) require the mandatory use of DBLs with (2) a minimum list of information, data structure, and functionalities that must be included, and (3) move towards establishing a European DBL register that is aimed to verify the unicity of the various DBL initiatives across the EU. Above all, all buildings owned by the EC should have a DBL to encourage and promote the concept and increase buy-in.

The market further calls for multiple competitive DBL providers that can offer a variety of features and functionality across the different kinds of housing stock. There is an opportunity for the EC to push for (1) minimum data standards at the core of each DBL, (2) clarity of ownership rules for DBLs, and (3) the standardisation of approaches and information requirements to make public data available to DBLs. Promoting cross sectoral collaborations between homeowners and public entities via the development of centralised systems that link information available to public authorities with data of individual homes and buildings is hereby proposed.

Nevertheless, keeping in mind the (significant) differences between DBLs of different Member States —for instance, factors such as data availability, the roles of public and private actors, the maturity levels of the tools— flexibility in the way the EC should approach the mandatory implementation of a DBL is called for:

1. The EC could allow various DBL templates to prevent hyper-centralising operations of individual DBLs that is tailored to each MS;

2. The EC could play the role of developing standardised information in terms of the architecture and data processing protocols in DBLs, based on best practices observed across member countries; and

3. The EC could help establish a protocol to verify stakeholders that seek to access private data and that they indeed have a legitimate relationship with the building (owner).

The focus should therefore be placed on providing guidelines, protocols, minimum standards and quality control rather than centralising the operations of the tools itself.

4.2 Insight into the 5 Initiatives: Results from Focus Group Sessions

A series of focus group sessions with key stakeholders (across Belgium (BE), France (FR), Scotland (UK-SCT) and Germany (DE)) and DBL experts were designed to (1) discuss the various responses collected from the survey questionnaire, (2) identify key functionalities, benefits and prerequisites and (3) study ways to optimise the performances of the DBLs at study, (4) validate findings, and (5) brainstorm ways to augment existing DBL functionalities and/or developing new functionalities.

4.2.1 Functionalities Mapping

Building on the key functionalities identified from literature and later refined with the results of the survey, key stakeholders from the four regions at study were invited to together build a map on how they perceive the various functionalities are positioned within the initiative of their involvement. The mapping is largely two-part: (1) the distinguishment of functionalities into two categories and (2) the evaluation of the value of the output as well as the effort needed to collect the relevant data (see Figure 14 for template).

For this study, the two categories identified for the former are 'information storage' and 'data usage and (links to other) tools'. The first indicates the functionalities of the DBL that work towards building its role as a valuable repository, whereas the second identifies the roles of a DBL as a proactive data processor —for the calculations of cost- and/or energy savings for instance— as well as an intermediary that enables integrations with external tools such as public databases.

The latter on the other hand aimed to simultaneously (1) assess how the key stakeholders perceive the value of the functionalities within the context of using the tool and (2) evaluate the complexities in data collection to compare with other the initiatives at study. The latter is mapped in the form of a matrix to build a clearer overview for subsequent comparative analyses.

In cases where there is an overlap in functionalities due to its influences on specific stakeholders, participants were invited to duplicate the functionalities and attach notes with the names of the stakeholder groups in reference to their reasoning. The combined mappings were thereafter validated and debated upon by DBL experts.

Table 9 then builds on Table 6 with the findings of this exercise. The table projects a clearer view on the how the functionalities are used within the scope of the tools studied. It is suggestive that there is a rather good balance between the functionalities in both categories, although the two concerns raised in 3.5.2 that surrounds (1) the actual reflection of the usage of the tool and (2) the terminology used likewise maintains. Nevertheless, it is interesting to highlight that the functionality to integrate BIM models is valued more as a stored data then to proactively track the performance of the house.

Digital repository to store key documents
Easy access to all relevant building-related information according to the different level of users and stakeholders
Storage of maintenance and operation plans
Traceability of building materials and/or material passport
Building renovation passport or digital repository to store past maintenance activities and improvements
Monitoring of indoor environment quality
Monitoring of environmental impacts over lifetime
Calculation of building performance and/or provision of energy performance certificates
Visualising future energy/cost-saving potentials and lifecycle costing
Integration with construction project management tools for planning and financing
Enabling integration of BIM
Option to consent for third party use of data
Enabling integration with asset management tools
Indication of smart readiness level of the building
Enabling integration with smart energy services
Building renovation roadmap or provision of (automated) renovation advice
Benchmarking, reporting and links to similar buildings, certifications and assessment schemes
Provision of overview of the building stock for public authorities, policy makers housing organisations and/or real-estate companies
Maintenance calendars with reminders
Information about heating installation
EPC (ie. the current energy label of my home)
Benchmarking EPC to similar buildings
Conformity to legal standards
Clear view on energy performance
Easy access to all building-related information according to the different level of users and stakeholders
Integration with legal/conveyancing systems
Retrofit assessment

Table 8: Figure 12 legend.

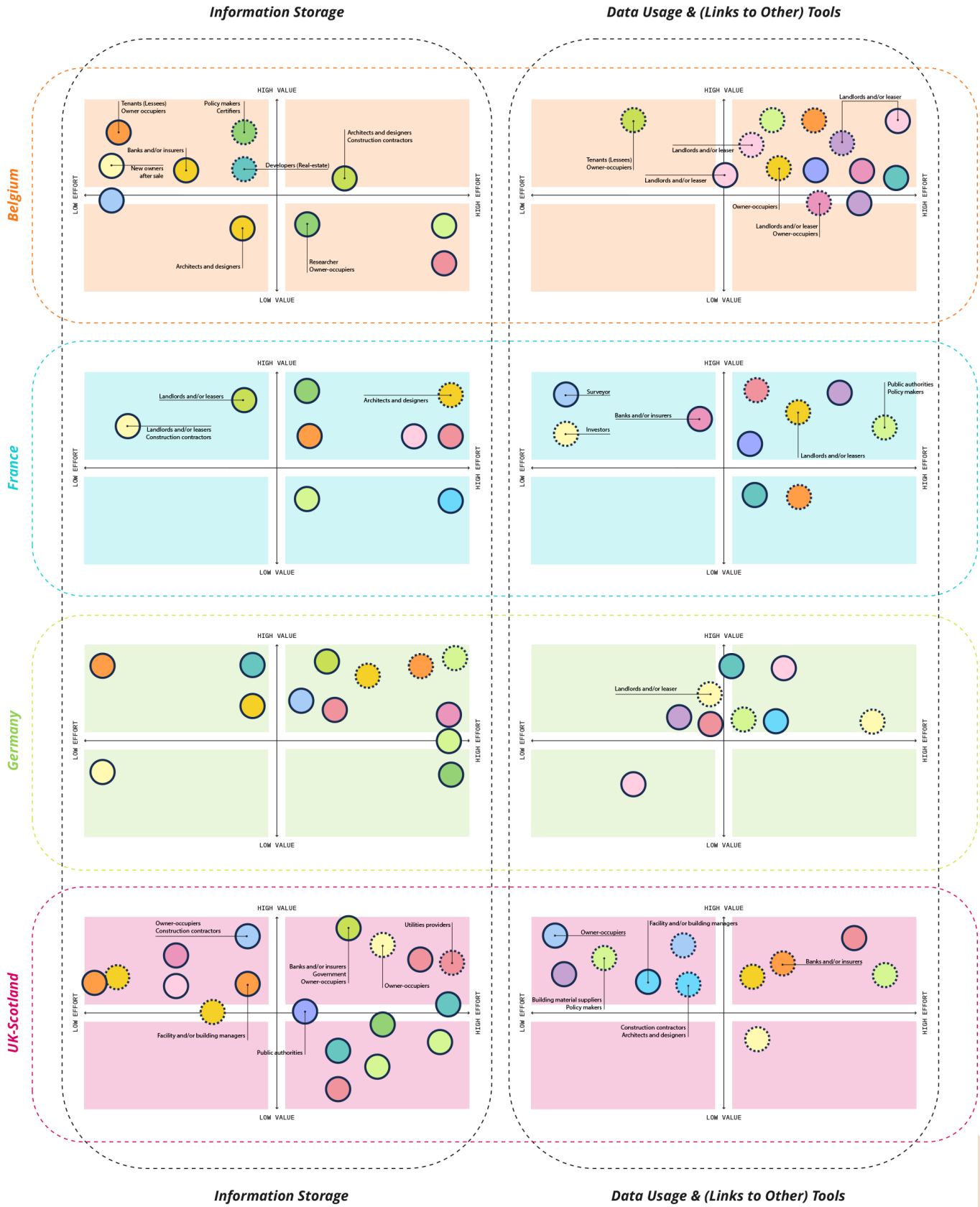


Figure 12: Results of the functionality mapping with key stakeholders, validated with DBL experts.

Functionalities	Information Storage				Data Usage and (Links to Other) Tools			
	BE	FR	DE	UK-SCT	BE	FR	DE	UK-SCT
Digital repository to store key documents	x	x	x					
Easy access to all relevant building-related information according to the different level of users and stakeholders	x		x					
Storage of maintenance and operation plans	x	x	x	x				
Traceability of building materials and/or material passport	x	x	x	x				
Building renovation passport or digital repository to store past maintenance activities and improvements	x	x	x	x				
Monitoring of indoor environment quality	x	x	x	x				
Enabling integration of BIM	x	x	x	x			x	x
Building renovation roadmap or provision of (automated) renovation advice		x	x	x	x		x	x
Option to consent for third party use of data	x		x	x		x		x
Calculation of building performance and/or provision of energy performance certificates	x		x		x		x	
Monitoring of environmental impacts over lifetime			x	x	x	x	x	
Visualising future energy/cost-saving potentials and lifecycle costing			x	x	x	x		
Benchmarking, reporting and links to similar buildings, various certification and assessment schemes			x		x	x		x
Provision of overview of the building stock			x		x	x	x	x
Enabling integration with asset management tools		x					x	x
Easy access to all relevant building-related information according to the different level of users and stakeholders				x		x		
Integration with construction project management tools for planning and financing					x	x	x	x
Indication of the smart readiness of the building				x	x	x		
Enabling integration with smart energy services				x		x	x	x
Conformity to legal standards					x			
Clear view on energy performance					x			
Maintenance calendar with reminders					x			
Retrofit assessment								x
Integration with legal and/or conveyancing systems								x
~~Links to financial incentives~~								
~~Monitoring of building performance *(may incl. climate change resilience; adaptability and flexibility; health and safety)*~~								

*Table 9: Functionalities further defined and categorised during focus group sessions; newly included functionalities (**bolded**), reworded (italicised), unincluded functionalities (~~stroked through~~).*

4.2.2 Identification of Benefits

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. To that, the EC distinguished 21 benefits that deliver the additional values to DBL users across the ecosystem.[14] Articulating clearly these benefits will help market actors realise the actual value of information and, conversely, the risk of incomplete or unreliable data.

Table 10 further explores specific benefits identified from the focus group sessions that can be brought forward to the next generation of DBLs in the four regions explored:

	Benefits
Belgium	1. The very fact that Woningpas is compulsory **eliminates doubts** about the tool itself. 2. Good collaborations and cooperation between public entities and/or databases make it possible for **data to be constantly updated**. 3. Possibility to grant third party access to data **relieves stress in communication** between stakeholders when necessary. 4. No competition in market guarantees **equal access to all available data and linked databases**. 5. Aids policy making in identifying areas and neighbourhoods where renovations are most needed. 6. **Free of charge**. A lot of the information in the DBL at this moment is open data from the government which is already covered by taxes. 7. **Profound base of trust** within the systems that regulate the tool.
France	1. **Easy to get started with**. Consumers can easily access the tool and customise it with the data that they want without obligation. 2. **Easy and safe transfer of all building data** to subsequent owners at moments of change. Also possible to duplicate the data for new owners. 3. **A wider range of options in the market**. The French State does not call for the centralisation of the tools. Competition is therefore left to the professionals alone to define their own orientations when identifying the uses and qualities of the tools, creating more unique options in the market.
Germany	1. Very easy due to the **automation of data collection processes**. The tool does not require an extensive set of skills for people employed to collect the data and eliminates personal biases. 2. **Cost efficient**. The service itself is cheap and does not require a large budget. 3. Great corporate perks. Simple to use for **sustainability reporting** of real estate portfolios and loggings of construction materials for future redevelopment and/or refurbishment works. 4. **Applicable in different climatic zones** using the energy conservation codes developed by the tool.
UK-Scotland	1. A **revolutionary move** from paper documents and storing digital copies on cloud drives for homeowners. 2. When better implemented, local authorities will benefit from **understanding the properties in their local area better**. It will also aid understanding the **energy use profiles of properties** in their area. 3. Provides a good overview of all of properties that are mortgaged to banks, and it is in their interests to retain useful information on those properties. It is also an opportunity for banks and lenders to **provide finance to fund retrofit improvements** in addition to **enhancing their assets**.

Table 10: Overview of benefits underlined during the focus group sessions.

14. See Chapter IV of European Commission et al. (2020b) for more information on DBL benefits.

4.2.3 Identification of Prerequisites

During the focus group sessions, several prerequisites for the better advancements of the initiatives were recognised. These prerequisites were founded around the running concerns pertaining to the widespread introduction of the DBLs in its future growth.

	Prerequisites
Belgium	1. Though data is widely available and accessible for various key stakeholders, it is **not yet available on a single platform**. Certain cities in Flanders aspire to grow into a one-stop-shop service for its citizens. 2. **Improved collaborations** between local authorities and private market players. 3. **Simplify third party authorisation processes** for local governments to proactively provide renovation advice and take on neighbourhood plannings. At the moment, the granting of access to data is temporary.
France	1. It is up to the owner of the property to add the building data to the system in the case where the DBL is implemented in the current building stock. The challenge lies in **ensuring that the data is fully and correctly entered**. 2. **A lot more data is needed** than what is available now for an efficient transmission of data between owners and EPC bodies. 3. When appropriately implemented, the reminder feature can **facilitate the pre-financing of large operations** when it comes to maintenance logs of multi-family apartment complexes.
Germany	1. **Improved collaborations with local partners and public authorities** for projects funded by NGOs.
UK-Scotland	1. **Lack of demand and awareness of DBLs**. There is no consensus to how DBLs should be rolled out in the UK at the moment; there are only very tentative support from public establishment around property ownership. 2. **Support from intermediary establishments is therefore vital**. For instance, legal companies are conveyances support the roll out of logbooks during purchasing. 3. **Endorsements from the central government is key**. Every home in the country should have a digital link to their local authority to exchange information on topics including building certification and maintenance work, but there is no push from the central government at the moment. 4. **Partners that should be involved in retrofit must be identified**. Every professional intermediary body has to understand the big picture and should be aligned to achieving the goals together. 5. **The EPC could be a catalyst or a starting point for any DBL data because the data can be passed straight into the logbook repository**. In the UK, EPC data is government owned. It can be used as a quality audit tool as it shows the retrofit works completed on the home. However, privacy risks must be addressed.

Table 11: Overview of prerequisites raised during the focus group sessions.

The most relevant features that could be seen to simultaneously enhance the identified benefits and address the prerequisites are as follows:

a. Digital interface;
b. Interoperability;
c. Data synching and matching;
d. Storage of data and information; and
e. User-friendly navigation and visualisation.

It can therefore be concluded that these features should be given priorities in future developments of the DBLs.

OPTIMAL DBL PERFORMANCE

The analysis of the state of play of the DBLs engaged in Demo-BLog shows that the basic concept underpinning the initiatives, although with different facets, are similar. Building logbooks are used to collect administrative information, as well as those on building characteristics and operational data. It is observed that there is a clear interest in all five cases when it comes to integrating the 'classical' building data fields with more advance features that fuel the evolution of the basic repository to become a dynamic tool that can better respond to different stakeholders' requests and needs.

5.1 Discussion

The main purpose of the DBL is to develop a better understanding of the building throughout its full lifecycle, simultaneously improving transparency and trust which altogether form the base 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. DBLs should likewise be made available and accessible across the wide(r) spectrum of key stakeholders, most notable being building owners and occupants, the construction and real estate sectors, financial institutions and public authorities. Permission should be granted under specific conditions, depending on who is considered the 'owner' of the DBL data and/or upon the consent of the owner.

Both desk research and feedback from stakeholders confirmed that ease of use is the key element for a successful building logbook. Different countries, the United Kingdom in particular, emphasised that synergy between a wider understanding of the usefulness of the DBL and active collaborations between public and private entities could accelerate the rollout of the tool and potentially create a business interest for private companies. Above all, all issues related to data, including quality assurance, lack of standardisation, privacy and accuracy, can influence the utility and utilisation of the building logbook. Not validated and outdated DBLs can not only be deemed redundant, but it also makes the whole process an onerous and time-consuming exercise with very little benefits.

The type of information stored in the DBL should present the capacity to evolve over time with additional data fields and relevant functions. A common understanding from the qualitative studies is that a DBL should not just hold a limited number of essential data fields and functions, but also aspire to adopt a wider spectrum of additional features. To offer maximum value and successful market uptake, DBL functionalities must be prioritised effectively to ensure that it is first and foremost responsive to the greater needs of the construction and real estate industries. Focus should therefore orbit around developing a robust structure and UX on getting the primary features and relevant functionalities right, whilst maintaining flexibility in adding further functionalities in a modular fashion. This was the case with Woningpas, which now allows all homeowners to proactively consult building related information with the tool on information such as EPCs, urban planning, the possibility for solar energy installation, availability of public transport, information exchange with third parties, alerts for recommended actions, and an overview of executed maintenance in the past.

The DBLs demonstrated in this project have the potential to eventually reflect the whole lifecycle with an extensive capacity for unlimited data access, input and output, and data export. They are also capable of embracing future technological developments, such as the widespread use of BIM, Internet of Things (IoT), digital twins and blockchain. Demo-BLog has considerable potential to optimise the use of resources and waste, performance prediction, visual analytics and energy management contributing to the overall goal of "making Europe the first digitally led circular, climate neutral and sustainable economy".[15]

5.2 Key Takeaways

The purpose of this report is to provide the foundation for all future studies within the scope of the Demo-BLog project, by reviewing the state of play of the DBLs at study in relation to the wider market across the EU and the UK. It is designed as an encyclopaedia that contains the fundamentals of the five tools, the perspectives of the respective markets, as well as the future goals and underlying prerequisites thereof, which should serve as a common ground for all subsequent collaborative studies. For this, a series of qualitative studies were designed and conducted for the collection of relevant data, information and perceptions.

The findings of this study proved to have refined the specifications of the EC's definition of DBLs (see 2.1). The following list provides a summary of key takeaways —including flaws in the studies conducted, recommendations for subsequent studies and overall goals— identified throughout the writing of this report that should be addressed in all subsequent studies:

1. Primary focus should orbit around developing a robust structure and UX on getting key features and the relevant functionalities right, whilst maintaining flexibility in adding further functionalities in a modular fashion.

2. DBLs should be made available and accessible across the wide spectrum of key stakeholders. For all authorised stakeholders, information should be provided equally in terms of ease of use, data quality and volume of data.

3. The most relevant features that could be seen to simultaneously enhance the identified benefits and address the prerequisites are (1) digital interface, (2) interoperability, (3) data synching and matching, (4) the storage of data and information and (5) user-friendly navigation and visualisation.

4. Identifying exactly how the key functionalities are employed per initiative at which stages in the phase and the leading actors thereof is crucial. A balance between the developers, users and external third parties should be a constant in all future qualitative studies when determining the actual representation of the tools.

5. The research carried out so far shows that the DBL needs to be further compared between the diverse local contexts with different needs, culture and processes — for instance on the type of data is gathered differ from country to country— as well

15. See https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/strategic-plan_en for more information on the second Horizon Europe Strategic Plan 2025-2027.

as their respective capacity for cross applications and market perceptions. Walking through the user journey per DBL and comparing the findings is highly recommended to understand the differences in the processes, phases of the building lifecycle and terminology.

CONCLUDING WORDS

This report is built on the common concern that the construction sector is underdeveloped in terms of overall digitalisation and data applications in comparison with other industrial sectors. Building related data continues to face challenges in terms of scarcity, unreliability and limited accessibility. The absence of a sound data repository will continue to amount to additional costs and inefficiencies, hinder innovation, increase overall risks and challenge investor confidence if not properly addressed.

The content of this report establishes that Demo-BLog calls for the advancement of DBLs beyond their current scope. The project recognises the potentials of DBLs to encompass renovation roadmaps and enrich investment decision making with elements that push for a circular economy. This report marks the first step into the maturing the **Woningpas**, **CIRDAX**, **CLÉA**, **CAPSA** and **Chimni** DBLs, by means of developing and demonstrating the four key functionalities that is aimed to directly address the growing societal challenges in the built environment.

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ANNEX

8.1 Data Template

This data template was created for the purpose of identifying a common data language and/or categorisation method that can be applied to all five DBL initiatives studied in this project. The initial categorisations as indicated in the table is the result of studying every functionality and data field employed across the five initiatives, with the terms and scope generalised thereafter to encompass the varying approaches into one universal table.

The five DBL manager-owner partner institutions were requested to fill in columns that are relevant to their respective initiatives.

	x = yes; / = in the future	Notes	Data Source	Data type	In case of multiple options	Woningpas (BE)	CIRDAX (NL/BE)	CLEA (FR)	CAPSA (DE)	Chimni (UK)
DBL Functionality										
a)	Digital repository to store key documents	i.e. design plans; certifications; proof of installations	n/a			x		x	x	x
b)	Easy access to all relevant building-related information according to the different level of users and stakeholders					x	x	x	x	x
c)	Operation, monitoring and maintenance plan	May incl. predictive maintenance; notifications and alerts				x	x	x	x	x
d)	Overview of building performance	May incl. whole life resource consumption; climate change resilience; adaptability and flexibility; health and safety; accessibility				x			x	/
e)	Monitoring and logging of indoor environment quality								/	
f)	Provision of environmental impacts over lifetime	i.e. demolition and re-use of materials					x		/	
g)	Visualising future energy/cost-saving potentials and lifecycle costing						x	/	x	/
h)	Traceability of building materials and/or material passport					/	x		/	
i)	Construction project management tools	To assign roles, KPIs, accountability and liabilities during the design, development and construction phases.								
j)	(Automatic) Integration of BIM								x	/
k)	Indicates the smart readiness of the building									
l)	Enables smart energy services	i.e. demand response; dynamic pricing							x	
m)	Digital repository to store past renovations	May incl. design plans; certifications; proof of installations				x	/	x	x	x
n)	Building renovation passport or renovation roadmap					x	/	/	x	/
o)	Automated renovation advise					x		/	x	/
p)	Benchmarking, reporting and links to similar buildings, various certification and assessment schemes					x	/		x	
q)	Improved overview of the building stock								x	
r)	Links to 3rd party actors to use the logbook upon authorisation	Third parties may include (prospective) buyers and tenants, real estate, financing institution, construction professionals & governing bodies				x	x		/	x
s)	Links to financial incentives					x		/	x	
t)	Estimation of environmental impacts of building lifetime						x		x	
u)	Asset management support						x		x	
DBL Features										
a)	Digital interface		n/a							
b)	Interoperability									
c)	Data syncing/matching									
d)	Storage of data and information									
e)	User-friendly navigation and visualisation									
DBL Characteristics										
a)	Data owner				Home owner (H); DBL owner (D); Governing body (G)	H/D/G	D	H	H	H/G
b)	Access to data	Third parties may include (prospective) buyers and tenants, real estate, financing institution, construction professionals & governing bodies			Home owner (H); Authorised third parties (A); Public sharing (P)	H/A/P	H/A	H	H/A	H/A
c)	Initiative				Public (PU); Private (PR)	PU	PR		PR	PR
					Mandatory (M); Voluntary (V)	V	V		V (some functions will be mandatory soon, e.g. the decarbonisation rodmap)	V
d)	Service fee				Yes or no	NO	YES	YES	YES	NO
e)	Building typology				Single-family home (S); Multi-family home (M); Others (O)	S/M/O	S/M/O	S/M	S/M/O	S/M
Data Category										
A Administrative Information										
1	Unique building identifier or name		Public registry	Alfa-numerical code or text	Uploaded by Home owner (H); DBL owner (D); Governing body (G); Builder (B)	x	x		x	x
2	Address or location			Text		x	x	x	x	x
3	Information on building owner and/or administrator			Name and contact details			x	x	x	x
4	Tenancy agreement		Building owner	Linked document(s) or data				x	H	H
5	Maintenance log		Facilities manager					x	H	
6	Maintenance service contact		Building owner; Service contractor				x, but only available if maintenance module is activated	x	H	
7	Maintenance instructions/regulations					x		x	H	
8	Insurance documents		Building owner; Insurance company			H=D		x	H	H
9	Building permits and licenses		Building owner			x		x	H	H
10	Overview of renovation works carried out	May incl. renovation year(s); past property identification; past building permits; past building plans	Building owner; Facilities manager; Service			H/D/G	/	x	H	H
11	Attestation on soil		Developer; Audit			x	x	x	automated	
12	Attestation on asbestos					x	x	x		
13	Attestation on dwelling quality					x		x		
14	Inspection report(s) on sewage					x		x		
15	Inspection report(s) of inland water installations					x		x	B	
16	Inspection report(s) on domestic water supply					x		x	B	
17	Inspection report(s) on central heating					x		x	B	H
18	Inspection report(s) on workplace							x	B	
19	Test certificates for private water drainage and water							x		
20	Gas certificate					x		x	B	H
21	Ecological research						x	x	D	
22	Housing energy audit					H/D		x	D	H
23	Pre-demolition audit					H/D	x	x	D	
	Other: Please specify									
B General Information										
1	Year built		Public registry	Date		x	x	x	x	x
2	Solar potential		Openly available	Linked data		x			x	/
3	Soil/terrain	i.e. soil contamination; soil health check	Public registry			x	x		x	
4	Flood sensitivity		Openly available			x		x	x	
5	Climate information					x		x	x	
6	Physical accessibility		Audit	Descriptive		/			x	
7	Safety manual								x	

8	3D/BIM models of the building and its systems		Developer	Linked data			/		x, if available	/
	Other: Please specify									
C Building descriptions and characteristics										
1	Design and plans of the building		Developer			H/D	x	x (pdf)	x	x
2	Building information model		New data; Developer	Linked data			x, but not yet fully automatically		x	/
3	Floor area		Building owner	m2		x	x		x	x
4	Heated floor area		EPC			x	x		x	
5	Number of floors		Building owner	#			x	x	x	x
6	Volume of home			m3		x	x	x	x	
7	Facade					x	x		x	
8	(Load-bearing) Floor					x	x		x, but estimated	
9	(Load-bearing) Walls					x	x		x, but estimated	
10	Roof and/or ceiling					x	x		x	/
11	Window and door					x	x		x	/
12	Building material inventory	If yes, see ddd					x		x	
13	Heating systems and related energy carriers	Should incl. description and design; instructions/regulations for maintenance; assembly and dissembly; expected service life or use times				x	x	x	x	
14	Cooling systems					x	x	x	x	
15	Lighting systems					x	x	x	x	
16	Ventilation systems		Developer; Audit			x	x	x	x	
17	Electrical plan			Descriptive		H/D	x	x (pdf)	x	
18	Technical building systems						x	x (pdf)	x	
19	Renewable energy systems					x	x	x (pdf)	x	/
20	Domestic water	Information on (hot) water supply for drinking and everyday use				x	x		x	
21	Sewer systems	May incl. information on the need to connect to a sewage system or individual remediation; presence of watercourses and canals and the consequences thereof				x	x	x (pdf)		
22	Rainwater drainage					x	x		x	
23	Fire Safety Plan	May incl. evacuation plans; snitisation; alarms					x, but only as a document		x	
24	District heating access			Linked data		x	x, but only as a document		x	
25	Building surroundings	e,g, facilities in the vicinity such as shops and public transporation; information about spatial planning	Public registry	Descriptive		x	x, but only as a document	x (API)	x	
26	Historical context	e.g. blueprint plans; heritage of the building and municipality					x, but only as a document		x	
27	Expected lifetime		Calculation	Year			x, but only as a document		x	
	Other: Please specify									
D Building operation and use										
1	Utilities contracts		Building owner; Utility companies	Linked document(s) or data			x	x	x	x
2	Number of occupants		Building owner	#					x	
3	Functions			Descriptive					x	
4	Measured heating and/or cooling consumption		Utility company	kWh/year				x	x, if smart meter (uncommon in Germany)	/
5	Measured electricity consumption					x		x	x, if smart meter (uncommon in Germany)	/
6	Measured (hot) water consumption			litres/year				x	x, if smart meter (uncommon in Germany)	/
7	Dynamic heating and/or cooling consumption		Smart meter	kWh/year					x, if smart meter (uncommon in Germany)	
8	Dynamic electricity consumption					x			x, if smart meter (uncommon in Germany)	
9	Ventilation capacity		Smart meter; Utility company	m3/s					x, if smart meter (uncommon in Germany)	
10	Renewable energy production			kWh/year					x, if smart meter (uncommon in Germany)	/
11	Behavioural insights		Smart meter; Sensors; Survey	Descriptive				x	x, if smart meter (uncommon in Germany)	
	Other: Please specify					Gas consumption in general				
E Building performance										
1	Energy Performance Certification		EPC; Audit	Linked data		x		x	x	/
2	Building energy label			Alphabetical or scale		x		x (pdf)	x	/
3	Housing quality score		EPB	Scale		x			x	
4	Building envelope	Insulation score per component (e.g. glazing, walls, roof) or u-value of the different components.	EPC; Audit	u-value		x			x	/
5	Total annual calculated heating and/or cooling consumption		EPC	kWh/year					x	/
6	Total annual calculated electricity consumption								x	/
7	Tailored (automated) renovation recommendations	May incl. estimate cost of renovation; estimate savings post renovation; predicted change in energy label upon replacement; recommendations with financial incentives; replacement obligation reminder; urgency	BRP; Audit	Descriptive		x		/	x	/
8	Climate resilience potential		Audit			x			x	
9	CO2 impact calculator		Product/material manufacturer	Audit				x	/	x	/
10	Averages of comparable homes in your municipality, province and region		Public Authority; Openly available; Public registry	Scale		x			x	
11	Average annual energy consumption in respective municipality			kWh/year		x			x	
12	Other ratings/certifications	i.e. BREEAM; LEED	Certification institutions	Linked data				x (pdf)	x	
	Other: Please specify					EPB				
F Building material inventory										
1	Type		Developer; Installer	Descriptive		/	x		x, but estimated	
2	Source		Product/material manufacturer			/	x		x, but estimated	
3	Location		Developer; Installer	Physical		/	x		x, but estimated	
4	Quantity and/or total volume			# and/or m3		/	x		x, but estimated	
5	Weight			kg		/	x		x, but estimated	
7	Life span and end-of-life economic value			Physical		/	x		x, but estimated	
8	Physical and thermal characteristics of materials			Physical		/	x, but not a standard functionality	x (pdf)	x, but estimated	
9	Embodied carbon and/or carbon impact calculator			Physical		/	x		x, but estimated	
10	Demountability of materials		Product/material manufacturer	Descriptive		/	x, but not a standard functionality		x, but estimated	
11	Waste category			Code		/	x		x, but estimated	

12	Recycling and/or reuse potential	May incl. evaluation on potentially recoverable materials and components; assessment on suitability of building materials for trading; advice on reusing building materials; availability for future reuse (time)		Descriptive		/	x		x, but estimated	
13	Disposal options					/	x, but not a standard functionality		x, but estimated	
	Other: Please specify									
G Smart readiness										
1	SRI result		Audit	Rating			x			
2	Charging infrastructure for e-mobility		Building owner		YES; NO					
3	Smart district potential		Public registry	Descriptive						
4	Demand response potential		Audit							
	Other: Please specify									
H Finance										
1	Annual rent		Building owner	EUR					x, but in ERP system (linked but not integrated)	/
2	Annual property tax		Building owner; Public authority						x, but in ERP system (linked but not integrated)	/
3	Annual maintenance costs		Building owner; maintenance company				x		x, but in ERP system (linked but not integrated)	/
4	Property value		New data; Broker; Building owner				x, but value of materials in the property instead of the building itself		x, but in ERP system (linked but not integrated)	/
5	Valuation date		Valuation firm	Date					x, but in ERP system (linked but not integrated)	/
6	Valuation method			Descriptive			x		x, but in ERP system (linked but not integrated)	
7	Valuation conducted by			Name			x		x, but in ERP system (linked but not integrated)	
8	Valuation documents		Valuation firm; Building owner	Linked document			x		x, but in ERP system (linked but not integrated)	
9	Property yield		Calculation	%					x, but in ERP system (linked but not integrated)	
10	Annual electricity cost		Utility company	EUR						/
11	Annual water cost									/
12	Annual heating cost									/
	Other: Please specify									

8.2 Survey Questionnaire

The survey questionnaire was conducted using the Qualtrics tool.

Q0 Dear participant,

Funded by the European Commission, we are a group of **13 partner institutions** that are looking into **developing a common European framework for a digital building logbook (DBL)** to support the Renovation Wave in the MS of the EU. For that, we are evaluating, developing and demonstrating (new) functionalities and improved user interface of 5 active DBLs active in Europe.

The purpose of this survey is to **identify the requirements, functionalities and benefits that are relevant to the stakeholders**, which includes data, equipment and technology, standards, and benefits such as decarbonisation, cost efficiency, resource allocation and access to trusted and traceable information. Information collected from this survey will form the foundation for the 4 focus group sessions (in Belgium, France, Scotland and Germany) to study the optimal DBL performance later in the study.

The survey should take **no longer than 20 minutes**.

If you have any questions or remarks on the survey and/or the project, please do not hesitate to reach out to me or our DBL partners.

Thank you in advance for your participation in the Demo-BLog project.

Q0 Please note:

1. Your participation in this research is voluntary.
2. You have the right to withdraw at any point during the study.
3. Your privacy will be respected. All personal data will be anonymised during the analysis.
4. Your data will be removed from our systems at the end of the project.

By clicking yes, you acknowledge that you consent and wish to participate in the study.

- ○ Yes

Q1 Please select **all** the stakeholder categories you belong in:
(Multiple answers possible)

- ☐ Landlords and/or leaser
- ☐ Owner-occupiers (Owners living in the self-owned home)

- ☐ Tenants (Lessees)
- ☐ Architects and designers
- ☐ Developers (Real-estate)
- ☐ Construction contractors
- ☐ Investors
- ☐ Banks and/or insurers
- ☐ Building material suppliers Facility and/or building managers
- ☐ Demolition contractors
- ☐ Utilities providers
- ☐ Real estate agents
- ☐ Lawyers, solicitors and/or conveyancers
- ☐ Valuers
- ☐ Certifiers
- ☐ Researcher
- ☐ Public authorities
- ☐ Policy makers
- ☐ Other: _____

Q2 In what country do you reside?

- ○ Belgium
- ○ France
- ○ Germany
- ○ Netherlands
- ○ UK
- ○ Other: _____

Q3 Which of the following digital building logbook initiatives are you familiar with? *(Multiple answers possible)*

- ☐ Dossier d'intervention ultérieure (Belgium)
- ☐ Woningpas (Belgium)
- ☐ Bedrebolig (Denmark)
- ☐ Building Passport GBC (Finland)
- ☐ Ilmastoviisaat Taloyhtiöt (Finland)
- ☐ CLÉA (France)
- ☐ Homebook (France)
- ☐ Le carnet numérique du logement (France)
- ☐ CAPSA (Germany)

- ☐ Eigenheim Manager (Germany)
- ☐ Gëbaudepass (Germany)
- ☐ Hausakte (Germany)
- ☐ ImmoPass (Germany)
- ☐ Electronic building ID (Greece)
- ☐ Fascicolo del Fabbricato (Italy)
- ☐ Madaster (Netherlands)
- ☐ Opleverdossier (Netherlands)
- ☐ CIRDAX (Netherlands-Belgium)
- ☐ Livro de obra (Portugal)
- ☐ Home report (Scotland)
- ☐ Libro del Edificio (Spain)
- ☐ Basta (Sweden)
- ☐ Klimatdeklaration (Sweden)
- ☐ Federal Register (Switzerland)
- ☐ Chimni (UK)
- ☐ CIBSE TM31 (UK)
- ☐ GBuilder (UK)
- ☐ Home Information Pack (UK)
- ☐ The National Deeds Depository (UK)
- ☐ Property information pack (Pip) (UK)
- ☐ Spaciable (UK)
- ☐ Virtual Viewing (UK)
- ☐ Other: _____

Q4 Are you currently involved in the management and/or development of a digital building logbook initiative?

- ○ Yes
- ○ No

Skip To: Q8 If Are you currently involved in the management and/or development of a digital building logbook ini... = No

Q5 Name of digital building logbook

_____

Q6 URL of digital building logbook website

_____

Q7 In what capacity?
(Multiple answers possible)

- ☐ Steering
- ☐ Research and Development
- ☐ Data provider
- ☐ Other: _____

Q8 Have you been involved in the management and/or development of any (other) digital building initiatives before?

- ○ Yes
- ○ No

Skip To: Q12 If Have you been involved in the management and/or development of any (other) digital building initi... = No

Q9 Name(s) of digital building logbook(s)
(Multiple answers possible)

_____

_____

Q10 URL(s) of digital building logbook website
(Multiple answers possible)

_____

_____

Q11 In what capacity?
(Multiple answers possible)

- ☐ Steering
- ☐ Research and Development

- ☐ Data provider
- ☐ Other: _____

Q12 How important are the following functionalities in a digital building logbook?

	Not at all important	Slightly important	Moderately important	Very important
Digital repository to store key documents	○	○	○	○
Easy access to all relevant building-related information according to the different level of users and stakeholders	○	○	○	○
Storage of maintenance and operation plans	○	○	○	○
Traceability of building materials and/or material passport	○	○	○	○
Building renovation passport or digital repository to store past maintenance activities and improvements	○	○	○	○
Monitoring of indoor environment quality	○	○	○	○
Monitoring of environmental impacts over building lifetime	○	○	○	○
Calculation of building performance (ie. the current energy label of my home)	○	○	○	○
Visualising future energy/cost-saving potentials and lifecycle costing	○	○	○	○
Integration with construction project management tools for planning and financing (ie. material circularity, calculation of renovation costs, financial incentives and/or subsidies)	○	○	○	○
Enabling integration of BIM	○	○	○	○
Indication of the smart readiness of the building	○	○	○	○
Enabling integration with smart energy services	○	○	○	○
Building renovation roadmap or provision of (automated) renovation advice	○	○	○	○
Benchmarking, reporting and links to similar buildings, various certification and assessment schemes	○	○	○	○

Provision of overview of the building stock for public authorities, policy makers, housing organisations and/or real-estate companies	○	○	○	○
Option to consent for 3rd party use of data	○	○	○	○
Enabling integration with asset management tools	○	○	○	○
Other: _____	○	○	○	○

Q13 How important are the following data fields in a digital building logbook?

	Not at all important	Slightly important	Moderately important	Very important
Ownership information	○	○	○	○
Energy performance certificate	○	○	○	○
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, electricity, heating and other resources)	○	○	○	○
Building materials	○	○	○	○
Material cost information for calculation of residual value	○	○	○	○
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	○	○	○	○

Other: _____	○	○	○	○				

Q14 What are the (potential) sources of information?
(Multiple answers possible)

	Building owners	Public authorities	Land and ownership registers (public and private)	Designers, constructors and other building	Energy Performance Certificate (EPC) databases	Energy agencies	Financial institutions	Other:
Ownership information	☐	☐	☐	☐	☐	☐	☐	☐
Energy performance certificate	☐	☐	☐	☐	☐	☐	☐	☐
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, electricity, heating and other resources)	☐	☐	☐	☐	☐	☐	☐	☐
Building materials	☐	☐	☐	☐	☐	☐	☐	☐
Material cost information for calculation of residual value	☐	☐	☐	☐	☐	☐	☐	☐
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	☐	☐	☐	☐	☐	☐	☐	☐
Other: _____	☐	☐	☐	☐	☐	☐	☐	☐

Q15 In your opinion, who should be responsible for data ownership and liability?
(Multiple answers possible)

- ☐ Homeowner and landlord
- ☐ DBL owner
- ☐ Public authorities
- ☐ Other: _____

Q16 In your opinion, who should have access to the data?
(Multiple answers possible)

- ☐ Homeowner and landlord
- ☐ Tenants
- ☐ Data owner (including DBL owner/manager, external database owner etc.)
- ☐ Public authorities and policy makers
- ☐ Authorised 3rd parties (Please state who:)

_____

Q17 How often should a DBL be updated?

- ○ Real-time
- ○ Annually
- ○ Point of sale
- ○ Change in use
- ○ Anytime the building undergoes intervention works (envelope and equipment)
- ○ Other: _____

Q18 In your opinion, how can we ensure the quality of data so that it is reliable and up-to-date?

_____

Q19 In less than 50 words, please describe the roles the European Commission should play in promoting, designing, implementing digital building logbooks.

_____

Q20 The European Commission plans to introduce an EU-centralised digital building logbook in the near future.

In less than 50 words, please describe action(s) that would best facilitate the implementation thereof.

_____

End of Block: Default Question Block

8.3 Focus Group Sessions

8.3.1 Focus Group Session with Key Stakeholders

As an extension to the survey (see Annex 8.2), this focus group session was designed to discuss the various responses collected and study the optimal performance of the DBL at study. Four sessions were held across Belgium, France, UK-Scotland and Germany.

Each session was composed of 3-5 representatives of different stakeholder groups that are of great significance to the respective initiatives. All participants were required to take part in the survey questionnaire prior to the sessions. The set-up of the sessions is as follows:

1. *Introduction and icebreaking (±5 minutes)*

2. *Interactive stakeholder mapping via Miro (±20 minutes)*
   Participants were invited to play with virtual cards to identify and categorise key stakeholders of the respective DBL and evaluate their role(s) as data providers and/or data users (see Figure 13).

3. *Interactive functionality mapping via Miro (±20 minutes)*
   Participants were invited to play with virtual cards to discuss the functionalities listed in the survey and together arrange them in terms of importance (see Figure 14). The purpose of this exercise is to compare individual perspectives and group perspectives on the functionalities that should be adopted and further developed in the EU-common platform.

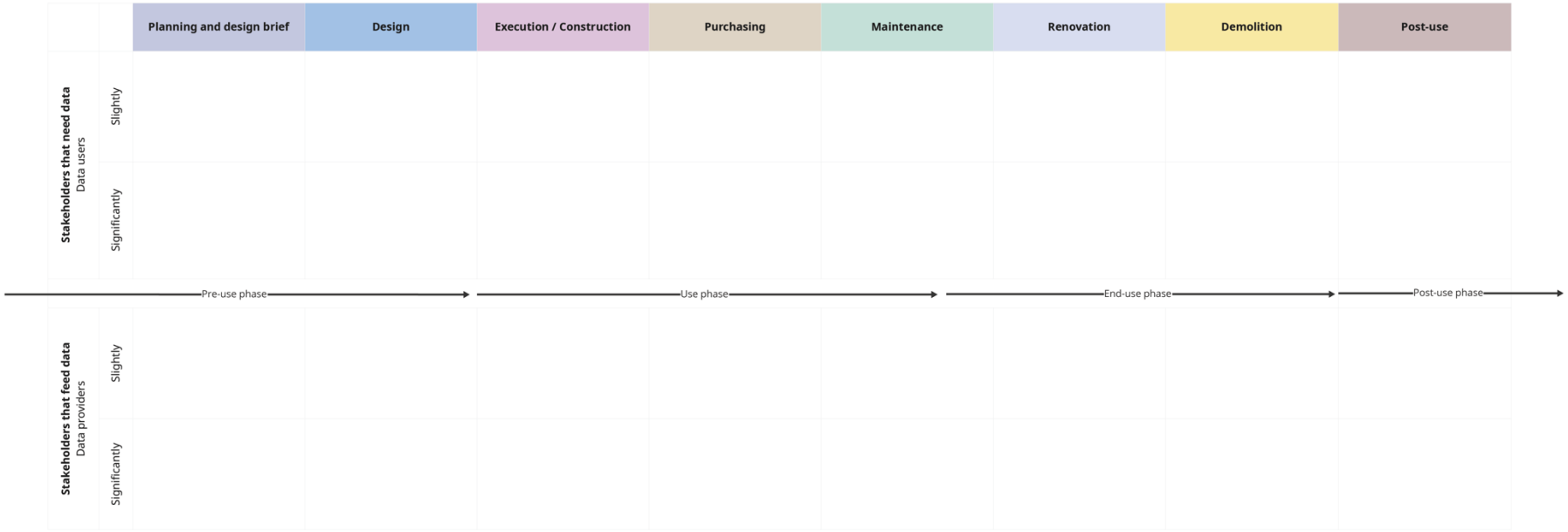
4. *Interactive benefit mapping via Miro (±20 minutes)*
   On the two previous Miro boards, participants were invited to add 'post-it' notes with that describe the benefits of the various functionalities for the different stakeholders.

5. *Role play session (±20 minutes)*
   a. If the use of the DBL in question is not mandatory in the active region:
      How would you convince your friends and family to use the tool?

   b. If the use of the DBL in question is mandatory in the active region:
      How would you market the tool to your friends and family outside the region?

6. *Closing (±5 minutes)*

Stakeholder Mapping:

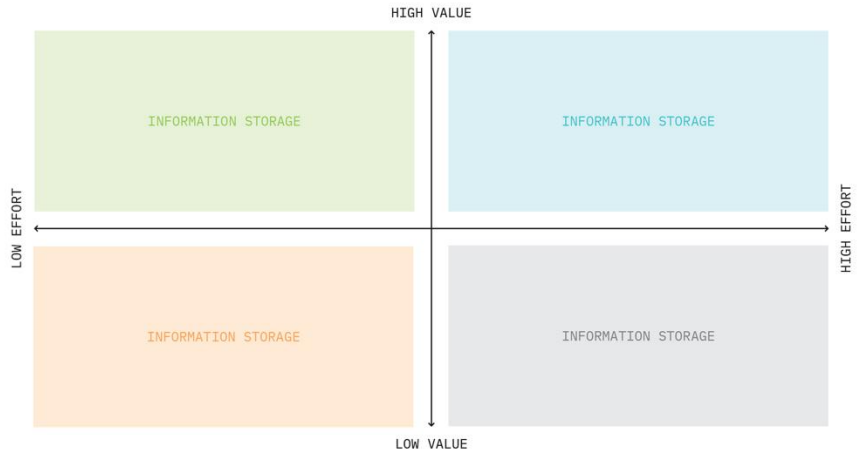


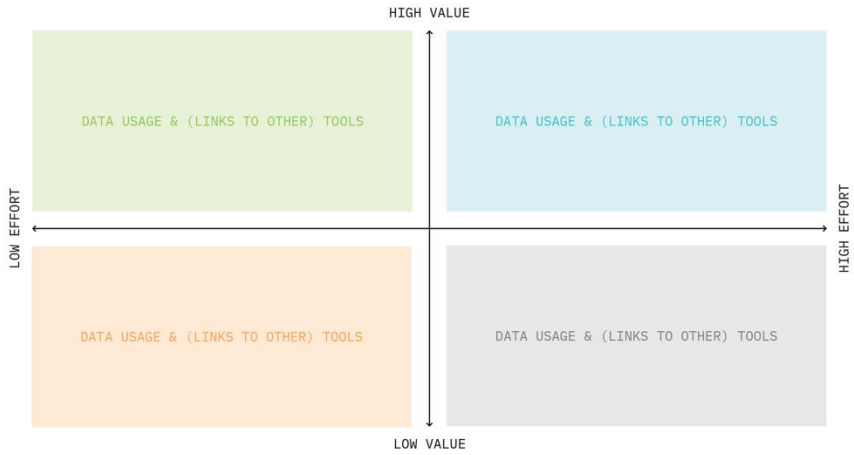
List of potential users derived from the literature and survey:

Landlords and/or leaser	Owner-occupiers	Tenants (Lessees)	Architects and designers	Developers (Real-estate)	Construction contractors	Investors	Banks and/or insurers	Building material suppliers	Facility and/or building managers	Demolition contractors	Utilities providers	Real estate agents	Lawyers, solicitors and/or conveyancers	Valuers	Certifiers	Researcher	Public authorities	Policy makers	Service designer (UX)	Data companies (Inventories and registering)	International organisations	IT providers
Other	Other	Other	Other	Other	Other	Other	Other	Other														

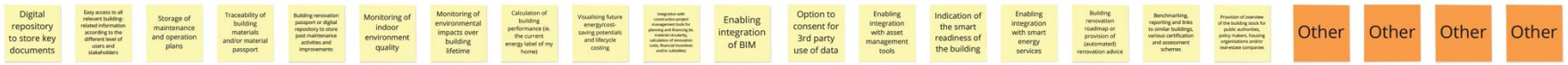
Figure 13: Stakeholder mapping matrix (template).

Functionality Mapping:





List of functionalities derived from the literature and survey:



List of potential users derived from the literature and survey:

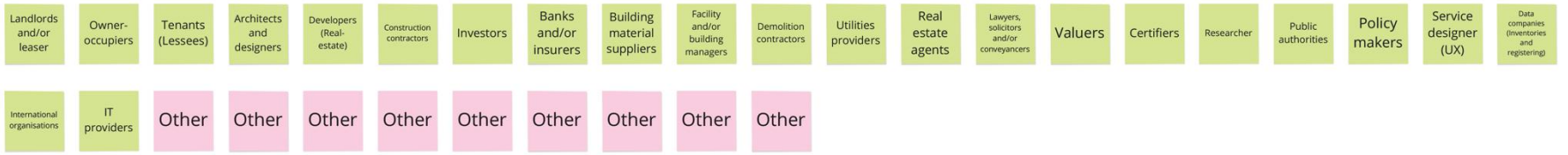


Figure 14: Functionality mapping matrix (template).

8.3.2 Focus Group Session with DBL experts

The key functionalities, benefits and prerequisites identified by key stakeholders (see Annex 8.3.1) were validated to use as a framework for the evaluation of demo cases in task 3.7 of the Grant Agreement.

Validation took place via 3 focus group sessions with Demo-BLog experts. Topics that were also covered during these sessions include data characterisation methods (T2.1), links with other datasets (T2.2), innovative data collection methods (T2.3), data governance (T2.5) as well as other relevant barriers and opportunities.

The three-part session was participated by 14 members of the consortium of different stakeholder groups that are of great significance to the respective initiatives. All participants were required to take part in the survey questionnaire prior to the sessions. The set-up of the sessions is as follows:

1. *Introduction*
2. *Theme I: Review on stakeholder perception on existing DBLs*
    a. Interactive stakeholder mapping via Miro
    Participants were presented with the 4 Miro boards created by key stakeholders in sT3.1.1 (see Annex 8.3.1). Participants were invited to discuss the previous findings and further work on these boards with 'post-it' notes.

    b. Interactive functionality mapping via Miro
    Participants were presented with the 4 Miro boards created by key stakeholders in sT3.1.1 (see Annex 8.3.2). Participants were invited to discuss the previous findings and further work on these boards with 'post-it' notes.
3. *Theme II: On augmenting existing DBL functionalities and/or developing new functionalities (open discussion)*
    a. External open databases: Links with existing data sources and/or initiatives.

    b. Data collection methods: Evolving innovative data collection methods.

    c. Data governance: Smart aggregation solutions VS SOLID (SOcial LInked Data).
4. *Closing*