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A framework for digital building logbooks: Drivers of affordable, circular and sustainable built environment

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PEER-REVIEWED PAPER

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ABSTRACT

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Digital building logbooks (DBLs) can improve information management, reduce transaction costs, facilitate effective decision-making, and increase transparency throughout the building lifecycle and across the building value chain. They do this by enabling the integration of various information tools (e.g. energy performance certificates and material passports) with data demands from policy makers, financial actors, businesses and markets. Although the concept of 'building logbook' has existed for the past three decades, DBLs are formally defined in EU legislation in the 2024 Energy Performance of Buildings Directive (EPBD). Despite efforts by market participants and the Commission to advance the use of DBLs, they have not been widely adopted and their potential remains unfulfilled. The primary barriers to progress include the difficulty of demonstrating clear, tangible value to stakeholders, the ongoing fragmentation of data across incompatible systems, and the need for more coherent regulatory requirements. This study examines the EU policy landscape, identifying opportunities for policy coherence and data alignment. It maps specific impact pathways through which DBLs achieve regulatory goals and presents a social cost-benefit analysis of large-scale implementation. The SCBA results provide a compelling business case, with a cost-to-benefit ratio ranging from 2 to 9, depending on the number of DBL functionalities. Even in a low DBL uptake scenario, the net present value is at least €11 billion. The findings reveal that current policy enablers, technical readiness, and market maturity provide a timely opportunity to transit from disparate DBL systems to a comprehensive, legally anchored EU framework. To support this transition, we propose a multi-layered framework for DBL development that is simple to understand and implement. Implementing a common EU framework would foster innovation and cost savings, accelerating the shift toward a sustainable and digital built environment.

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INTRODUCTION

Improving information management across the building value chain is essential to address the low levels of digitalisation and data availability within the buildings and construction sector (European Commission, 2019). A Digital building logbook (DBL) serves as a central repository that optimises data flow and facilitates informed decision-making throughout a building's lifecycle. By increasing transparency and reducing transaction costs at every stage, from initial design and financing to renovation and demolition, DBLs can streamline the delivery of housing, encourage innovation and promote the efficient use of resources.

Building data is generated and accessed by a variety of user groups, as well as by automated agents such as IoT and smart devices, through manual and automated protocols via web-based or mobile interfaces. For DBLs, to reach their full potential, they must be interoperable with existing tools and databases, such as energy performance certificates (EPCs) and Building Information Modelling (BIM). By structuring and categorising this information, DBLs renders building data functional and enhance clarity, while significantly improving its overall usability and accessibility. This process effectively transforms raw data into actionable insights that align with the specific needs and interests of diverse stakeholders. At its foundation, the core functionality of a DBL is the systematic collection, storage, and retrieval of data. By performing these technical tasks, a DBL renders building data functional, transforming it into usable, meaningful, and actionable information that directly aligns with the specific needs and interests of diverse stakeholders (Koronen et al., 2023).

The rising demand for data, driven by regulatory compliance and value creation for financial stakeholders, has led to the development of a variety of single-purpose building information tools. Although the growth in the number of DBLs is encouraging and necessary for innovation, their proliferation has led to significant fragmentation of both data and tools because these tools often use disparate data technologies and management protocols. Across the EU, at least 30 different 'building logbook' initiatives exist, ranging from digital to paper-based and from public to private (Hwang et al., 2023). While these initiatives offer approximately 22 diverse functionalities, such as automated renovation passports and secondary market facilitation, the lack of a standardised nomenclature and common framework restricts interoperability and prevents the seamless exchange of information (European Commission et al., 2020; Hwang et al., 2023).

To consolidate ongoing efforts and encourage their wider adoption, the European Commission has funded strategic studies and innovation projects exploring the purpose, role and benefits of DBLs, and defining and developing a common European DBL framework (Ecorys et al., 2023; European Commission, 2022; European Commission et al., 2020). For the first time in an EU legislative instrument, DBLs are defined in Article 2(41) of the Energy Performance Buildings Directive (EPBD) (Directive (EU) 2024/1275) as a common repository for all relevant building data, including building information tools, such as building information modelling (BIM), policy instruments, such as EPCs and indicators, such as global warming potential (GWP). To support this anchoring, a draft standardisation request aims to harmonise DBL formats by 2028 (European Commission, 2026). These DBL-specific measures form part of a broader Commission strategy to fully digitalise the construction sector and facilitate a single market for construction (European Commission, n.d.). This includes setting up the Construction Digital Product Passport System, which is interoperable with Building Information Modelling (BIM) under Article 75 of the Construction Products Regulation (CPR) (Regulation (EU) 2024/3110). The integration of CPPD, BIM and DBL allows stakeholders to access and update product-level circularity data directly within the building's digital logbook.

Despite sustained policy efforts and market initiatives, DBLs remain highly fragmented and are frequently perceived as abstract and overly complex. This lack of clarity is exacerbated by the absence of a harmonised EU-wide governance framework and the common standards needed to consolidate diverse lifecycle data into a single, intelligible framework. Consequently, while their theoretical benefits, such as greater transparency, improved decision-making, cost savings, enhanced performance, support for circularity and reduction of administrative burden are widely acknowledged, the concrete value proposition and the practical implementation challenges remain poorly understood by key market and policy actors. For example, the absence of reliable data, such as that obtainable from DBLs, can lead to a significant "cost of inaction." This is illustrated by the French Court of Auditors, which estimated housing policy inefficiencies in France at approximately EUR 40 billion (COUR DES COMPTES, 2022).

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This study aims to consolidate recent progress and clarify the strategic potential of DBLs for policymakers, financial stakeholders, and market actors. The analysis first provides an overview of the data requirements and governance models emerging from current and upcoming EU legislation. It then evaluates existing data management practices, identifying the key sources and technologies required to drive DBL development. Furthermore, the study maps the specific 'impact pathways' through which DBLs achieve regulatory objectives while generating a measurable cost-benefit advantage. The paper demonstrates how policy goals can be met with a net positive value by grounding the purpose of DBLs in these requirements. By integrating policy, technical, market, and economic perspectives, the paper aims to address an important gap, which is the lack of a common framework for DBLs. Therefore, it proposes a simplified DBL framework to enhance cross-sectoral understanding, which is coherent at the EU level yet adaptable to national contexts, concluding with key priorities for large-scale implementation.

METHODS

This paper builds on two reports – Gokarakonda & Zsolt (2025) and Gokarakonda & Zsolt (2026). The former is publicly available, and the latter is under review and will soon be made publicly available. Gokarakonda and Zsolt (2026) presented case studies of DBLs and conducted interviews with seven public and private DBL providers regarding their business models. It also provides a high-level social cost-benefit analysis (SCBA) of implementing DBLs. Gokarakonda & Zsolt (2026) presented a review of the EU policy framework, focusing on building data requirements and tools, and alignment. To capture the multi-dimensional nature of DBLs, this study synthesis the results from the reports to integrate policy, technical, market, and economic perspectives. It presents coherent arguments for the policy and business case for developing and implementing digital building logbooks. It also adds scenario analysis to the SCBA and presents new discussion points, including the development of a DBL framework based on consolidated findings.

The paper presents a review of the EU legislative framework, identifying instruments with significant implications for building data. For clarity, these policies were categorized into six thematic groups as shown in Table 1.

Table 1 EU Policies analysed.

POLICY AREA	RELATED EU POLICIES/INITIATIVES
Operational energy performance and renewable energy	Energy Performance of Buildings Directive (EPBD); Energy Efficiency Directive (EED); Renewable Energy Directive (RED); Internal Market for Electricity (IME) Directive
Whole life carbon (WLC), lifecycle assessment (LCA), circularity and embodied energy	Circular Economy Action Plan (CEAP); Strategy for a Sustainable Built Environment; Ecodesign for Sustainable Products Regulation (ESPR); Construction Products Regulation (CPR)
Market and competitiveness	Infrastructure for Spatial Information in the European Community (INSPIRE) Directive; Public Procurement Directive (PPD)
Sustainability reporting and disclosures	EU Taxonomy Regulation; Corporate Sustainability Reporting Directive (CSRD); European Sustainability Reporting Standards (ESRS)
Digitalisation and smart technologies	Data Governance Act (DGA); Interoperable Europe Act (IEA); Data Act (DA); Open Data Directive (ODD); General Data Protection Regulation (GDPR); European Strategy for Data (ESD); Data Union Strategy (DUS)
Societal impact and wellbeing	European Affordable Housing Plan (EAHP); European Strategy for Housing Construction (ESHC); New European Bauhaus (NEB)

Building on this policy foundation, we evaluated current data management and alignment practices through a literature review to identify existing data sources and technologies. We then mapped impact pathways to illustrate how specific DBL functionalities translate into tangible benefits and contribute to specific policy objectives. This mapping provided the qualitative framework necessary to transition into the quantitative economic analysis.

Then we conducted a social cost-benefit analysis of DBLs, considering the core functionality of DBLs (i.e., data storage and retrieval) and three additional functionalities of high impact and relevance: 1) Automated renovation passports with DBLs 2) Integration of DBLs with BIM models 3) DBLs as facilitators of secondary marketplaces and circularity. Table 2 shows the assumptions regarding the capital costs involved in setting up the DBLs, as set out in the EU

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technical study (Ecorys et al., 2023). The study and the literature do not make it clear how many DBLs this capital cost can support, but we assume that it can support setting up at least 10,000 DBLs.

Table 2 Capital cost assumptions for setting up DBLs (based on Ecorys et al., 2023).

		PERSON DAYS	PERSON DAY COST	TOTAL PERSONNEL COSTS	BULK COSTS – ONE TIME	BULK COSTS – RECURRING PER MONTH
DBL development – capital costs	Collecting data on existing buildings	1.5	500	750		
	Verification of data	0.5	500	250		
	Development of an online platform				50,000	
	Development of a semantic model				10,000	
	Agreement about data norms with stakeholders				50,000	
	Developing a data dictionary				5,000	
	Costs for licensed data					
Data infrastructure – hardware	Virtual machine					300
	Cloud storage					650
Data infrastructure – software	Semantic modelling tools					200
	Semantic model hosting tools					100
	Software to store and search data					50
	API software to collect and/or share data					200
	Total DBL setup and operation without no additional functionality			1,000	115,000	18,000

Furthermore, we made the following assumptions for the SCBA of DBL implementation (Table 3). We assume that the figures presented below are sufficient to inform the results and discussion in this paper. Further explanations and details on the assumptions can be found in Gokarakonda & Zsolt (2025). In this model, "benefits" are defined as the cost savings realised when DBL-integrated processes outperform conventional methods, while "costs" represent any additional expenditures required for implementation. Notably, the "basic costs" for the core infrastructure were calculated as a single investment to avoid duplication across individual functionalities.

Table 3 Assumptions for social cost-benefit analysis.

DBL FUNCTIONALITIES	COSTS/ BENEFITS	COST COMPONENT	COST OF CONVENTIONAL PROCESS PER DBL (EUR)	COST OF DBL-ENABLED PROCESS PER DBL (EUR)	COST DIFFERENCE	COST IMPLICATION/ NOTES
Renovation passport	Primary benefit	Labour (on-site data collection)	1,000	100	900	Cost savings resulting from reduced labour and travel time.
Renovation passport	Primary cost	Software/Tools	0	50	–50	Additional costs for renovation passport functionality
Renovation passport	Primary benefit	Professional fees for generating a renovation passport	95	32	63	Cost savings resulting from reduced expert time and fees.
Renovation passport	Primary benefit	Maintenance/ Updates	500	5	495	Cost saving: reduced manual updates over time.

(Contd.)

DBL FUNCTIONALITIES	COSTS/ BENEFITS	COST COMPONENT	COST OF CONVENTIONAL PROCESS PER DBL (EUR)	COST OF DBL-ENABLED PROCESS PER DBL (EUR)	COST DIFFERENCE	COST IMPLICATION/ NOTES
Renovation passport	Other benefit	Data management & integration	500	20	480	Cost savings resulting from easier access to data.
Renovation passport	Other benefit	Quality assurance	10	5	5	Cost savings resulting from fewer manual checks and higher data quality.
Circular market places	Primary benefit	Labour (on-site data collection)	1,000	100	900	Cost savings resulting from reduced labour and travel time.
Circular market places	Primary benefit	Labour (making a digital inventory of components and materials)	250	150	100	Cost savings resulting from eliminating manual labour.
BIM integration	Primary benefit	Digital platform for materials		150	–150	Cost savings resulting from the existing DBL digital infrastructure
BIM integration	Primary benefit	Duration of the permit process	6,500	1,350	5,150	Cost savings resulting from reduced time required.
Data collection, storage and access	Primary cost	Data management & integration	0	100	–100	Additional costs for storage and software
Data collection, storage and access	Primary benefit	Administrative burden	2,500	100	2,400	Cost savings resulting from eliminating manual labour and time saving.

To reflect different market scenarios and levels of uptake, we modelled three cases involving different numbers of DBL functionalities, discount rates, and levels of DBL uptake. We then used Net Present Value (NPV) and Benefit-to-Cost Ratio (BCR) as the primary assessment metrics, comparing the cost estimates with data from existing DBL initiatives to ensure a fair comparison. The cost of the current DBL initiatives is based on interviews conducted in Gokarakonda and Zsolt (2025). For cost-optimality studies, a discount rate of 4% is recommended; however, actual discount rates vary between approximately 2% and 7% in various EU countries (European Commission, 2012). Therefore, we considered 2%, 4% and 6% in our scenarios. The time horizon for the three scenarios was set at 25 years to allow for easier comparison. The scenarios are shown in Table 4.

Table 4 SCBA scenarios.

	DBL FUNCTIONALITIES	DISCOUNT RATES	DBL UPTAKE (ANNUAL ARITHMETIC INCREASE)	INCREASE IN ANNUAL OPERATIONS AND MAINTENANCE COSTS DUE TO SCALING UP
Scenario 1 (low uptake)	Core DBL function (data storage and retrieval	6%	10,000	2.5%
Scenario 2 (medium uptake)	Scenario 1+ Automated renovation passports with DBLs	4%	100,000	5%
Scenario 3 (high uptake)	Scenario 2+ Integration of DBLs with BIM models; DBLs as facilitators of secondary marketplaces and circularity	2%	200,000	10%

RESULTS

POLICY ANALYSIS

The EU policy landscape for the built environment is increasingly defined by a shift towards digitalisation and transparency, which is enabled by building-related data and information requirements, as well as tools and policy instruments. The following subsections discuss the sectoral policy coherence enabled by DBLs by articulating the role and purpose of building-related data, specific data and information requirements, tools, policy instruments and digital governance frameworks in the EU policy framework.

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Sectoral policy coherence: energy, circularity, simplification and market competitiveness

Figure 1 shows the primary objectives of building-related data in relation to relevant EU legislation. It provides guidance on the **purpose and role** of DBLs, as well as the imperative for their implementation. This information is organised into four strategic themes, with examples of key policy instruments as shown below.

- **Minimise the administrative burden and simplify regulatory compliance**: DBLs can support the implementation of the EU Taxonomy by improving the availability, consistency, verifiability and longevity of the building-level data required for assessing alignment with the technical screening criteria (TSC). By linking existing data sources, such as EPCs and Environmental Product Declarations (EPDs), DBLs can reduce the administrative burden on financial market participants and facilitate data verification, in line with Articles 20 and 26. Similarly, DBLs facilitate CSRD and ESRS reporting by providing a single, digital repository that captures and updates building-related ESG data across the entire lifecycle of construction projects.
- **Facilitate data-driven decision-making and renovation planning**: EPBD requires Member States to establish machine readable building information tools, such as renovation passports (Art. 12), smart readiness indicators (Art. 15), and energy performance certificates (Art. 19), inspection schemes and digital verification tools to ensure compliance with designed energy performance and minimum building code requirements (Art. 23(8)). It further mentions the use and application of digital tools, such as digital twins (Art. 19(14)), BIM models, simplified EPC update tools (Art. 12(6)), and building automation and control systems (Art. 13(9)) to facilitate continuous performance tracking, reduce administrative burden, and support data-driven renovation decisions (Art. 19(4), Annex IV(1)).
- **Promote the circular economy and material reuse**: According to Article 75 of the CPR on CDPPs, stakeholders should be able to access, introduce or update information in DPPs, or create new ones. DBLs can help identify stakeholders and define their roles and responsibilities, as well as providing authorised access.
- **Encourage transparency, market competitiveness and consumer empowerment**: Under the IME, DBLs could facilitate customer empowerment and market efficiency by providing accessible, validated, and comparable information on energy use, dynamic pricing contracts, and demand response potential to consumers, citizen energy communities, and other market participants in line with Articles 14, 16, 18, 25.

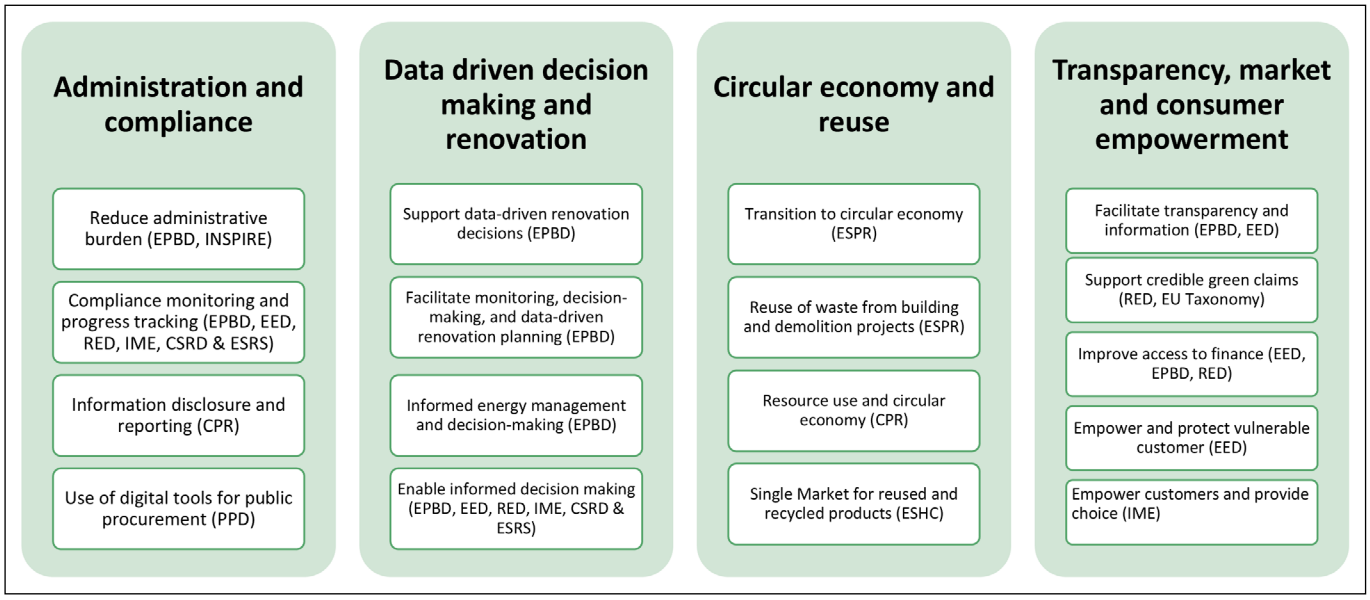

Figure 1 Role and purpose of DBLs (building data) as envisaged in the EU policy framework.

Data, databases and information requirements in the EU policy framework

The current EU legislative landscape requires an extensive array of data points and information, creating a complex reporting environment for the construction and real estate sectors, as well as for public authorities and Member States. This covers the information that is required, generated, collected, stored, reported, exchanged or displayed during policy implementation.

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This often overlaps with existing market-driven data held by stakeholders, albeit in a fragmented way. In this context, DBLs can be positioned as an enabling instrument that aligns data and streamlines data flow, all the while preserving the level of policy ambition and regulatory objectives. Figure 2 shows the key data points, information requirements, and databases mentioned in the relevant EU legislation, grouped thematically.

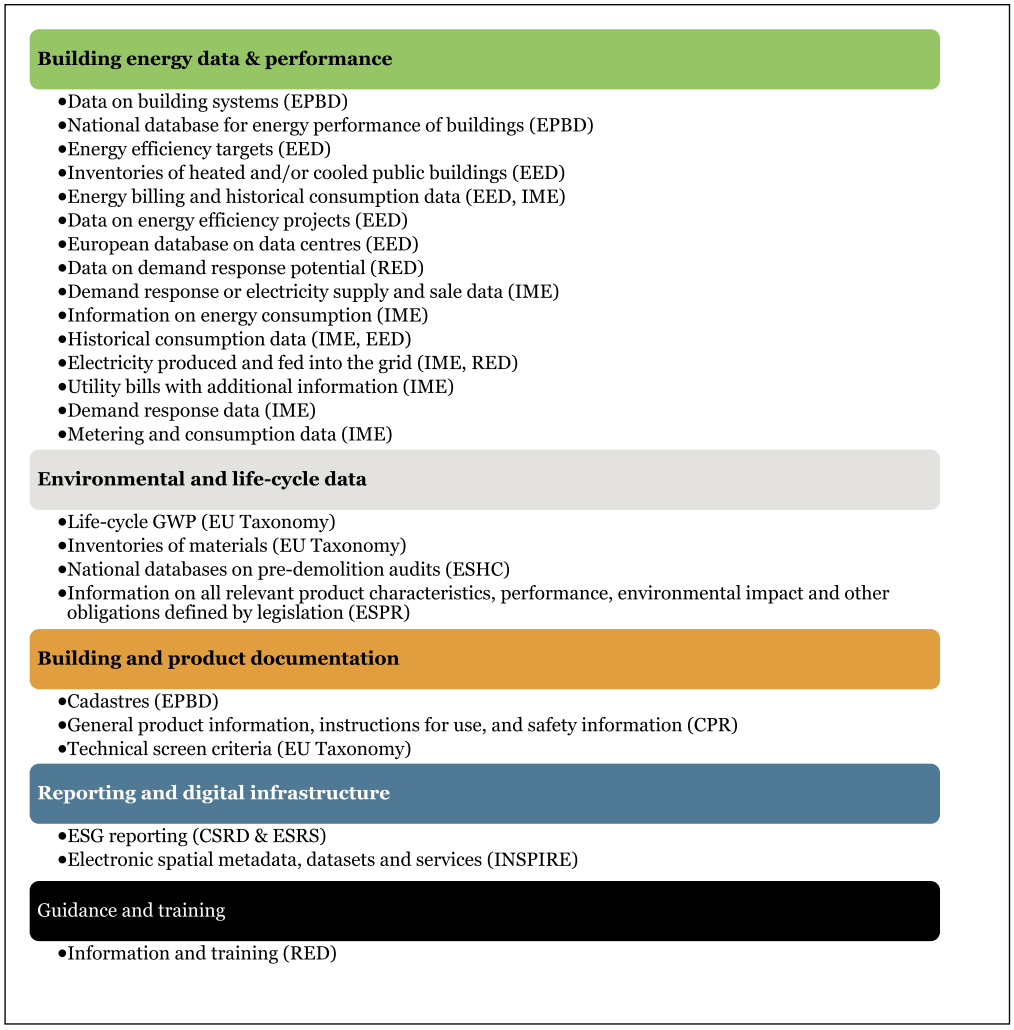

Figure 2 Building data requirements as envisaged in the EU policy framework.

Tools and policy instruments in the EU policy framework

The effective implementation of DBLs requires a structured approach that aligns with established building information tools and instruments. While EU policies provide the regulatory context, the operationalisation of these goals depends on a specific suite of technical tools, as mapped in Figure 3. These instruments, ranging from energy performance databases to digital permitting systems, act as the functional drivers of the DBL. By integrating these tools into a unified framework, Member States can accelerate the digitalisation, transparency, and sustainability of the built environment while ensuring that DBLs remain interoperable with existing national and regional systems.

Digital governance and enabling frameworks

Beyond sectoral requirements, a robust horizontal framework for data and digital governance is essential for the implementation of DBLs. DBLs can leverage current legislation to establish the necessary terminology, roles, responsibilities and principles for secure, interoperable data management. Table 5 summarises the relevant EU legislation that could inform the development of a digital governance framework for DBLs.

Governance and implementation models

The governance of DBLs varies significantly across the EU, reflecting different national priorities regarding data ownership, funding, and regulatory integration. These models can be broadly categorised into public-led ecosystems and mandated market-driven frameworks.

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Building energy performance and renovation tools

- Energy performance certificates (EPCs) (EPBD, EED)
- Renovation passports (EPBD, EED)
- Smart readiness indicator (SRI) (EPBD)
- Inspection reports and digital verification tools (EPBD, EED)
- Tools to facilitate access to finance (EPBD, EED, RED)
- Smart metering (EPBD, EED)
- IT systems that monitor, collect, validate and communicate metering data (EPBD, IME)

Digital design, modeling and data management

- Building Information Modelling (BIM) (EPBD, CPR)
- Digital twins (NEB, EPBD, RED)
- Digital product passports / Construction-focused digital product passport (C-DPP) (CPR)
- Electronic tools to digitally document as-built characteristics of the building (EU Taxonomy)
- Interoperability of existing spatial data / Geographical information systems (GIS) (INSPIRE)
- Open standards, machine-readable and interoperable formats (ODD)

Decision support, consumer and stakeholder empowerment

- Data access to third parties (EPBD, RED, IME)
- Building automation and control systems (BACS) (EED, RED)
- Comparison tool for utility contract offers (IME)
- Billing information, including electronic bills, flexible payment, prices and discounts (IME, EED)
- Single points of contact (IME)
- Energy communities / Citizen energy communities (RED, IME, NEB)

Digital permit, procurement and regulatory tools

- Digital permit granting process (RED, ESHC)
- Digital procurement tools (EED, PPD)
- Digital building permits (ESHC, PPD)

Environmental assessment and circular economy tools

- Global warming potential calculation tools (EPBD, EU Taxonomy)
- Guarantees of origin (RED)
- Ecodesign (ESPR)
- Platform on sustainable finance (EU Taxonomy)
- Degree of alignment with TSC and administrative burden for financial actors (EU Taxonomy)
- EU Construction and Demolition Waste Management Protocol (EU Taxonomy)
- Pre-demolition audits (EU Taxonomy)
- Level(s) indicators (EU Taxonomy)
- Environmental product declarations (EPDs) (CPR, EU Taxonomy)
- Digital European Construction Resource Assessment (DECRA) platform (ESHC)

Reporting and standardisation

- Electronic reporting format (CSRD & ESRS)
- Digital Building Logbooks (DBLs) (EPBD, NEB)

Figure 3 Tools and instruments as envisaged in the EU policy framework.

Table 5 Enablers for digital governance framework for DBLs.

POLICY	ENABLERS FOR DBLs
Data Governance Act	• Builds trust in voluntary data sharing • Establishes data intermediation services • Deploys trusted mediators between data holders and users • Ensures data interoperability • Establishes European Data Innovation Board for cross-sector standards • Enables data sharing between emerging European data spaces
Interoperable Europe Act	• Provides governance framework for cross-border interoperability of trans-European digital public services • Establishes Interoperable Europe Board (IEB) • Establishes European Interoperability Framework (EIF) • Provide a single point of contact per Member State
Data Act	• Provides harmonised rules for making product and related service data available • Facilitate access to data, its transfer, interoperability, and switching between service providers
Open Data Directive	• Enables innovation in products and services using open data • Provides high-value datasets leading to value-added services and job creation
General Data Protection Regulation	• Governs the collection and use of personal data of EU citizens, protecting fundamental rights and privacy

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POLICY	ENABLERS FOR DBLs
European Strategy for Data	• Enables a single market for data • Strengthens Europe's global competitiveness and data sovereignty • Develops Common European Data Spaces (CEDS) as an ecosystem for new products and services
Data Union Strategy	• Improves data access for AI to develop innovative services for consumers • Enables high-quality data sharing • Implements European data quality standards • Supports Data Spaces and Data Labs • Enables one-click compliance initiatives
NEB	• Promotes use of digital tools • Supports high-quality research and scaling of innovations • Enables circularity in the built environment • Develops EU Local Digital Twin applications • Applies AI tools

Public-led and centrally managed platforms

- Flanders (Belgium): The Flemish Energy and Climate Agency (VEKA) provides building owners and occupants with the Woningpas (or Gebouwenpas), a free-to-use DBL. (*Gebouwenpas*, n.d.). It provides information on a variety of topics, including the location and layout of buildings, technical installations, environmental performance (including EPCs), soil contamination, building permits, water and sewerage, housing quality, glazing and insulation, flood sensitivity, and access to amenities (Mobiscore).
- Estonia: The Ministry of Climate's Department of Construction and Housing, in cooperation with the Land and Spatial Planning Department, has established an ecosystem of digital platforms for construction, known as e-ehitus (e-construction) (e-ehituse platvorm, n.d.-a). The platform enables BIM-based digital permitting and automated compliance checks (Fauth et al., 2025). A wide range of stakeholders, including insurers, banks, real estate agents and valuers, can access building information for due diligence processes such as mortgage approvals and property transactions. The platform aims to strengthen digital permitting processes, energy renovation processes, and the management of data related to circularity (e-ehituse platvorm, n.d.-b).
- Greece: The Electronic Building Identity is a national digital register of building information managed by the Technical Chamber of Greece (TEE) on behalf of the state (gov.gr, 2026). Certified engineers can access the system via secure authentication to register and update information, while property owners can view relevant documentation through their appointed engineer.

Legally mandated, market-driven frameworks

- France: The CIL (Le Carnet d'information du logement), or housing information booklet, is a legally required document that must be created during construction or renovations. It contains all technical, material and energy-related data about a dwelling (Direction de l'information légale et administrative, n.d.). Complementing this, the Technical Centre for Building (CSTB) National Buildings Database aggregates and cross-references data from over thirty databases of public bodies, often filling in missing data with statistical estimates (CSTB, n.d.). The platform supports infrastructure planning, identifies priority social housing, models urban heat islands and promotes the energy and ecological transition. It allows authorities to track energy performance, prioritise renovations and assess the impact of policies. It also supports tools such as renovation passports and Go-Rénove, which guide phased renovations in line with national decarbonisation targets.
- Vienna (Austria): In the Austrian municipality of Vienna, DBLs are a mandatory requirement specifically tied to the building permit and approval process.

Infrastructure ownership and funding structures

A critical distinction between these governance models is who builds and pays for the DBL system. In Estonia, Greece and Flanders, the state provides the core infrastructure. However, cost-sharing varies: while the service is free in Flanders, building owners in Greece and Estonia typically pay fees towards the DBL's maintenance. In the French model, reliance on private

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developers shifts infrastructure investment and innovation risks to the market. However, it requires a robust regulatory framework to ensure data interoperability between competing private systems.

DATA MANAGEMENT AND ALIGNMENT

Building on the governance structures discussed previously, this section examines the technical frameworks and operational data sources required to populate DBLs. These include EPCs and other energy-related databases and cadastres, as well as building registries and other administrative databases (Ecorys et al., 2023). To ensure scalability, DBL implementation must transition from proprietary, siloed data technologies to harmonised, interoperable standards. It also presents voluntary and research initiatives that aim to facilitate and streamline data sharing and alignment within the built environment.

EPC and energy-related databases

EPCs represent the most well-established information tool under the EPBD. While most Member States have implemented central registers, the scope of data collected and levels of public access vary significantly; some registries capture only specific indicators, while others store all calculation inputs and outputs (Ruggieri et al., 2023). Similarly, access to the databases ranges from fully public to semi-public to restricted.

Under Article 20(8) of the EPBD, full EPCs, along with the input data required to calculate them must be uploaded to the database for the energy performance of buildings (Art. 20(8)). In turn, the databases must be interoperable and integrated with other administrative databases, such as building cadastres, land registries, and DBLs. This makes the information on building geometry, construction characteristics and technical systems already available in the databases. When linked with unique identifiers, this would enable the creation and implementation of DBLs at minimal additional cost. For example, in Portugal, when an energy expert issues a certificate, they must verify the building's identification details by checking them against national databases, including cadastral information (Graf & Steuwer, 2025).

In addition to leveraging the EPC databases to develop the core functionality of the DBLs, their wider implementation across Member States demonstrates how digitalisation, data interoperability, management and access, quality assurance and integration with financial and policy frameworks can inform DBL development and expand their functionalities (Gokarakonda & Diaconu, 2026).

- **Quality assurance**: Spain has adopted a multi-layered approach to ensure data reliability and quality, combining automation, document control, field inspections and enforcement to ensure EPC quality and compliance.
- **Policy implementation**: Portugal links its EPC database, which provides results on energy and CO_2 reductions, with grant-funded renovations in order to evaluate actual energy savings and adjust programme design.
- **Automated verification**: Many countries, including Denmark, Portugal, Austria and Greece, have enabled the automatic verification of EPC data.
- **Stakeholder led design**: In Italy, indicators in the SIAPE (Information System on EPCs) platform have been agreed with the regions and key stakeholders. The platform ensures interoperability with regional databases and provides differentiated user access to detailed and aggregated data.

Voluntary, research and industry initiatives for data sharing and alignment

The demand for building data has been driven by regulatory compliance, such as that relating to EU Taxonomy, sustainability and disclosures, and market frameworks for green building certifications. Promoting stakeholder-led convergence of building data helps to reduce the further fragmentation of data-related activities and prevent the creation of incompatible parallel systems.

- **Voluntary and research initiatives** are working to facilitate seamless ESG reporting, enhance resource efficiency, and benchmark whole-life carbon in the real estate and

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construction sectors, while ensuring building data is aligned, accessible, meaningful, and actionable across the value chain. These initiatives include the Building Passport Alignment Project (BPAP, 2024), the Centre for Built Environment Data Sharing (C-BEDS) (C-BEDS, n.d.), the Global Building Data Initiative (GBDI) (GBDI, 2026) and the Open Standards for Construction and Real Estate (OSCRE, 2026).

- **Organisations and industry initiatives**, such as the EU BIM Task Group and buildingSMART, have long been driving the digitalisation of the construction sector by encouraging the use of BIM and developing open BIM frameworks (buildingSMART International, 2026; EU BIM Taskgroup, 2018).
- **National-level digitalisation initiatives and committees, as well as standardisation activities**, provide further support for these efforts by offering governance and structural frameworks (European Commission, 2019).
- **EU-level organisations and bodies**, such as the European Construction Observatory (ECO), the European Data Innovation Board (EDIB) and the Interoperable Europe Board (IEB), could further strengthen these efforts by coordinating standards, promoting interoperability and supporting harmonised approaches across Member States.

Technical guidelines and frameworks for DBLs

For best practices in data technology and management, the sector draws upon established general frameworks and maturity models, such as those developed by DAMA International and capability-based data management maturity model approaches inspired by CMMI Institute (Pörtner et al., 2025). The ISO family of standards (e.g., ISO 8000, ISO/IEC 38505, ISO/IEC 11179) establishes formal, internationally agreed requirements for data quality, governance, and metadata management. For the building sector specifically, standards such as ISO 19650 and the open data formats, standards and services frameworks developed by buildingSMART International provide sector-specific foundations for information management, including BIM implementation, and lifecycle data governance (buildingSMART International, 2026; DIN, 2023).

In the context of DBLs, the EU technical study on DBLs provides the guidelines for establishing a common EU framework for DBLs (Ecorys et al., 2023). The study categorised DBL information into seven key aspects: 1) identification; 2) general aspects; 3) legal and financial aspects; 4) dimensions; 5) performance; 6) structure and materials; and 7) building services. Key aspects of the technical implementation include defining principles for DBL implementation, ensuring semantic and technical interoperability, and creating a data management plan. The study also identifies five key principles for technical implementation, including simplicity, FAIRness, data quality, levels of information need (LOIN) and keeping data at its source. The study also suggests a semantic data model comprising a data dictionary and ontology, as well as an interoperability framework based on existing standards (Böhms et al., 2023). Semantic interoperability ensures the reusability and interoperability of the data, while technical interoperability ensures its accessibility and findability.

While the EU study only provides the high-level principles, there are few other frameworks tailed for budlings data. Achieving this requires a more granular, multi-layered structural architecture. To meet this need, the **DWELT framework** offers a "system-of-systems" approach specifically designed for the architecture, engineering, and construction (AEC) domain (Farghaly et al., 2026). This framework provides a clear pathway for technical implementation through five distinct layers:

- **Define (D):** Establishing a federated data model through combined top-down and bottom-up requirements.
- **Wire (W):** Ensuring data structuring, validation, and interoperability across heterogeneous sources.
- **Engineer (E):** Providing a secure, federated data ecosystem for real-time data exchange via APIs and publish–subscribe mechanisms.
- **Leverage (L):** Applying advanced analytics, such as machine learning and predictive modelling, to support data-driven optimisation.

- **Transfer (T):** Delivering insights to stakeholders through intuitive dashboards and 3D visualisations, ensuring effective communication and usability.

Another adaptation of this framework proposes a data governance model for the built environment, focusing on delivering a vision for data in the built environment based on five key characteristics: the data should be **1) aligned, 2) transparent, 3) interoperable, 4) trustworthy, and 5) clear, consistent, and unambiguous** (Jones et al., 2025). These principles align with the digital governance and enabling frameworks in the EU, which were discussed earlier.

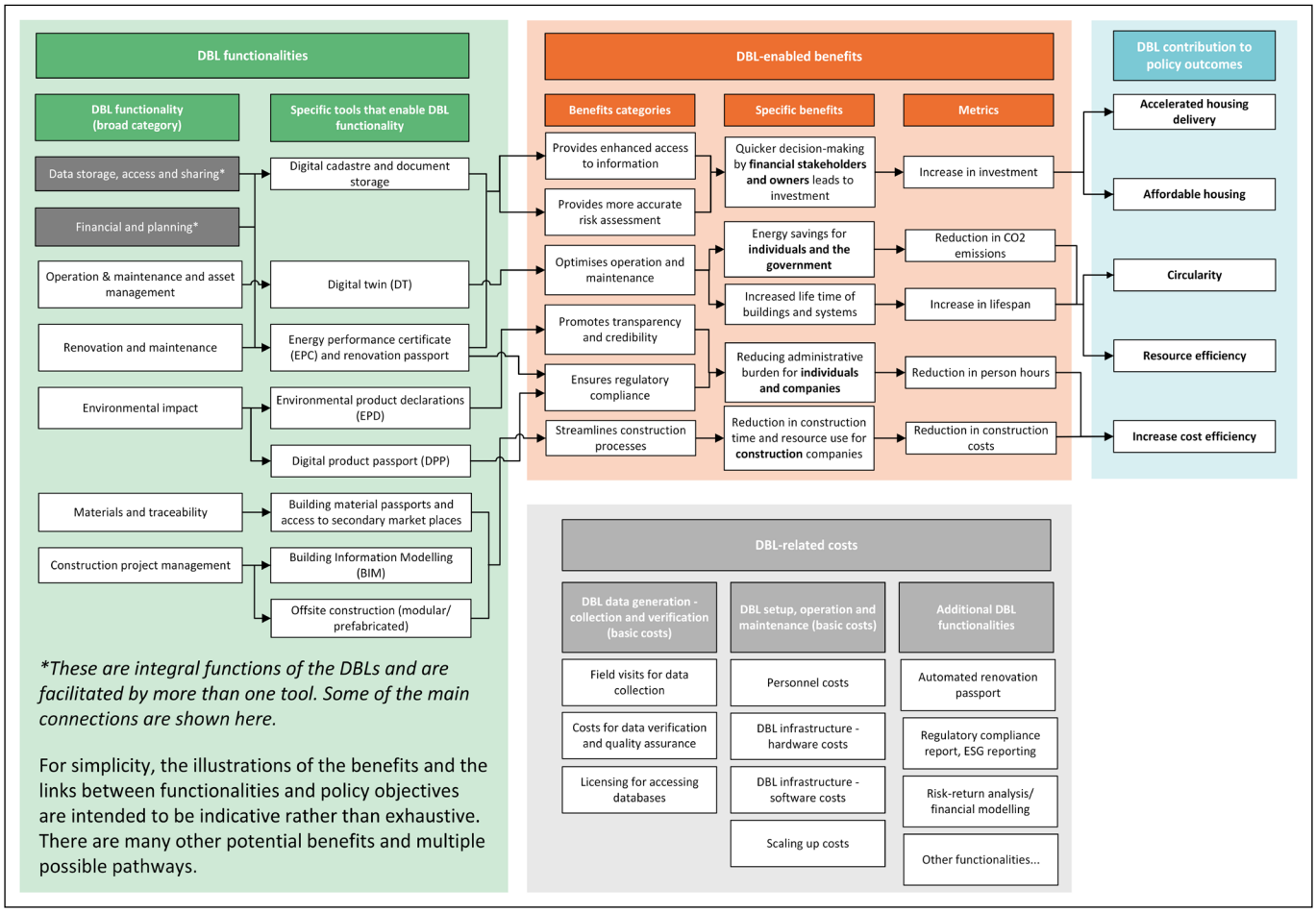
By applying this structured approach, DBLs can deliver a vision for the built environment where data is aligned, transparent, interoperable, trustworthy, and consistent. This technical rigour is particularly necessary given that most existing private DBLs currently rely on proprietary technologies, leaving their methods for governing data quality and interoperability largely opaque. Transitioning toward these open, standardised frameworks is therefore essential to prevent further data fragmentation and ensure DBLs provide measurable market value.

COST AND BENEFITS OF DBLs

Impact pathways from DBL functionalities to policy outcomes

As shown in Figure 4, DBL functionalities generate multiple quantifiable benefits that are systematically linked to specific policy outcomes. Establishing these systems involves three primary cost components: 1) human resources, 2) capital, and 3) operational costs (Ecorys et al., 2023). The capital costs required to enable the core DBL functionality of data collection, storage and access involve the following: collecting and verifying data; creating an online platform and semantic model; reaching an agreement on data standards with stakeholders; acquiring licensed data; and compiling a dictionary. DBLs also incur operational costs relating to maintenance, scaling up the number of DBLs and adding additional functionalities. The resulting benefits of DBLs are primarily realised as avoided costs, most notably through significantly reduced labour for information gathering and a decrease in the time required for regulatory permits and approvals.

Figure 4 Functionalities, benefits and costs of DBLs (Gokarakonda & Zsolt, 2025).



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Social cost-benefit analysis (SCBA)

In all three scenarios, the results demonstrate a positive Net Present Value (NPV) and a Benefit-to-Cost Ratio (BCR) greater than one, indicating that the cumulative benefits of DBL implementation clearly outweigh the costs of setting up and operating the platform (Table 6). The CBR increases with the number of additional functionalities.

Table 6 Results of the SCBA analysis (NPV and CBR).

	SCENARIO 1	SCENARIO 2	SCENARIO 3
NPV (EUR bn)	3,746.6	562.2	11.5
CBR	9.4	3.6	2.1

The SCBA model estimates a cost per DBL of approximately €1,000 in the first year, rising to approximately €1,100 by year 25, with only a marginal difference in the three scenarios. While this is higher than certain existing public DBLs or DBLs largely based on statistical models, it aligns with private-sector initiatives that rely on rigorous, on-site data collection. For comparison, the costs obtained from interviews with DBL providers vary significantly depending on their data collection methods and business models (Gokarakonda & Zsolt, 2025):

- **Public and mandatory**: Approximately €1.17 per building by consolidating existing public databases.
- **Mandated private**: A privately operated DBL in a country with a DBL mandate that gathers building-related information from existing data sources and on-site visits costs about €10 for a year of subscription.
- **Private and voluntary (statistical)**: DBL with focus on material passports that largely uses statistical methods to develop DBLs at a cost of approximately €7.5 per DBL.
- **Private and voluntary (on-site data collection)**: A DBL provider for large housing portfolios that collects and verifies data based on on-site visits costs between €500 and €1,000 for buildings requiring first-hand verification. However, the same DBL provider also considers that a licensing model for owners of large portfolios of between €0.13 and €0.25 per dwelling per month to be a feasible business model.

The high variability in the costs of DBLs is largely due to differences in governance and business models and the data collection methods. It underscores that DBL financial models are highly sensitive to the costs of data collection and verification methods. Although the total annual cost increases with the number of DBLs, capital expenditure ('basic costs') accounts for the largest proportion in the early years. From year five onwards, operational (recurring costs) and functionality-related costs become more significant. The cost per DBL stabilises at €1,160–€1,250, indicating that the DBL platform has reached maturity and the technical costs have levelled off due to economies of scale.

Another interesting finding of the SCBA is the disproportionate value generated by the functionalities. Table 7 enables the direct comparison of the proportion of total costs for setting up and maintaining the DBLs, and the proportion corresponding to the core and the additional functionalities in scenario 3. Although, the functionalities account for only around 12% of total costs, they represent over 60% of the total benefits.

Table 7 Approximate costs per DBL (selected years).

YEAR	TOTAL COST PER DBL (€)	BASIC COST PER DBL (€)	ADDITIONAL FUNCTIONALITY COST PER DBL (€)	SHARE OF ADDED FUNCTIONALITIES
3	1,185	1,035	150	~13%
10	1,237	1,084	153	~12%
25	1,251	1,101	150	~12%

Overall, the analysis shows that although initial investments are intensive, the benefits grow exponentially as the number of users increases. Because the savings from automated updates and reduced administrative effort are ongoing throughout a building's lifecycle, the system achieves a swift transition from an investment-heavy phase to one where the societal and market benefits clearly dominate the costs. These benefits become even more significant as additional functionalities are added, as the cost of these is often negligible compared to the capital costs of setting up DBLs.

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DISCUSSION

While significant progress has been made in promoting and implementing DBLs, and in consolidating data-related efforts in the built environment, several critical issues remain to be addressed if their wider adoption and full potential are to be realised. These include overcoming existing barriers and bottlenecks, establishing a common vision, and developing a simplified, fit-for-purpose implementation framework. The discussion that follows critically examines these issues and their implications for future development.

CHALLENGES AND OPPORTUNITIES FOR EU-WIDE DBL UPTAKE

Although DBLs have been on the EU policy agenda for over five years, it is likely to take at least another five years to establish an effective EU-wide governance framework, despite their formal recognition in the EPBD and ongoing standardisation efforts. Existing initiatives, such as Woningpas, are largely local or regional public-sector projects that are often constrained by limited funding and restricted functionality. The French model of mandatory DBLs operated through private providers could provide a governance pathway, but implementation must ensure that costs do not disproportionately affect small landlords or vulnerable households. While current pricing models appear manageable, greater market competition, broader service offerings, public funding and targeted incentives could improve affordability further and support wider adoption.

Experience with EPC implementation can provide useful lessons for DBLs. Despite long-standing EU requirements, EPC databases vary considerably across Member States in terms of cost, data scope, storage practices and access conditions. These variations reflect different administrative traditions and interpretations of data governance, even within GDPR compliance. For example, Germany does not maintain a central EPC database, whereas several Member States provide partial public access.

A major practical challenge is the cost of collecting data on-site in existing buildings. However, this is likely to decline as digital permitting becomes more widespread, automatically generating building data – including BIM models – and significantly improving the long-term cost-benefit ratio. In the short term, costs can be reduced by making use of existing data collection processes. The EPBD already requires on-site visits for EPC assessments and stipulates that calculation inputs must be stored, including data on building geometry, construction and technical systems. When linked to a unique building or unit identifier, this data could provide a practical starting point for DBLs. Advanced scanning technologies offer an additional way to reduce data collection costs.

These findings suggest that the main barriers to EU-wide deployment of DBL are now institutional rather than technical or economic. Therefore, the priority is to align governance models and stakeholder expectations through a shared European vision and a simplified framework that balances harmonisation with national flexibility.

A SHARED EUROPEAN VISION FOR DBLs

The lack of strategic alignment and standardised functionality necessitates the establishment of a shared European vision for DBLs to provide a unified direction for future development. This vision is a fundamental prerequisite for a robust EU-wide framework that integrates information across the entire building lifecycle. By converting raw building-level data into **actionable insights**, DBLs can streamline decision-making, reduce administrative burdens, and facilitate the sector's **twin (digital and green) transition**. Achieving coherence across multiple building-related policies – and ensuring their reliance on shared digital tools – will accelerate DBL adoption and unlock wider market benefits. Three prerequisites are essential for DBLs to deliver these benefits and impact (see Figure 5):

- **Data and databases** with clear requirements, protocols and robust approaches to data storage, exchange and management;
- **Tools and policy instruments** that enable the collection, storage, exchange and management of data, such as energy performance certificates and digital product passports, as well as other building information tools used across the construction and buildings sector, including BIM and digital twins; and
- **Policy coherence** between information needs and data requirements, with explicit recognition of DBLs as an enabling, cross-policy tool.

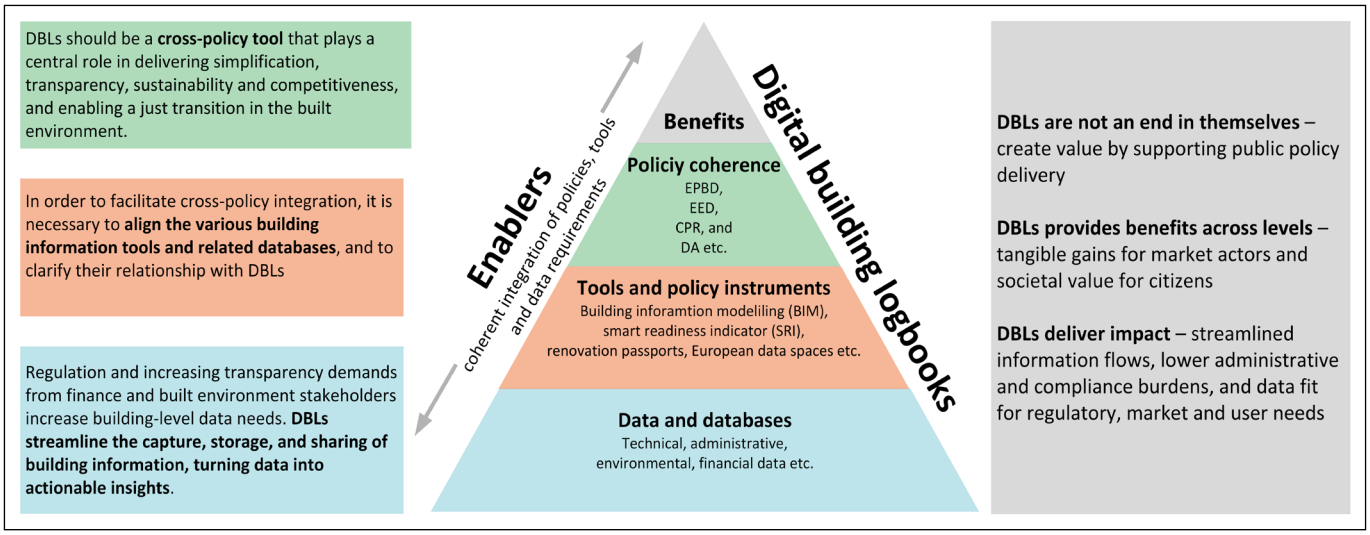

Figure 5 A vision for DBLs in the EU policy framework.

Drawing on these principles, the EU and its Member States could establish a clear, shared understanding of the DBL's role in supporting both national and broader European policy objectives. This process must be informed by extensive consultation with the diverse stakeholders identified in the EU policy framework, including public authorities, building owners, energy system operators, financial actors, and digital service intermediaries. A governance framework built upon this vision should identify and enable the DBL as a central hub and a cross-policy tool for streamlining data management across four key domains: operational energy performance, circularity and whole-life carbon, market competitiveness, and smart technologies.

SIMPLIFIED FRAMEWORK FOR DBLs

To bridge the gap between abstract policy goals and practical market application, we propose a simplified framework for DBL development. The framework should be as simple as needed to ensure usability, and as complex as necessary to deliver functionality and impact. It should enable a clear, accessible, and user-friendly core design to support broad uptake, while incorporating sufficient technical depth, regulatory alignment, and interoperability to generate measurable benefits and real market impact. We propose the following layered approach for the development of an EU-wide DBL framework (Figure 6).

- **Layer 1: Input–Process–Output (IPO) model:** This layer defines the specific **DBL functionality** to ensure that all stakeholders across the EU share a clear and intuitive understanding of what the DBL offers.
- **Layer 2: The 5W1H model (Who, What, Where, When, Why, and How):** By identifying specific needs and **mapping data and user journeys**, this layer ensures that the DBL is objective, deliver value and responds to real-world requirements.
- **Layer 3: Use case-specific value generation:** This layer focuses on scalability, generating tangible value by applying the 5W1H model to specific, **high-impact use cases** such as renovation planning or circularity.
- **Layer 4: Data governance and management:** This layer establishes the framework for ensuring data quality, usability, and privacy, protecting the rights of data owners while enabling access for authorized intermediaries. For example, we propose to use the framework proposed by (Jones et al., 2025).
- **Layer 5: Technical implementation:** The final layer manages the underlying **data technology and architecture**, ensuring the efficient management and exchange of building-related information across the value chain. For example, we propose to use the framework proposed by (Farghaly et al., 2026).

This structured approach recognizes that while a formal EU-wide governance framework is still being finalized, various market actors are already collecting and using building data to meet regulatory requirements (e.g., EPBD, CPR) and market demands (e.g., EU Taxonomy, ESG reporting). By aligning these existing practices within a unified, layered framework, Member States can prevent further fragmentation and ensure that DBLs deliver a net positive value for the entire built environment.

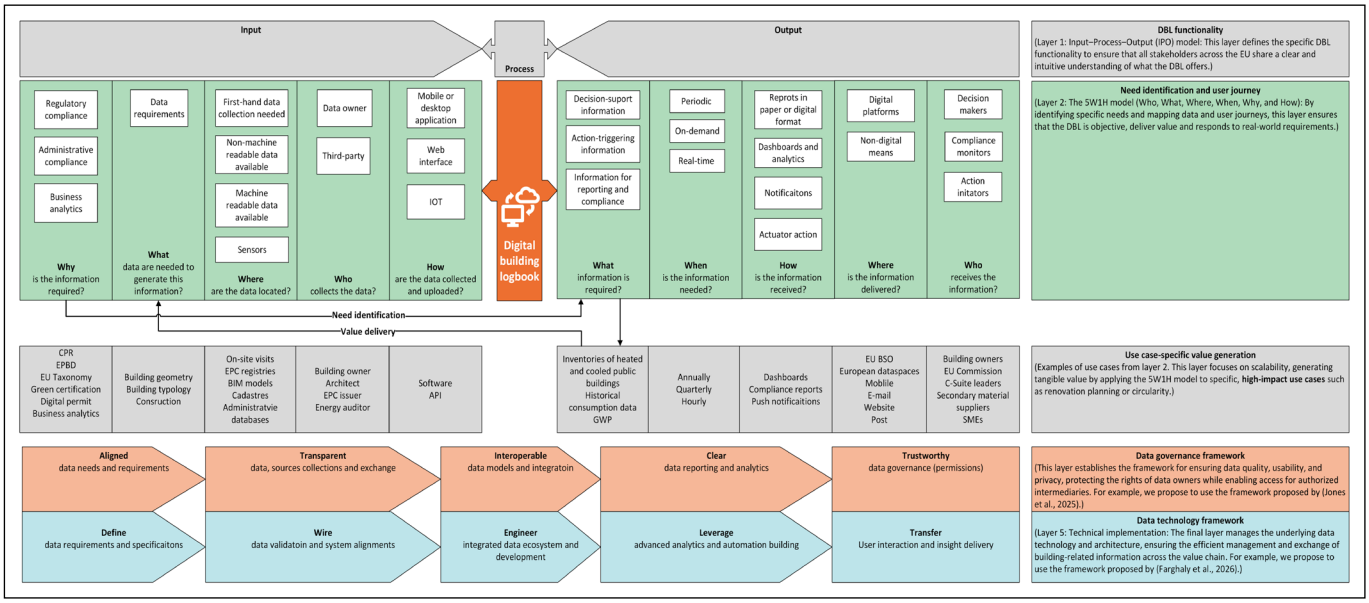

Figure 6 Simplified framework for DBLs.

CONCLUSION

The construction sector faces an increasing necessity to manage complex data for both regulatory compliance and strategic business needs. Digital building logbooks offer a primary solution to streamline this information management, providing measurable benefits to stakeholders while directly contributing to EU policy objectives. Currently, a significant window of opportunity exists to transition from fragmented national initiatives to a harmonised, EU-wide approach, supported high technological readiness, and increasing market maturity. Crucial measures to drive market uptake include leveraging the implementation of the EPBD implementation, standardising data frameworks for the built-environment, and aligning information requirements across all building-related policies, tools and policy instruments.

LIMITATIONS

The nature and set-up costs of DBLs vary widely. As they are still emerging instruments or products, it is difficult to accurately estimate their costs and benefits. Consequently, the net present values in this study, particularly the best-case scenarios, may be overestimated. Although this study attempts to provide reasonable assumptions based on the literature, a study more specifically focused on geographic location and use cases would provide more accurate and reasonable assumptions.

DATA ACCESSIBILITY STATEMENT

The SCBA model can be made available upon request.

ADDITIONAL FILE

The additional file for this article can be found as follows:

- **PowerPoint Slides.** PowerPoint Slides relating to this article. URI: https://eceeeproceedings.org/articles/7/files/6a5df08030538.pdf

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The authors have no competing interests to declare.

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