



**Building Performance Digitalisation  
and Dynamic Logbooks  
for Future Value-Driven Services**

**Deliverable 6.2**

**CHRONICLE Business**

**Innovation Plan & Replication**

**Roadmap**



**Funded by  
the European Union**

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## Abbreviations and Acronyms

TERM	DESCRIPTION
AECO:	Architecture, Engineering, Construction & Operations
BIM:	Building Information Modelling
CDE:	Common Data Environment
DBL:	Digital Building Logbook
DT:	Digital Twin
EED:	Energy Efficiency Directive
EPBD:	Energy Performance of Buildings Directive
EPC:	Energy Performance Contract
ESCO:	Energy Service Company
FM:	Facility Management
GDPR:	General Data Protection Regulation
HVAC	Heating, Ventilation and Air Conditioning
IAQ:	Indoor Air Quality
IFC:	Industry Foundation Classes
IoT:	Internet of Things
IPR:	Intellectual Property Rights
KPI:	Key Performance Indicator
KR:	Key Result
LCA:	Life Cycle Assessment
LCC:	Life Cycle Costing
ROI:	Return on Investment
SLA:	Service Level Agreement
SRI:	Smart Readiness Indicator
TRL:	Technology Readiness Level
UC:	Use Case

## Executive summary

Deliverable 6.2 – **CHRONICLE Business Innovation Plan & Replication Roadmap** – presents the overall strategy to support the **market uptake, exploitation, and scaling** of the solutions developed within the project. It brings together the outcomes of Tasks **T6.4** and **T6.5**, linking CHRONICLE's technical achievements with viable business models and long-term pathways for replication across Europe.

The deliverable provides an integrated framework that combines **market analysis, stakeholder mapping, and value-chain assessment** to ensure that CHRONICLE's **Key Exploitable Results (KERs)** can evolve into operational and economically sustainable products and services. Key tools such as the **Exploitation Roadmap, the IPR Checklist, and the BFMULO Matrix** support partners in defining responsibilities, identifying suitable protection strategies, and clarifying future exploitation intentions.

A dedicated section of the deliverable outlines the **ten KERs developed in CHRONICLE**, including the Common Data Environment, the Data-Driven and Physics-Based Digital Twins, the Renovation Planner, the Investment Appraiser, the Digital Building Logbook, and the ChroView suite of applications. For each KER, the document summarises its technological maturity, involved partners, expected impact, and possible exploitation routes.

The deliverable also introduces the concept of the **Replication Roadmap**, which is not presented as a single, isolated chapter. Instead, the roadmap is embedded across multiple sections of the deliverable. The analyses of the KERs, the Exploitation Roadmap, the replication methodology, and the Business Model Canvases collectively form the basis of CHRONICLE's replicability strategy. Together, these components provide a structured understanding of how CHRONICLE solutions can be transferred and adapted across different geographical and regulatory contexts.

In addition, the report presents **business models for each use case**, developed through Business Model Canvas analyses and the identification of alternative revenue streams. These models support innovative service concepts such as **comfort-as-a-service, predictive maintenance, renovation planning services, and user-centric digital tools** for building occupants and facility managers.

The deliverable concludes with **strategic recommendations** for stakeholders, highlighting the importance of:

- **integrating technical and business considerations** from an early stage,
- **strengthening collaboration across the building value chain**, and
- adopting **innovative financing mechanisms** to accelerate the transition towards Zero and Net-Zero Carbon Buildings.

Overall, Deliverable 6.2 provides the strategic foundation to ensure that CHRONICLE's solutions can become **scalable, replicable, and market-ready**, supporting Europe's objectives for a more sustainable and climate-neutral built environment.

# 1. Introduction

## 1.1. Objectives of the deliverable

The objective of Deliverable 6.2, “**CHRONICLE Business Innovation Plan and Replication Roadmap**,” is to present a comprehensive framework for the **exploitation and future uptake** of the solutions developed within the CHRONICLE project. The deliverable consolidates the project’s exploitable outputs and provides strategic guidance on how these results can be transferred, adopted, and replicated across the European building sector.

The document identifies CHRONICLE’s **Key Exploitable Results (KERs)** and analyses their potential value, target users, ownership structures, and exploitation opportunities. For each KER, the deliverable outlines its technological maturity, expected benefits, and possible pathways for further development beyond the project’s duration.

In addition, the deliverable introduces key tools such as the **IPR Checklist**, the **BFMULO Matrix**, and the **Exploitation Roadmap**, which support partners in defining responsibilities, managing intellectual property, and aligning individual and collective exploitation intentions.

The deliverable also presents the **Replication Roadmap**, understood as a cross-cutting framework rather than a single chapter. The roadmap is constructed through the combination of several core components: the KER analyses, the exploitation strategy, the replication methodology, and the Business Model Canvases. Together, these elements provide a structured approach for transferring CHRONICLE solutions to different geographical, regulatory, and operational contexts. This integrated roadmap builds on the outcomes of the project’s demonstrations and identifies the factors that may enable or hinder large-scale adoption.

The main objectives of this deliverable are therefore to:

- **Identify and structure the CHRONICLE Key Exploitable Results**, including their characteristics, beneficiaries, and exploitation potential.
- **Clarify ownership, responsibilities, and IPR management**, ensuring a clear framework for post-project use.
- **Support partners in defining their exploitation intentions**, both individually and collectively.
- **Provide guidance for replication and scaling**, ensuring that CHRONICLE results can be transferred to broader European contexts.

By fulfilling these objectives, Deliverable 6.2 contributes to **maximising the long-term impact** of CHRONICLE innovations and supports their evolution into **replicable and sustainable solutions** that can accelerate the digital and green transition of the European building stock.

## 1.2. Deliverable description

**Deliverable 6.2, “CHRONICLE Business Innovation Plan and Replication Roadmap,”** presents the consolidated approach for the **exploitation, management, and replication** of the results generated within the CHRONICLE project. It brings together the activities carried out under **Task 6.4** and **Task 6.5**, providing a unified framework to support the future uptake and long-term sustainability of CHRONICLE’s Key Exploitable Results (KERs).

The document is structured into several core sections:

- **Introduction:** Outlines the purpose, scope, and relevance of the deliverable, explaining how it supports the transition of CHRONICLE outcomes toward future use and adoption.
- **Key Exploitable Results (Task 6.4 & Task 6.5):** Presents the **ten CHRONICLE KERs**, detailing their characteristics, technological maturity (also called Technology Readiness Level or TRL), exploitation potential, target stakeholders, and associated ownership. This section also introduces tools such as the **BFMULO Matrix** and the **IPR Checklist** to structure and support exploitation activities.
- **Exploitation Strategy:** Defines the approach adopted to manage CHRONICLE’s tangible and intangible results, including **IPR considerations**, ownership models, and responsibilities of the partners. It also outlines the **individual and joint exploitation intentions** collected from the consortium.
- **Exploitation Roadmap:** Provides a forward-looking view of how each KER can evolve beyond the project’s lifetime, highlighting development needs, expected benefits, and potential application pathways.
- **Replication Roadmap:** Describes the methodology and strategic considerations for transferring CHRONICLE outcomes to different European contexts. It integrates lessons learned from the project’s demonstrations and assesses **enabling factors, barriers, and context-specific requirements** for broader adoption.
- **Conclusions:** Summarises the key elements of the business innovation and replication strategy, reinforcing the role of this deliverable in ensuring the long-term relevance, usability, and impact of CHRONICLE’s results.

Through this structure, Deliverable 6.2 acts as both an **exploitation framework** and a **replication guide**, ensuring that the project’s innovations can be effectively transferred, further developed, and adopted within the European building sector.

## 1.3. Methodology

The methodology developed for the final exploitation activities has been defined as part of Task 6.5.

In particular, the following steps are foreseen:

- a. **Exploitation Roadmap:** The Exploitation Roadmap is a comprehensive checklist aiming to define all the necessary actions (strategic, marketing, technical, administrative activities) to create a solid exploitation approach for each KER. It involves the definition of the roles in the value chain and an estimation of costs and

revenues. This effort is aimed at ensuring that the exploitation process can be executed in the most optimal and effective manner possible.

- b. **IPR Checklist:** It is a Word form intended to highlight all the results of the CHRONICLE project which will be protected with IP protection tools.
- c. **BFMULO Matrix:** BFMULO is an acronym for Background, Foreground, Making, Using, Licensing, Other. The matrix is used for the identification of partners' roles towards exploitation and commercialisation of results.

The activities listed above are further detailed in the following sections.

### 1.3.1. Exploitation Roadmap

The Exploitation Roadmap is a checklist developed by RINA-C for EU-funded R&D projects intended to design a roadmap for the exploitation of KERs. It is structured into different sections to cover all the relevant aspects, in order to fully exploit the results.

**Actions.** In this section partners indicate which commercial, technical and administrative activities they plan to perform in the first 12 months after the end of the project to exploit the results.

**Roles.** It intends to define the suppliers' and commercial side of the business model, offering an overview of the supply and value chain connected to the KER.

**Timing.** A visual representation of the timeline of the indicated actions is given through a GANTT chart.

**Financial costs.** It highlights the costs associated with each activity needed to exploit the result.

**Revenues.** The goal is to estimate pricing, margin and payback time of the developed result.

**Sources of coverage.** In this section partners indicate where they intend to find the financing needed for exploitation of results.

**Impact.** This section highlights the expected impact of the KER three years from the end of the project.

Table 1 presents a blank template for the Exploitation Roadmap for reference.

Table 1: Exploitation Roadmap blank template

Exploitation Roadmap: <i>KER N#</i>	
Lead: <i>KER Leader N#</i>	
KER Owners: <i>Partner/s</i>	
TRL at the end of the project: <i>TRL #</i>	
<b>Actions</b>	<p><i>Briefly describe actions planned to be executed within 12 months after the end of the project (select the relevant ones).</i></p> <p><b>Pre-Commercial strategic activities:</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Definition of the supply chain</li> <li><input type="checkbox"/> Definition of the distribution chain</li> <li><input type="checkbox"/> Definition of the logistics</li> <li><input type="checkbox"/> Other</li> </ul> <p><b>Commercial agreement preparation:</b></p>

- With partners (suppliers) from the supply chain
- With technical consultants and/or experts
- With manufacturers
- With third parties that will supply resources (manpower, machine, plants, facilities)
- With financial bodies and investors
- With the distribution chain (sellers, agents, shops, retailers, installers etc.)
- With the logistics operators
- Other

**The agreement on common IP (if any) should include at least the following items, please select those that still need to be discussed:**

- Shares of the IP
- Roles of IP owners in the future value chain, revenue streams and third parties involved
- Rules for managing the IP, in particular costs of maintenance
- Rules for accessing the IP (e.g. licensing fees, royalties)
- Rules on exclusion or exclusivity (e.g. exclusion of potential competitors as third-party users)
- Rules for specific geographic coverage or markets
- Other

**Technical activities towards TRL 9:**

Select the pilot customers for TRL 9 tests.

- Test the solution at TRL 9, in real operational environment (pilot)
- Build or finalise manufacturing processes and lines
- Build or finalise procedures for:
  - Quality control
  - HSE
  - Further testing
  - Involvement of third parties
  - Other
- Prepare the technical manual
- Prepare the operation and maintenance procedures and plans
- Finalise pre-production tests
- Other

**Administrative activities towards TRL 9:**

- Start contracts with suppliers
- Start contracts with selling channels
- Build or finalise procedures for:
  - Purchasing
  - Warehousing
  - CRM

- Invoicing
- After-sales engagement
- Management of spare parts
- Management of consumables
- Management of accessories
- Other

**After-sales activities towards TRL 9:**

- Creation of an after-sales team
- Definition of procedures for technical support
- Definition of procedures for customers to claim
- Definition of warranty
- Operation and maintenance technical support
- Definition of procedures for technical support with spare parts
- Definition of procedures for technical support with consumables
- Definition of procedures for technical support with accessories
- Other

**Marketing campaign towards TRL 9.** As soon as the commercial agreements among partners are signed, a marketing plan should be defined with the aim of promoting the launch of the product and involve new stakeholders in the business. Please select relevant items which are still missing (or to be finalised):

- The creation of a dedicated website centred on the solution
- The creation of a dedicated web-campaign centred on the solution
- The creation of a dedicated social media campaign centred on the solution
- The set up of a number of remote events (e.g. webinars) to show the achievements of the solution
- The identification of a (few) final test case of great resonance, which could become a “testimonial” of the solution
- The creation of all the useful dedicated services around the product (e.g. CAD model of the product, free trials for software, lite versions, handbook and manuals, helpdesk service etc.)

**Target geography:**

List of top 3 target countries/regions where the solution will be proposed:

1. ....
2. ....
3. ....

**Activities related to geography:**

- Start-up of local commercial offices/branches
- Start-up of local manufacturing/assembly facilities
- Start-up of local technical support offices, including helpdesk
- Establishment of local value chains (production)

	<input type="checkbox"/> Establishment of local commercial partnerships (selling) <input type="checkbox"/> Planning of local communication (including partnerships with local consultants) <input type="checkbox"/> Establishment of other local synergies <input type="checkbox"/> Design of local brands or trademarks
<b>Roles</b>	<p>Please check the relevant boxes of the supply chain and insert the name of partners from the current consortium, who are already covering some of the roles:</p> <p><b>Suppliers' side of the business model:</b></p> <p>Suppliers of (hardware/manufacturing):</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Raw materials</li> <li><input type="checkbox"/> Semi-finished products</li> <li><input type="checkbox"/> Components</li> <li><input type="checkbox"/> Accessories</li> <li><input type="checkbox"/> Design, Consulting services</li> <li><input type="checkbox"/> Quality and certification services</li> <li><input type="checkbox"/> Human resources</li> <li><input type="checkbox"/> Production machines / lines</li> <li><input type="checkbox"/> Packaging</li> <li><input type="checkbox"/> Other</li> </ul> <p>Suppliers of (service/software development):</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Digital services (e.g. cloud)</li> <li><input type="checkbox"/> IT support</li> <li><input type="checkbox"/> Basic software</li> <li><input type="checkbox"/> Hardware</li> <li><input type="checkbox"/> Design, Consulting services</li> <li><input type="checkbox"/> Quality and certification services</li> <li><input type="checkbox"/> Human resources</li> <li><input type="checkbox"/> Other</li> </ul> <p>Other suppliers:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Administrative services</li> <li><input type="checkbox"/> HSE consulting</li> <li><input type="checkbox"/> IP, legal consulting</li> <li><input type="checkbox"/> HR training</li> <li><input type="checkbox"/> Other human resources</li> <li><input type="checkbox"/> Other</li> </ul> <p><b>Commercial side of the business model:</b></p> <p>Technical partners:</p>

	<input type="checkbox"/> System integrator <input type="checkbox"/> Installer <input type="checkbox"/> Operation support <input type="checkbox"/> Maintenance support <input type="checkbox"/> Local on-site helpdesk <input type="checkbox"/> Decommissioning support  Commercial partners:  <input type="checkbox"/> Dealers, distributors <input type="checkbox"/> Local agents <input type="checkbox"/> Local Service providers <input type="checkbox"/> Financial bodies (e.g. banks, ESCOs etc.)
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Please build a GANTT chart for the abovementioned activities:

<b>Activities/months after the end of the project</b>	1	2	3	4	5	6	7	8	9	10	11	12
Pre-Commercial strategic activities												
Commercial agreements												
agreement on common IP												
Technical activities towards TRL 9												
Admin activities towards TRL 9												
After-sales activities towards TRL 9												
Marketing campaign towards TRL 9												
Activities related to geography												
Manufacturing side of the business model												
Commercial side of the business model												
<b>Financial Costs</b>	Please provide an estimation of the costs for each activity towards TRL 9, by specifying the sub-activity from the previous checked lists:											

	<b>Activity</b>	<b>Sub-activity</b>	<b>Cost estimation range (€)</b>
	Overall project costs		
	Pre-Commercial strategic activities		
	Commercial agreements		
	IP and legal activities		
	Technical activities towards TRL 9		
	Admin activities towards TRL 9		
	After-sales activities towards TRL 9		
	Marketing campaign towards TRL 9		
	<b>Total</b>		<b>0</b>
<b>Revenues</b>	<b>Pricing strategy for the KER:</b>		
	<b>Unit</b>	e.g. pieces, full package, service, person-months etc.	Please specify
	<b>Estimated price (range) for the KER</b>		(€)
	<b>Yearly fees or other sources of revenues</b>		(€/year)
	<b>Margin on KER (%)</b>	0	
	<b>Margin on the fee (%)</b>	0	
	Estimated years for payback: <input type="checkbox"/> < 1 year <input type="checkbox"/> 1 year <input type="checkbox"/> 2 years <input type="checkbox"/> 3 years <input type="checkbox"/> > 3 years		
<b>Other sources of coverage</b>	Possible alternative sources for covering the previously introduced costs: <input type="checkbox"/> Local/national public funds (please provide details): <input type="checkbox"/> European R&D funds (e.g. Horizon Europe): <input type="checkbox"/> Private investments: <input type="checkbox"/> Banks <input type="checkbox"/> Financial funds <input type="checkbox"/> Business angels		

	<input type="checkbox"/> Private industry <input type="checkbox"/> Other private investors, please specify:..... <input type="checkbox"/> Own investments
<b>Impact in 3-year time</b>	<p>Summary of expected impacts:</p> <p><b>Economic impacts</b></p> <input type="checkbox"/> Increased direct revenues <input type="checkbox"/> Increased indirect revenues <input type="checkbox"/> Increased margin <input type="checkbox"/> Increased market share <input type="checkbox"/> New market entrance <input type="checkbox"/> New geography entrance <input type="checkbox"/> Other <p><b>Social impacts</b></p> <input type="checkbox"/> New jobs created <input type="checkbox"/> Increased quality of job <input type="checkbox"/> Increased quality of life <input type="checkbox"/> Cultural impacts <input type="checkbox"/> New market entrance <input type="checkbox"/> New geography entrance <input type="checkbox"/> Other <p><b>Environmental impacts</b></p> <input type="checkbox"/> Decreased CO2 <input type="checkbox"/> Decreased PM10 <input type="checkbox"/> Decrease of other pollutants <input type="checkbox"/> Water savings <input type="checkbox"/> Energy savings <input type="checkbox"/> Resources savings <input type="checkbox"/> Other <p><b>Other impacts</b></p> <p>.....</p> <p>.....</p>

### 1.3.2. BFMULO matrix

The BFMULO matrix is utilised as a tool for recording the exploitation claims and expectations of partners. The acronym BFMULO represents specific intentions regarding exploitation, which are to be placed within the BFMULO matrix.

BFMULO is an acronym that stands for:

- **B:** IPRs on *background* information. It is pre-existing knowledge, information, technologies, or intellectual property that a project partner already possesses or has

developed before entering the project. It encompasses any existing intellectual property rights, patents, copyrights, trade secrets, or other proprietary information that may be relevant to the project.

- **F:** IPRs on *foreground* information. Information and knowledge represented by outcomes produced by project partners. Ownership, rights, and responsibilities related to the project partner foreground are typically addressed in the collaboration agreement or contract between the project partners. These agreements specify how the foreground intellectual property will be owned, shared, used, and protected among the partners. Properly defining and managing the project partner foreground is important to ensure a fair distribution of rights and benefits among the collaborating parties and to facilitate the effective exploitation and commercialisation of the project outcomes. If a partner wants to have a contribution recognised in an exploitable outcome (choosing to be an F in the KER), they must be actively involved in tasks that directly contribute to achieving that outcome.
- **M:** Making the result. Being engaged in tasks directly associated with the manufacturing process, creating and selling the results. A partner should actively participate in activities that contribute to the successful production and commercialisation of the product/software outlined in the KER. This is not strictly connected to IP ownership: if the IP owner does not have the resources or skills to produce and sell the result, an agreement may be signed between the parties.
- **U:** Using the result. Utilising one's own expertise to generate novel product lines or processing techniques is a way to implement foreground intellectual property. Moreover, foreground intellectual property can be directly or indirectly employed in supplementary research tasks beyond the project's scope or in the development, production, and marketing of a method, product, or service. Demo partners typically display minimal interest in manufacturing or commercialising the outcomes. Their involvement in the project stems from the belief that incorporating the developed solution into their processes or systems could bring potential benefits. As active participants in the study, it is expected that they will have fair access to the outcomes as end-users.
- **L:** Licensing the result. Revenue generated through agreements with external parties, who are not part of the consortium, is an example of income from deals with third parties. One option in such cases is to license the protected intellectual property (IP) when a partner lacks the necessary skills or resources to fully capitalise on a particular result or wishes to explore non-commercially viable areas. This means that a third party, who is not a member of the consortium, may enter into a contract with the owner of the IP and utilise it for their own purposes.
- **O:** Other. Any other methods of exploitation (e.g.: consultancy, provide special services, build academic courses, etc.).

The partner is called to select the appropriate "actions" (B, F, M, U, L, O) in the initial table and provide a brief explanation for their decision. To assist in completing this task, a checklist is provided to guide the partner's selection process, as shown in Table 2.

Table 2: BFMULO checklist blank template

<b>Name of the partner</b>	.....
<b>Title and number of the KER</b>	KER n° .... – Title: .....
<b>B – Background</b>	Do you have background for this KER?

	<input type="checkbox"/> YES <input type="checkbox"/> NO In case you checked "YES", your background is: <input type="checkbox"/> A patent (please specify the title and publication number) <input type="checkbox"/> Other types of IP (e.g. copyright, design, etc.) <input type="checkbox"/> Industrial secret <input type="checkbox"/> A product/service <input type="checkbox"/> A scientific publication (or similar) <input type="checkbox"/> Other (please specify)
<b>F – Foreground</b>	Do you have foreground for this KER? <input type="checkbox"/> YES <input type="checkbox"/> NO In case you checked "YES", your proposed foreground is: <input type="checkbox"/> A patent (please specify the title and publication number) <input type="checkbox"/> Other types of IP (e.g. copyright, design, etc.) <input type="checkbox"/> Industrial secret <input type="checkbox"/> A new or improved product/service <input type="checkbox"/> A scientific publication (or similar) <input type="checkbox"/> Other (please specify)
<b>M – Manufacturing</b>	Are you going to: <input type="checkbox"/> Manufacture (and sell) the full KER (which is a product) <input type="checkbox"/> Manufacture (and sell) part of the KER (e.g. one component) <input type="checkbox"/> Write the software/firmware (or similar) <input type="checkbox"/> Create the tools, software tools to propose the KER (which is a service) <input type="checkbox"/> Sell, adjust, evolve the KER (which is a service) <input type="checkbox"/> Other (please specify)
<b>U – Using</b>	Are you going to: <input type="checkbox"/> Buy / adopt the full KER (which is a product) <input type="checkbox"/> Integrate part of the KER (e.g. one component) in one of your products <input type="checkbox"/> Buy / use the service <input type="checkbox"/> Other (please specify)
<b>L – Licensing</b>	Are you going to licence to third parties (out of the initial consortium) the KER? <input type="checkbox"/> YES <input type="checkbox"/> NO In case you answered "YES", have you identified the entity for licensing:

	<input type="checkbox"/> Yes, there is already a name for licensing and initial commercial agreements have started <input type="checkbox"/> Yes, there is already a name for licensing <input type="checkbox"/> Yes, there is a clear profile of the entity for licensing <input type="checkbox"/> No, but it is necessary to find an entity for licensing What will be the main role of the entity and the scope of licensing (please select all relevant answers): <input type="checkbox"/> Manufacturing (also considering software and tools) <input type="checkbox"/> Selling the product or providing the same service <input type="checkbox"/> Distributing the product <input type="checkbox"/> Service, after sales <input type="checkbox"/> Maintenance and repair <input type="checkbox"/> Other, please specify:...
<b>O - Other</b>	There are several other options to exploit a KER. Please select one or more that can be relevant for your organisation and add anything else that is not included in the list: <input type="checkbox"/> Build academic courses <input type="checkbox"/> Provide consultancy <input type="checkbox"/> Create a Spin-Off Company <input type="checkbox"/> Support further R&D studies <input type="checkbox"/> Other, please specify:...

Finally, the information collected via the checklist is reported, for each KER, with the following format:

Table 3: Blank

Partner Name	KER 1					
	B Background	F Foreground	M Making	U Using	L Licensing	O Other
CIRCE						
KTU						
HYP						
PRAGMA						
QUE						
R2I						
FællesBo						

### 1.3.3. IPR Checklist

The IPR Checklist is a questionnaire developed by RINA-C intended to highlight all the results of the CHRONICLE project which will be protected with IP protection tools. The Checklist is a useful tool to investigate the means of protection used by partners to protect inventions, innovative solutions, software and algorithms, scientific articles, trademarks and knowledge.

A blank template for the IPR Checklist is reported as reference.

Table 4 - IPR Checklist Blank Template

Name of the PARTNER:			
<b>INVENTION / INNOVATIVE SOLUTION</b>			
<b>Have you developed inventions / innovative solutions / innovative technologies you have protected, or you plan to protect with IP instruments?</b>			
<ul style="list-style-type: none"> <li>• <input type="checkbox"/> YES</li> <li>• <input type="checkbox"/> NO</li> </ul>			
If YES, please give a brief description of the invention / innovative solution, indicate if it has already been protected and how ( <b>P</b> : Patent, <b>UM</b> : Utility Model, <b>ID</b> : Industrial Design, <b>C</b> : Copyright, <b>T</b> : Trademark, <b>TS</b> : Trade Secret)*. A technology can be protected in multiple ways, please select all the applicable options in column 4.			
Invention / Innovative solution description	Relevant WP(s)	Already protected (YES / NO)	How? (P, UM, ID, C, T, TS)*
<b>Example: Carbon membrane for separation of hydrogen from NH<sub>3</sub> cracking. The carbon membrane is made from ... with innovative materials ... (please explain shortly)</b>	3	NO	P
<b>Example: New propulsion system for cars based on ... (please explain shortly)</b>	2, 5	YES	ID (a component of the system) TS
Type here			
Type here			

Type here			
Type here			
Type here			

**SOFTWARE**

**Are you writing code / Have you developed software(s) in the scope of the project?**

- YES
- NO

**If YES, what software did you develop?**

1. Example: Digital twin for X and Y
2. ....
3. ....
4. ....
5. ....
6. ....

By EU laws, you automatically own the copyright for any software you develop. The software can be patented only if it provides a technical solution to a technical problem. **Please list below the software, if any, you plan to protect with a patent.**

1. ....
2. ....
3. ....
4. ....
5. ....

**SCIENTIFIC ARTICLES**

**Have you published or participated in the publication of scientific articles related to the project in the past? Will you in the future?**

- YES, we already did it
- YES, we plan to do it in the future
- YES, we already did it and also plan do to it in the future

- NO

If YES, please insert in the table the topic of the publication and if the article was already published. If so, insert the link to the publication.

Topic of the publication	Already published (YES / NO)	Link/DOI (if already published)
Type here		
Type here		
Type here		
Type here		
Type here		

**TRADEMARK**

Do you plan to protect (or did you protect) any of the signs that distinguish your products or services (names, words, phrases, symbols, images, ...) developed during the project?

- YES
- NO

If YES, which ones?

Type of trademark (name, word, phrase, symbol, image, ...)	Trademark	Already protected (YES / NO)
Example: Name of the company	APPLE	NO
Example: Symbol		YES
Type here		
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Type here			
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**KNOW-HOW**  
**What is the knowledge or know-how developed during the project that you will keep secret (Trade Secret)?**

1. Example: Recipe of Coca-Cola
2. ....
3. ....
4. ....
5. ....
6. ....

**OTHER**  
**Is there something not listed before that you protected or intend to protect?**

1. ....
2. ....
3. ....
4. ....
5. ....



### 1.3.4. Use Cases and Business models

The definition of **Use Cases and Business Models** represents a core component of the methodology adopted in Deliverable 6.2, ensuring that CHRONICLE’s technological solutions are grounded in real operational needs and supported by viable market pathways. The approach combines qualitative and quantitative analyses to translate pilot activities, stakeholder interactions, and tool functionalities into validated business opportunities.

The process began with a **comprehensive mapping of CHRONICLE Use Cases**, as presented in Chapter 2 of this deliverable. Each Use Case is linked to specific CHRONICLE tools—such as the **Common Data Environment, Digital Twins, Renovation Planner, Dynamic Building Logbook, and ChroViewFM**—and reflects the concrete conditions of the project’s pilot sites. For each Use Case, the consortium analysed:

- **Actors and stakeholders involved**, their roles, interests, pain points, and expected benefits.
- **Key technological components**, including data sources, digital workflows, and integration needs.
- **Regulatory, financial, and operational constraints**, evaluated through feasibility, impact, and alignment checks.
- **Market relevance**, including user demand, service potential, and scalability across Europe.

Building on this assessment, the project developed a **Business Model Canvas** for all Use Cases (Chapter 3). The business modelling followed a structured, iterative methodology that included:

1. **Value Proposition definition** – identifying the tangible and intangible benefits created by CHRONICLE solutions, from comfort-as-a-service models to data-driven renovation planning, predictive maintenance, and trusted building logbooks.
2. **Stakeholder and customer segmentation** – distinguishing the roles of building owners, facility managers, ESCOs, AECO professionals, tenants, and public authorities.
3. **Revenue model exploration** – assessing subscription-based models, performance-based contracts, licensing opportunities, Data-as-a-Service (DaaS), and alternative network-based revenue streams.
4. **Cost structure and key resources** – understanding infrastructure requirements, digital capabilities, and maintenance needs to ensure long-term operational viability.
5. **Partner ecosystem mapping** – identifying technological, financial, and operational partners essential to market uptake.

The resulting Use Case–driven business models form the foundation for the **Replication Roadmap and Exploitation Strategy**, providing a structured pathway from technological innovation to market-ready, scalable solutions.

### 1.3.5. Replication Roadmap

The methodology adopted for the Replication Roadmap follows a simplified and high-level approach and is directly informed by the activities carried out under Task 6.4 (Business Models) and Task 6.5 (Exploitation Planning). The Roadmap is therefore built on the evidence, analyses, and insights already developed within the project regarding the exploitation potential of the Key Exploitable Results (KERs) and the associated business opportunities. The process was structured around three main steps:

#### **1. Consolidation of inputs from exploitation activities**

The starting point consisted in collecting and reviewing the key outcomes of the exploitation work, including the Business Model Canvas analyses, the KER exploitation strategies, and the results of the BFMULO and Exploitation Roadmap exercises. These elements provided an overview of the value propositions, target users, expected benefits, and conditions for future uptake of the CHRONICLE solutions.

#### **2. Identification of general factors influencing replication**

Based on the consolidated exploitation insights, a set of high-level factors that may affect the replication of CHRONICLE results was identified. These factors include broad technical, organisational, regulatory, and economic conditions that could either enable or limit the transfer of the solutions to other buildings, organisations, or geographical contexts. The analysis is qualitative and does not aim to provide a country-by-country assessment.

#### **3. Definition of generic replication considerations**

The final step consisted in translating the above into a set of general considerations to guide potential future adopters. These considerations include the need to ensure a minimum level of technical interoperability, the involvement of relevant stakeholders, alignment with national and European regulatory frameworks, and the possible use of available financing or incentive schemes. Such considerations do not constitute a detailed implementation plan but represent high-level guidance based on the project's experience.

This methodology provides a concise and flexible basis for the Replication Roadmap, reflecting the current maturity of the project results and their exploitation analysis. It is intended as an initial supporting framework that can be further expanded in future initiatives or commercial developments.

## 2. Key Exploitable Results (KERs)

### 2.1. Identification of KERs

The main purpose of the Key Exploitable Results list is to establish the results developed throughout the project. The list, which has been continually updated during the project, includes the following information:

- Name of KER: clear and concise label for the KER. It is technically accurate and visually appealing for dissemination purposes.
- Relevant WP(s): work package(s) where the KER is designed, developed, demonstrated, and tested.
- Leading partner: the partner responsible for developing the KER. Generally, it is the one with the most significant responsibilities (task leaders, WP leaders, intellectual property owners).
- Involved partners: all partners involved in the relevant WP(s) and directly connected to actions related to the KER.

Table 5: Final list of KERs sorted by KER number

N°	Name of KER	Relevant WP(s)	Leading partner	Involved partners
1	Common Data Environment (CDE)	WP2, WP3, WP4, WP5	QUE	
2	Data-driven Digital Twin	WP2, WP3	HYP	QUE
3	Physics-based Digital Twin	WP3	IES	
4	Renovation Planner	WP2, WP3, WP4, WP5, WP6	PRAGMA	CIRCE, IES, QUE, HYPERTECH
5	Investment Appraiser	WP2, WP3, WP4, WP5	CIRCE	PRAGMA, IES, KTU
6	Digital Building Logbook (DBL)	WP2, WP3, WP4, WP5, WP6	R2M	QUE, HIVE
7	ChroViewFM	WP2, WP3, WP4	QUE	HYP
8	ChroViewOcc	WP2, WP3, WP4	HYP	QUE
9	ChroViewPlus	WP4	IES	
10	SRI+ Calculator	WP2, WP4	QUE	HYP

## 2.2. Business Use Cases Overview

### 2.2.1. Use case 1.1 description

In this use case, the **ESCO** will seek **personalised renovation recommendations** focusing on **optimal thermal comfort scenarios** for the **building's tenants** while also respecting possible financial restrictions. These scenarios will be generated by applying renovation strategies and measures beyond energy-related interventions. In this sense, the main focus of this use case's renovation scenarios will be on the **HVAC systems** on site. This use case is considered as the business opportunity for the **integrated DT** framework's capabilities of simulating the tenants' actual comfort conditions and combine them with possible active renovation scenarios (under varying control methods) towards identifying optimal SLAs.

This use case falls within the “**Comfort-as-a-Service**” scenario, where CHRONICLE tools enable ESCOs to provide comfort-focused services to occupants. The Digital Twin framework, combined with the enhanced Performance Evaluator, ensures transparent and trusted tracking of occupant comfort. Real-time monitoring of indoor parameters (temperature, humidity, luminance, IAQ, hot water usage) and dynamic learning of tenant comfort patterns allow for improved building performance, enhancing well-being indicators in line with the CHRONICLE Dynamic Level(s) approach.

The scenario prioritises tenant comfort due to health considerations. The use case is about how CHRONICLE innovations can create value for both tenants and ESCOs, providing replicable insights for similar buildings and scenarios.

### 2.2.2. Use case 2.1 description

The UC focuses on the application designed to provide user-friendly and comprehensive insights of the building operational performance based on real-life data.

The app delivers simplified performance reports, aiming at providing an overview of how energy is used within the building of interest in comparison to its baseline performance also addressing the building smartness performance. In addition, an assessment of the building's performance in regard to the quality of living it offers (e.g. thermal comfort, IAQ etc.) is provided along with information on current indoor conditions from the sensors installed on site.

UC2.1 presents the afore-listed aspects and assesses them in relation to their usability, performance and user acceptance.

IoT equipment will almost always be installed, therefore UC2.1 is considered universally relevant as a means of involving residential participants. Where residential tenants are less familiar with technology, a very simplified mobile app is considered to be easier to accept and likely to be more widely used.

### 2.2.3. Use case 3.1 (a) description

This use case focuses on the **Renovation Planner** which can evaluate the current state of residential buildings based on energy performance and cost related factors and propose renovation scenarios towards optimised renovation strategies. This use case considers energy-related renovations and not changes in the building geometry. With each

renovation scenario selected by the **AECO**, the Renovation Planner issues a **Building Renovation Passport** (BRP). The BRP contains and describes automated “trigger points” for building inspections, maintenance and renovations in a pro-active manner based on the expected service life of the components, systems and materials to be used and applied during the renovations. BRPs and renovation planning is considered universally useful for lower energy rated buildings where sufficient building knowledge in the correct formats can be provided.

This use case is related to UC3.1 (b) – Post renovation performance analysis as that UC is defined to be building directly upon UC3.1 (a).

#### 2.2.4. Use case 3.1 (b) description

This use case could evaluate the post renovation energy performance of a building and compare it against the predicted performance according to the Renovation Planner’s pre-renovation analysis. In addition to the above, operational cost KPIs calculated during the selection of the renovation scenario can be evaluated against the operational costs referring to the real renovation’s data. The generation and the selection of a renovation scenario through the Renovation Planner is done in UC3.1(a). For this use case an actor requires before and after renovation monitoring and building data of sufficient quality to capture the KPIs.

This use case is directly related to UC3.1(a) Assessment of different renovation scenarios.

#### 2.2.5. Use case 3.2 description

UC3.2 aims to inform AECOs about costs associated with LCA indicators. Carbon Pricing is a policy tool used by governments and other institutions to discourage the emission of greenhouse gases across different industries including the building sector that contribute to climate change. The Carbon Bill is an associated cost that measures the environmental impact of emissions throughout a building’s lifecycle and sets an economic magnitude according to a standardised quantity. The goal of the carbon bill is to establish a price on carbon emissions in a similar form that entities which produce or import fossil fuels like coal, oil, and natural gas calculate theirs. The idea behind Carbon Pricing is to make it more expensive to emit greenhouse gases, and to incentivise companies and individuals to reduce their emissions. In this Use Case, the Carbon Bill is calculated using the WLC for the base line and selected renovation scenarios. The WLC includes the embodied carbon associated with materials and components as well as operational carbon (emissions during the use phases). It is vital for proper assessment of the carbon impact of interventions over time.

#### 2.2.6. Use case 4.1 description

UC4.1 focuses on a viewer designed specifically for the Facility Manager (FM). The viewer, hereafter referred to as ChroViewFM,; (i) provides visualisation of building-related (IoT) data and KPIs in a comprehensive and standardised way;(ii) allows the user to interact with 3D building models and other relevant graphs and; (iii) provides insights into energy, costs, sustainability, comfort etc. Among the possible services offered could be, on the one hand, the continuous energy benchmarking of the baseline building and, on the other hand, notifications for major changes in consumption observed over time.

### 2.2.7. Use case 4.2 description

UC4.2 functions as an extension of UC4.1, given that they both relate to the same application, the ChroViewFM. As UC4.1 focuses only on the visualisation of information to the facility managers, this UC4.2 does not involve any visualisation actions, and instead only focuses on the back-end mechanism in place for the delivery of predictive and preventive maintenance. Notifications for predictive & preventing maintenance in regard to the major loads of the building (main focus on HVAC systems) become available to the facility manager through the ChroViewFM app. Notifications can either inform the user of upcoming maintenance actions (planned maintenance from the BRP) or flag unexpected consumption behaviours of the HVAC system based on statistics and comparative analysis of historical data series.

UC4.2 is relevant where the corresponding stakeholders are already responsible for part of the maintenance activities on site and have an interest in improving the current process.

### 2.2.8. Use case 5.1 description

The building owner wants to increase the value of his/her property for future exploitation by adopting the Digital Building Logbook to visualise the data (i.e. a timeline showing the IFC history files that indicate the renovation processes that the building went through) along with integrity and authenticity of information. These trusted and unaltered files can then be shown to the buyer to prove the current building state based on the previous renovation activities, hence, adding value to the building itself.

This use case focuses on the usage of the Digital Building Logbook by the building owner. The DBL provides a secure and trusted archive for the building owner for relevant data (i.e. IFC files). The user is able to access documents and data related to the present and past situation of the building. The goal of the use case is to allow the user to have access to easy to understand, accessible, trusted, unaltered and reliable information about the building's state history.

The building owner logs in to the DBL. Through the DBL UI, the owner is able to select parameters and perform research to retrieve the needed documents and information. Among these, there is integrity and traceability information. The data history of the IFC files are presented to the user of the DBL chronologically, so the user can add or check comments or tags, check for the integrity of the files, or simply download and see the information. The IFC file is just one example of data that can be stored in the DBL.

### 2.2.9. Use case 5.2 description

These use cases will focus on the development of the upload functionality for the Digital Building Logbook. It provides the possibility for the building owner to upload files through the DBL web interface and provide data exchange functionalities with the CDE to store relevant building data in a trusted documental archive.

These use cases are related to UC 5.1 - Digital Building Logbook for Secure and Trusted Documental archive.

## 2.3. KER Exploitation

For each KER, a summary of the exploitation roadmap and the BFMULO table are reported in the following sections.

### 2.3.1. KER 1 - Common Data Environment (CDE)

The CHRONICLE framework will use a semantically enriched and BIM-based Common Data Environment (CDE) and relevant data governance services to ensure the efficient management of both static building information (e.g. design) and continuous information collected on site. CHRONICLE's CDE enables management of project information and collaboration throughout the project's lifecycle. The CDE will facilitate the sharing, management, and storage of data relevant to the various stakeholders and respective CHRONICLE tools. The CDE will ensure that authorised users involved in the project have access to the most current and accurate information, and that the data is consistent, reliable and secure.

Table 6: Exploitation strategy overview - KER 1

KER 1	
Name	Common Data Environment
Leader	QUE
Final TRL	7
Exploitation strategy	Further research
Payback period	N/A
Funding	Banks Own investment

The following table reports the exploitation intentions of the involved partners (please refer to section **Error! Reference source not found.** for a detailed explanation of the acronyms "B", "F", "M", "U", "L" and "O").

Table 7: BFMULO Matrix - KER 1

Partner Name	KER 1					
	B Background	F Foreground	M Making	U Using	L Licensing	O Other
KTU				X		X
QUE	X	X	X			X
R2I	X		X	X		X

Please refer to **Error! Reference source not found.** for the complete Exploitation Roadmap checklist.

### 2.3.2. KER 2 - Data-driven Digital Twin

Combining powerful building thermal modelling techniques and machine learning algorithms, CHRONICLE's Digital Twin Framework will accurately forecast the behaviour of the building's conditions and systems in real life usage.

The Data-driven Digital Twin aims to mimic the behaviour of the building occupants to bridge the gap between simulated and real operation, and to provide an accurate and representative building model, continuously calibrated based on current IoT data streams.

Table 8: Exploitation strategy overview - KER 2

KER	
Name	Data-driven Digital Twin
Leader	HYP
Involved partners	QUE
Final TRL	9
Exploitation strategy	Further development of the KER will be pursued through participation in other projects and consulting activities
Time to market	N/A as commercial exploitation is not foreseen at the moment
Funding	European R&D funds

Table 9: BFMULO Matrix - KER 2

Partner Name	KER 2					
	B Background	F Foreground	M Making	U Using	L Licensing	O Other
CIRCE	X	X	X			X
KTU			X	X		X
HYP	X	X	X			X
R2I	X		X	X		X

### 2.3.3. KER 3 - Physics-based Digital Twin

The Physics-Based Digital Twin uses complex algorithms to model the physical interactions between various aspects of a building, such as heat transfer between rooms, occupant behaviour, and the impact of the external environment. It provides the baseline energy models and different scenarios within CHRONICLE. In the project, we have enhanced the BIM capabilities through direct IFC import into the software library.

Table 10: Exploitation strategy overview - KER 3

KER	
Name	Physics-based Digital Twin
Leader	IES
Final TRL	7
Exploitation strategy	Further development to scalability, and integration with data platforms and front-end tools, through internal R&D and future collaborative projects.
Time to market	Already applicable within consultancy and project-based services for specific use cases (e.g. renovation assessment, scenario analysis), with progressive integration into standardised workflows.
Funding	Own, private financing, through private and public partnerships (projects)

Table 11: BFMULO Matrix - KER 3

Partner Name	KER 3					
	B Background	F Foreground	M Making	U Using	L Licensing	O Other
IES	X	X	X	X		X
KTU			X	X		X
R2I	X		X	X		X

#### 2.3.4. KER 4 - Renovation Planner

The Renovation Planner is designed to help building professionals and homeowners plan renovations of buildings and dwellings. It will help to assess various renovation scenarios of the building, focused on optimising its energy performance. Furthermore, the tool will present a complete financial assessment per renovation scenario proposed, while also evaluating other important factors like the tenants' comfort and carbon emissions. Depending on the parameters that the user chooses to prioritise, the renovation planner will give a list with the best scenarios to proceed. Each proposed scenario will contain and describe a renovation roadmap with concrete renovation measures to be applied. Continuing on from the selection of the preferred renovation scenario by the user, the Renovation Planner will also issue a building renovation passport (BRP) which will include and present all the details about future building inspections, maintenance and renovations in a pro-active manner based on the expected service life of the components, systems and materials to be used and applied during the renovations. All the functionalities and results of the Renovation Planner are achieved through the interaction of the end-user with the tool's UI, the ChroViewRen.

Table 12: Exploitation strategy overview - KER 4

KER	
Name	Renovation planner
Leader	PRAGMA
Involved partners	CIRCE, IES, QUE, HYPERTECH
Final TRL	6
Exploitation strategy	further research upon and develop the KER within European R&D projects and commercial exploitation after the TRL has been improved
Time to market	Between 3 and 10 years
Funding	European R&D funds

Table 13: BFMULO Matrix - KER 4

Partner Name	KER 4					
	B Background	F Foreground	M Making	U Using	L Licensing	O Other
CIRCE	X	X	X	X		X
KTU			X	X		X
PRAGMA	X	X	X	X		X
R2I			X	X		X

### 2.3.5. KER 5 - Investment Appraiser

The Investment Appraiser is a tool that will be developed to forecast value and liabilities related to buildings' performance as well as energy saving investments. Together with the other CHRONICLE applications, it will provide support to the stakeholders of the AEC Industry and owner/occupiers. The first part of the Investment Appraiser aims to support a property (building) valuation, performing a Life Cycle Cost (LCC). The application consists of a backend solution that performs LCC according to literature proven cost KPIs. The second part of the Investment Appraiser oversees calculating the Carbon Bill for both the Base Line of each pilot and the generated renovation scenarios. According to the UC3.2 the Carbon Bill is an associated cost that measures the impact of emissions and sets an economic magnitude according to a standardized quantity

Table 14: Exploitation strategy overview - KER 5

KER	
Name	Investment Appraiser
Leader	CIRCE
Involved partners	PRAGMA, IES, KTU
Final TRL	8
Exploitation strategy	property valuation, energy-saving investments, and environmental impact assessments, ultimately contributing to sustainable development goals
Time to market	Between 1 and 3 years, though currently useful as an adhoc service.
Funding	Own investments

Table 15: BFMULO Matrix - KER 5

Partner Name	KER 5					
	B Background	F Foreground	M Making	U Using	L Licensing	O Other
CIRCE	X	X	X	X		X
KTU			X	X		X
PRAGMA			X	X		X
R2I			X	X		X

### 2.3.6. KER 6 - Digital Building Logbook (DBL)

The Digital Building Logbook (DBL) is an information repository for all relevant building data. It allows to store, organise, manage and trace information and data throughout the whole building's lifecycle. It is a valuable resource for building owners and stakeholders to observe the evolution of the building based on trusted information and it facilitates decision making. The DBL bridges the gap between the great amount of data and information generated during the building's life cycle and the lack of methodologies and tools to safely manage, organise, structure, and share this data. The building information, milestones and data can be archived in one, secure place where it will be accessible to authorized parties in the long-term. The CHRONICLE DBL offers intuitive features (such as a timeline of the building's lifetime) that supports the involved stakeholder's decision making on critical decisions regarding the building management. It will offer multiple ways of searching for and managing data. Through the communication established with the Common Data Environment of CHRONICLE, results and information from other CHRONICLE solutions will be automatically stored in the logbook. The system uses blockchain technology to guarantee the integrity and traceability of data.

Table 16: Exploitation strategy overview - KER 6

KER	
Name	Digital Building Logbook (DBL)
Leader	R2I
Involved partners	QUE, HIVE
Final TRL	6
Exploitation strategy	extend and validate it in research activities and projects, developing new functionalities and at the same time analyse the market while developing partnerships
Time to market	Between 3 and 5 years
Funding	Local/national public funds: European R&D funds (e.g. Horizon Europe): Private investments

Table 17: BFMULO Matrix - KER 6

Partner Name	KER 6					
	B Background	F Foreground	M Making	U Using	L Licensing	O Other
KTU			X	X		X
R2I	X	X	X	X		X

### 2.3.7. KER 7 - ChroViewFM

This online BIM-based tool enables (i) the three-dimensional (3D) visualisation of the building and (ii) the monitoring of near-real time data from smart equipment installed on site, such as energy consumption, environmental conditions, and other performance indicators. These include energy usage analysis, costs, CO2 emissions, indoor air quality and tenant-user's comfort. ChroViewFM's dashboard allows the user to track the building's energy use and comfort levels and, eventually, identify any significant changes over time. To this end, ChroViewFM provides notifications of upcoming maintenance activities and warnings of any unexpected behaviour of the building equipment, thus facilitating the building's predictive and preventive maintenance. Finally, it offers a user-friendly 3D visualisation tool, where the user e.g., Architect/BIM modeler, FMs etc., can upload actual or hypothetical IFC files that capture the static data of a building of interest.

Table 18: Exploitation strategy overview - KER 7

KER	
Name	ChroViewFM
Leader	QUE
Involved partners	HYP
Final TRL	7
Exploitation strategy	Additional research into market needs, regulatory frameworks, and ongoing R&D activities is required to refine the ChroViewFM and identify strategies for monetization and the provision of consultancy services.
Time to market	N/A as commercial exploitation is not foreseen at the moment
Funding	European R&D funds

Table 19: BFMULO Matrix - KER 7

Partner Name	KER 7					
	B Background	F Foreground	M Making	U Using	L Licensing	O Other
KTU				X		X
QUE	X	X	X			X
R2I	X		X	X		X

### 2.3.8. KER 8 - ChroViewOcc

The ChroViewOcc is a mobile app that will allow building residents to understand and improve their energy consumption, transforming performance rating from an administrative document to a useful and comprehensive tool for the actual building tenants. Apart from insights on current energy performance, the app will provide indicators related to comfort and health conditions (e.g. air quality) per household as well as insights on the current ambient conditions, depending on the smart devices installed on site. This will result in tenants actually improving the energy efficiency of their home, further resulting in reductions in their energy bill.

Table 20: Exploitation strategy overview - KER 8

KER	
Name	ChroViewOcc
Leader	HYP
Involved partners	QUE
Final TRL	7
Exploitation strategy	ChroViewOcc, supports policy recommendations on the development and standardization of dynamic EPCs and user-friendly ratings
Time to market	N/A as commercial exploitation is not foreseen at the moment
Funding	N/A

Table 21: BFMULO Matrix - KER 8

Partner Name	KER 8					
	B Background	F Foreground	M Making	U Using	L Licensing	O Other
KTU			X	X		X
HYP	X	X	X	X		X
R2I	X		X	X		X

### 2.3.9. KER 9 - ChroViewPlus

The primary objective of ChroViewPlus is to assist Energy Service Companies (ESCOs) and other professional stakeholders by offering them expert recommendations and in-depth insights to effectively reduce energy consumption. The final application examines energy insight, real-time system patterns, and provides recommendations for identifying opportunities to save on costs.

Table 22: Exploitation strategy overview - KER 9

KER	
Name	ChroViewPlus
Leader	IES
Final TRL	7
Exploitation strategy	Further upgrades of the ChorViewPlus dashboard concept to support Digital Twin driven analysis. Additonlay, refinement of visualisation and features in future R&D and innovation projects,
Time to market	. Further refinement required, particularly for user recommendations and usability
Funding	Own, private financing, through private and public partnerships (projects)

Table 23: BFMULO Matrix - KER 9

Partner Name	KER 9					
	B Background	F Foreground	M Making	U Using	L Licensing	O Other
IES	X	X	X	X	X	X
KTU			X	X		X
R2I			X	X		X

### 2.3.10. KER 10 - SRI+ Calculator

The SRI+ Calculator is a data-driven framework designed to assess building smartness in alignment with SRI Method C. It leverages automated real-time data readings to evaluate

building and system performance, making it a pivotal tool for managing building operation and maintenance service level agreements (SLAs). The framework provides a standardized approach to smart readiness assessment, integrating user-centric adjustments and coupling with other established schemes like EPC, Levels, LCA/LCC, and BRPs.

Table 24: Exploitation strategy overview - KER 10

KER	
Name	SRI+ Calculator
Leader	QUE
Involved partners	HYP
Final TRL	7
Exploitation strategy	The SRI+ Calculator facilitates the creation of cost-effective, service-based contractual agreements between market actors and building users. Its comprehensive and standardized approach to smart readiness assessment provides a competitive edge in the smart building and building management markets, offering opportunities for significant innovation and market expansion
Time to market	N/A as commercial exploitation is not foreseen at the moment
Funding	European R&D funds

Table 25: BFMULO Matrix - KER 10

Partner Name	KER 10					
	B Background	F Foreground	M Making	U Using	L Licensing	O Other
KTU			X	X		X
HYP	X	X		X		X
QUE	X	X	X	X		X
R2I	X		X	X		X
FællesBo						X

## 2.4. Final IPR management strategy

The Key Exploitable Results of CHRONICLE are mainly software related. All software is covered by copyright protection, which is obtained automatically from the moment of the creation of the software solution. There is no formal application process. To indicate to other actors the authorship of the work, the author may attach a copyright notice to their work – such as the "all rights reserved" text, or the © symbol – together with the year the work was created.

Copyright registration via a service provider can establish proof of creation at a specific time<sup>1</sup>.

<sup>1</sup> [https://europa.eu/youreurope/business/running-business/intellectual-property/copyright/index\\_en.htm](https://europa.eu/youreurope/business/running-business/intellectual-property/copyright/index_en.htm)

In EU countries, copyright protects intellectual property for 70 years after the author's death or, in the case of joint authorship, 70 years after the death of the last surviving author<sup>2</sup>.

In the EU, software can be protected via patents only in case they include at least one innovative algorithm that provides a technical contribution to the state of the art; furthermore, to be considered patentable, software and apps must also meet the patentability requirements which apply to traditional inventions, in particular novelty and inventive step<sup>3</sup>.

Therefore, all the KERs are protected by copyright, while no partner intends to apply for patent protection. Furthermore, many scientific publications have been submitted, potentially hindering the possibility of patent applications. Most commercially sensitive information will be kept secret by the partners. They will obtain trade secret protection (which is granted indefinitely) if the following conditions are met:

- The information is not known either by the public at large or by the experts of the sector in question.
- The information has commercial value.
- The responsible partners have taken steps to keep the information secret: for example, it is in safe storage and non-disclosure agreements (NDAs) have been signed with anyone that has access to it.

## 3. Business Models

This chapter presents the Business Model Canvas for each UC and additional alternative potential revenue streams.

### 3.1. Use Case 1.1

#### 3.1.1. Business Model Canvas (Comfort-as-a-Service & Energy-Efficient Renovation)

Component	Description
1. Key Partners	<ul style="list-style-type: none"> <li>• <b>ESCOs</b> – Deliver Comfort-as-a-Service.</li> <li>• <b>Building Owners (FællesBo, AEM)</b> – Provide infrastructure &amp; renovation investments.</li> <li>• <b>Facility Management (FM)</b> – Ensure efficient building operations.</li> <li>• <b>Tenants (Residents, Businesses)</b> – End-users benefiting from smart comfort control.</li> </ul>

<sup>2</sup> [https://europa.eu/youreurope/business/running-business/intellectual-property/copyright/index\\_en.htm#:~:text=In%20EU%20countries%2C%20copyright%20protects,a%20work%20of%20joint%20authorship.](https://europa.eu/youreurope/business/running-business/intellectual-property/copyright/index_en.htm#:~:text=In%20EU%20countries%2C%20copyright%20protects,a%20work%20of%20joint%20authorship.)

<sup>3</sup> <https://www.sib.it/en/patents/inventions-insights/patents/software-patents/>

	<ul style="list-style-type: none"> <li>• <b>Public Authorities &amp; Green Energy Funds</b> – Provide incentives for climate-neutral renovations.</li> <li>• <b>CHRONICLE Digital Twin Platform</b> – AI-powered analytics for monitoring and optimization.</li> </ul>
2. Key Activities	<ul style="list-style-type: none"> <li>• Develop Comfort-as-a-Service contracts.</li> <li>• Implement data-driven HVAC renovation strategies.</li> <li>• Optimise energy usage through AI-driven automation.</li> <li>• Integrate tenant feedback loops into digital twin models.</li> <li>• Establish network-based collaboration models for cost-sharing.</li> </ul>
3. Value Proposition	<ul style="list-style-type: none"> <li>• <b>For Tenants:</b> Low utility costs, high-quality indoor comfort, smart control over HVAC.</li> <li>• <b>For Building Owners:</b> Data-driven renovation strategies, higher property value, tenant satisfaction.</li> <li>• <b>For ESCOs:</b> Steady revenue via service-based contracts instead of one-time HVAC sales.</li> <li>• <b>For FM Providers:</b> New revenue from predictive maintenance services.</li> <li>• <b>For Public Authorities:</b> Lower carbon footprint, green energy compliance.</li> </ul>
4. Customer Relationships	<ul style="list-style-type: none"> <li>• Subscription-based comfort services with <b>SLA guarantees</b>.</li> <li>• Direct engagement via <b>user-friendly apps</b> for temperature control &amp; feedback.</li> <li>• Incentives for energy-efficient behaviour (discounts, rewards for lower usage).</li> </ul>
5. Customer Segments	<ul style="list-style-type: none"> <li>• <b>Residents &amp; Office Tenants</b> – Comfort-as-a-Service subscribers.</li> <li>• <b>Building Owners</b> – Need cost-effective renovations &amp; operational savings.</li> <li>• <b>ESCOs &amp; FM Providers</b> – Offer new energy-as-a-service models.</li> </ul>
6. Key Resources	<ul style="list-style-type: none"> <li>• <b>CHRONICLE Digital Twin</b> – AI-powered comfort monitoring &amp; optimization.</li> <li>• <b>High-Performance HVAC Systems</b> – Upgraded, data-driven heating/cooling.</li> <li>• <b>Smart Sensors &amp; IoT Devices</b> – Enable real-time monitoring.</li> <li>• <b>Green Financing &amp; Public Incentives</b> – Support renovation funding.</li> </ul>

7. Channels	<ul style="list-style-type: none"> <li>• <b>ESCO Digital Platforms &amp; Dashboards</b> – For contract management &amp; SLA tracking.</li> <li>• <b>Mobile Apps</b> – For tenant interaction &amp; comfort settings.</li> <li>• <b>Facility Management Software</b> – Integrated for predictive maintenance.</li> <li>• Green Energy Certifications &amp; Public Reports – For attracting investors.</li> </ul>
8. Cost Structure	<ul style="list-style-type: none"> <li>• Upfront renovation &amp; HVAC upgrade costs.</li> <li>• Investment in AI-driven automation &amp; digital twin technology.</li> <li>• Operational expenses for monitoring &amp; predictive maintenance.</li> </ul>
9. Revenue Streams	<ul style="list-style-type: none"> <li>• Subscription-based Comfort-as-a-Service plans (fixed-fee, pay-per-use).</li> <li>• <b>ESCO-FM revenue sharing</b> on energy efficiency savings.</li> <li>• Green building certifications &amp; tax incentives (monetised by building owners).</li> <li>• <b>Data monetization</b> (aggregated, anonymised insights for urban planning &amp; energy policy).</li> <li>• <b>Demand response programs</b> (building owners earn by participating in energy grid balancing).</li> </ul>

### 3.1.2. Alternative Network-Based Revenue Streams

Alternative Network-Based Revenue	Description
Premium B2B Listing / Sponsored Placement	HVAC providers or renovation contractors can pay to appear as preferred options to ESCOs on the platform.
Marketplace Transaction Fees	Take a small percentage fee whenever a service contract (HVAC installation/upgrade/maintenance) is executed through the platform.
Consulting or SLA Optimisation Fees	Offer ESCOs or building owners paid insights or simulation reports based on tenants' comfort scenarios generated by DT.
Joint Pilot Funding / Co-Innovation Programs	Partner with manufacturers (HVAC, sensors, building tech) who pay for access to test and showcase products within the platform network.
Tenant Engagement Incentives	Enable tenants to pay small fees or upgrade to “enhanced comfort scenarios” that the platform simulates; revenue flows from tenant subscriptions integrated with the network.

## 3.2. Use Case 2.1

### 3.2.1. Business Model Canvas (Comfort-as-a-Service & Energy-Efficient Renovation)

Component	Description
1. Key Partners	<ul style="list-style-type: none"> <li>IoT Equipment Providers: Suppliers of sensors and hardware.</li> </ul>
2. Key Activities	<ul style="list-style-type: none"> <li>Application Development: Continuous improvement and updating of the application.</li> <li>IoT Installation and Maintenance: Setting up and maintaining IoT equipment at pilot sites.</li> <li>Data Analysis and Reporting: Generating insights and reports from collected data.</li> <li>User Training and Support: Educating users and providing technical assistance.</li> <li>Marketing and Outreach: Promoting application to potential users and stakeholders.</li> </ul>
3. Value Proposition	<ul style="list-style-type: none"> <li>Comprehensive Insights: User-friendly and detailed insights into building operational performance.</li> <li>Dynamic EPCs: Simplified performance reports comparing current and baseline energy usage.</li> <li>Smartness Performance: Evaluation of building smartness and integration of IoT data.</li> <li>Quality of Living Assessments: KPIs for thermal comfort and indoor air quality.</li> <li>User Engagement: Simplified mobile app for easy adoption by residential tenants.</li> </ul>
4. Customer Relationships	<ul style="list-style-type: none"> <li>Personalized Support: Offering tailored support and consulting services.</li> <li>User Training: Providing training materials and workshops for effective use.</li> <li>Feedback Mechanisms: Regularly collecting user feedback to improve the application.</li> </ul>
5. Customer Segments	<ul style="list-style-type: none"> <li>Building Owners and Managers: Primary users who need insights into building performance and energy efficiency.</li> <li>Residential Tenants: End-users who interact with the application and provide feedback.</li> <li>Energy Consultants and Analysts: Professionals who use the data for analysis and reporting.</li> </ul>

6. Key Resources	<ul style="list-style-type: none"> <li>• Application Development Team: Developers and designers creating and maintaining the application.</li> <li>• IoT Equipment: Sensors and hardware for data collection.</li> <li>• Data Management Systems: Infrastructure for storing and processing data.</li> <li>• Customer Support Team: Providing ongoing support and training to users.</li> </ul>
7. Channels	<ul style="list-style-type: none"> <li>• Direct Sales: Targeting building owners and managers through direct sales efforts.</li> <li>• Partnerships: Collaborations with IoT equipment providers and energy consultants.</li> <li>• Online Platforms: Website and mobile app for user access and engagement.</li> <li>• Workshops and Training: Conducting sessions to educate users on the application.</li> </ul>
8. Cost Structure	<ul style="list-style-type: none"> <li>• Development and Implementation: Costs associated with designing, developing, and deploying the application.</li> <li>• IoT Equipment and Installation: Expenses for purchasing and installing sensors and hardware.</li> <li>• Data Management and Storage: Costs for cloud storage, data processing, and security.</li> <li>• Maintenance and Support: Ongoing technical support and application updates.</li> <li>• Training and User Engagement: Expenses for creating training materials and conducting workshops.</li> <li>• Marketing and Outreach: Costs for promoting the application and engaging users.</li> </ul>
9. Revenue Streams	<ul style="list-style-type: none"> <li>• Subscription Fees: Recurring fees for different tiers of access and functionality.</li> <li>• Freemium Model: Basic features for free, with advanced features requiring a subscription.</li> <li>• Value-Added Services: Additional consulting, audits, and custom reporting services.</li> <li>• Data Monetization: Selling anonymised data insights to third parties.</li> </ul>

### 3.2.2. Alternative Network-Based Revenue Streams

Alternative Network-Based Revenue	Description
Portfolio Benchmarking & Compliance Reporting Fees	Building owners, housing associations, or ESCOs pay to access <i>portfolio-level</i> insights comparing multiple buildings' dynamic EPCs, smartness indicators, and living-quality KPIs. This leverages the network effect: the more pilot buildings connected, the more valuable the benchmarking datasets become.
Integrated Service Provider Referrals (HVAC, IAQ, Maintenance)	When the app detects persistent comfort issues (e.g. poor IAQ, overheated rooms, high humidity), it can refer tenants or facility managers to trusted HVAC/maintenance providers. Providers pay a referral fee or small commission for being listed as a recommended solution. This is realistic because the app already generates real-time performance and comfort KPIs from installed IoT sensors.
Data-Driven Audit Support Packages for Energy Consultants	Energy auditors and EPC assessors pay for enriched data packages (historic sensor trends, baseline comparisons, comfort KPIs, smartness scores) generated by the UC2.1 network. This helps them produce faster, higher-quality audits and dynamic EPC updates without additional site work.
IoT Device Health & Monitoring Coverage for Building Operators	Facility managers or housing associations pay a small monthly fee for continuous monitoring of the installed IoT devices across multiple units. Since sensors are deployed at all pilot sites, a network-level monitoring service (battery status, connectivity, data quality) is valuable and reduces operational burden for building owners.

## 3.3. Use Case 3.1(a) and 3.1(b)

### 3.3.1. Business Model Canvas (Comfort-as-a-Service & Energy-Efficient Renovation)

Component	Description
1. Key Partners	Building professionals, AECO sector stakeholders, homeowners, material suppliers, financial institutions providing green loans or subsidies.
2. Key Activities	Assessing energy renovation scenarios; generating optimised renovation plans; issuing Building Renovation Passports (BRPs); engaging stakeholders for scenario implementation; monitoring energy performance; supporting financing and incentive processes.
3. Value Proposition	The Renovation Planner evaluates multiple energy-focused renovation scenarios, optimising energy performance while considering tenants' comfort and carbon emissions. Each scenario includes a complete financial assessment. Users can prioritise parameters via a user-friendly

	interface, and the tool provides a ranked list of the most suitable strategies. The platform generates a step-by-step renovation roadmap and issues a BRP detailing future inspections, maintenance, and upgrades based on the expected service life of components and systems. Uniquely, the tool can adapt recommendations based on owner-specific inputs, such as income, to produce a tailored, cost-effective renovation plan that maximises energy savings and occupant comfort.
4. Customer Relationships	Direct engagement through the app interface; ongoing support and consultation with building owners and tenants; facilitation of connections with renovation companies and service providers; personalized guidance on renovation financing.
5. Customer Segments	Building owners, tenants, AECO professionals, facility managers, investors interested in energy-efficient renovations.
6. Key Resources	Engineers, energy and renovation specialists, software/tool developers, BIM and simulation data, digital infrastructure for app and sensor integration.
7. Channels	Web and mobile app interfaces; integration with building sensors and IoT devices for energy monitoring; workshops and pilot site demonstrations; collaboration with AECO networks.
8. Cost Structure	Tool development and ongoing software maintenance; data collection and sensor deployment costs; personnel costs for engineers and AECO specialists; marketing, training, and customer support.
9. Revenue Streams	Subscription fees for the app; one-time fees for BRP issuance; commissions from renovation implementation by AECO professionals; partnerships with material suppliers; performance-based revenue tied to energy savings; facilitation of access to green financing and incentives.

### 3.3.2. Alternative Network-Based Revenue Streams

- Purchase Fee for Renovation Plan and BRP Issuance**  
 Building owners, AECO professionals, or facility managers could pay a fee to access a tailored renovation plan and receive a Building Renovation Passport (BRP). This provides direct value by offering a comprehensive, step-by-step roadmap for energy-efficient renovations.
- Commission from Renovation Implementation**  
 The tool developer could earn a commission when renovation companies implement the scenarios proposed by the Renovation Planner. For example, after generating a BRP, the AECO sector carries out the renovations, creating a performance-based revenue opportunity.
- Contribution from Construction Material Providers**  
 Providers of construction materials could contribute financially to the tool's ecosystem, as the Renovation Planner may recommend specific sustainable or high-performance materials that they supply. This aligns incentives between the tool and suppliers.
- Integration with Banks and Financing Mechanisms**  
 The Renovation Planner could be linked to green financing programs, energy-efficiency loans, or subsidies. Users can demonstrate potential energy savings and cost

reductions, helping secure funding while the tool receives a percentage-based fee or partnership revenue.

- **Revenue Based on Energy Savings**

A performance-based model could capture a share of the energy cost reductions achieved after renovations are implemented. This aligns the tool's success with tangible outcomes for the building owner and tenants.

### 3.4. Use Case 3.2

#### 3.4.1. Business Model Canvas

Component	Description
1. Key Partners	Tool developers, AECOs, building owners, policy advisors/regulators (for alignment with carbon pricing rules)
2. Key Activities	Evaluate renovation scenarios considering both energy efficiency and LCA indicators; calculate associated carbon costs (Carbon Bill) using WLC; support AECOs and owners in selecting scenarios that minimize both renovation cost and carbon emissions.
3. Value Proposition	The Renovation Planner estimates the carbon cost of each renovation scenario, enabling AECOs and building owners to choose options that reduce the Carbon Bill while also lowering energy and renovation costs. This supports environmental compliance and cost savings through lower emissions.
4. Customer Relationships	Direct support and consultation for AECOs and building owners; in-app guidance and reporting from the tool developer; updates on carbon pricing regulations.
5. Customer Segments	AECOs, building owners, and entities responsible for paying carbon-related costs or managing building energy performance.
6. Key Resources	Software developers, LCA and carbon calculation experts, digital twin data, WLC databases, and cloud infrastructure to run the tool
7. Channels	Web-based or desktop application providing scenario analysis, carbon cost estimates, and decision-support dashboards.
8. Cost Structure	Tool development and software engineering costs; ongoing maintenance and updates; cloud computing infrastructure; marketing and training; compliance and regulatory monitoring.
9. Revenue Streams	Subscription or licensing fees for using the Renovation Planner; consulting services; indirect savings for customers through reduced Carbon Bill payments due to optimised renovation scenarios.

#### 3.4.2. Alternative Network-Based Revenue Streams

- **Data Sharing & Analytics Services**

Provide anonymised LCA, energy, and renovation data to municipalities, research institutions, or sustainability consultancies.

Offer predictive analytics services for urban planning, energy grids, or carbon offset programs.

- Marketplace for Low-Carbon Materials & Services

Facilitate a network where building owners and contractors can access verified low-carbon materials, products, or services recommended by the Renovation Planner.

Revenue through transaction fees or referral commissions.

- Carbon Credit Facilitation

Help building owners or developers monetise reductions in carbon emissions through carbon credits or ESG reporting.

Revenue from service fees or a percentage of credits earned.

- Partner Integrations & API Access

Offer APIs for other software platforms (BIM tools, facility management platforms, or energy management systems) to integrate the Renovation Planner's carbon and LCA calculations.

Revenue through licensing or per-call fees.

- Certification & Compliance Services

Support AECOs and owners in obtaining green building certifications (LEED, BREEAM) or compliance reporting for carbon regulations.

Revenue via consulting fees, audits, or certification support.

- Performance-Based Contracts with ESCOs

Facilitate contracts where payment is linked to verified carbon reductions and energy savings achieved through Renovation Planner recommendations.

Revenue from shared savings or success-based fees.

## 3.5. Use Case 4.1

### 3.5.1. Business Model Canvas

Component	Description
1. Key Partners	Technology providers, facility managers and site owners.
2. Key Activities	Development and integration of the ChroViewFM platform, collection and visualisation of building data, user training and support.
3. Value Proposition	ChroViewFM delivers real-time insights for Facility Managers, enabling energy and cost optimization, regulatory compliance and improved comfort and sustainability.
4. Customer Relationships	Built on collaborative co-design with Facility Managers, supported by ongoing technical assistance.
5. Customer Segments	Targeted at Facility Managers, building owners and operators, energy consultants and managers of public and private building portfolios.

6. Key Resources	Includes the CHRONICLE digital infrastructure such as the Digital Building Logbook, IoT and BIM systems, the development team, pilot site data.
7. Channels	Delivered through a web-based platform, integrated with existing facility management systems and supported by workshops and training sessions.
8. Cost Structure	Comprises development and maintenance expenses, costs for IoT and BIM integration, user training and support, and data storage and cybersecurity measures.
9. Revenue Streams	Generated through licensing or subscription fees, consulting and customisation services.

### 3.5.2. Alternative Revenue Streams

- ChroViewFM can generate revenue through Data-as-a-Service by offering anonymised building performance datasets to research institutions, policy makers, and ESG analysts. This creates value from aggregated insights while maintaining privacy
- A Freemium model can be implemented by providing a basic version of ChroViewFM for free, with advanced features such as predictive analytics, multi-building dashboards, and custom reporting available through paid tiers.
- White-label licensing is another option, allowing real estate firms or FM companies to rebrand and deploy the platform under their own name, with fees based on usage or number of buildings.
- Lastly, training and certification services can be monetised by offering structured programs for professionals to learn how to use ChroViewFM effectively for compliance, benchmarking, and optimisation.

## 3.6. Use Case 4.2

### 3.6.1. Business Model Canvas

Component	Description
1. Key Partners	IoT sensor providers, FM teams, software developers (CHRONICLE), pilot site operators, HVAC vendors.
2. Key Activities	Real-time data collection, predictive analytics, anomaly detection, maintenance notifications.
3. Value Proposition	Reduced downtime, cost savings, proactive HVAC maintenance, improved comfort and energy efficiency.
4. Customer Relationships	Long-term engagement with FM teams, technical support, training
5. Customer Segments	Facility managers, building owners, maintenance service providers
6. Key Resources	IoT infrastructure, historical building data, analytics engine, FM feedback, cloud computing.
7. Channels	ChroViewFM app, FM platforms, web dashboards, mobile notifications.

8. Cost Structure	Sensor deployment and maintenance, software development, data storage and processing, training
9. Revenue Streams	Subscriptions for predictive maintenance services, licensing of analytics modules, integration fees, consulting and customisation services.

### 3.6.2. Alternative Network-Based Revenue Streams

- **Training & Certification:** Develop paid training programs and certifications for facility managers on predictive maintenance and smart building operations.
- **Data-as-a-Service (DaaS):** Monetise anonymised building performance data for benchmarking, research, and product development by third parties.
- **Maintenance Marketplace:** Enable third-party certified maintenance providers to offer services directly through ChroViewFM, with commission-based revenue.

## 3.7. Use Case 5.1

### 3.7.1. Business Model Canvas

Component	Description
1. Key Partners	DBL platform developers, architects/engineers/contractors, regulatory bodies, facility managers
2. Key Activities	Secure data storage, integrity verification, renovation documentation upload, certification validation
3. Value Proposition	Trusted and unaltered building history, increased property value, easy access to certified documentation
4. Customer Relationships	Self-service access, onboarding support, trusted data assurance
5. Customer Segments	Building owners, real estate investors, facility managers
6. Key Resources	Renovation data (e.g., IFC files), traceability tools, user interface, secure storage infrastructure
7. Channels	Web-based DBL platform, integration with property management systems
8. Cost Structure	Platform development and maintenance, data storage, user support and training
9. Revenue Streams	Subscription fees, premium features (analytics, certification tools), licensing to real estate platforms

### 3.7.2. Alternative Network-Based Revenue Stream

- **Data monetisation for market insights:** Aggregate anonymised renovation and building lifecycle data to provide insights to construction firms, insurers, and urban planners.
- **Real estate platform integration:** license DBL access to real estate listing platforms, allowing sellers to showcase verified building history directly in property ads.

- Property certification services: offer third-party certification of building history and renovation quality based on DBL data

## 3.8. Use Case 5.2

### 3.8.1. Business Model Canvas

Component	Description
1. Key Partners	CDE providers, regulatory authorities, public institutions
2. Key Activities	Platform development, CDE integration, regulatory compliance, user support, continuous improvement
3. Value Proposition	Secure and compliant digital archive, simplified document upload, integration with CDEs, long-term data integrity, support for audits and lifecycle management
4. Customer Relationships	Self-service portal, technical support, compliance alerts, feedback mechanisms
5. Customer Segments	Building owners, facility managers, public authorities, designers, engineers, contractors, real estate developers, regulatory bodies
6. Key Resources	DBL platform, cloud infrastructure, development teams, cybersecurity expertise, legal and compliance support
7. Channels	DBL web interface
8. Cost Structure	Development and maintenance, cloud storage, security audits, licensing, support and training
9. Revenue Streams	Subscription fees, licensing for integrations, consulting services, public funding

### 3.8.2. Alternative Network-Based Revenue Streams

- Compliance Certification Services: providing digital certification or validation services for uploaded documents to ensure they meet regulatory or industry standards.
- Training and Accreditation Programs; offering paid courses or certifications for professionals on using the DBL system, data management, and regulatory compliance.
- Data Monetisation (with Consent): aggregating anonymised building data for market research, benchmarking, or urban planning insights, with full user consent and privacy safeguards.

## 4. Replication Roadmap

The Replication Roadmap provides a high-level overview of how the CHRONICLE solutions could be transferred and adopted beyond the pilot sites. It builds on the insights gathered through the exploitation activities, the Business Model analyses, and the implementation of the Use Cases, and offers general considerations to support future uptake.

The roadmap highlights that the replicability of CHRONICLE results depends on a combination of technical, organisational and regulatory conditions. In particular, successful adoption requires:

- **Basic technical readiness**, including availability of building data, IoT infrastructure where relevant, and compatibility with existing digital systems.
- **Clear stakeholder involvement**, especially building owners, facility managers, ESCOs and tenants, whose roles were identified through the Use Cases and business model work.
- **Alignment with national and EU frameworks** such as EPC schemes, renovation requirements, smart readiness indicators and data-related regulations.
- **Economic feasibility**, which is influenced by the business models defined in the project, the expected value created for each stakeholder, and the potential access to incentives or public support.

While detailed deployment plans fall outside the scope of this deliverable, the roadmap suggests that CHRONICLE solutions can be replicated most effectively in contexts where digitalisation strategies, renovation obligations and data-driven building management practices are already advancing. The experience gained in the five pilot sites demonstrates that the solutions are adaptable to different building types and operational environments, provided that minimum technical and organisational preconditions are met.

Overall, the Replication Roadmap offers general guidance to future adopters, indicating the key aspects to consider when evaluating the transfer of CHRONICLE tools and services to new buildings, organisations or regions. It serves as an initial reference framework that can support further exploitation and scaling efforts beyond the project.

## 5. Conclusions and Recommendations

Deliverable 6.2 consolidates the work carried out under Tasks 6.4 and 6.5 and provides a structured framework to guide the future use, transfer, and adoption of the CHRONICLE project results. By identifying and detailing the project's **10 Key Exploitable Results (KERs)**, including their technological maturity, potential value, ownership, and expected users, the deliverable establishes a clear foundation for their exploitation beyond the project's lifetime. Tools such as the **IPR Checklist**, the **BFMULO Matrix**, and the **Exploitation Roadmap** support partners in defining responsibilities, clarifying exploitation intentions, and ensuring coherent management of intellectual property. Furthermore, the **Replication Roadmap** outlines how CHRONICLE solutions can be transferred to different contexts, taking into account enabling conditions, barriers, and context-specific requirements observed during project demonstrations. Overall, this deliverable plays a central role in maximising the long-term impact of CHRONICLE by ensuring that its outcomes are prepared for future uptake, scalable across diverse environments, and capable of contributing to the digital and sustainable transformation of the European building sector.

## 6. Appendix

### 6.1. Appendix 1: Analysis of UC 1.1

#### 6.1.1. Actors & Stakeholders

The stakeholders in this business case include the ESCO, which is responsible for seeking and implementing personalized renovation recommendations. The building's tenants are the primary beneficiaries, as the focus is on their thermal comfort. FællesBo from Denmark and AEM from Switzerland are the pilot partners involved in this use case. Moreover, HVAC system providers play a crucial role, as the renovation scenarios will focus on these systems. Financial stakeholders are concerned with the financial aspects and restrictions of the renovation. Lastly, the developers of the integrated DT framework are responsible for simulating comfort conditions and renovation scenarios.

#### 6.1.2. Main CHRONICLE Tool involved

The main chronicle tool involved in UC 1.1 is the Digital Twin framework. This tool accurately models and simulates the building's processes based on real life data, monitoring buildings operations and environmental conditions, collected through an IoT network installed on site.

Combining powerful building thermal modelling techniques and machine learning algorithms, CHRONICLE's DT Framework will accurately forecast the behaviour of the building's conditions and systems. It will additionally mimic the behaviour of the building's occupants to bridge the simulation gap and provide an accurate and representative building model, continuously calibrated based on current IoT data streams.<sup>4</sup>

#### 6.1.3. Evaluation of UC 1.1 impact according to Energy Consumption

Energy consumption is a critical factor in evaluating and optimising the performance of HVAC systems. By analysing current energy consumption patterns at the demo sites (FællesBo and AEM), the ESCO can develop targeted renovation strategies.

1. **Baseline Energy Consumption:** Establishing a detailed baseline of current energy usage is essential. This involves collecting data on electricity and fuel consumption for heating, cooling, ventilation, and any other HVAC-related functions.
2. **Usage Patterns:** Understanding the patterns of energy consumption, including peak usage times, seasonal variations, and the influence of external weather conditions.
3. **System Efficiency:** Assessing the efficiency of existing HVAC systems, identifying inefficiencies, and pinpointing opportunities for energy-saving improvements.
4. **Simulation with DT Framework:** Utilising the digital twin (DT) framework to simulate various renovation scenarios and predict their impact on energy consumption. This includes testing different control methods and system upgrades.

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<sup>4</sup> <https://www.chronicle-project.eu/tools/>

5. Post-Renovation Monitoring: Continuously monitoring energy consumption post-renovation to ensure that the implemented measures are delivering the expected savings and performance improvements.

#### 6.1.4. Evaluation of UC 1.1 impact according to Energy Efficiency Directive (EED)

The Energy Efficiency Directive (EED) is a key legislative framework in the European Union that promotes energy efficiency improvements. Compliance with the EED is essential for the renovation projects at FællesBo and AEM.

1. Regulatory Compliance: Ensuring that all renovation measures and strategies comply with the requirements of the EED, including specific targets for energy savings and efficiency improvements.
2. Energy Audits: Conducting regular energy audits as mandated by the EED to identify areas for improvement and ensure continuous compliance.
3. Reporting and Documentation: Maintaining thorough documentation and reporting on energy savings achieved through the renovation measures, as required by the EED.
4. Incorporating EED Guidelines: Integrating EED guidelines into the renovation plans, such as using energy-efficient technologies, improving building insulation, and optimising HVAC system performance.
5. Funding and Incentives: Exploring funding opportunities and incentives provided under the EED framework to support the renovation projects financially.

#### 6.1.5. Evaluation of UC 1.1 impact according to Cost and Technology

The cost of renovations and the selection of appropriate technologies are pivotal in ensuring the financial viability and effectiveness of the renovation projects at the demo sites.

1. Cost Analysis: Conducting a comprehensive cost analysis for different renovation scenarios. This includes initial investment costs, operational costs, maintenance costs, and potential savings.
2. Financial Restrictions: Taking into account any financial restrictions and budget constraints of FællesBo and AEM. Developing cost-effective solutions that maximize thermal comfort and energy efficiency within the available budget.
3. Technology Selection: Choosing the most appropriate and advanced technologies for HVAC system upgrades. This might include high-efficiency boilers, heat pumps, smart thermostats, advanced control systems, and energy recovery ventilators.
4. Lifecycle Costs: Evaluating the total lifecycle costs of the technologies, including installation, maintenance, and operational expenses. Prioritising technologies that offer the best return on investment (ROI) over the long term.

5. **Scalability and Flexibility:** Selecting technologies that are scalable and flexible, allowing for future upgrades and adaptations as needed. This ensures the longevity and adaptability of the renovation solutions.
6. **Integration with DT Framework:** Ensuring that the chosen technologies are compatible with the digital twin framework, facilitating seamless integration for monitoring, simulation, and optimisation purposes.

In this use case, focusing on energy consumption, compliance with the Energy Efficiency Directive (EED), and a careful analysis of costs and technology options will be key to achieving optimal thermal comfort for tenants while respecting financial restrictions. By leveraging the capabilities of the digital twin framework, the ESCO can provide tailored renovation recommendations that deliver significant energy savings, enhance tenant comfort, and ensure regulatory compliance.

### 6.1.6. Stakeholder Positioning within the Building Ecosystem

For this Comfort-as-a-Service & Renovation Optimisation Use Case, each stakeholder plays a distinct role within the building ecosystem, leveraging their experience, expertise, and competitive edge.

#### **Energy Service Company (ESCO)**

**Positioning:** The ESCO positions itself as a leader in providing personalized renovation recommendations that prioritise tenant comfort while adhering to financial constraints.

**Role:** Leads the initiative, seeking and implementing renovation strategies.

**Competitive Edge:** Expertise in personalized renovation strategies that go beyond energy-related interventions.

**Key Benefits & Opportunities:** Enhanced thermal comfort for tenants, cost-effective renovation strategies, and the opportunity to test and implement advanced technologies.

#### **Building's Tenants**

**Positioning:** The tenants are positioned as the primary beneficiaries of the renovation efforts.

**Role:** Beneficiaries of improved thermal comfort.

**Competitive Edge:** Directly benefit from enhanced living conditions without bearing the renovation costs.

**Key Benefits & Opportunities:** Improved thermal comfort, better living conditions, and potential long-term savings on energy costs.

#### **FællesBo (Denmark) and AEM (Switzerland)**

**Positioning:** FællesBo and AEM position themselves as innovators in the field, willing to test and implement advanced renovation strategies.

**Role:** Pilot partners testing the renovation strategies.

**Competitive Edge:** Commitment to innovation and willingness to test new technologies.

**Key Benefits & Opportunities:** Opportunity to be at the forefront of innovative renovation strategies, enhanced reputation, and potential insights from the pilot project.

### **HVAC System Providers**

**Positioning:** HVAC system providers are positioned as essential contributors to achieving optimal thermal comfort.

**Role:** Supply and maintain the HVAC systems.

**Competitive Edge:** Advanced HVAC solutions that enhance thermal comfort.

**Key Benefits & Opportunities:** Increased demand for their systems, opportunity to showcase advanced HVAC technologies, and potential long-term partnerships.

### **Financial Stakeholders**

**Positioning:** Financial stakeholders ensure the economic viability of the project.

**Role:** Oversee the financial aspects and ensure budget adherence.

**Competitive Edge:** Ensuring financial feasibility and sustainability.

**Key Benefits & Opportunities:** Cost-effective renovation strategies, potential return on investment, and long-term financial sustainability.

### **Integrated DT Framework Developers**

**Positioning:** The developers of the integrated DT framework position themselves as pioneers in simulating and optimising tenant comfort conditions.

**Role:** Develop and test the digital twin framework to simulate comfort conditions and renovation scenarios.

**Competitive Edge:** Cutting-edge technology to simulate and optimise tenant comfort.

**Key Benefits & Opportunities:** Data-driven insights for renovation decisions, opportunity to refine and improve the DT framework, and potential for broader application in future projects.

## 6.2. Appendix 2: Analysis of UC 2.1

### 6.2.1. Actors & Stakeholders

Residential tenants at the pilot sites: as they are the end-users of the mobile app and the primary recipients of the performance insights and comfort indicators.

Building owners and facility managers: who benefit from operational performance data and smartness assessments to improve efficiency and value.

Technology providers and IoT integrators: responsible for installing and maintaining the sensors and ensuring data accuracy.

Regulatory and certification bodies: since the app delivers dynamic EPCs and smartness indicators aligned with EU standards.

### 6.2.2. Evaluation of UC 2.1 impact according to Energy Consumption

This scenario has the potential to significantly influence the energy consumption of buildings. The application can provide users a deep understanding of how energy is utilised within the building.

The tools allow a more informed and proactive method of energy management in buildings, potentially leading to significant reductions in energy consumption and improvements in overall building performance.

### 6.2.3. Evaluation of UC 2.1 impact according to Energy Efficiency Directive (EED)

This scenario is closely aligned with the objectives of the Energy Efficiency Directive (EED), which seeks to enhance energy efficiency and reduce energy consumption across the European Union.

By providing comprehensive insights into building operational performance and delivering dynamic Energy Performance Certificates (EPCs), the application facilitates the monitoring and improvement of energy efficiency. This is in line with the EED's goal of reducing energy consumption and enhancing the energy performance of buildings.

The emphasis on building smartness performance and the use of IoT equipment for real-time data collection supports the EED's focus on digitalization and the integration of smart technologies to optimise energy use. Additionally, the assessment of thermal comfort and indoor air quality (IAQ) through relevant key performance indicators (KPIs) ensures that energy efficiency measures do not compromise occupant comfort. This holistic approach aligns with the EED's objective to improve living standards while enhancing energy efficiency.

Overall, this scenario supports the EED's objectives by promoting a more informed, proactive, and user-friendly approach to energy management in buildings, potentially leading to significant reductions in energy consumption and improvements in overall building performance

### 6.2.4. Evaluation of UC 2.1 impact according to Cost and Technology

The primary costs associated with this scenario encompass several areas:

#### CAPEX:

Development and implementation expenses, which include the design, development, and deployment of the application. This involves software development, user interface design, and integration with existing systems.

- The acquisition and installation of IoT equipment at all pilot sites represent a significant expenditure. This includes the costs of purchasing sensors and other necessary hardware, as well as setting up the required infrastructure to support these devices.

#### OPEX

- Managing and storing the real-time data collected from the IoT sensors necessitates robust data management systems, which incur costs for cloud storage, data processing, and ensuring data security and privacy.
- Maintenance and technical support for both the application and the IoT equipment are essential to ensure smooth operation. This includes regular updates, troubleshooting, and user support services.

### 6.2.5. Stakeholder Positioning within the Building Ecosystem

UC2.1 connects building operational data, occupant experience, and decision-making.

- **Residents/Tenants:** End-users of the app, providing feedback on usability and comfort. Their engagement is central, especially where simplified interfaces are needed.
- **Building Owners & Facility Managers:** Use insights to optimise energy use, reduce costs, and improve tenant satisfaction. They ensure IoT systems are properly maintained and data is actionable.
- **Technology Providers:** Supply and integrate IoT devices and the app platform, ensuring reliable data collection, visualisation, and security.
- **Regulatory/Certification Bodies:** Provide standards and frameworks, ensuring outputs support compliance and benchmarking.

UC2.1 positions residents at the centre, supported by operators and technology providers, within a regulated framework that enhances operational efficiency and user satisfaction.

## 6.3. Appendix 3: Analysis of UC 3.1 (a) and UC 3.1 (b)

### 6.3.1. Actors & Stakeholders

- Tool Developer
- AECO (Architecture, Engineering, Construction and Operations)
- Investors / Homeowners

- Tenants

The primary stakeholder benefiting from CHRONICLE's innovative tool is the AECO sector, which can apply it across various stages of a building's life cycle. While the focus in this case is on AECO professionals as the main users, the tool also provides value to investors and homeowners in the long term, as well as to tenants in the short term. By enabling the selection of renovation scenarios that best align with users' needs and optimise energy efficiency, the tool has broader appeal. Therefore, when developing the business model in the following chapters, we also consider tenants, homeowners, and tool developers as key stakeholders in this case.

### 6.3.2. Key CHRONICLE Innovation: Renovation Planner

The Renovation Planner stands out as a user-friendly tool that enables building professionals and homeowners to evaluate and compare renovation scenarios, with a strong focus on optimising energy performance. What differentiates it from similar tools is its holistic approach. Each scenario includes a full financial assessment, carbon emissions evaluation, and consideration of tenant comfort, based on the user's selected priorities. In addition, it generates a detailed renovation roadmap and issues a Building Renovation Passport (BRP), offering a long-term strategy for future inspections, maintenance, and upgrades, aligned with the service life of building components and systems.

### 6.3.3. Evaluation of UC 3.1(a) according to its business impact

This subchapter evaluates UC 3.1(a) according to its potential business impact, based on assumptions regarding potential market volume and value delivered to stakeholders. The objective is to demonstrate, even at an early stage, the expected benefits the solution could generate when adopted at scale. These insights will serve as the foundation for constructing viable business models in subsequent sections.

The target market for the Renovation Planner includes all buildings that are candidates for renovation, initially within Europe, with the potential to expand globally in the future. The primary focus is on energy-efficiency improvements in buildings. In this section, we provide a preliminary analysis of the potential market volume for the tool.

Business impact refers to the effect or influence that an event, decision, action, or change has on an organisation's performance, effectiveness, and overall success<sup>5</sup>

Here, we examine how the introduction of the Renovation Planner platform may influence building performance and assess the expected outcomes following its implementation in pilot sites, as well as its potential adoption across other buildings. Since feedback from pilot sites is not yet available, the analysis is based on assumptions, including estimated market size and potential demand for the tool among buildings requiring renovation.

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<sup>5</sup> [ [What is Business Impact | Prohance.](#) ]

Several factors influence the business impact of the Renovation Planner:

- **Market Conditions:** Economic trends, market demand, and the competitive landscape significantly affect the potential uptake and influence of business tools.
- **Operational Efficiency:** Improvements or inefficiencies in processes, technology, and resource management can substantially alter outcomes.
- **Customer Satisfaction:** Changes in service quality, product offerings, or engagement strategies can influence user adoption, loyalty, and long-term value.

In this preliminary analysis, we focus on market conditions to benchmark the Renovation Planner against similar tools and estimate potential demand. Operational efficiency, technology, and customer satisfaction are important factors but fall outside the scope of this deliverable, as no direct feedback from pilot site users is available. Therefore, the analysis emphasizes the tool's potential to reduce renovation costs, support revenue generation, and enable more efficient decision-making by identifying the most effective renovation scenario(s) for each building.

### Target Market / Volume Assumption

The necessary decarbonization of the Union building stock requires energy renovation at a large scale: almost 75 % of that building stock is inefficient according to current building standards, and 85 to 95 % of the buildings that exist today will still be standing in 2050. However, the weighted annual energy renovation rate is persistently low at around 1 %<sup>6</sup>

As announced in the European Green Deal, the Commission presented its Renovation Wave strategy in its communication of 14 October 2020 entitled 'A Renovation Wave for Europe — greening our buildings, creating jobs, improving lives. The Renovation Wave strategy contains an action plan with concrete regulatory, financing and enabling measures, with the objective to at least double the annual energy renovation rate of buildings by 2030 and to foster deep renovations, resulting in 35 million building units renovated by 2030 and the creation of jobs in the construction sector<sup>7</sup>

According to the above targets specified by the EU, there will be a need for at least 35 million building units to be renovated by 2030 which shows a considerable market for renovation planner tool.

The Renovation Planner addresses a significant market opportunity created by the EU's Renovation Wave initiative and the urgent need to decarbonize Europe's aging building

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- <sup>6</sup> European Union. (2024). Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast). Official Journal of the European Union, L, 8 May 2024.

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32024L1275>

- <sup>7</sup> European Union. (2024). Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast). Official Journal of the European Union, L, 8 May 2024.

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32024L1275>

stock. With around 35 million buildings expected to undergo renovation by 2030, demand for digital planning tools that optimise renovation scenarios is expected to grow rapidly.

The solution provides strong value for AECO professionals by enhancing decision-making efficiency, for investors and homeowners through cost and energy savings, and for tenants by improving comfort and reducing energy bills. Furthermore, its alignment with EU policy frameworks (EPBD, EED) and the Building Renovation Passport concept reinforces its strategic relevance and market readiness.

Considering the large addressable market, policy drivers, and multi-stakeholder value generation, the **business impact of Use Case 3.1(a) is assessed as high**. Future adoption at scale could significantly contribute to Europe's energy efficiency targets and generate considerable economic value for the AECO ecosystem, provided that market uptake and technical integration challenges are effectively managed.

#### 6.3.4. Evaluation of UC 3.1(a) according to its feasibility

The feasibility of the Renovation Planner use case is strong within the European context, supported by existing competencies in energy performance assessment, lifecycle analysis, and regulatory alignment with frameworks like the EPBD. AECO professionals and stakeholders are generally equipped to engage with renovation workflows, while the development and integration of digital tools such as BRPs and scenario modelling require targeted technical expertise and training. Financial modelling and stakeholder communication present moderate challenges but are manageable with proper support. Overall, the use case is viable and scalable across pilot sites, offering clear value in proactive, energy-focused renovation planning.

#### 6.3.5. Evaluation of UC 3.1(a) according to regulation

According to the 2024 recast of the Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive (EED), this use case is highly feasible and well-aligned with EU policy goals. The EPBD now mandates Member States to implement Building Renovation Passport (BRP) schemes by May 2026, based on a common framework outlined in Annex VIII. BRPs are recognised as voluntary but strategic tools to guide staged deep renovations, improve energy performance, and support the transition to Zero-Emission Buildings (ZEBs). They are also intended to work in synergy with Energy Performance Certificates (EPCs) and financial instruments like green mortgages. The EED complements this by promoting energy savings and renovation strategies across sectors. Together, these directives provide a robust regulatory foundation for the Renovation Planner, reinforcing its technical, operational, and policy feasibility across Europe.

#### 6.3.6. Evaluation of UC 3.1(a) according to costs & technologies

Considering costs and technologies, the Renovation Planner use case remains highly feasible across Europe. Existing energy assessment tools and lifecycle databases support the technical foundation, while emerging digital technologies enable scenario modelling and BRP generation. Although initial development and integration costs may be moderate to high—especially for tool customisation and stakeholder training—the long-term savings from optimised energy renovations and predictive maintenance justify the investment. With

EU incentives and regulatory alignment, the technological and financial landscape is favourable for successful implementation.

### 6.3.7. Evaluation of UC 3.1(a) according to security & privacy

Security and privacy should be assured by developing a secure interface which ensures the user data is protected.

### 6.3.8. Define a winning value proposition

The Renovation Planner enables building owners and AECO professionals to assess multiple renovation scenarios, with a primary focus on optimising energy performance. Each scenario is accompanied by a complete financial assessment, while also evaluating critical factors such as tenant comfort and carbon emissions. Users can prioritise parameters through a user-friendly interface, and the tool automatically generates a ranked list of the most suitable renovation strategies. In addition, the Renovation Planner produces a step-by-step renovation roadmap with concrete measures and issues a Building Renovation Passport (BRP), detailing future inspections, maintenance, and upgrades based on the expected service life of building components, systems, and materials. What sets this tool apart is its holistic approach: it combines energy efficiency, financial feasibility, environmental impact, and occupant comfort, and can even incorporate user-specific inputs, such as owner income, to suggest an optimal renovation plan that maximises energy savings and overall building value.

### 6.3.9. Stakeholder Positioning within the Building Ecosystem

In this use case, each stakeholder plays a distinct role in supporting energy-focused renovation planning and the implementation of BRPs. AECOs evaluate and select renovation scenarios, building owners use the BRPs to optimise investments, and facility managers implement maintenance and inspection triggers. Suppliers and contractors carry out the renovation measures, while the Renovation Planner provides intelligent decision support. Tenants benefit from improved energy performance, and policymakers ensure compliance with standards. Together, these stakeholders enable data-driven, cost-effective, and energy-efficient renovation strategies across all pilot sites.

Stakeholder	Position / Role in Ecosystem	Relation to Renovation Planning & BRPs
AECOs (Architects, Engineers, Consultants)	Decision-makers and scenario selectors	Evaluate proposed renovation scenarios, select optimal strategies, receive BRPs
Building Owners / Developers	Investors and asset managers	Use BRPs to plan and finance energy-efficient renovations, improve long-term building value
Facility Management (FM)	Operational enabler	Implement maintenance and inspection triggers from BRPs, ensure operational efficiency

Suppliers / Contractors	Providers of materials and services	Execute renovation interventions based on selected scenarios
CHRONICLE Renovation Planner	Developer of the tool	Generates multiple energy-focused renovation scenarios and BRPs
Policy Makers / Regulators	Standardization and compliance enforcers	Ensure that renovation practices align with regulations and energy performance standards
Tenants / Occupants	End users and feedback contributors	Benefit from improved energy efficiency, reduced operational costs, and enhanced comfort

## 6.4. Appendix 4: Analysis of UC 3.2

### 6.4.1. Actors & Stakeholders

- **AECO professionals** – primary users who assess renovation costs and carbon-related impacts.
- **Building owners and investors** – benefit from transparent cost and carbon information supporting sustainable investment decisions.
- **Tenants** – indirectly benefit from reduced operational costs and lower carbon footprints.
- **Policy makers / regulators** – can use outputs for compliance monitoring with carbon pricing and emission targets.
- **Tool developers** – responsible for integrating carbon cost calculations into the CHRONICLE platform.

### 6.4.2. Main CHRONICLE Tool:

#### **ChroViewREN (Investment Appraiser & Renovation Planner)**

ChroViewREN is a CHRONICLE tool developed for owners, investors, and professionals in Architecture, Engineering, and Construction (AEC). It supports informed decision-making in building valuation, renovation planning, and sustainability management.

The **Investment Appraiser** forecasts value, liabilities, and carbon-related costs associated with building performance and energy-saving measures. It performs Life Cycle Cost (LCC) analysis using validated cost KPIs, covering both dynamic costs (e.g., energy and water consumption) and static costs (e.g., building materials). It also calculates the **Carbon Bill**, quantifying the economic impact of emissions for both baseline and renovation scenarios.

The **Renovation Planner** helps assess and compare renovation scenarios focused on optimising energy performance, user comfort, and carbon reduction. Each scenario includes a full financial and environmental assessment, presenting a ranked list of best options based on user priorities. Once a preferred scenario is selected, the tool generates a **Building Renovation Passport (BRP)** a proactive roadmap detailing future inspections, maintenance, and upgrades according to component service life.

Together, these modules enable data-driven renovation strategies that balance cost efficiency, energy performance, user comfort, and carbon impact across a building's life cycle.

### 6.4.3. Evaluation of UC 3.2 according to its business impact

It was already mentioned in UC 3.1 (a) that The necessary decarbonization of the Union building stock requires energy renovation at a large scale: almost 75 % of that building stock is inefficient according to current building standards, and 85 to 95 % of the buildings that exist today will still be standing in 2050. However, the weighted annual energy renovation rate is persistently low at around 1 %<sup>8</sup>

As announced in the European Green Deal, the Commission presented its Renovation Wave strategy in its communication of 14 October 2020 entitled 'A Renovation Wave for Europe — greening our buildings, creating jobs, improving lives. The Renovation Wave strategy contains an action plan with concrete regulatory, financing and enabling measures, with the objective to at least double the annual energy renovation rate of buildings by 2030 and to foster deep renovations, resulting in 35 million building units renovated by 2030 and the creation of jobs in the construction sector.

Although the potential market encompasses around 35 million buildings targeted for renovation, this figure alone does not determine the success of the tool. It is equally important to assess how attractive the tool is to potential users, as well as whether existing or upcoming regulations create incentives or obligations for its adoption. Therefore, in the following sections, this use case is further evaluated not only in terms of its market potential but also considering factors such as feasibility, regulatory drivers, and user motivation.

### 6.4.4. Evaluation of UC 3.2 according to its feasibility

UC 3.2 is broadly feasible given the current state of knowledge among AECO actors, but its implementation requires interdisciplinary expertise. Existing competencies in LCA, cost modelling, and whole-life carbon assessment vary significantly across the participating pilot partners. Some organisations especially those already engaged in sustainability certification, energy retrofitting, or digital building management possess strong LCA and WLC skills. However, additional competencies are required to standardize carbon data input, interpret carbon pricing frameworks, and integrate environmental impact metrics with cost estimation tools. This implies a learning curve and potential training needs for partners less familiar with carbon accounting methodologies.

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- <sup>8</sup> European Union. (2024). Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast). Official Journal of the European Union, L, 8 May 2024.

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32024L1275>

Moreover, the feasibility of accurately calculating a Carbon Bill depends on the availability and quality of data across the building lifecycle. Many organisations already collect materials and energy data but extending this into harmonised LCA datasets and dynamic carbon pricing scenarios requires new processes and improved data governance. Overall, the competence gap is bridgeable, but structured capacity-building, shared digital platforms, and methodological alignment will be essential for full feasibility.

#### 6.4.5. Evaluation of UC 3.2 according to regulation

Regulation plays a central role in carbon pricing, and UC 3.2 aligns well with the broad direction of EU and national policies toward mandatory carbon measurement. Several countries—Denmark, Switzerland, Ireland, and Spain—are moving toward or already applying carbon performance requirements in construction. However, carbon pricing mechanisms differ widely: some countries apply carbon taxes, others use emissions trading systems (ETS), and some have no binding carbon cost instruments for buildings. As a result, implementing a standardized Carbon Bill across five pilots requires careful mapping to national regulatory frameworks.

Because the EU is moving toward harmonised whole-life carbon reporting (Level(s), EPBD revisions, and national LCA mandates), UC 3.2 anticipates future requirements. Yet, regulatory uncertainty remains a challenge particularly regarding how carbon cost will be incorporated into building legislation. UC 3.2 is therefore compliant with the direction of travel but must remain adaptable to evolving national and EU-level carbon accounting rules.

#### 6.4.6. Evaluation of UC 3.2 according to costs & technologies

The technological requirements for UC 3.2—such as digital LCA tools, databases (e.g., EPDs), BIM integration, and WLC calculators—are mature and widely available. Implementing the Carbon Bill does not require new technologies, but it does require system integration and consistent data workflows. The main cost factors relate to acquiring or upgrading LCA software, training staff, harmonizing data sources, and maintaining updated carbon price datasets. These costs are moderate compared to other digitalization initiatives and can leverage existing BIM, asset management, and energy monitoring tools used by AECOs.

Long-term cost efficiency is strong: once the workflows are established, automated carbon-cost calculations become a routine part of project evaluation and renovation planning. Because carbon pricing is expected to rise, using UC 3.2 to anticipate carbon-related financial risks could result in substantial economic benefits. Technological barriers are therefore low, but organisational costs related to data management and interoperability should not be underestimated.

#### 6.4.7. Evaluation of UC 3.2 according to security & privacy

UC 3.2 does not handle sensitive personal data but relies heavily on building information, material inventories, and operational energy records. While these datasets are generally considered low risk from a privacy perspective, there may still be security concerns when integrating digital tools across multiple partners and countries. Ensuring secure data exchange, especially when using cloud-based LCA platforms or cross-border databases, requires adherence to basic cybersecurity practices and EU GDPR principles where applicable.

The risk mainly concerns commercial confidentiality: material quantities, cost structures, and performance data may be sensitive for some organisations. Implementing UC 3.2 will therefore require access control, secure APIs, and clear data-sharing agreements among pilot partners. Overall, security and privacy risks are manageable and low, provided standard industry protections are implemented.

#### 6.4.8. Evaluation of UC 3.2 according to standards

UC 3.2 draws strongly on well-established international and European standards for LCA and carbon accounting, which enhances its robustness. Key standards include EN 15978 for building LCA, EN 15804 for EPDs, ISO 14040/44 for LCA methodology, and Level(s) as the EU-wide reporting framework for whole-life carbon. Most pilot partners already operate within these standards or have access to tools aligned with them, making standard compliance feasible.

However, the challenge lies in applying these standards consistently across countries with differing datasets and carbon factors. Harmonization—especially in embodied carbon factors, operational carbon calculation rules, and carbon price references—will be essential. UC 3.2 can serve as a unifying framework across the pilots, but must adopt a clear standardization approach to avoid inconsistencies in the Carbon Bill methodology. With proper guidance, strong compatibility with existing standards is achievable.

The Renovation Planner enables AECOs and building owners to select the optimal renovation scenario by estimating the Carbon Bill based on the building's life cycle (WLC). By choosing the most efficient scenario, users reduce renovation costs, minimize carbon emissions, and lower the carbon price they have to pay. The tool balances energy efficiency, tenant comfort, and environmental impact, ensuring that renovations are cost-effective, sustainable, and comfortable for occupants. In this way, the Renovation Planner helps stakeholders achieve both financial savings and reduced carbon footprint simultaneously.

The CHRONICLE Renovation Planner distinguishes itself from other renovation planning tools by integrating carbon cost estimation into the renovation decision-making process. Unlike traditional tools that primarily focus on cost and design, CHRONICLE's tool assesses the **Carbon Bill** associated with different renovation scenarios, providing AECOs and building owners with a comprehensive understanding of the environmental and financial implications of their choices. This integration of carbon pricing aligns with EU

sustainability goals and supports compliance with regulations such as the Energy Performance of Buildings Directive (EPBD).

Other renovation planning tools offer useful features, but they fall short of CHRONICLE's integrated approach:

- **IWG5 Tool** (EURAC Research) provides energy and cost simulations across EU climates but lacks comfort metrics and carbon pricing integration (EURAC Research).
- **Block Renovation Studio** simplifies design and budgeting for homeowners using AI, yet doesn't assess lifecycle carbon impacts (Block Renovation). <https://www.blockrenovation.com/>
- **Planner 5D** focuses on visual modelling and layout planning, ideal for interior design but not for energy or sustainability analysis (Planner 5D).
- **MagicPlan** and **Kukun** offer cost estimation and floor planning tools but lack environmental performance tracking or BRP generation (MagicPlan, Kukun).
- **STAAD Pro** supports structural retrofitting and compliance but doesn't provide multi-criteria renovation scenarios or carbon cost evaluation <https://www.bentley.com/software/staad/> (Bentley STAAD Pro).

By offering a tool that combines energy efficiency, cost-effectiveness, and carbon emission considerations, the CHRONICLE Renovation Planner provides a unique value proposition that supports sustainable building practices and informed decision-making.

#### 6.4.9. Stakeholder Positioning within the Building Ecosystem

The stakeholder positioning table identifies the main actors across the building lifecycle and their roles in implementing Use Case 3.2. It illustrates how architects, engineers, contractors, owners, policymakers, and end users interact within the carbon pricing and LCA framework. By clarifying responsibilities and data flows, the table supports effective collaboration and ensures that each stakeholder can contribute to reducing carbon emissions and lifecycle costs while benefiting from the implementation of Whole Life Costing and LCA tools.

Stakeholder	Position / Role in Ecosystem	Relation to Carbon Pricing / LCA
Architects & Engineers	Designers and planners	Integrate low-carbon design strategies early on
Construction Companies (Contractors)	Builders and material specifiers	Choose materials and methods that reduce embodied carbon
Building Owners / Developers	Investors and decision-makers	Bear or benefit from carbon costs; decide renovation strategies
Facility Managers / Operators	Manage buildings in use phase	Optimise energy use and operational carbon
Government / Policy Makers	Regulators	Define and enforce carbon pricing mechanisms

Residents / Tenants	End users	Benefit from lower energy costs and better environment
Suppliers / Manufacturers	Material producers	Account for embodied carbon in products

## 6.5. Appendix 5: Analysis of UC 4.1

### 6.5.1. Actors & Stakeholders

#### 1. Facility Managers (FMs)

- Primary users of ChroViewFM.
- Responsible for monitoring building performance, energy use, maintenance, and comfort.
- Need actionable insights and intuitive visualisations.

#### 2. Building Owners

- Interested in cost savings, sustainability, and long-term asset value.
- May use ChroViewFM for strategic decisions on renovations or investments.

#### 3. Energy & Resource Efficiency Engineers

- These professionals analyse energy data and propose efficiency measures.
- May use the tool for benchmarking, diagnostics, and reporting.

#### 4. IT and Software Developers

- Responsible for developing ChroViewFM.
- Ensure integration with IoT systems, 3D models, and data visualisation tools.

### 6.5.2. Main CHRONICLE tool involved

The main CHRONICLE tool involved is ChroViewFM.

The online BIM-based tool enables:

1. the three-dimensional visualisation of the building and
2. the monitoring of near-real time data from smart equipment installed on site, such as energy consumption, environmental conditions, and other performance indicators.

These include:

- energy usage analysis
- costs

- CO2 emissions
- indoor air quality
- tenant-user's comfort

ChroViewFM's dashboard allows the user to track the building's energy use and comfort levels and, eventually, identify any significant changes over time. To this end, ChroViewFM provides notifications of upcoming maintenance activities and warnings of any unexpected behaviour of the building equipment, thus facilitating the building's predictive and preventive maintenance.

Finally, it offers a user-friendly 3D visualisation tool, where the user e.g., Architect/BIM modeler or Facility Manager, can upload actual or hypothetical BIMs of a building of interest.

### 6.5.3. Evaluation of UC 4.1 according to its business impact

ChroViewFM has a high business impact as it empowers Facility Managers with real-time, data-driven insights into building performance. This enables reduced operational costs through energy optimization, improved occupant comfort and satisfaction, and more informed decision-making for maintenance and renovation. Additionally, it supports evidence-based investment planning.

### 6.5.4. Evaluation of UC 4.1 according to regulation

ChroViewFM is well aligned with European Union directives. It supports the Energy Performance of Buildings Directive (EPBD) and integrates with frameworks such as Energy Performance Certificates (EPCs) and the Smart Readiness Indicator (SRI). Furthermore, it facilitates compliance with national energy efficiency regulations and reporting obligations, making it a valuable tool for regulatory alignment.

### 6.5.5. Evaluation of UC 4.1 according to costs and technologies

The platform requires a moderate initial investment, primarily due to the need for integration with IoT infrastructure and BIM models. However, it proves cost-effective in the long term by reducing energy waste and lowering maintenance costs. The technology includes IoT, cloud computing, and potentially AI-based analytics, all of which are mature and widely adopted technologies.

### 6.5.6. Evaluation of UC 4.1 according to security and privacy

ChroViewFM incorporates role-based access control through the Digital Building Logbook and ensures secure handling of sensitive building and occupant data.

### 6.5.7. Evaluation of UC 4.1 according to standards

The system is built to support and extend key industry standards. It is aligned with ISO 19650 for BIM data management and EN 15232 for building automation and control. Additionally, it promotes the use of standardized KPIs for benchmarking and performance tracking, contributing to consistency and comparability across buildings and projects.

### 6.5.8. Stakeholder Positioning within the Building Ecosystem

Stakeholder	Role	Positioning
Facility Managers (FMs)	Operational decision-makers	Core Users
Maintenance & Renovation Teams	Operational support	Secondary Users
Energy Efficiency Engineers	Technical advisors	Technical Contributors
IT/Software Developers	Technical implementers	Enablers
Occupants/Tenants	End beneficiaries	Indirect Stakeholders

## 6.6. Appendix 6: Analysis of UC 4.2

### 6.6.1. Actors & Stakeholders

#### 1. Facility Managers (FMs)

- Primary user of the ChroViewFM application.
- Responsible for monitoring, decision-making, and maintenance coordination.
- Receives visual insights (UC4.1) and predictive/preventive maintenance notifications (UC4.2).

#### 2. Maintenance Planner

- Provides planned maintenance schedules.
- Collaborates with FM to ensure timely execution of maintenance tasks.

#### 3. IT & Software Developers (CHRONICLE Project Team)

- Develop and maintain the ChroViewFM platform.
- Ensure integration, data security, and user experience.

#### 4. Building Owners/Asset Managers.

- Oversee long-term value and performance of the building.
- Interested in cost savings, sustainability, and tenant satisfaction.
-

### 6.6.2. Main chronicle tool involved

The main CHRONICLE tool involved is ChroViewFM.

Please, see chapter 6.5.2 for a brief description of the tool ChroViewFM.

### 6.6.3. Evaluation of UC 4.2 according to its business impact

UC4.2 has an interesting business impact due to its potential to reduce operational costs, extend equipment lifespan (especially HVAC systems), and improve building performance. By enabling early detection of anomalies and scheduling maintenance proactively, it minimizes downtime and enhances service continuity. This contributes to better tenant satisfaction and long-term asset value, especially in pilot sites where FM teams are directly involved in maintenance activities.

### 6.6.4. Evaluation of UC 4.2 according to its feasibility

The feasibility of UC4.2 depends on the maturity of the building's IoT infrastructure and data availability. Technically, predictive maintenance algorithms are well-established, and integration with ChroViewFM is achievable. Operational feasibility depends on the FM's capacity to act on notifications and the site's readiness to adopt data-driven workflows.

### 6.6.5. Evaluation of UC 4.2 according to regulation

UC4.2 must comply with data protection regulations (e.g., GDPR in Europe), especially since it involves monitoring and analysing building usage patterns. Additionally, maintenance activities must adhere to local building codes, HVAC safety standards, and environmental regulations. Legal feasibility is strong if these aspects are considered early and legal counsel is engaged.

### 6.6.6. Evaluation of UC 4.2 according to costs & technologies

The cost of implementing UC4.2 varies based on existing infrastructure. If IoT sensors and data platforms are already in place, costs are relatively low and mostly related to software integration and analytics. However, in buildings lacking digital infrastructure, upfront investment in sensors and connectivity may be significant. The technologies required—such as time-series analysis, anomaly detection, and cloud-based platforms—are mature and widely available.

### 6.6.7. Evaluation of UC 4.2 according to standards

UC4.2 aligns well with existing standards in building automation (e.g., BACnet, ISO 16484), predictive maintenance (ISO 13374), and data interoperability. Adhering to these standards ensures compatibility across systems and facilitates scalability across different pilot sites. Standardization also supports benchmarking and regulatory compliance.

### 6.6.8. Stakeholder Positioning within the Building Ecosystem

Stakeholder	Role	Positioning
Facility Manager (FM)	Uses ChroViewFM to monitor building data and receive maintenance alerts	Central operational role; connects data insights with on-site actions
Maintenance Planner	Provides planned maintenance schedules	Back-end support; coordinates with FM for maintenance execution
IT & Software Developers (CHRONICLE Project Team)	Develop and maintain ChroViewFM	Ensure platform functionality and integration
Building Owners / Asset Managers	Oversee building performance and value	Strategic stakeholders; use data for investment and operational decisions

## 6.7. Appendix 7: Analysis of UC 5.1

### 6.7.1. Actors & Stakeholders

#### 1. Building Owner

The building owner is the primary user of the Digital Building Logbook (DBL). Their goal is to access and manage trusted renovation and building history data to increase the property's market value. They use the DBL to retrieve, verify, and present authenticated documentation (e.g., IFC files) to potential buyers or investors.

#### 2. Digital Building Logbook Provider/Platform Developer

This stakeholder is responsible for developing, maintaining, and securing the DBL platform. They ensure that the system supports data integrity, traceability, and user-friendly access. Their role is critical in enabling the building owner to store and showcase renovation history in a reliable and standardized format.

#### 3. Professionals in Architecture, Engineering, and Construction (AEC)

AEC professionals contribute technical documentation related to renovations, upgrades, and construction activities. They generate IFC files data that are uploaded to the DBL. Their input forms the foundation of the building's historical timeline, which the owner uses to demonstrate the building's evolution and quality.

### 6.7.2. Main chronicle tool involved:

The main CHRONICLE tool involved is ChroViewDBL (Dynamic Building Logbook)

This tool is for:

- Owners/Investors

- Facility Managers (FM)
- Professionals in Architecture, Engineering and Construction (AEC)
- Energy Service Companies (ESCO)

The Dynamic Building Logbook (DBL) is an information repository for all relevant building data. It allows to store, organise, manage and trace information and data throughout the whole building's lifecycle. It is a valuable resource for building owners and professional stakeholders to observe the evolution of the building based on trusted information and it facilitates decision making. The DBL bridges the gap between the great amount of data and information generated during the building's life cycle and the lack of methodologies and tools to safely manage, organise, structure and share this data.

The building information, milestones and data can be archived in one, secure place where it will be accessible to authorised parties in the long-term. The CHRONICLE Dynamic Building Logbook offers intuitive features (such as a timeline of the building's lifetime) that supports the involved stakeholder's decision making on critical decisions regarding the building management. It will offer multiple ways of searching for and managing data. Through the communication established with the Common Data Environment of CHRONICLE, results and information from other CHRONICLE solutions will be automatically stored in the logbook.

The system uses blockchain technology to guarantee the integrity and traceability of your data.

### 6.7.3. Evaluation of UC 5.1 according to its business impact

By providing a secure, traceable, and comprehensive history of building renovations and performance, the DBL enhances property transparency, marketability, and investment confidence. It supports better-informed decisions for buyers and investors, potentially increasing the building's resale value and reducing transaction friction.

### 6.7.4. Evaluation of UC 5.1 according to its feasibility

The feasibility depends on the digital maturity of the building and the availability of structured renovation data (e.g., IFC files). Technically, DBLs can be implemented using existing BIM and data management tools. However, widespread adoption requires stakeholder engagement, training, and integration with legacy systems.

### 6.7.5. Evaluation of UC 5.1 according to regulation

DBLs align well with EU regulatory frameworks, particularly the Energy Performance of Buildings Directive (EPBD). They support compliance with energy performance certification, smart readiness indicators, and renovation passports. However, national-level harmonization is still evolving, and regulatory clarity may vary across Member States.

### 6.7.6. Evaluation of UC 5.1 according to costs & technologies

Initial costs include platform development, data digitisation, and integration with BIM systems. However, DBLs reduce administrative overhead, improve data accessibility, and support renovation planning. Technologies involved—such as IFC, BIM, and secure cloud storage—are mature and widely available.

### 6.7.7. Evaluation of UC 5.1 according to security & privacy

Security and privacy are critical. DBLs must ensure data integrity, access control, and compliance with GDPR. Sensitive building data must be protected from unauthorised access, especially when shared with external stakeholders.

### 6.7.8. Stakeholder Positioning within the Building Ecosystem

Stakeholder	Role	Positioning
Building Owner	Accesses and manages trusted building data to increase property value	Strategic stakeholder; focuses on asset transparency and marketability
DBL Provider / Platform Developer	Develops and maintains the Digital Building Logbook system	Technology enabler; ensures secure, user-friendly access to building data
Professionals in Architecture, Engineering and Construction (AEC)	Generate renovation documentation (e.g., IFC files)	Content providers

## 6.8. Appendix 8: Analysis of UC 5.2

### 6.8.1. Actors & Stakeholders

#### 1. Building Owner / Facility Manager

- Initiates the upload of documents via the DBL interface.
- Responsible for ensuring the accuracy and completeness of the data.

#### 2. System Administrator

- Manages user access, roles, and permissions.
- Ensures system integrity and security.

### 6.8.2. Main chronicle tools involved:

#### **ChroViewDBL (CHRONICLE Dynamic Building Logbook)**

**Description:** ChroViewDBL is a BIM (Building Information Model) based repository, whose purpose is to store the enhanced building information related to performance, renovation advice, housing quality and other building aspects. In summary, a dynamic, BIM based Digital Building Logbook.

A Digital Building Logbook (DBL) is a comprehensive digital repository that serves as a central hub for capturing, storing, and managing a wealth of data, documents, and information related to a building's entire lifecycle. This dynamic tool ensures that valuable insights and records, from construction to ongoing operations, are accessible, shareable, and easily comprehensible for stakeholders.

**Features & Benefits:** in particular, ChroViewDBL is a trusted archive of relevant building data, aligned with the rest of the CHRONICLE project tools, and focused on I) facilitating access to information, rather than confusing the user with hundreds of its organized documents; II) differentiating itself from other solutions in the construction software ecosystem, targeting the trusted archiving and the preservation of events and documents for further use. ChroViewDBL has a user-friendly design and is fully oriented to interconnectivity, integrity and traceability of the building documentation.

#### **Common Data Environment**

**Description:** the Common Data Environment (CDE) is a cloud-based data management framework that enables secure, consistent and interoperable data exchange among project components and stakeholders.

Designed around principles of semantic interoperability, it supports the integration of static BIM data, dynamic IoT data from diverse sources, performance analytics and renovation scenario modelling into a unified digital environment.

**Features & Benefits:** serving as the central hub for digital twin operations, the CDE ensures that heterogeneous data is harmonised, accessible and meaningful. It facilitates real-time data ingestion, long-term storage and structured querying to support use cases such as monitoring, performance assessment and certification.

It ensures that authorised stakeholders – including facility managers, energy service companies (ESCOs), AEC professionals, owners, investors, and residents – can access consistent, reliable and up-to-date project information throughout the building lifecycle.

### 6.8.3. Evaluation of UC 5.2 according to its business impact

The implementation of a secure upload functionality within the Digital Building Logbook (DBL) has a strong business impact. It enables building owners and managers to centralise and digitise critical documentation, improving operational efficiency and reducing the risk of data loss. This use case supports better decision-making, facilitates compliance with regulatory requirements, and enhances collaboration among stakeholders such as contractors, designers, and public authorities. By ensuring that building data is

securely archived and easily accessible, the DBL becomes a strategic asset for long-term facility management and value preservation.

#### 6.8.4. Evaluation of UC 5.2 according to regulation

Regulatory compliance is a critical aspect of this use case. The system must adhere to the General Data Protection Regulation (GDPR) to ensure the protection of personal data, especially when documents contain sensitive information. Additionally, the use of digital signatures and trust services must comply with the eIDAS regulation. National and regional laws governing building documentation and digital archives must also be considered, potentially requiring certification or validation by public authorities. Ensuring regulatory alignment not only mitigates legal risks but also enhances the credibility and trustworthiness of the DBL platform.

#### 6.8.5. Evaluation of UC 5.2 according to costs & technologies

The cost of implementing this use case includes initial development, integration with existing systems, licensing of secure storage or CDE platforms, and ongoing maintenance. While the upfront investment may be significant, the long-term benefits - such as reduced manual handling, improved data quality, and streamlined compliance - are consistent. Technologically, the use case is supported by mature solutions including cloud-based storage, metadata tagging, and document versioning systems. These technologies are widely available and scalable, making the technical implementation feasible with the right planning and resources.

#### 6.8.6. Evaluation of UC 5.2 according to security & privacy

Security and privacy are foundational to the success of this use case. The system must implement robust measures such as role-based access control, encryption of data both in transit and at rest, and detailed audit trails to track document activity. Multi-factor authentication and secure login protocols are essential to prevent unauthorised access. Given the sensitivity of building documentation, especially when it includes personal or contractual data, maintaining high standards of cybersecurity is non-negotiable. Regular security audits and compliance checks should be part of the operational model.

#### 6.8.7. Stakeholder Positioning within the Building Ecosystem

##### Building Owner / Facility Manager

The Building Owner or Facility Manager is positioned as the primary initiator and beneficiary of the Digital Building Logbook (DBL) upload functionality. Their role within the building ecosystem is strategic, as they are responsible for ensuring that all relevant building documentation is collected, maintained, and made accessible throughout the asset's lifecycle. They interact directly with the DBL interface to upload documents, verify data accuracy, and ensure compliance with regulatory and operational requirements.

### System Administrator

The System Administrator occupies a technical and governance-oriented role within the ecosystem. They are responsible for configuring and maintaining the DBL platform, managing user roles and permissions, and ensuring that the system operates securely and reliably. Their positioning is more infrastructural, supporting the backend operations that enable trusted document exchange and archival. They ensure that the platform adheres to security protocols, regulatory standards, and interoperability requirements, making them a key enabler of the use case's success. While not directly involved in the business decisions, their role is critical in maintaining the trust and functionality of the digital ecosystem.

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