Circularity in practice during a retrofit of a historical building – A case study of the CISL Entopia Building

CISL Code:

Assignment Type: Individual

Date:

Word Count:

Figure 1: CISL Entopia Building (Source: www.architype.co.uk, n.d.)

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Glossary

Abbreviation	Full Form Text	Overview
CISL	Cambridge Institute of Sustainability Leadership	The Cambridge Institute for Sustainability Leadership, formerly the Cambridge Programme for Sustainability Leadership and the Cambridge Programme for Industry, is part of the University of Cambridge.
EMF	Ellen Macarthur Foundation	The foundation has played a key role in promoting and evolving Circular Business Models across the industries
RIBA	Royal Institute of British Architects	The Royal Institute of British Architects is a global professional membership body driving excellence in architecture
BCO	British Council Office	The British Council for Offices is a membership organisation devoted to research and discussion. Through their publications, events and networking opportunities they provide the platform to debate all aspects of the office sector.
Well Gold	Second highest level of Certification from IWBI from 4 levels	Global movement to transform health and well-being with our people-first approach to buildings, organizations and communities. We do this using our WELL Building Standard (WELL), a roadmap for creating and certifying spaces that advance human health and well-being.
EnerPhit Classic	The EnerPHit Classes: Classic, Plus or Premium can be achieved depending	Passive House is a building standard that is truly energy efficient, comfortable and affordable at the same time.

Abbreviation	Full Form Text	Overview
	on the use of renewable energy sources	
BREEAM	Globally recognized sustainable building certification	BREEAM is the world's leading science-based suite of validation and certification systems for a more sustainable built environment.
9Rs of Circular Economy	Hierarchy of strategies to keep products and materials in use for longer	Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, and Recover
Urban Mining	Urban Mining	Urban mining is the process of recovering valuable materials from the built environment and reintroducing them into the supply chain. It treats buildings, infrastructure and construction waste as sources of reusable resources. This approach allows us to retain materials such as cement, aggregates and steel, and feed them back into future projects.

1. The Phenomenon

The construction sector, although a major contributor to economic growth, is responsible for nearly 40% of carbon emissions, over one-third of global raw material consumption, and 60% of waste (Pomponi & Moncaster, 2017). The World Green Building Council, in its 2019 report, called for the built environment to reduce its embodied carbon by 40% by 2030 (World Green Building Council, 2022).

The UK has a rich architectural heritage, with roughly 400,000 buildings recognised for their historic and cultural significance, situated in both urban and rural contexts (Gov.uk, 2024; Historic England, 2023). These structures are legally protected to safeguard their character under the Planning (Listed Buildings and Conservation Areas) Act 1990 (Historic England, 2014; GOV.UK, 2014). Preserving these assets is crucial to the nation's cultural identity, as they offer tangible links to the past and serve as a vital resource for future generations (Historic England, 2014). Moreover, historical buildings often act as anchors for local tourism, generating significant economic value for surrounding communities (Panakaduwa, Coates and Munir, 2024).

Retrofitting existing buildings, particularly of historical significance, is identified in policy as an imminent strategy for reducing carbon emissions and advancing sustainability objectives (GOV.UK, 2014; Rania Obead et al., 2025). Historical circular retrofits are central to climate adaptation and, at the same time, unique, requiring careful examination, targeted interventions, time, and patience (Cartwright, 2025). It requires specialist knowledge, providing not only opportunities for skills development but also industry innovation and collaboration (Climate Change Committee, 2023). Although circular building retrofits remain a topic of discussion (Neil, 2025), they are highly context-specific and depend on poorly understood institutional, cultural, and governance systems (Adams et al., 2017).

1.1. Case Study, its context and rationale

This case study examines the retrofit of the Cambridge Institute for Sustainability Leadership's (CISL) Entopia Building, located on Regent Street in Cambridge, a designated conservation site. The building, originally constructed as a telephone exchange in the 1930s, was acquired by CISL, which began retrofit works in 2018 and completed them in 2022.

The Entopia Building was selected for this study due to its approach to circular retrofit, as documented by the Royal Institute of British Architects (RIBA, 2022). The project addressed sustainability challenges in the built environment and received several certifications and awards, including BREEAM Outstanding, WELL Gold, Passivhaus EnerPHit Classic, RIBA Regional East, and BCO (Fuller, 2025a). The project has been cited as an example of a retrofit that aimed to balance cost-effectiveness with sustainability standards (Cambridge Forum for Construction Industry, 2023; CIBSE, 2025).

The project was initiated to assess the feasibility of implementing significant sustainability improvements in an existing, century-old building (CISL, 2018b). It was intended to demonstrate how a circular retrofit could improve the energy performance and reduce the embodied carbon of a historical building (CISL, 2024a; Historic England, 2024b).

The retrofit process followed the seven stages recommended by the Royal Institute of British Architects (RIBA) and established bold targets for circular-economy principles, the use of bio-based materials, and the reduction of whole-life embodied carbon (CISL, 2018a; Eve Waldron Design, 2026). From the outset, the building was intended to function as an innovation centre and co-working space within the built environment sector. The project aimed to generate knowledge and insights for application in other projects, policies, and investments (Architype, 2022; Brundrett, 2025; Fuller, 2025b).

In summary, the CISL Entopia Building was deemed suitable for demonstrating how circular retrofit strategies in a historical context were implemented, when guidance on circular retrofits in a historical context was under development (Historic England, 2024b) and when information and availability of secondary markets were even scarcer (Architype, 2022). Hence, by outlining the challenges encountered and the innovative approaches that led to a circular outcome, the research question of this case study is:

> How was circularity achieved during the retrofit of a historical building in a conservation site?

2. Literature Review

An extensive review of research journals and case studies was conducted to assess the status, challenges, motivations and potential solutions associated with circular retrofits of historical buildings.

The UK has committed to achieving net-zero carbon emissions by 2050, with policy identifying the built environment as a key strategy for decarbonisation (Gov.uk, 2024). Retrofitting existing buildings with energy-efficient, low-carbon technologies and materials is one approach under consideration (Densley Tingley, 2022; Historic England, 2024b; World Economic Forum, 2025). Examples of interventions include improved insulation, increased use of natural light and materials, high-performance glazing, modernised heating and cooling systems, and the integration of renewable energy solutions (Panakaduwa, Coates, and Munir, 2024; Historic England, 2024b).

A substantial proportion of UK buildings were constructed in the early to mid-19th century. Many of these structures may be unused or lack regular maintenance, resulting in increased energy consumption, the presence of damp and mould, and higher embodied carbon associated with older materials (Panakaduwa, Coates, and Munir, 2024). These factors may also affect public health and safety. Research indicates that adapting historical buildings for energy and carbon efficiency can yield benefits for both owners and the wider community (Cartwright, 2025; Historic England, 2024b; Rania Obead et al., 2025; Woodside & Huggett-Jones, 2022). Circular approaches are essential to ensure both heritage preservation and sustainability. Application of the 9R circular principles (Muñoz et al., 2024) such as Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, and Recover reframes interventions from waste-intensive activities into circular resource loops, reducing dependence on virgin materials (Tukker et al., 2023), lowering embodied carbon and energy usage, and supporting job creation through take-back schemes and material recovery (Ellen MacArthur Foundation, 2022). Key strategies include designing for disassembly, deploying prefabricated circular components, urban mining (Xavier et al., 2023), and extending product lifespans (Eve Waldron Design, 2026), all of which contribute to achieving sustainability objectives and decarbonisation targets (Densley Tingley, 2022).

The unconventional features of historical buildings, however, can add to the challenge of heritage preservation while prioritising sustainability. A lack of technical expertise and suitable solutions, along with uncertain building conditions, highlight the need for more concerted and advanced assessment techniques (Historic England, 2024c). Economic viability is another concern, as retrofitting historical buildings is often expensive due to the specialised materials and skills required. As much as tailored strategies and advanced technologies (Historic England, 2024c), retrofitting requires ambitious targets, financial incentives and coordination amongst all stakeholders (Panakaduwa et al., 2024; European Investment Bank, 2024). Regulatory approvals for retrofitting historical buildings are often time-consuming and complex (GOV.UK, 2014). The unintended consequences of retrofit interventions, such as alterations to the historical fabric (Historic England, 2024d), emphasise the need for thorough and timely intrusive evaluations and adherence to standards (Historic England, 2024b).

The lack of stakeholder education, availability and acceptance of secondary markets, and standardised assessment techniques for repurposed materials obstructs the implementation of circular retrofits (Otasowie et al., 2024; Adams et al., 2017; Andabaka, 2024; Thung et al., 2025). Given these barriers, governments and local authorities play a critical central role as infrastructure managers, regulators, and legislators, as shown in Figure 2 (Andabaka, 2024). They can influence, particularly through policies, by promoting public procurement that effectively incentivises and drives the use of circular materials, reduces waste, supports the development of zero-emission circular buildings, and stimulates market innovation (World Economic Forum, 2025).

Figure 2: Author adaptation of Stakeholder Loop based on European Investment Bank (2024)

Given these multifaceted challenges, there is a greater need for a determined vision and a holistic, unconventional approach that integrates green skills development, progressive technologies, and collaborative frameworks to support sustainable retrofitting practices (Densley Tingley, 2022), particularly in the historical context (Historic England, 2024c).

Addressing these complexities requires creating a collaborative ecosystem that actively engages all stakeholders across the built environment value chain, as illustrated in Figures 2 and 3 (European Investment Bank, 2024). The adoption of innovative digital technologies, such as Building Information Modelling (BIM), digital materials passports, and the incentivisation of secondary markets for construction materials, has been identified as a key enabler of circular retrofits (De Wolf et al., 2024). These technological advancements, along with streamlined regulations, financial incentives, and improved access to storage facilities and logistics (UKGBC, 2024; World Economic Forum, 2025; Tukker et al., 2023), contribute to the effective implementation of circular practices. Collectively, these measures support achieving sustainability objectives while preserving the cultural significance of historical buildings (Historic England, 2024b).

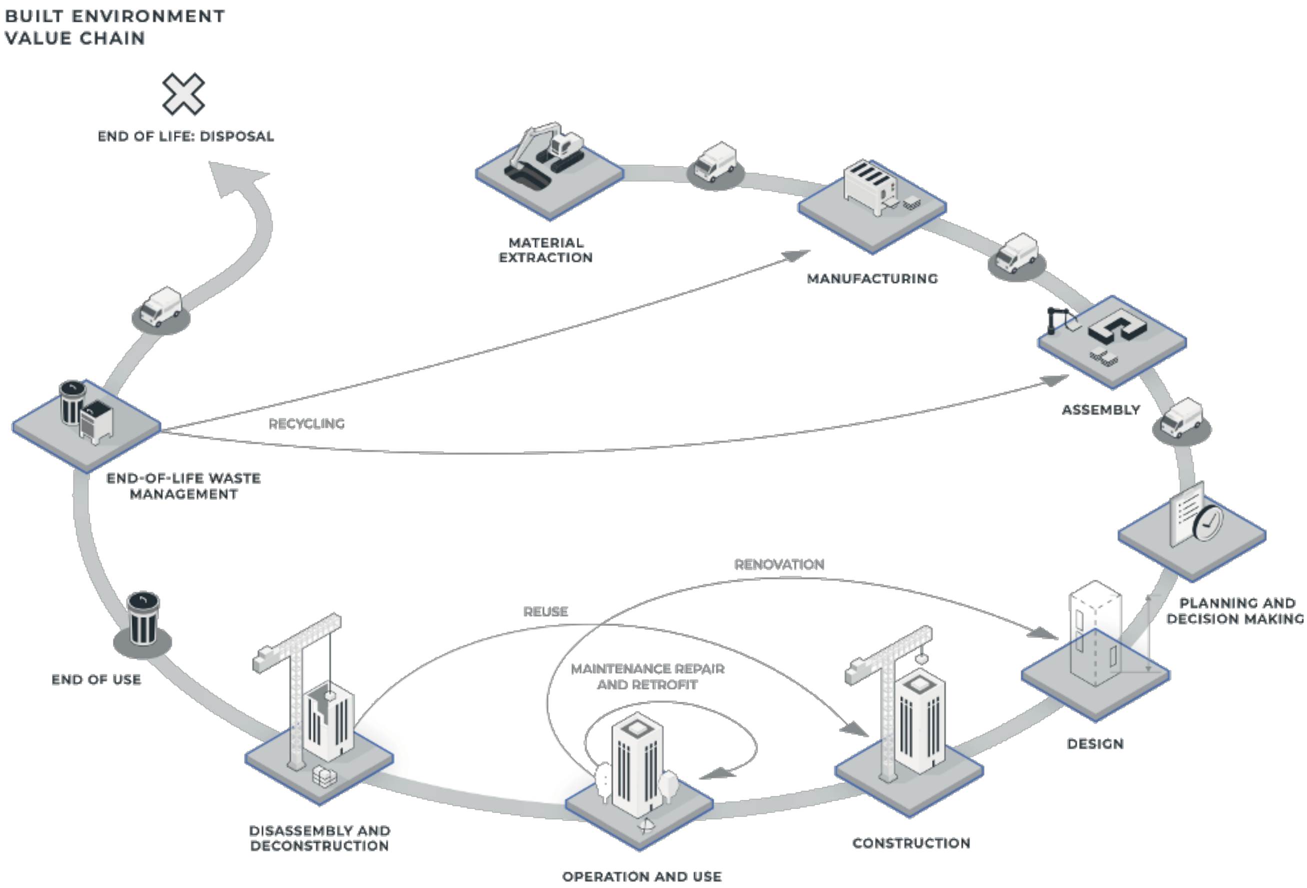

Figure 3: Built Environment Value Chain (European Investment Bank, 2024)

In summary, the literature review identifies the urgent need for circular retrofits while highlighting persistent challenges in adapting historic buildings, including regulatory complexity, technical constraints, and financial barriers. Despite growing theoretical discourse, there remains a significant gap in empirical evidence demonstrating how circular retrofit strategies can be implemented within heritage constraints. By examining the Entopia retrofit, this research investigates how circularity can be achieved in a historic building located within a conservation area. The findings aim to bridge the gap between theory and practice by identifying key enablers and barriers and informing future policy development, industry practice, and academic research in sustainable, heritage-sensitive architecture.

3. Methodology

To address the research question on how circularity was achieved during the retrofit of the Entopia building, this study adopts a qualitative, exploratory single-case study approach (Hollweck, 2016). This methodology is well-suited to examine the complex, context-specific, and socially constructed aspects of circular retrofit projects (Brinkmann & Kvale, 2018). Aligned with a constructionist epistemology, this exploratory research assumes that the meanings of circularity are not fixed but co-created through interactions among project actors, institutions, and constraints (Braun & Clarke, 2022). Circularity embedded in retrofits in built environment practice is therefore interpreted as a negotiated and relational process rather than merely a technical outcome (Densley Tingley, 2022).

As illustrated in Figure 4, the research process draws on both primary and secondary data to understand developments, challenges, and innovations (Flyvbjerg, 2011).

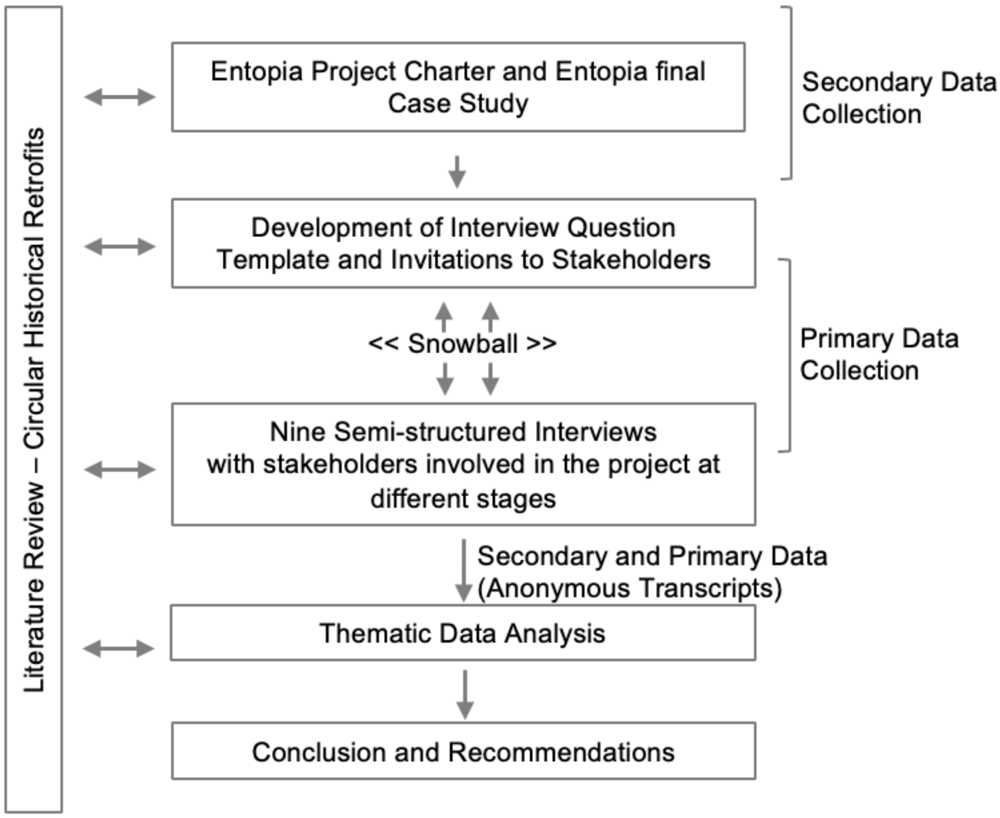

Figure 4: Research Methodology

3.1. Data Collection

3.1.1. Secondary Data Collection

The following project documents were shared directly via email with the researcher in relation to the retrofit project by the CISL team:

Entopia Project Charter (2018): This document served as a starting brief for the Entopia retrofit and was agreed upon by the project team.

Entopia Case Study (2022): This document was the final deliverable and varied from the Project Charter in line with the project team's final outcomes.

Although secondary data offers benefits such as speed, efficiency, and breadth, saving time and resources, it also has drawbacks, including a lack of specificity for the case study's needs and potential bias, which requires careful evaluation (Pérez-Sindín, 2017). Hence, key stakeholders were identified from these documents and contacted for interviews.

3.1.2. Primary Data Collection

Interviewees were selected based on their direct involvement in the project and their capacity to provide insights relevant to the case. They included a diverse range of project and client stakeholders, including the senior PMO, client lead, design team members, contractors, sustainability advisors, and CISL project informants. Participants were asked to introduce additional stakeholders who could contribute to the research, creating a snowball sample (Parker et al., 2019).

3.1.2.1. Interview Questions Design

Interview questions were developed in advance to align with the study's research question and objectives, supporting the elicitation of nuanced insights (Kakilla, 2021). Primary questions were prioritised, with supplementary prompts included where time allowed (Appendix 7.1).

Participants received the interview questions and consent forms prior to their interviews (Appendices 7.1 and 7.2), allowing time for reflection and more focused responses (Shirani, 2015). A semi-structured format enabled flexibility in participant narratives while allowing the interviewer to maintain relevance to the research aims (Mashuri et al., 2022).

3.1.2.2. Interview Process

A total of nine interviews were conducted (Table 1), each lasting approximately 1 hour, either online or in person. The interviews enabled in-depth exploration of emergent topics such as material reuse, risk perception, and collaborative innovation, yielding insights unlikely to have been captured through more rigid or purely technical approaches (Brinkmann & Kvale, 2018; Flyvbjerg, 2011; McLeod, 2023). Data saturation was reached when repetitive answers started to emerge (Baker & Edwards, 2012).

Role in the Entopia Retrofit	Participant Nos	Stakeholder Category
Fit-Out Contractor	P1	Contractor
Senior PMO	P2	Contractor
Client Lead	P5	Client
Energy Consultant	P4	Contractor
PMO	P3	Contractor
Building Designer	P6	Contractor
Interior Designer	P7	Contractor
MEP Engineer	P8	Contractor
Client - Post Occupancy Evaluator	P9	Client

Table 1: List of Interview Participants

3.2. Analysis Method

The interviews were recorded and transcribed using a voice recording tool with participants' consent, and the transcripts were used for anonymous data analysis alongside secondary information from CISL. The benefit of capturing both primary and secondary data was the triangulation of insights across all data sources (Akutey & Tiimub, 2021).

The method employed for this research was thematic analysis (Figure 5), a structured, multi-stage process that systematically analyses qualitative data from various sources to yield meaningful findings (Ahmed et al., 2025). Firstly, all collected data was thoroughly examined to gain an in-depth understanding of the context. Any discussions deemed tangential or unrelated were excluded. Secondly, codes were assigned to text that related to the research questions or highlighted emerging patterns. Subsequently, identified themes were synthesised to ensure they accurately represent the data and as distinct from one another as possible (Thomas & Harden, 2008).

3.3. Limitations

The context-specific nature of this case study limits the generalisability of the findings to other settings. While the single-case approach provides rich, in-depth insights, the results may not be representative of all circular retrofit initiatives. Focusing on a single historic building within a specific regulatory and institutional context may limit the transferability of conclusions to other geographic or industry settings (Hollweck, 2016). In addition, the sample comprised nine stakeholders, which, although sufficient to achieve data saturation for this study, may not reflect the full range of perspectives present in larger or more complex projects.

Despite these limitations, the case study offers valuable practical insights into how circularity can be operationalised within the constraints of historic building retrofits, contributing empirically grounded evidence to an under-researched area of circular construction practice.

3.4. Ethical Considerations

This study was conducted in accordance with the University of Cambridge’s ethical guidelines for qualitative research and adhered to principles of transparency and integrity throughout data collection, analysis, and reporting. All interview participants were informed of the research purpose and scope prior to participation and provided written consent, acknowledging the voluntary nature of their involvement. To protect participant privacy, interview data were anonymised and stored securely (Flanagin et al., 2020). No identifying personal or commercial information is disclosed in the reporting of findings, and all data were used solely for academic purposes and not shared beyond the research context (Service, 2025).

4. Data Analysis and Interpretation

The research purpose was to examine how circularity was achieved during the retrofit of a historical building on a conservation site, by outlining the challenges and innovative approaches, in an era when guidance for historical retrofits was under development and information on the availability of repurposed materials was even scarcer. Figure 5 summarises the thematic analysis as a flowchart, with arrows indicating the progression from raw data to final findings, namely the 'Barriers' and 'Enablers'.

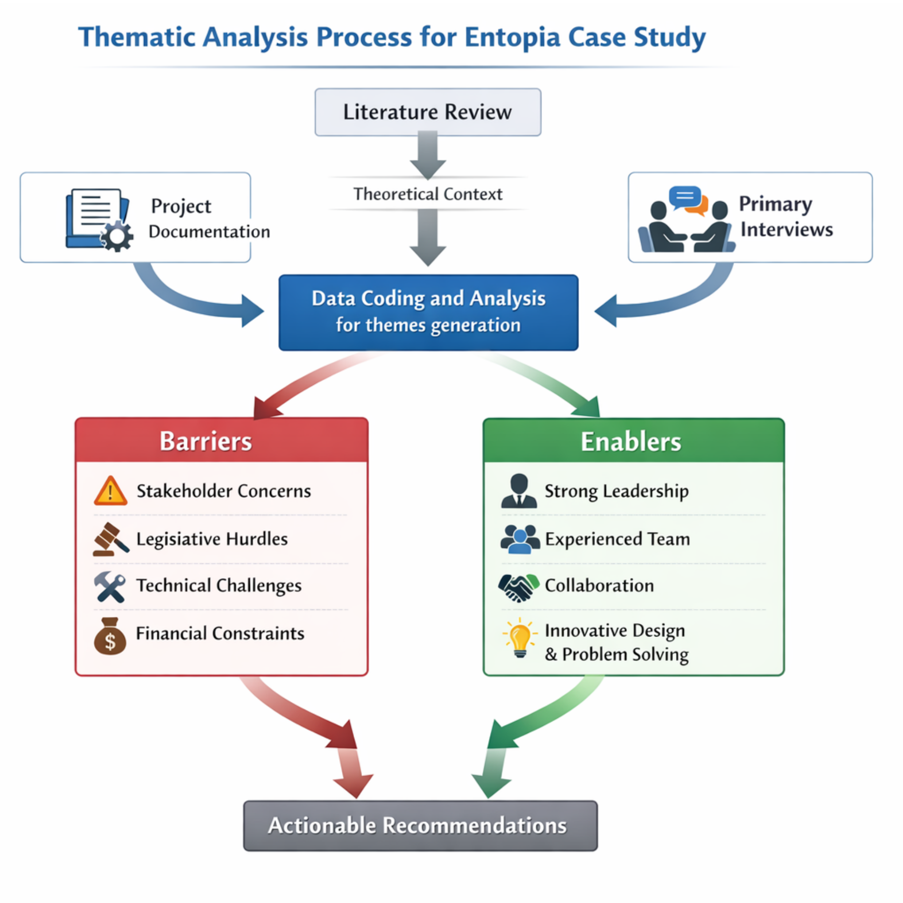

Figure 5: Thematic Analysis Process for Entopia Case Study

4.1. Emerging Themes

The coding process yielded recurring themes, summarised in Figure 6, across the 10 data sources.

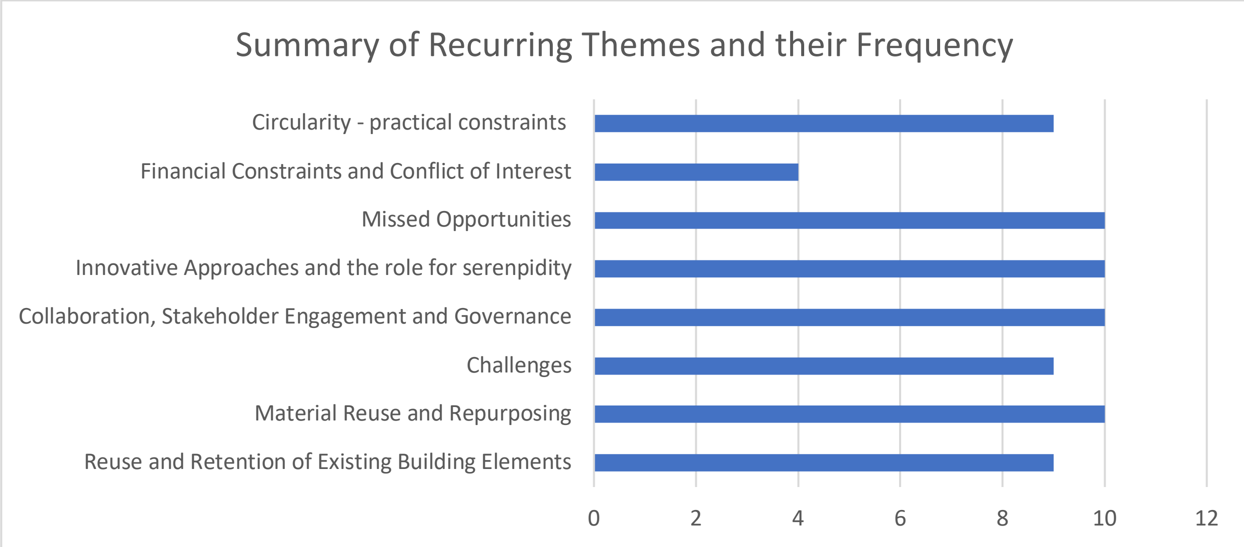

Figure 6: Summary of recurring Themes (Appendix 7.3)

The themes reveal that the Entopia project adopted a fabric-first approach and an adaptable modular design that supported long-term flexibility. Sustainable retrofitting was approached carefully, integrating principles of the circular economy, energy efficiency, and carbon reduction into the complexities of the historical fabric. Key technical elements included the use of bio-based materials, opportunistic procurement of repurposed materials with paper trails and honoured warranties, such as steel, lights, paint, and furniture, and the retention of electricals, carpet tiles, furniture, lifts, and raised-access floors, which reduced embodied carbon and energy use and diverted significant waste from landfills. Governance, collaboration and leadership were pivotal, with stakeholders aligning on shared sustainability goals through workshops and open communication, despite blockers including the unravelling of technicalities during late intrusive surveys, COVID-19, suppliers going into administration and limited industry benchmarks. Additional challenges included financial constraints, technical complexities, and regulatory gaps.

4.2. Representation of Findings

The recurring themes identified in Figure 6, further organised into 'Barriers' and 'Enablers' in Figure 7, are presented as a conceptual balance model. The seesaw symbolises the tension between constraints and enabling factors, indicating the key factors influencing the circular outcome of the Entopia Building being sufficiently strong to counter systemic and project-level barriers.

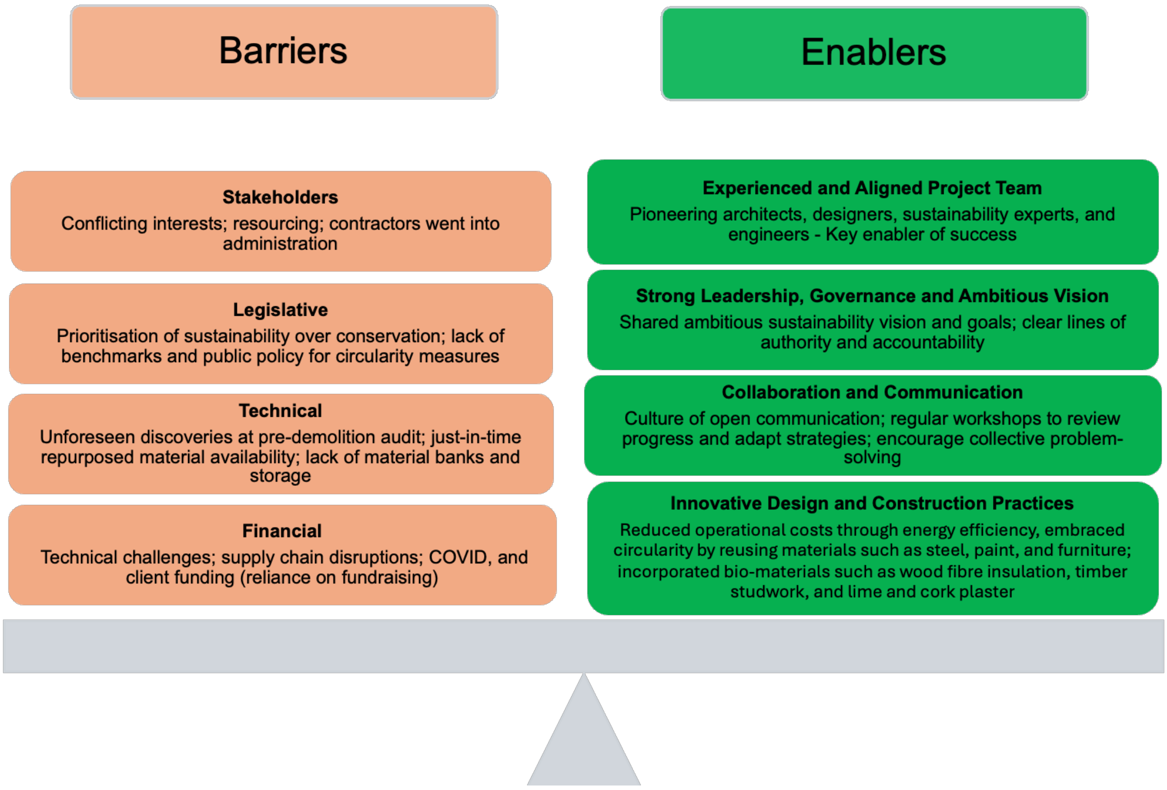

Figure 7: Enablers and Barriers

4.3. Interpretation and Discussion

The Entopia retrofit demonstrates how circularity in a historic context emerges through the interaction of enabling organisational behaviours, regulatory navigation, opportunistic decision-making, and innovative design responses. Overall, the findings align with the literature on circular retrofits while adding nuance on the practical constraints and trade-offs involved in achieving circular outcomes in heritage settings.

Consistent with research on heritage retrofit challenges, regulatory processes played a significant role in shaping the project's approach. The literature identifies heritage planning as a complex environment requiring negotiation and specialist knowledge (Historic England, 2024b), and the Entopia team experienced similar pressures and delays. The need to preserve the building's historical integrity limited certain interventions and required closer coordination with conservation officers. However, as narrated by 5 of 9 participants, "Local planners objected to replacing windows with clear and bigger panels due to conservation area regulations. The project faced planning rejection and had to appeal to proceed", causing delays. Constructive early engagement and clear communication with regulators helped secure approvals and prioritise sustainability. While regulation is often framed as a barrier, this case illustrates how it can operate as a negotiable constraint when supported by collaborative governance arrangements and experienced project teams.

Unconventional building features, another widely cited challenge in historic retrofits (Historic England, 2024c), were also evident. Incomplete records, unexpected material conditions, and the difficulty of integrating modern systems into older fabric required intrusive surveys and iterative design responses. Although the late undertaking of intrusive audits led to unforeseen discoveries, the project benefited from multidisciplinary expertise that could respond flexibly to emerging on-site conditions. This supports the literature arguing that circular retrofits require adaptable teams able to revise strategies as new information becomes available (Densley Tingley, 2022). Rather than hindering progress, these uncertainties created opportunities for innovation, including the reuse of raised access floors, retention of the mechanical and electrical core, and experimentation with bio-based materials to improve airtightness and energy performance. As 7 of 9 participants highlighted, the reuse of major components delivered substantial embodied carbon savings that would not have been possible without on-site adaptability. Quote: "There were issues discovered under the floor once the raised access floor came up, which I think would have been very difficult to diagnose without taking everything up beforehand."; "Like I think reusing the raised access floors is a very important one because that saved a huge amount of carbon. The mechanical and electrical core of the building was all retained. The electrical infrastructure, much of which was retained. We retained the raised flooring, for example, which otherwise would have got scrapped".

A further recurring theme was the limited availability of reused materials and the logistical challenges of sourcing and validating them. The immaturity of secondary material markets is well documented in the literature (Andabaka, 2024; Tukker et al., 2023), and this constraint was consistently raised across all interviews (P1–P9). Participants cited inconsistent supply chains, difficulties in obtaining warranties for reused components, and additional storage and transport requirements that increased cost and complexity (Appendix 7.3). The project team addressed these challenges through collaboration, flexibility, and opportunistic sourcing, incorporating reused materials when suitable options became available unexpectedly. While this aligns with research emphasising adaptability in retrofit projects (Ajayi et al., 2016), the case adds practical insight by showing that circularity often depends not only on advance planning but also on timing, local networks, and informal material exchanges. This reinforces calls for public procurement reform, regional material exchange hubs, and digital reuse platforms to improve predictability and scalability in circular procurement.

The most significant enablers identified in the Entopia project, consistent with the literature, were strong leadership, a skilled multidisciplinary team, and collaborative, adaptive problem-solving practices. A clear project vision, supported by CISL, alongside governance structures that encouraged open communication and shared decision-making, enabled the team to pursue solutions that might otherwise have been perceived as too risky or complex. This was echoed by all nine participants and aligns with socio-technical perspectives that emphasise leadership, organisational culture, and capability as critical drivers of circularity (World Economic Forum, 2025). Importantly, collaboration did not remove project barriers; rather, it enabled them to be managed constructively, preventing them from becoming prohibitive constraints.

Overall, the Entopia Building provides a grounded example of how circularity can be achieved within the constraints of a historic building retrofit. The case reinforces key themes in the literature, including regulatory complexity, technical uncertainty, and market immaturity, while demonstrating how ambitious leadership, specialised expertise, collaborative team cultures, and adaptive problem-solving can transform these challenges into opportunities for innovation. As such, the study contributes to the field by showing that circular retrofits in heritage contexts are not only feasible but can generate transferable lessons for policy, practice, and future research when supported by clear objectives, flexible methodologies, and strong stakeholder alignment.

5. Conclusion and Recommendations

This case study examined how circularity was achieved in the retrofit of a historic building by analysing the challenges encountered and the approaches adopted in the Entopia Building project. Using a qualitative case study methodology, supported by interviews and documentation, the study explored how circular economy principles interact with the realities of heritage constraints, procurement structures, and technical retrofit requirements. The findings conclude that circularity in historical contexts is shaped by a combination of strategic leadership, ambition, and collaborative problem-solving. When these elements align, they enable project teams to pursue bold visions, reuse, material retention, and low-carbon strategies even within highly constrained regulatory and planning environments.

The research also demonstrates that circular outcomes are most successful when supported by adaptive and innovative practices. The Entopia case highlighted how flexibility, experimentation, and responsiveness to new information helped to overcome challenges such as technical uncertainties, supply chain gaps, and cost pressures. At the same time, the study revealed persistent obstacles including regulatory ambiguity, inconsistent material-reuse pathways, and difficulties securing warranties or performance assurances for reclaimed components. These findings reinforce the importance of recognising heritage retrofit as a socio-technical process that requires negotiation across competing priorities rather than as a purely technical implementation exercise.

From a practical perspective, the study emphasises the need for enhanced market conditions and supportive infrastructure. Strengthening secondary material markets, developing robust testing and verification mechanisms, and improving supply chain coordination will be essential to scaling circular practices beyond pioneering demonstration projects.

Overall, this research contributes to ongoing discussions around policy development, design education, and industry practice in the transition to a more circular built environment. The Entopia Building shows that with ambitious leadership, coordinated teamwork, and thoughtful integration of circular principles, historic buildings can play a meaningful role in climate change mitigation.

Future actions should focus on developing regulatory and procurement frameworks, enabling secondary-market exchanges and conducting post-occupancy evaluations in heritage contexts. By addressing these areas, policymakers and industry practitioners can create the systemic conditions needed to embed circular retrofits at scale and deliver long-term environmental, economic, and community benefits.

5.1. Strengthen Governance, Policy, and Financial Enablers

Enhance regulatory frameworks, streamline planning and permitted development processes (including those in heritage contexts), and conduct on-the-ground audits. Deploy targeted financial support and incentives, such as grants, tax reliefs, and green finance, to accelerate the adoption of circular retrofit practices in historic and existing buildings. Enhance transparency and accountability by rewarding wins on local authority dashboards, thereby helping maintain public confidence and preventing greenwashing. Address skills gaps through targeted training and knowledge-sharing across the value chain, including public-private and academic-industry collaboration.

5.2. Enable Circular Markets and Supply Chains

Enhance existing industry frameworks to assess industry/project readiness for circular retrofits, encompassing not only technical solutions but also public procurement reform, behavioural change, the complexities of historical buildings, and circular-economy standards. Establish industry standards and benchmarks for the use of circular materials. Promote and incentivise secondary market exchanges by developing material banks, storage facilities, logistics, and digital exchange platforms. Enable access to just-in-time secondary materials, including digital passport information, paper trails, and existing warranties; thereby reducing costs, risks, and supply chain barriers associated with circular construction. This will also encourage manufacturers to design products with a cradle-to-cradle approach, enabling responsible consumption, reducing waste, and dependency on raw material extraction.

5.3. Post-Occupancy Performance

Assess the periodic post-occupancy performance of circular retrofits in historic buildings, with a focus on energy consumption, material longevity, and the health and safety standards associated with repurposed components. It should also examine occupant satisfaction and the alignment between design intentions and actual outcomes, thereby strengthening the evidence base for effective heritage building interventions.

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7. Appendices

7.1. Interview Questions Template

Name of the Interviewee:

Date:

Time:

Format: In Person/Online

Researcher Name: Rashmi Rungta (PG Diploma Student at CISL)

Focus for Case Study: Entopia Deep Retrofit

Research question: How did CISL achieve circularity in its structure, and why was it successful?

Interview Questions:

In order of preference:

1. Do you think the circularity delivered was adequate and to your satisfaction? Can you elaborate?
2. Can this project serve as an exemplar for other historical / grade-listed deep retrofits or ongoing retrofits? How can it be made replicable?
3. What risks were envisioned and what mitigations were planned?
4. Were there any missed opportunities, and how / if they could have been resolved?
5. Is there any additional information you would like to provide that I have not requested or that was not mentioned in the documents, which would be relevant to my case study analysis?
6. Would you have done anything differently if given the same opportunity again?
7. Can you recommend/make further introductions to those who can provide more information for my case study analysis? Would you be open to another interview in case I require any clarification?

In case time permits:

8. Do you think local policies and construction waste monitoring and measurement by local councils can drive circular construction and more retrofits? Or do you think the current planning approvals based on Circularity and deep retrofits are enough, and will construction firms implement them on the ground? How are the construction firms held accountable for planning approvals?

Additional questions from review of the documents received by the Living Labs Team:

9. Were the below the only challenges found in terms of the structure – examples below

   Foundation

   Asbestos (Was this a challenge, as I could not find this in the documents)

   Insulation – windows, carpets, single glazing

   Finance

   Cladding (Was this a challenge, as I could not find this in the documents)

   Small Power Supply

10. The benchmarks used for this project were from BREEAM, RIBA, Passivhaus, and Enerphit. Was Historical England guidance referred to as well, and if not, why?

11. Was any construction waste generated during the retrofit, and is there any indication of the construction waste in metric tonnes that was avoided?
12. What were the unplanned challenges that came up, and how/if they were resolved, e.g. below

    Finance

    Insurance

    Health and Safety

    Timing

    Planning approval

    Stakeholder/Resources

    Supply Chain / Raw Material Availability

7.2. Participant Consent Form Template

UNIVERSITY OF CAMBRIDGE
INSTITUTE FOR SUSTAINABILITY LEADERSHIP

Consent Form for Research Interviews

Please read this form carefully. If you are happy to participate in this study, please sign and date below.

- ☐ I have read the participant information, and consent to participate in this research study about **Circular economy in practice via deep retrofit of a historical building**.
- ☐ I have had the opportunity to ask the researcher any questions that I have about the study and my involvement in it. I am aware that I can contact the researcher rrungta.sln2011@gmail.com at any time.
- ☐ I understand that personal data and any audio recordings (see below) will be stored initially in a password-protected file on the researcher's laptop and thereafter on a secure server at the University of Cambridge Institute for Sustainability Leadership (CISL).
- ☐ Audio/video recording [please tick to give your preference]:
    a. I give permission for my participation to be **audio** recorded only (no video) (audio recording will be deleted after assignment/publication of the outcomes)
    b. I wish my participation to be recorded by the interviewer's **notes** only (no audio or video)
- ☐ I agree that anonymised data may be used in the publication of the results and shared with University of Cambridge staff for degree-awarding purposes.

  I understand that all efforts will be made to ensure I cannot be identified (except as may be required by law). However, I am aware that information in the public domain may make it possible to identify me.
- ☐ I understand that I am free to withdraw at any time without giving a reason, by emailing the researcher rrungta.sln2011@gmail.com.
    - ☐ *I agree that my job title and organisation may be used in the publication and/or public dissemination of the results of this project*
    - ☐ *I do not agree to my name/job title/organisation being used in this way, but am content that anonymised data may be used in the publication of the results and shared with other researchers at the University of Cambridge for future research. I understand that all efforts will be made to ensure I cannot be identified (except as may be required by law).*

I have read and understand the information above and voluntarily consent to participate in this study.

Signature: --

Name (printed): --

Date: --

Links

Privacy Policy: https://www.cisl.cam.ac.uk/privacy-and-cookie-policies

University of Cambridge Data Protection: www.information-compliance.admin.cam.ac.uk/data-protection/research-participant-data

7.3. Data Table

https://app.box.com/file/2114224204169?s=828b6xzno117u7ftozrwmdtwajspnicz