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Using existing buildings as material banks in the UK

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Abstract: Although the practice of Building As Material Banks (BAMB) is gaining momentum, it remains in its nascent stages compared to recycling or retrofitting. Existing knowledge either pertains to broader circular economy topics or lacks focus on the UK-built environment. Given the dynamic nature of the subject, with new guidelines emerging rapidly, it is crucial to comprehend the lack of actions in BAMB even with its economic and social benefits. This paper presents insights obtained through interviews with nine UK circular economy experts from diverse stakeholder roles, including architects, clients, stockists etc. Utilising both quantitative and qualitative analysis methods, the research sheds light on both the hierarchy of urgency for barriers and suggestions as well as the current practice for reuse. Despite cost barriers being identified as a primary obstacle, most participants exhibited a positive outlook towards the current progress, indicating a growing interest in reuse. The study emphasises the need for effective legislation and inter-stakeholder collaboration in promoting BAMB adoption. Furthermore, the interviewer's sentiments underscore the significance of swift action in overcoming psychological barriers such as risk and unfamiliarity with BAMB practices.
Keywords: BAMB, Circularity, Reuse, Sustainability, Stakeholders.

1. Introduction

The construction industry faces significant waste production and environmental challenges, prompting a shift towards 'Buildings as Material Banks' (BAMB). BAMB envisions buildings as reservoirs of valuable, recoverable materials, promoting harvesting during deconstruction, reuse, repurposing, and designing for disassembly. In turn, BAMB reduces waste, conserves resources, and curbs environmental impact. However, despite its potential, BAMB faces obstacles to widespread UK adoption, encompassing legal, awareness, technical, and financial issues. This dissertation investigates these barriers, leveraging insights from circular economy (CE) experts, to contribute to a more resource-efficient built environment.

2. The circular economy model and BAMB progress in the UK

The Circularity Gap Report 2023 unveiled a stark reality for the UK, with a circularity metric of 7.5%, indicating that a staggering 92.5% of the country's materials derive from virgin sources, with 80% of which originating from abroad. The construction sector's carbon intensity is evident, with nearly 40 million tonnes of CO2, making it the second-largest single industry contributor (Circularity Gap Report, 2023). Moreover, the UK salvage industry primarily reclaims high-value components, limiting broader material reuse (CRWP and Salvo, 2007).

Initiatives such as the Circular Construction in Regenerative Cities (CIRCuIT) project, financially supported by Horizon 2020, seek to reduce virgin material usage in construction while demonstrating cost savings. Additionally, ReLondon's reusable material sourcing guide suggests sourcing opportunities through retailers and online exchange platforms, fostering material reclamation. London has emerged as a hub for detailed circular economy policies, mainly through the 2021 London Plan and Policy SI 7, which sets ambitious targets for waste reduction, increased material reuse, and future design for disassembly. London has also seen reuse supply chain initiatives like the Excess Materials Exchange by Enfield Council. The rest

of the UK has policies stemming from the EU Waste Framework Directive such as the Clean Growth Strategy and the Waste Management Plan for England.

However, for the full realisation of the benefits of reusing, repurposing, and upcycling, a shift from policy recommendations to enforceable requirements is essential (Rose and Stegemann, 2018). Overall, the UK has effectively raised recycling diversion rates through voluntary initiatives and tax escalations, the absence of distinct targets for reuse and recycling has resulted in waste being recycled into lower-value products (Hobbs, 2011).

3. Barriers and enablers to existing building component reuse

Several studies delved into barriers and enablers for circular economy practices within the construction industry, including financial, organisational, operational, regulatory, and cultural factors, underlining the need for business incentives (Conde, Colloricchio & Bertham, 2023). Challenges like the lack of market mechanisms, industry-wide awareness, and consensus persist, with a pressing need for a clearer financial case to transition toward a circular economy in the construction sector (Adams et al., 2017).

There is limited literature on barriers and enablers specifically for BAMB practice in the UK. Rose and Stegemann's study explored current methods for understanding building component reuse, identifying their ineffectiveness, and proposing an information system to address this gap (Rose & Stegemann, 2019). Another study introduced critical enablers for cleaner demolition, emphasising economic demand and disassembly routines providing insights into strategies for element recovery and reuse (Van den Berg, Voordijk, & 2020).

Most BAMB-relevant research only investigated the practice of steel reuse. A study revealed key hurdles to structural steel reuse, highlighting cost and availability while suggesting solutions such as creating a supplier database and demonstrating client demand (Densley Tingley, Cooper, & Cullen, 2017). Dunant et al. highlighted poor communication and coordination across the supply chain as a major barrier to steel reuse and proposed collaborative efforts among stockists and fabricators for transparency (Dunant et al., 2017).

While there is a wealth of literature on the subject matter, several research gaps exist concerning the examination of specific practices within the UK BAMB context: 1. Limited research specifically on BAMB and the UK context; 2. Lack of emphasis on different stakeholder perspectives; 3. Most studies are quantitative studies.

4. Research methodology

The aim of the research was to investigate the current state of BAMB practices, barriers and enablers in the UK built environment. To achieve this, an interview methodology was chosen as it provides the opportunity to collect first-hand perspectives on specific practices, behaviours, or attitudes on the topic and can foster deeper empathy and understanding of the experiences and challenges encountered by different stakeholders.

The participants were recruited for their expertise with CE in the built environment, and a range of different built environment stakeholders were carefully selected. Presenters from built environment circularity events and key employees from companies with CE practice were contacted, and where suitable, participants were also selected through work and university contacts. The final participants' profile is shown in Table 1.

In this research, a semi-structured interview style was employed. The questions and procedures were developed iteratively with care from the literature review and two pilot studies prior. They included questions related to background information for the purpose of comparative analysis, participants' experience with BAMB practice, possible barriers and enablers based on the literature review and specialised practice based on the stakeholder's

types. Most of the questions were open-ended to encourage participants to elaborate and express personal ideas and these responses could be analysed qualitatively.

The interviews were carried out through online video format, recorded, and transcribed. The interview durations were between 30 to 1 hour. Initially, participants were asked about the BAMB definition, and an official answer was provided to ensure focus on the topic.

Table 1 Interviewee's profile.

Participants	Stakeholder type	Position	Years in the industry	Gender
Case 1	Client	Project Manager	8	Male
Case 2	Stockist	Managing director	31	Male
Case 3	Architect	Associate Architect & Sustainability Lead	16	Female
Case 4	Academic	Strategic Advisor & Partnership Lead	18	Male
Case 5	Architect	Associate Architect & Sustainability Lead	20	Male
Case 6	Sustainability Specialist	Partner & Sustainability and Circular Economy Advisor	30	Female
Case 7	Structural Engineer	Senior Structural Engineer	8	Male
Case 8	Contractor	Quality Director	10	Male
Case 9	MEP Engineer	Circular Economy and Embodied Carbon Lead, Principal Sustainability Consultant	17	Female

5. Results

In this research, an iterative analysis of interview results was conducted using a hybrid coding method facilitated by NVivo software. The approach combined predefined themes derived from the literature review and adjusted based on pilot studies. Interview transcripts were then coded into these themes, with any newly emerging topics as unexpected themes. A quantitative analysis of themes was carried out, including trend and relationship identification. Moreover, significant responses were compiled for qualitative analysis, complementing quantitative findings, and contributing to the research's overall arguments.

5.1 Interviewee's attitude towards current BAMB progress and practice in the UK

The interviews delved into participants' perspectives on the current progress and practices of BAMB in the UK. Notably, most participants expressed positive attitudes toward the current progress (Figure 1), citing increased interest, awareness, and promising developments like the GLA's circular economy statement. However, participants voiced concerns about the pace of change, confusion between reuse and recycling, and the absence of economies of scale.

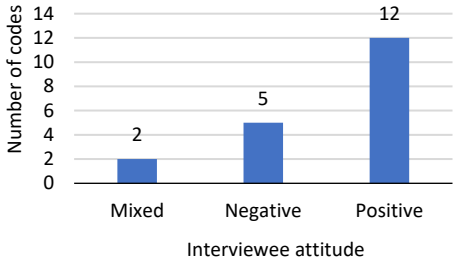

Figure 1 Participants' attitude on overall BAMB progress.

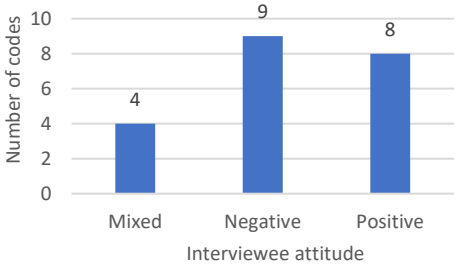

Figure 2 Participants' attitude on reuse practice.

On the other hand, the interviewee's attitude towards current reuse practice is more mixed (Figure 2). In responses regarding current reuse practices, discussions encompassed various aspects such as market mechanisms, existing systems, standards, legislation, and

deconstruction methods. Case 1 client-side participants' positive engagement of consultants to bridge information gaps was promising. However, concerns arose about the lack of case studies to establish baselines for the circularity route. Procurement challenges were observed, particularly when companies don't own deconstruction sites, requiring rigorous assessments for reclaimed materials. In Case 8 the contractor participant mentioned their tight timeframes for salvaging materials in demolition contracts.

5.2 Barrier and enablers hierarchy

Table 2 Barriers themes coded frequencies and coded cases.

Codes	Number of Codes	%	Number of cases	%
Unexpected responses	73	24%	9	100%
Cost	31	10%	8	89%
Lack of procurement system	30	10%	7	78%
Lack of Trust in quality	25	8%	6	67%
Lack of Interest or culture	24	8%	8	89%
Lack of legislative requirement	21	7%	8	89%
Lack of market mechanism	18	6%	6	67%
Risk & Liability	17	6%	8	89%
Lack of circularity assessment	13	4%	6	67%
Lack of standards or guidance to reuse	13	4%	3	33%
Difficulty to deconstruction	11	4%	6	67%
Fear & Unfamiliarity	11	4%	3	33%
Lack of studies or scenario data	10	3%	4	44%

The coding hierarchy in Table 2 displayed the barriers to BAMB practice in the UK. Unexpected responses constituting 24% of all barrier codes, demonstrated the significance of the current research gap. Notably, 89% of all interviewees identified 'cost,' 'lack of interest or culture,' 'lack of legislative requirements,' and 'risk and liabilities' as common barriers. 'Lack of a procurement system' included concerns over timing, storage, and quantity. The study also identified mistrust in the quality of reclaimed materials as the third most prevalent barrier. Stakeholders are also concerned about the lack of material standardisation, which can complicate the design and construction processes, along with the absence of warranties and insurance for reclaimed materials. Interestingly, this barrier was prominently raised by a client-side project manager (Case 1) and an architect (Case 5).

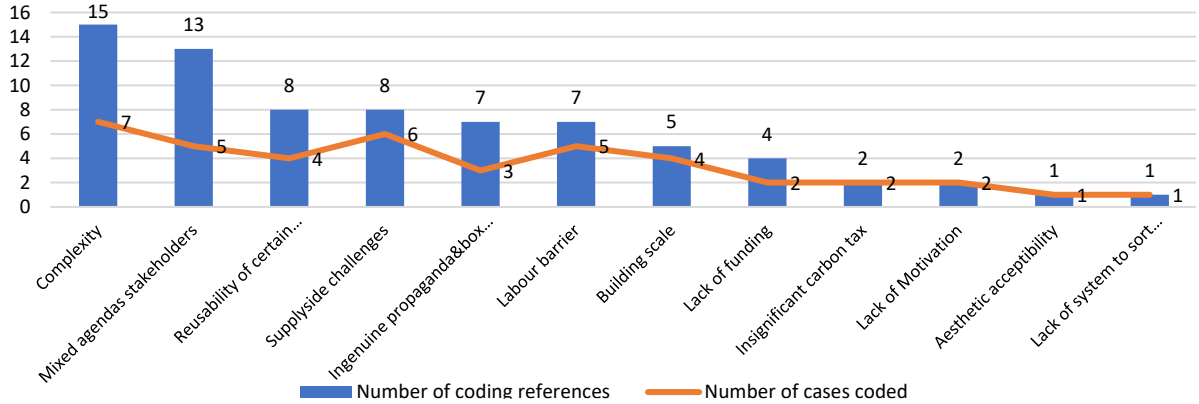

Figure 3 Coding hierarchy chart for unexpected responses for barriers of BAMB in the UK.

The primary unexpected barrier (Figure 3) identified in the study was "complexity," which encompassed concerns related to the intricate nature of BAMB practices, like procurement

and insurance, reclaimed materials installation, and the physical variability encountered in deconstruction. Participants were also apprehensive about the overall complexity within the industry, which magnified uncertainties. The second most prevalent unexpected barrier was "mixed agendas between different stakeholders,". This barrier reflected challenges in aligning the practical expertise of those involved in building deconstruction with the intentions of policymakers and designers who may lack hands-on experience. Finally, "supply-side challenges" were raised 8 times. The managing director of a stockist/database stakeholder, with three decades of industry experience, passionately emphasised the critical issue, noting that the demand for BAMB construction had been created, but the challenge remained in addressing the supply side, particularly in deconstructing old structures.

Table 3 Coding hierarchy of enablers in the UK BAMB practice

Codes	Number of codes	%	Number of cases	%
Effective legislative requirements	18	19%	7	78%
Other	13	14%	6	67%
Warranty and trust	12	13%	5	56%
Reuse standards and guidance	10	11%	4	44%
Action and speed	7	8%	3	33%
S&D Market mechanism	6	6%	4	44%
Encourage studies & scenario data	5	5%	4	44%
Establish a circularity assessment matrix	4	4%	3	33%
Cost	4	4%	2	22%
Deconstruction over demolition	4	4%	3	33%
Culture & Awareness	3	3%	2	22%
Design for disassembly	3	3%	3	33%
Establish procurement system (storage & timeframe)	2	2%	2	22%
Centralised information	2	2%	2	22%

In terms of enablers (Table 3), "effective legislative requirements" emerged as the most frequently mentioned and discussed theme among participants even though it was only classified as a barrier in a small fraction of discussions. However, it's noteworthy that some of the most identified enablers, such as warranties and trust for materials and reusable standards and guidance, were closely linked to the most prevalent barriers. Moreover, the importance of collaboration among various stakeholders was stressed by 5 participants in 'Other', with participants recognising the need for external expertise and consultants in BAMB implementation, particularly among cost consultants and project managers, who play a crucial role in guiding clients on return on investment noted by Case 9 MEP engineer.

5.3 Stakeholder types in relation to the barriers and enablers

Table 4 Most coded barriers for different stakeholder types

	Architects	Structural Engineers	MEP Engineers	Client
1	Cost	Difficulty to deconstruction	Lack of procurement system	Lack of trust in quality
2	Lack of procurement system	Lack of procurement system	Mixed agendas stakeholders	Lack of legislative requirement
3	Complexity	Lack of trust in quality	Lack of circularity assessment	Lack of case studies or scenario data
	Contractor	**Stockist/database**	**Academics**	**Sustainability Specialist**

1	Mixed agendas stakeholders	Lack of interest & culture	Lack of market mechanism	Lack of interest & culture
2	Time and contract constrain	Cost	Lack of standards and guidance to reuse	Fear & Unfamiliarity
3	Cost	Lack of procurement system	Fear & Unfamiliarity	Lack of legislative requirement

Table 4 shows different stakeholder perspectives on core barriers to BAMB in the UK, with the caveat that the limited number of participants may not fully represent the entire industry, but still offer valuable insights, especially for aligning agendas in stakeholder collaboration.

6. Discussions

Findings revealed significant hurdles linked to cost and the absence of effective procurement systems, aligning with previous research by Adams et al. (2017). Surprisingly, certain prior challenges, such as the lack of market mechanisms, received less prominence here. Unexpected barriers were identified, emphasising the need for further research. Additionally, the study underscored the demand for industrial enablers like guidance, standards, and legislative requirements to support BAMB adoption, with suggestions for encouraging action and speed in embracing these practices. As this research delved into the perspectives of various stakeholder types, it revealed nuanced differences in their perceptions of core barriers. The results could be informative concerning stakeholder collaboration and the alignment of agendas which also resonate with the study by Dunant et al. (2017). However, several limitations, including a small sample size, potential participant bias, and limited interview time, should be noted when interpreting the findings.

7. Conclusions

In sum, this research has illuminated the multifaceted landscape of BAMB practices in the UK, uncovering both common and unexpected barriers and enablers. It highlights the significance of effective legislation and collaboration in promoting BAMB practices. Taking prompt action and overcoming psychological barriers is also crucial. Despite the challenges, participants remained positive about the progress of BAMB in the UK. Larger sample sizes in further research could provide more insights. Overall, BAMB offers an opportunity for sustainable construction and circular economy, demanding a holistic approach involving stakeholders, education, policies, and research.

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