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Improving survey-based data collection for more effective domestic retrofit evaluations: perspectives from occupants and surveyors

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ABSTRACT

Evaluating the performance of domestic retrofits is essential in appraising their success and identifying if they improved the lives of occupants. In the UK, billions of pounds are invested annually in retrofits through policy funding; however, current building regulations do not mandate evaluation, and monitoring requirements are poorly defined. Without agreed standardised protocols or tools, retrofit evaluations remain inconsistent and incomparable, providing little assurance to occupants, landlords, installers, or the government. Post-occupancy evaluation (POE) is a common and well-established form of building performance evaluation used in retrofit evaluations; however, it faces challenges in multi-dwelling retrofit schemes. This research evaluated the effectiveness of occupancy evaluation surveys in five domestic retrofit projects overseen by a local authority in Northern England between 2022 and 2024. Phase one implemented a retrofit survey taken from the UKGBCs BuildUpon2 Framework. In phases two and three, iterative improvements were made to the survey based on feedback from occupants and surveyors. Five key barriers were identified: resources, technical challenges, surveyor engagement, trust, and accessibility. Addressing these challenges increased the survey response rate from 25% to 98%. The refinements significantly improved the quality and usefulness of the data collected, offering valuable insights for designing robust, easily implementable occupant surveys.

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Introduction

Climate change is widely regarded as one of the most serious concerns for governments around the world (Paris Agreement, 2015). The built environment accounts for approximately 40% of UK carbon emissions (HM Government, 2022d), with 20% of it from the residential sector (House of Commons, 2024). Older dwellings tend to be less energy efficient and so produce more CO_2 emissions per year than newer homes (HM Government, 2022a; ONS, 2022)and consequently can have higher fuel bills, which takes on greater significance since in the UK, people who live in older homes are more likely to be in fuel poverty (Committee on Fuel Poverty et al., 2024). The UK Government has therefore made the upgrading of older buildings a priority to achieve climate, health, and societal wellbeing goals (Committee on Fuel Poverty et al., 2024; DLUHC et al., 2024).

Installing measures to improve the fabric and system performance of buildings – *retrofitting* – is generally considered to be preferable to demolition and rebuilding of old homes since it results in less disruption, can be cheaper, is seen as more socially acceptable, and results in fewer embodied carbon emissions (DLUHC et al., 2024). Retrofitting also offers additional benefits, such as reducing maintenance costs, improving occupant comfort levels, increasing property value and stimulating the economy by creating employment (European Commission, 2024; HM Government, 2021) Approximately 15 million (60%) homes need to be retrofitted in the UK by 2050 via multiple retrofit policy schemes, including Energy Company Obligation (ECO), Smart Export Guarantee (SEG), Social Housing Decarbonisation Fund (SHDF), Great British Insulation Scheme (GBIS), Home Upgrade Grant (HUG), and Local Authority Delivery (LAD) (DESNZ, 2021; DESNZ, 2024a; HM Government, 2021; House of Commons Library, 2024). However, this retrofitting activity takes place without any mandatory, robust monitoring and evaluation. This represents a significant gap in current practice, limiting the ability to assess whether intended outcomes – such as energy efficiency gains,

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cost savings, and improved occupant comfort – are being achieved. In turn, it hinders accountability and constraints evidence-based improvements in policy and practice.

Retrofit evaluation in the UK

The major retrofit evaluation tool used in the UK is an energy model called the Reduced Standard Assessment Procedure (RdSAP), which produces Energy Performance Certificates (EPCs) that predict retrofit performance based on assumptions and defaults of how a building and retrofits perform in theory (DESNZ and BEIS, 2021; MHCLG, 2024). EPCs are useful as they are relatively easy and cheap to produce and offer a standardised energy efficiency assessment, awarding homes a rating between A (most efficient) and G (least efficient) (DCLG-HM Government, 2017). These models are therefore used to predict the potential improvement achieved through retrofits and provide evidence to satisfy retrofit funding requirements (DCLG-HM Government, 2017; HM Government, 2022a; House of Commons Library, 2024). However, EPC predictions themselves have been found to be unrealistic assessments of real performance (Ben & Steemers, 2019; Hardy & Glew, 2019; Kelly et al., 2012), as they are based on standardised assumptions that may not reflect measured energy use, occupant behaviour, variations in building operations, or site-specific conditions, and, can vary significantly between assessors (Coyne & Denny, 2021; DECC – Department of Energy & Climate Change, 2011; Kelly et al., 2012). Relying solely on EPCs, therefore, conceals the discrepancies between predicted and actual performance. Robust performance evaluation is essential to understand whether retrofit measures delivered their intended outcomes.

Other retrofit evaluations commonly undertaken in the UK include PAS2035 (HM Government, 2022c), which focuses on domestic retrofit; the Building User Survey (BUS) methodology (Arup, 2018), mainly used in non-domestic buildings across both new-build and retrofit projects; and the Soft-Landing framework by Building Services Research and Information Association (BSRIA) (Mirzaie, 2024) which helps improve outcomes during handover and early operation of non-domestic buildings. Platforms such as CarbonBuzz launched in 2008 by Royal Institute of British Architects (RIBA) and the Chartered Institute of Building Service Engineers (CIBSE) and the Building Performance Evaluation Project (BPE) by Innovate UK (Gupta et al., 2017), while primarily focused on new-build projects, also provide transferable insights that are relevant to retrofit performance assessment. Significant contributions to POE have originated in the non-domestic sector (Menezes et al., 2012; Pritchard & Kelly, 2017), highlighting the potential for cross-sector learning to strengthen evaluation practices. In UK retrofit projects, monitoring and evaluation are bespoke for each project or scheme and do not follow a standardised or validated methodology, or use approved or regulated tools for occupant surveys. Additionally, it is the responsibility of the building owner or retrofit project manager to implement their own monitoring programs, meaning there is no requirement for building performance evaluation (BPE) specialists to be involved, or for quality assurance (QA) of the evaluations taking place, which limits the reliability, effectiveness, and comparability of the evaluations taking place (Durosaiye et al., 2019; Hadjri & Crozier, 2009).

Existing retrofit evaluations are therefore limited by their reliance on modelling and tend to omit feedback from occupants and BPE tools post installations, and lack formalised quality assurance or structured learning mechanisms (Cheng & Steemers, 2011; Stazi et al., 2017). This makes it difficult for evaluations to be used to inform comparisons over time, or between schemes, or between individual projects. Moreover, it cannot be known if claimed benefits of over 1.8 million retrofits costing more than £6 billion that have taken place in the UK over the last 3 years are typically achieved, or if there are any systematic problems associated with the retrofits (HM Government, 2020; HM Government, 2022b; HM Government, 2023a, 2023b, 2024a, 2024b; HM Publications, 2024).

Surveys for building performance evaluation

As mentioned, there is no requirement in current retrofit evaluations to undertake occupant surveys; however, surveys are recognised as an effective form of data collection to assess building performance (HM Government, 2014, 2018; O'Brien et al., 2017). For instance, surveys traditionally have a major role in post-occupancy evaluations (POE), which are among the most well-established approaches to assessing building performance, in addition to collecting data from occupants via interviews and focus groups (Building Use Survey, 2010; UK Government, 2014). POE therefore assesses multiple aspects of building performance, including impacts on health, comfort and wellbeing (HM Government, 2018; Hua, 2013). POE can also use BPE tools to collect data on the building fabric and systems, such as fuel use, internal temperatures, relative humidity, or risk of condensation, or identify specific thermal performance characteristics (e.g. airtightness) (Boissonneault & Peters, 2023; Kelly et al.,

2012; Preiser, 2001). POE commonly also uses models to predict energy consumption and infer carbon emissions, and regularly collects data on the costs of running, maintaining, and even constructing buildings (Brady & Abdellatif, 2017; Cheng & Steemers, 2011; Gabrielli & Ruggeri, 2019; Kadrić et al., 2022). While POE may often be used as a catch-all term to describe multiple evaluation techniques, some standardised POE approaches exist (Hua, 2013; O'Brien et al., 2017; Preiser, 2005). However, their application in retrofit practice remains bespoke and inconsistent (Durosaiye et al., 2019; Hadjri & Crozier, 2009).

According to the findings of Artan et al. (2018) approximately 45 POE tools using occupant satisfaction measurements or building evaluation surveys have been published in the 40 years spanning from 1977 to 2017 across various countries to assess multiple building types, including offices, residential buildings, educational institutes and hospitals. However, as discussed in Arbulu et al.'s (2021) work, the assessments of energy retrofits globally have not been specifically designed or validated for mass application to domestic retrofit projects (Lee et al., 2014; Perisoglou et al., 2019; Seddiki et al., 2021). Only a few POE approaches have been developed specifically to capture occupant feedback in the evaluation of retrofit performance(Gomez et al., 2022; Turpin-Brooks & Viccars, 2006). Within the UK, such evaluations are used for bespoke projects or are specialised for commercial premises, and are limited in their use (Arup, 2018; Leaman, 1990; Wilson & Hedge, 2011).

Barriers to building performance survey success

Despite the increasing use of POE, several studies have identified challenges to its implementation. For instance, where POE projects investigate multiple performance metrics, they can become more costly, complex and time consuming (Artan et al., 2018; Hua, 2013). Balancing the extent of data collection needed for large-scale building stock evaluations against available funding is an important consideration for any evaluation tool – especially for tools intended for implemented across hundreds of thousands of retrofitted buildings each year. (Gonzalez-Caceres et al., 2019; National Research Council, 2002; Stanica et al., 2021; Woon et al., 2015).

Moreover, several challenges have been documented in administering POE, such as the inability to provide a comprehensive view of occupant satisfaction; difficulties in pinpointing the specific affected areas of the building or building elements causing complaints; lack of statistical validation for measurement constructs; absence of a consensus on occupant satisfaction metrics to ensure high-quality data; and low occupant willingness to participate in surveys (Artan et al., 2018; Hua, 2013; Turpin-Brooks & Viccars, 2006). Additionally, some practitioners have limited knowledge on how to carry out the surveys, which tends to lead to a failure to collect adequate or robust information (Izran, 2011; Woon et al., 2015). Several studies have identified that data collected from surveys may be limited or inconsistent, especially if surveys are too complex, for instance, using technical language and multiple objectives (Durosaiye et al., 2019; Meir et al., 2009; Vischer, 2001).

Sub-optimal survey challenges may also be expected where there is a lack of engagement or support within the construction industry and a lack of co-ordination between the agencies collecting and processing the data (i.e. contractors, tenant liaison officers, external consultants) and those that use the data for decision making (occupants, landlords, and governments) (Hay et al., 2018; Li et al., 2018).

Where these problems persist, opportunities to gain insights via POE, and specifically surveys, are limited. This challenge is further compounded by the lack of participation from building users in surveys, hindering the carry-over of valuable lessons into future projects (Leaman & Bordass, 2007; National Research Council, 2002). These challenges suggest that effective retrofit evaluations need to be simple, easy to implement and interpret, focused, and have some standardisation (Ho et al., 2021; Meir et al., 2009; O'Brien et al., 2017; Weiss, 1998; Zimring & Reizenstein, 1980). However, as mentioned existing approaches to retrofit evaluation in the UK do not necessarily have these characteristics.

This research aims to identify the barriers to implementing retrofit evaluation surveys in the UK, and to explore how to design more effective occupant surveys that are appropriate for a range of retrofit project scales, and allow comparisons of retrofit successes between, and within, large retrofit schemes. This research used UK Green Building Council's (UKGBC) Occupant Retrofit Survey, which is part of the broader BUILD UPON^2 (BU^2) Retrofit Evaluation Toolkit (UKGBC, 2021b). The BU2 project forms part of the European Union's Horizon 2020 research and innovation programme and aims to support cities in developing national renovation strategies by promoting stakeholder collaboration and tracking the wider impacts of building renovation (European Commission, 2020). This toolkit was selected due to its appropriate alignment with the study's emphasis on post-occupancy feedback and its comprehensive coverage of occupant concerns – including indoor environmental comfort, monitoring differences in energy consumption and improvements

resulting from retrofit interventions (UKGBC, 2015, 2021a, 2021b). This survey addresses a notable gap in analysing occupant experiences, which is increasingly becoming a requirement in government funding policies (DESNZ, 2024b; DLUHC, 2023). At the time of this study, this proposed occupant survey had not yet been trialled or tested in real-world settings. The introduction provided an overview of the context for retrofit evaluation and the rationale for selecting the BU2 occupant survey. The subsequent sections detail the methodology, present the findings from the surveyor and occupant perspectives and conclude with a discussion of the strategies adopted to improve data collection in large-scale retrofit evaluations.

Method

The occupant survey from the retrofit evaluation toolkit developed by the UK Green Building Council (BUILDUPON^2) (see Appendix 1 – BUILDUPON2 – Occupant Retrofit Survey) was used as the initial reference for this research. The survey was used to collect data from five council-led retrofit project case studies in the UK. The overall duration of the study spanned 26 months (2 years and 2 months), from September 2022 until October 2024. The use of multiple case studies allows for the identification of recurring patterns and to study the differences and similarities through cross-case analysis (Aaboen et al., 2012; Rosenwald, 1988; Yin, 2003). The research was designed in three phases, each including qualitative and quantitative data collection, as shown in Figure 1.

Iterative improvements were made to the survey in Versions 2 and 3 based on data collected in the preceding phases. In-person or face-to-face surveys were administered by surveyors who were tenant liaison officers appointed by the local council. As these surveyors were already involved in coordinating the retrofit projects, they had established relationships with the residents and were well positioned to facilitate meaningful engagement. In Phase 1, they administered the BU^2 survey for the first time, without any prior guidance. Table 1 provides details of the case studies. The focus was not on evaluating the success of the retrofit but on evaluating the evaluation of the retrofit. While the complete use of the tool would include collecting data before and after the retrofit, one meter reading was sufficient for this research, as the aim was to assess the effectiveness of the tool, not the retrofit outcomes.

Data collection included both quantitative survey responses and qualitative data gathered through semi-structured interviews with surveyors and occupants and a focus group discussion with occupants and surveyors. Participation was based on stakeholder availability. These were complemented by ethnographic observations of survey delivery, which were recorded through field notes. The participatory observations involved site visits and informal engagement with stakeholders such as surveyors, contractors, and project managers during the administration of the survey. Activities included shadowing the surveyors during the administration of the surveys, observing interactions between occupants and stakeholders, and engaging in informal discussions in communal areas. Observations focused

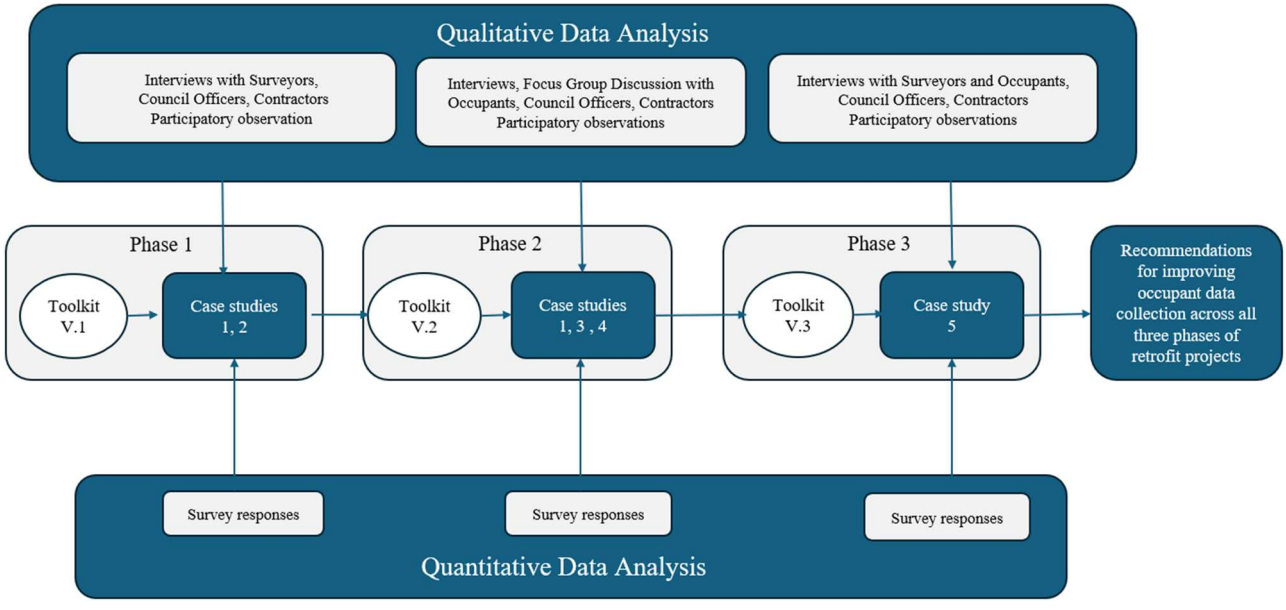

Figure 1. Research design.

Table 1. Overview of case studies.

Case study	No of homes	Tenancy	Type of homes	Type of retrofit
1	147	Social	Solid brick wall – Back to backs – Terraced housing	External wall insulation, (EWI) replacement of door and windows
2	99	Social	Reinforced concrete Apartments buildings	Ground source heat pumps
3	350	Social	Solid brick wall – Back to backs – Terraced housing	EWI, Roof replacements, Replacement of door and windows
4	150	Private	Semi-detached, Detached, Terraced, End terrace, Park homes	EWI, PV, replacement of door and windows
5	123	Private	Semi-detached, Detached, Terraced, End terrace, Park homes	EWI, replacement of doors, window, Loft insulations.

(Back-to-back houses in Leeds are Victorian-era terraced houses built during the industrial boom to accommodate growing working-class population, and they remain a distinctive feature of the city's historic urban fabric (Leeds City Council, 2022)).

on surveyor-occupant engagement, survey comprehension, and on-the-ground delivery challenges. These ethnographic observations provided contextual insights into stakeholder dynamics and the practical realities of survey implementation.

Semi-structured interviews were conducted to assess whether the survey was effective in capturing insight into their experience regarding the retrofit interventions. The interview topic guide aimed to extract meaningful reflections from participants on essential elements of the survey design, based on previous works (Adams, 2015; French, 2012; Frey & Fontana, 1991; Rattray & Jones, 2007). In later interviews, questions were added to explore specific findings emerging from the preceding research phases, such as exploring the participants' experiences and expectations regarding delivering and completing retrofit evaluation surveys, including reasons for incomplete responses or lack of occupant participation. The interview guide focused on whether the survey questions were clearly comprehended by both occupants and surveyors and was flexible to accommodate emerging themes. The scope of the guide also extended to the perceived relevance of the survey content, exploring delivery challenges, reasons for non-participation by surveyors and opportunities for improving future iterations. Interviews with occupants were conducted in person at their homes, while interviews with other stakeholders took place either in the site cabin or via video call, depending on stakeholder preference and accessibility. Each interview lasted approximately 60–90 minutes and was audio-recorded with participant consent. Two focus group discussions were conducted, one with occupants and another with surveyors, both following the semi-structure interview format. This data was transcribed manually and thematically analysed using NVivo, to identify recurring patterns, insights and challenges related to survey implementation and engagement. All qualitative data were interpreted using reflexive thematic analysis (RTA) following Braun and Clarke (2006, 2013). This included iterative coding and theme development to capture shared patterns and key issues emerging from participant groups.

Quantitative data from survey responses were analysed to assess the percentage of survey completion, response rate, identify inconsistent or ambiguous responses and evaluate trends across survey versions. Descriptive statistics from the survey responses were used to support interpretation and comparison, with the findings informing subsequent qualitative analysis. The aim was to evaluate the effectiveness and usability of the survey tools across various types of project scales. Each version (V1, V2, V3) was assessed using metrics such as response quality, consistency, and feedback from both surveyors and participants, and then compared to identify improvements in survey design and administration. Hence, the insights from the preceding versions informed refinements in subsequent versions, triangulating qualitative and quantitative findings enhanced the understanding of practical and contextual barriers to survey effectiveness. This process not only improved the clarity and relevance of the survey tools but also strengthened engagement strategies to increase response rates and data quality.

Table 2 describes which data collection activities took place in each of the case studies, wherein V1, V2, and V3, refer to the versions of the survey as shown in Figure 1. In Case Study 1, the researcher administered the survey twice: initially as a pre-retrofit assessment in Version1 and later using improved Version 2 for post retrofit evaluation. The same data was collected in both instances, making direct comparison possible. While not essential, this strategy was well-suited, and a direct comparison proved beneficial in highlighting

Table 2. Overview of data collection activities by case study.

	Case Study						
	1		2	3	4	5	Total
Survey version (V)	V1	V2	V1	V2	V2	V3	
No. of homes	147	62	99	1	14	123	446
Occupant Interviews	–		2	1	14	6	23
Surveyor Interviews	2		1	1	1	1	6
Focus group discussion	–		2	–	–	–	2
Participatory observations	2		3	5	8	6	22

Table 3. Interview and focus group samples.

	Male	Female	No of interviews	Total participants
Surveyors	6	4	6	10
Occupants	5	24	23	29
Focus group discussion	5	9	2	14

improvements between the two survey versions. In contrast to Case Study 1, only post-retrofit surveys were administered in Case Studies 2-5, as the retrofit work had already begun, and it was not possible to get any pre-retrofit assessment. The research adapted to fit within the constraints of ongoing project timelines, and this provided the opportunity to test the survey across a diverse range of conditions and participant groups.

The aim of the study was to evaluate the effectiveness and usability of the survey tool in collecting adequate responses and robust, good-quality data, rather than to assess the success of the retrofit, irrespective of household identity or demographic profile, such as age range, tenancy length, and household composition. No apparent bias was identified in relation to demographic or socio-economic characteristics of participants. Researchers maintained a non-participatory stance during interactions, ensuring that data collection reflected stakeholder perspectives without interference.

Table 3 provides an overview of participants involved in the interview and focus groups. Some interviews involved two participants, specifically with surveyors who were responsible for administering the survey on the same site. The participants of occupant interviews included residents of Northern England who lived in both social and private housing. Of the 446 surveys administered, demographic data, including age and gender, were collected, and no sampling bias was observed in their distribution. However, as the primary aim of this study is to evaluate the effectiveness of survey design and delivery in the retrofit context, a detailed analysis of demographic trends falls outside its scope.

The researchers ensured participation from all stakeholders was voluntary and based on informed consent. No incentives were provided for participation. The research followed best practices as per the General Data Protection Regulation.

Results

Insights were drawn from semi-structured interviews, discussions, and ethnographic observations with both occupants and surveyors, covering various aspects of survey design, delivery, participant engagement, and data quality. Analysis of the surveyor data identified three key themes, presented in Figure 2, while two distinct themes emerged from the occupant data, shown in Figure 3. The section concludes with an evaluation of the quantitative data, focusing on survey response rates and data quality. Although the analysis was

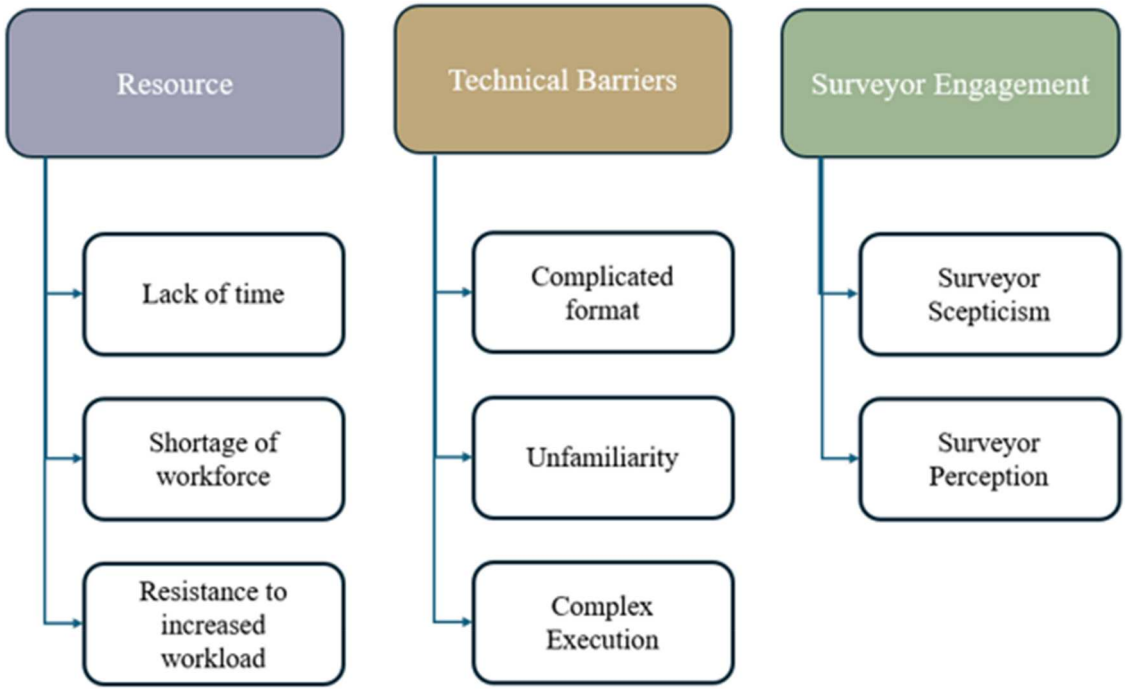

Figure 2. Insights from surveyor interviews and ethnographic observations.

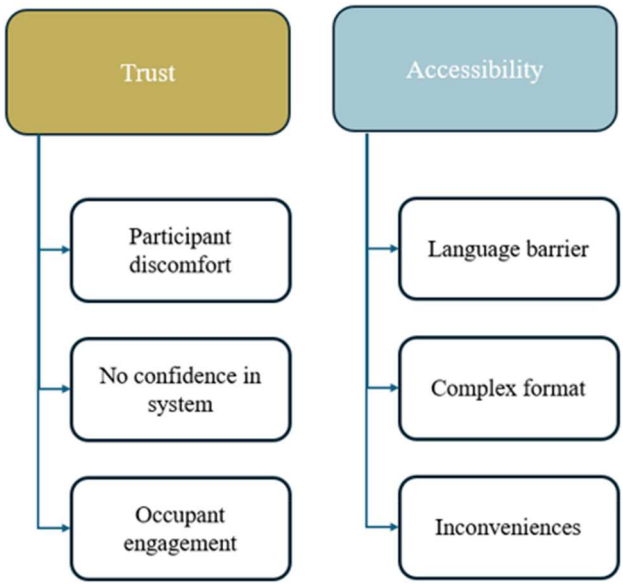

Figure 3. Insights from occupant interviews and focus groups.

conducted concurrently, the findings are presented sequentially to enhance analytical clarity and narrative coherence.

Surveyor interviews and survey observations

The surveyor interviews revealed three overarching themes – resource constraints, technical challenges, and levels of surveyor engagement – as illustrated in Figure 2.

Resource challenges

Lack of resources was also identified as a barrier to delivering occupant surveys, and three subthemes specific to retrofit surveys identified in this work are discussed here.

Lack of time. Surveyors reported that the pre-retrofit period was highly stressful, with work on the retrofits advancing so quickly that there was no opportunity to administer a pre-retrofit survey, and further, once the retrofit was completed, they were immediately moved on to the next assignment – in most instances, leaving no time for a post-retrofit survey.

> Surveyor 1 – So actually, we're in a chase, we were you know, we were sort of running faster than we can actually run in those early stages

The surveyors viewed the job of contacting and visiting the occupants to deliver the survey as an additional time burden. Moreover, surveys often took longer than expected, where occupants struggled to read, or understand the questions (due to complexity, reading, or language barriers), necessitating the surveyors' assistance in filling out the survey, which was not anticipated by the surveyors.

> Surveyor 3 – I didn't have the patience.

During participatory observations, the researcher also noticed that occupants often failed to honour scheduled times for the surveys, or were not at home at all, resulting in wasted time for the surveyor and the need for potential revisits to properties.

> Surveyor 5 – This is the second time; she's not at home, (despite a prior appointment being scheduled over the phone).

Shortage of workforce. The surveyors noted that they had no additional support in arranging visits for the surveys and often had to schedule visits outside regular work hours since occupants were at their place of work during normal working hours. This required the surveyors to work overtime or during holidays to administer the questionnaire since no additional out-of-hours staff were provided.

The task of administering the survey was not prioritised by supervisors, resulting in it being assigned to whoever was available at the time, regardless of their familiarity with the survey process or confidence in administering it effectively.

> Surveyor 7 – Surveyor 9 is a recruit who had joined the firm 1 month ago, she's the only one available, (to administer the occupant survey).

The site staff were working under high stress to meet the tight deadlines, which led them to delegate survey delivery to external personnel, often without adequate training, compromising the consistency of data collection.

> Surveyor 10 – We don't have the time so we're outsourcing the questionnaire job.

Resistance to increased workload. The additional workload of administering, especially paper-based surveys such as printing, storing responses, organising appointments, manually entering data into digital format had not been clearly communicated in advance or accounted for in planning. Furthermore, it was not specified in the contracts and so was perceived as extra work beyond the core responsibilities.

> Surveyor 4 – I'm not going to lie; it's been a pain. It's another thing we've had to fit in.

When surveyors needed to fill out the forms on site, the working conditions made it difficult to write properly,

resulting in illegible handwriting, improvised acronyms, or partially completed questionnaires.

> Surveyor 2 – The issue sometimes with questionnaires (is) that sometimes it can eat into our time.

Additionally, energy meter (gas and electricity) locations were often inaccessible, and the surveyors were unfamiliar with reading the meters, resulting in their reluctance to spend time collecting meter readings. This was further complicated in some cases by the presence of smart meters, which had varying interfaces and were often difficult to read. This highlighted that surveyors were not trained to read different types of utility meters, contributing to uncertainty and inconsistent data collection.

> Surveyor 2 – How to read the meter. To be fair, these prepayment meters are so complicated. I don't know.

Technical Barriers

Technical barriers are related to the format, language, and clarity of the survey itself.

Complicated format. The surveyors reported that some questions and terms, such as 'retrofit', and terminology related to various types of ventilation, were not understood by either themselves or the occupants, leading to confusion on how to answer these questions.

> Surveyor 6 – People looking at the paper – becoming overwhelmed and thinking, I don't want to do this. Why do I need to do this?

The surveyors struggled with the 5-point Likert scale. They observed that as it was challenging for the occupants, who tended to prefer simple verbal descriptors over numerical scales. This often resulted in surveyors randomly ticking between boxes on the Likert scales.

> Surveyor 5 – They found it quite confusing for tenants, because everything was all on (gesturing to the Likert scale matrix on survey) and they didn't understand.

Additionally, the grids designed to identify dampness, leaks, mould, and condensation were found to be confusing, resulting in incomplete or inconsistent answers.

> Surveyor 8 – Oh, I don't know that this is too complicated. I'm not gonna do that.

The limited writing space on the paper, made it difficult to write clearly, resulting in scribbled responses.

> Surveyor 2 – "And it was quite fuzzy."

However, in later versions of the survey, simplifying the language, replacing numerical values with words and restructuring the Likert scale matrices into multiple-choice questions led to more favourable feedback.

> Surveyor 9 – The work got a lot easier to get a tick off and to go from deciding the scale of it rather than calculating on a one to five scale.

Unfamiliarity. The surveyors emphasised the importance of using simpler language to understand technical terms used in the survey (e.g. acronyms like MVHR – Mechanical Ventilation with Heat Recovery, MEV – Mechanical Extract Ventilation, and PSV – Passive Stack Ventilation), and that having guidance on how to fill out the matrices in the survey would have allowed them to conduct the survey with greater confidence.

> Surveyor 8-It (the words in survey) was kind of hard to explain that too. But I don't know why. I don't know that it was just my first one and I wasn't explaining it properly.

Specifically, the surveyors needed clarification on several technical details, such as understanding that a 10 mm undercut is equivalent to 1 cm and recognizing what 'air bricks' were. Some were unaware that windows are considered part of a ventilation system and assumed that 'ventilation system' referred exclusively to mechanical devices.

Several surveys couldn't be analysed due to these inaccuracies in form filling. A detailed discussion of these issues and their implications is provided in Bhorkar et al. (2023), which draws on findings from the same study.

Request ease of execution. Initial difficulties with paper-based forms resulted in the survey being digitised for use on surveyors' mobile phones. This simplified access and eliminated the need to print and manage paper versions and made it easier and more efficient for surveyors to input the occupants' responses replacing the manual task of writing on paper or later transferring the data to digital format for analysis.

> Surveyor 3 – It (digital survey format) is a lot easier to work with.

Additionally, surveyors proposed specifying the administration of the survey in the contract and integrating it into routine introductory visits to occupants in order to save time and improve efficiency and accountability.

> Surveyor 1-I still feel that it (administration of the questionnaire) could be done as part of the induction process?

Engagement

This theme examines the surveyors' thoughts on their involvement and role in the evaluation.

Surveyor scepticism. The surveyors did not understand why the survey was being undertaken or how it differed from existing evaluations such as the RdSAP or PAS 2035, which led them to view this as an unnecessary and irrelevant task.

> Surveyor 4 – The retrofit work we're doing had to meet PAS 2035 standards, so that's the standard that we're all working to. (so, we don't need to do this additional survey)

> Surveyor 5-The contractor does the customer satisfaction survey that kind of looks at the process as a whole. (so, we don't need to do this additional survey)

Surveyor perception. During the implementation of the second and third versions of the survey, training was provided to the surveyors that clearly communicated its value and specific reasons for undertaking the survey. This shift led to a noticeable improvement in response rates and data quality in the latter case studies, with some surveyors expressing a strong interest in the survey results.

> Surveyor 8 – Yours (improved survey) is more focused on how it benefited that property and their lifestyle in terms of heat and humidity. (in comparison to customer satisfaction surveys)

> Surveyor 9 – There's no barrier for them (occupants) to be answering the questionnaire.

Additionally, when the surveyors observed how this data could help secure funding for more retrofit projects and create additional jobs, there was increased engagement and enthusiasm for doing a good job.

> Surveyor 9 – From the very outset, people are aware of what's gonna be happening on the property. (referring to them introducing the occupant survey during the initial retrofit meeting)

> Surveyor 10 – It is the benefit with this questionnaire. (Referring to the occupant data gathered reflecting the impact and effectiveness of the retrofit work.)

Occupant interviews and focus groups

Two key themes: trust and accessibility, emerged from the analysis of the occupant feedback on the survey administration, as illustrated in Figure 3.

Trust

This theme captures the occupants' hesitations and concerns about participating in the survey.

Participant discomfort. The occupants were uneasy about completing the questionnaire or sharing personal information through emails or with unfamiliar individuals, expressing that, if the survey was truly important, it should be conducted face-to-face by authorised personnel. Additionally, some elderly and other occupants who had limited literacy were unable to complete the survey independently.

> Occupant 5 – You have to remember we're people of a certain age and some of us cannot understand (referring to their inability to complete the survey, they wanted someone to read, explain, and complete the survey while they answered the questions verbally.)

Additionally, participation improved when occupants were informed that their information would be anonymized.

> Occupant 4 – You're supposed to get private information so somebody should come and collect it, not any Joe blokes.

Occupants were more inclined to participate if they knew their neighbours had also participated, indicating they trusted the process more when others in their community were involved.

> Occupant 1 – (We) relied on the neighbour. It's all word of mouth.

Moreover, site observations revealed occupants were initially hesitant to share their energy bills; however, when they were convinced of the relevance of the questionnaire, they were willing to provide their energy details and meter readings.

> Occupant 8 – Yeah, just send me a text and say you want the meter reading, and I just go in and find it and send it to you.

No confidence in system. Some occupants were sceptical about the potential improvements that retrofitting could bring to their homes and were only undertaking the retrofit at the request of their landlord. This highlighted a perception that they would not receive any benefit from filling in a survey about their experiences, and so they weren't interested in completing the survey.

> Occupant 6 – See whatever you complain nothing gets done. (Referring to the improvements in the house)

Occupants had little confidence in the landlord (and retrofit) and complained that they had to solve their (damp) problems themselves. This lack of trust fostered a disinterest in the entire retrofit process, including completing the survey.

> Occupant 2 – I don't have mould now because I keep doing it myself, put mould stuff on and paint it.

In the focus groups occupants recalled throwing the initial paper surveys into the bin, perceiving it as a marketing pamphlet. This indicated their disinterest in the survey process.

> Occupant 3 – Yeah, you won't do it anyway if it came through a door (gesturing to the paper survey), a survey for what?

Occupant engagement. In response to feedback from the initial version, the surveyors were instructed to explain the importance of the survey to the occupants in later survey versions. This resulted in greater willingness to participate in completing the survey as well as to share smart meter readings and past energy bills.

> Occupant 11 – If they (other occupants) know what it's all about, they'll all turn up, at least for half an hour.

> Occupant 18 – I think knowing what the survey is about in the first place (is important) I think you got to know what you're doing the survey for!

> Occupant 12 – Presumably because it saves money in the long run and it's a better way, more greener way to go about for the future.

Once engaged in the process, some occupants showed enthusiasm and were willing to complete future surveys, also expressing interest in the survey outcomes.

> Occupant I5-Think you might benefit from 2 (surveys). one just after it's done. And then one about six months later.

Accessibility

This theme focusses on how occupants should be central to the survey process and design, as their engagement, trust and insights are critical to gathering meaningful data and measuring the impact of retrofit interventions.

Language barriers. Many occupants found the survey overwhelming due to its length and complexity or because they were unable to read as they had sight-based health issues, often preferring to have questions read aloud. Additionally, several occupants did not speak English or needed assistance to understand terms like 'retrofit' or 'draughty'.

> Occupant 2 – I don't understand that it's not a word we're used to.

> Occupant 18 – Yeah, retro means old, so it (retrofitting) means you're fixing your home with something from the 60s and the 70s. (Many occupants didn't have a clue of what the word retrofit meant)

> Occupant 8 – Unless you've got very good eyesight you can't see it. You need to have your glasses on.

Complex design. A few occupants were overwhelmed by the general length and complexity of the survey questions, which resulted in them abandoning surveys or leaving some questions incomplete.

Occupant 8 – Yeah, how it's worded, so you make the question so simple that's how you're going to get the proper feedback, the more elaborate you go with your questions, some people are going to go, what the freaking is it and toss it (gesturing to a dustbin) you know.

Some occupants found the use of a matrix (for identifying ventilation options) and the 5-point numerical scales (Likert) used for stating comfort preferences particularly confusing even when descriptive words were used to accompany the scale. Many occupants expressed a preference for simpler 3- or 2-point scales and multiple-choice questions. Although the ventilation and dampness matrix was intended to be completed by the surveyors, in practice, it was often filled out collaboratively with occupants, as surveyors sought their input during the process. Both occupant and surveyors found the matrix and 5-point scale difficult to navigate leading to inconsistent responses.

> Occupant 15 – It's too airy fairy, yes, it's too many of the same thing (referring to Likert scale),(I'd prefer this question) like it says in this one – No or Yes. (Occupants meant questions which can be answered with a 'yes" or "no" rather than rate responses on a scale of 1–5.).

Inconveniences. Occupants were unwilling to complete the survey independently. Several occupants were willing to participate when someone read and explained the questions to them and filled out the answers for them. Occupants were uncomfortable with repeated visits, especially if it meant just for answering the survey. If answering the survey was integrated with other visits, such as routine visits for the retrofit, then occupants were more likely to participate. They were willing to respond to simple questions with fewer options. These patterns underscore the importance of integrating survey delivery into existing interactions that require minimally effort to complete and are not disruptive to occupants' routines.

> Occupant 8 – I don't know the spelling of Type, it's been a long time (since I wrote), so it's T … ? (Occupant asked the spelling of "type")

> Occupant 15 – That's too small, can't read that.

> Occupant 6 – It's (the survey) for your benefit really so, and there'll be a lot of people who'll just put it in the bin

Survey response rates and data quality

In the first research phase, the survey had a response rate of a maximum of 25% of 246 homes approached. Based on feedback from surveyors identified in this phase, a revised survey (Version 2) was introduced in Phase 2 as shown in Figure 1. The main changes from Phase 1 to Phase 2, included a switch to a digital (mobile phone) format, auto filling of survey meta data such as retrofit project name, surveyor's name, date of survey, etc., simplification of terminology used, introduction of drop-down multiple-choice answers, to reducing the written input required, alongside prompts to limit the number of incomplete responses. Optional comment boxes were provided at the end of each section to capture any additional observations, issues or responses that were outside the scope of the predefined survey questions. Additionally, a 30-minute training session for all surveyors was introduced. These changes increased the response rate to 61% of 62 homes approached, and the number of completed responses rose from 8% to approximately 49%. A further benefit was a significant reduction in the time taken to implement and analyse the survey.

The third phase, saw further refinements to the survey (Version 3) based on the feedback from the occupants to simplify the survey questions as shown in Figure 1. In this phase, surveyors were encouraged during the training session to explain the significance of the survey to occupants. Additionally, planning for the survey was integrated into the landlord and contractor procurement contract and specifications as part of occupant liaison processes. This meant ethical consent for the survey was collected at the same time as occupants' general consent for participating in the retrofit project, and the pre-retrofit evaluation surveys were implemented during the pre-retrofit home visits. This integration saved the surveyors time, as the occupants did not miss the appointments and were enthusiastic in answering the questions, as well as surveyors were well prepared for the process. This third iteration saw response rates increase from 61% to 98% of the 123 homes approached. Moreover, 100% of survey questions received valid responses.

Discussion

This occupant survey was specifically produced for use in retrofit evaluation, and the case studies were similar to other major retrofit programs taking place as part of policy funding across the UK, each with a contractual commitment to undertake some monitoring and evaluation. It is not known how representative the case studies and the survey used in this research are; however, it is possible that other retrofit programs taking place across the UK may face comparable challenges, suggesting a potential risk of ineffective evaluation approaches for large-scale retrofit projects. This is concerning, since robust evaluations are needed to ensure the benefits of retrofits are achieved in practice, are comparable, and to provide learning to improve future retrofit schemes. It is consistent with wider evidence that evaluation practices across UK retrofit schemes remain bespoke and inconsistent (Artan et al., 2018; DLUHC, 2023; Durosaiye et al., 2019). Furthermore, it reflects concerns raised in the literature about the limitations of existing retrofit evaluation tools, such as a lack of standardisation and the reliance on unvalidated survey methods (Fawcett & Topouzi, 2020; Saffari & Beagon, 2022). Iterative improvements were essential to address initial limitations in the survey design and to ensure it could more reliably capture outcomes relevant to the context of the retrofit projects.

The findings of this study have broader relevance for key stakeholders involved in large-scale retrofit programmes, such as local authorities, housing associations and retrofit delivery teams. Although developed in the context of UK domestic retrofit schemes, the survey refinements – particularly around digital delivery, accessible question design, and surveyor training – also have potential applicability in other housing-related evaluations, including post-occupancy assessments in social housing, energy efficiency programmes, and residential building performance studies in both national and international contexts. This research identifies approaches and techniques that can be adopted to improve survey evaluation. Incorporating these measures into future policy and practice could add value by improving data quality, supporting surveyor engagement and enhance the credibility of POE outcomes in large-scale domestic retrofit projects. Councils and delivery partners could benefit from improved occupant surveys that enable consistent data collection, allowing for comparisons and benchmarking across retrofit projects. This echoes previous studies that have called for consistent metrics and comparative frameworks in building performance evaluation (Cheng & Steemers, 2011; Stazi et al., 2017). Furthermore, there is potential for the insights from this research to inform improvements to existing industry tools such as the UKGBC's post-occupancy questionnaire. This study highlights the importance of conducting pre- and post-retrofit assessments to establish a baseline and

measure the effectiveness of retrofit intervention through comparative analysis of occupant experience and performance outcomes of the retrofit interventions. As the survey process evolved, digitising the survey for administration on mobile phones led to a marked increase in response rates and completeness of submitted data. Surveyors read the questions aloud and recorded responses on behalf of the occupants. This method was adopted to support participants with limited digital literacy and reduce nonparticipation due to low confidence in survey comprehension. Providing a digital resource also streamlined data collection and minimised human error and significantly reduced the time required for data entry and processing. These findings reinforce earlier work noting the benefits of digital tools in improving survey reach and reducing administrative time and increasing efficiency (Hardré et al., 2012; Pittaway & Montazemi, 2020; Siva et al., 2019; Vischer, 2001). While some recommendations have wider relevance, this study contributes to both practice and literature by highlighting underreported, and implementation challenges specific to retrofit survey administration.

This research identified that the survey attempted to collect data using matrices and technical terms that were unfamiliar or unclear to participants and surveyors. This complexity caused occupants to abort surveys or leave questions unanswered. This mirrors similar findings from previous research on the risks of complex survey design in POE (Durosaiye et al., 2019; Meir et al., 2009). These findings highlight the value of collecting information through clearer, simplified questions that aligned with the occupants' awareness of retrofit changes. The questions in the improved survey were phrased in easy-to-understand, language with consideration for accessibility – such as visual clarity, a user-friendly format, and easy navigation. While lengthy surveys can lead to respondent fatigue (French, 2012; Hansen & Hurwitz, 1946; Rolstad et al., 2011), this was managed by replacing complex matrices with simpler multiple-choice formats, which were easier for occupants to understand and respond to, thereby improving engagement and data quality.

When training was provided to surveyors on why the surveys were taking place and how to use the survey tool, the surveyors were more engaged, and the evaluations were more successful. This supports existing literature showing that having the survey delivered by an informed surveyor improves the effectiveness of POE delivery (Groves, 1989; Izran, 2011; Zielina, 2020). These findings highlight the need for stakeholders to provide training, and practical support, alongside clear ethical protocols for surveyors when administering the occupant surveys in retrofit projects. The findings also suggest surveys must be occupant centred, so that occupants trust the surveyor and are receptive to the process. For instance, conducting surveys face-to-face was found to be the only viable approach to achieving robust responses. Additionally, occupants who understood the purpose of the surveys and the potential benefits of participating were more likely to provide useful data. Integrating the evaluation process as part of the procurement contract, facilitated planning and ensured stakeholders executed the process methodically.

POE can be a useful tool for evaluating whether retrofit measures are contributing to improvements in building performance and occupant experience. These findings align with arguments in literature, that a well-structured evaluation process can help close the gap between design intentions and operational outcomes, by providing timely and occupant-informed feedback (Hua, 2013; O'Brien et al., 2017). In exploring this potential, this research identified challenges as well as facilitators that influenced the effective implementation of the surveys. These findings informed refinements to both the survey design and its administration, aimed at improving data quality and response rates. This toolkit was developed within the context of local authority-led retrofit projects in Northern England, and while we believe several insights from this study are broadly applicable, we acknowledge that the findings may not be generalisable to other regions, climates, or policy environments. As participation in this study was voluntary and no targeted sampling was used, the study does not assess the correlation between respondent characteristics and survey engagement. This is acknowledged as a limitation and highlights an area for future research on representativeness and response bias. Furthermore, this toolkit's success relied heavily on the availability of council surveyors, which may limit its application in resource-constrained settings. Its effective deployment also depended on technological tools and platforms, which may necessitate training for non-technical users and the availability of an internet connection to ensure its smooth implementation.

Conclusion

This study demonstrates that while occupant surveys are a common tool in retrofit evaluation, their current implementation falls short of delivering robust, reliable data. The results highlight that without adequate planning, integration, and support, survey tools fail to capture the impact of the retrofit interventions.

The UK has the oldest building stock in Europe with 10.2 million (37%) buildings built before 1944 (DLUHC et al., 2024) and retrofits take place annually in the UK via large-scale policy funded retrofit projects, and this is expected to increase in future years. Findings from this research suggest that to improve retrofit evaluations, surveys must be embedded within the evaluation framework, supported by adequate resources, trained personnel, and clear communication with occupants. Face-to-face survey administration, surveyor training and digitalisation of tools emerged as effective strategies to improve response rate and data quality. However, these strategies are insufficient if evaluations are not occupant-centred and coordinated with wider retrofit delivery timeline.

The findings point to a broader need for standardisation and quality assurance across retrofit evaluations in the UK. Rather than relying on ad hoc or bespoke approaches, future schemes should adopt structured, standardised, and tested methods that prioritise robust data integrity and participation. A pre-retrofit survey should be considered an essential component of the evaluation process, enabling comparison with post-retrofit findings to assess the impact of the retrofit on occupants.

To ensure future retrofit programmes deliver meaningful outcomes, evaluations must do more than meet contractual obligations. They must provide actionable insights that inform learning and accountability across the sector. These findings indicate that a significant shift in the approach to retrofit evaluation in the UK may be needed to ensure occupants, landlords, contractors, and the Government have confidence that retrofits are safe, effective and improving peoples' quality of life.

Data availability statement

The interview data could not be shared due to privacy concerns and the need to protect participant confidentiality.

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No potential conflict of interest was reported by the authors.

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