

If Homes Could Talk...

Connected Homes in Social Housing: From Pilot Paralysis to Predictive Practice

An examination of the
barriers to the large-scale
deployment of sensors
in UK social housing

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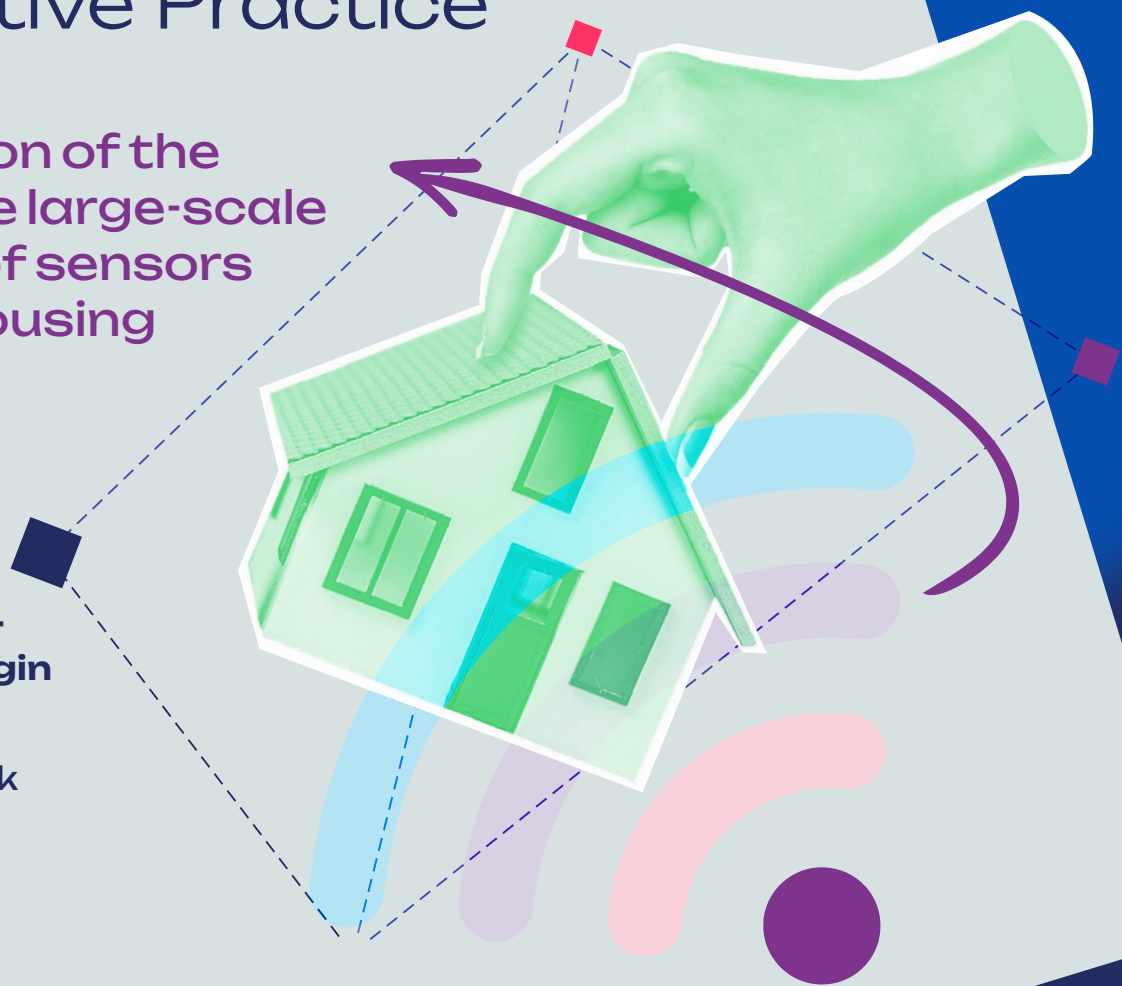
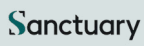
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Foreword

At Amazon Web Services (AWS), we believe technology can fundamentally improve how social housing services are delivered.

When we partnered with the Disruptive Innovators Network (DIN) on this research project, our shared goal was to understand how connected homes technology could best deliver impact and achieve widespread adoption in UK social housing.

This comprehensive study by Matthew Gardiner and Dr Philippe Demougin reveals that while the technical foundations for transformation exist, the real challenges lie deeper – in organisational readiness, procurement approaches, resident trust, and the cultural shift required to move from reactive to predictive service models.

Their findings show that scaling connected homes isn't simply a technology challenge, but a systems problem that requires careful consideration of people, processes, and technology working in harmony.

The vision presented here – of homes that can communicate their needs before problems escalate, of residents who are true partners in service delivery, and of housing providers equipped to act on real-time insights – aligns perfectly with AWS's commitment to improving lives through technology.

But as the research makes clear, realising this vision requires more than just installing sensors. It demands a fundamental rethinking of how housing services are delivered and managed.

As the sector faces mounting pressures around building safety, decarbonisation, and service improvement, the insights and recommendations in this report couldn't be more timely.

This research provides a practical roadmap for housing providers ready to embrace the transformative potential of connected homes technology, and we're proud to have supported its development.

Kris Burtwistle, Head of Local Government and NPO, AWS

Acknowledgements

This report has been made possible through the generous involvement of many people.

DIN would like to thank Dan Goodall, CTO Bromford Flagship for originally identifying the need and opportunity for the research to be carried out and for leading the Steering Committee, members of which provided funding for and guided delivery of the work. Steering Committee members were:

Aggie Batchelor	National Head of Asset Sustainability	Sanctuary
Sam Bulley	Account Manager, Social Housing	Amazon Web Services
Ian Chapman	Director of Transformation	Yorkshire Housing
Dan Goodall	Chief Technology Officer	Bromford Flagship
Andy Isted	Transformation, Data and Technology Director	Aster
Gareth Lloyd	Chief Information and Transformation officer	Stonewater
George Phillips	Director, Operations	Livv

Our thanks extend to all those who helped with the resident engagement part of the research. Designed by the research team with the support of Anna O'Halloran from O'Halloran Consultants, this important part of the work involved specialist staff from within Steering Committee members and also Clarion Housing contacting and connecting with residents to set up meetings and distribute surveys.

We would like especially to thank the residents who engaged in those meetings and surveys. Their experiences are a fundamental building block for this report.

Many people gave their time for the semi-structured interviews we conducted. Whether from landlord teams, suppliers or professionals working in the sector, interviewees were unfailingly thoughtful, helpful and insightful.

Part 1

Introduction and Research Design



Executive Summary

The Connected Homes research project set out to understand why connected technologies in social housing, like smart sensors, thermostats, and energy platforms, often remain stuck at pilot stage despite growing investment. While these tools promise better maintenance, healthier homes, and more proactive services, adoption across the sector has been slow and uneven.

Led by Bromford Flagship in collaboration with the Disruptive Innovators Network (DIN), the project explored the wider ecosystem around connected technologies. It examined not just whether the tech works, but whether it can be meaningfully embedded into everyday housing practice.

The research combined six strands: literature review, digital maturity assessment, stakeholder interviews, tenant engagement, market analysis, and roadmap testing. A total of 39 interviews were conducted across landlords, suppliers, and enablers (such as data platforms and connectivity providers), supported by tenant workshops, surveys, and case studies. Findings show a common pattern: successful pilots often fail to embed. Technology is bolted on, not built in. Tenants are involved too late. Procurement is often a challenge with some frameworks being based on outdated terms and conditions. And supplier offers don't always fit the operational needs of landlords.

However, some providers are beginning to make meaningful progress, using sensors for damp and mould compliance, linking IoT with decarbonisation efforts, or rethinking service delivery through data. These efforts are underpinned by leadership, clear strategy, tenant engagement, and organisational readiness.

The research surfaced a spectrum of strategic responses to connected home technologies, from limited compliance-driven pilots to more ambitious transformation efforts. While these varied in scale and intent, all underscored the need for greater alignment between vision, systems, people, and processes. Key enablers included clear leadership and internal ownership, procurement and commercial models fit for long-term service change, cross-system data integration, trust-building with tenants, and stronger collaboration between landlords, suppliers, and sector partners.

At their best, connected technologies can support healthier, safer, more sustainable homes. But that promise will only be realised if housing providers shift from isolated initiatives to system-wide change.

Background and Context

The social housing sector is standing at a digital crossroads. For years, connected technologies, ranging from humidity and temperature sensors to smart thermostats, remote diagnostics, and integrated energy platforms, have been positioned as game-changers: tools that can shift housing services from reactive to proactive, reduce maintenance costs, identify issues before they escalate, and empower tenants to live in healthier, more energy-efficient homes.

Yet despite this promise, large-scale, embedded adoption of these technologies remains limited. While countless pilot projects have been run across the UK housing sector, only a small minority have progressed beyond limited trials towards widespread operational delivery. Too often, promising pilots fail to scale. Technology is installed, data is gathered, and dashboards are created, but these fail to translate into sustainable business change or improved services for tenants.

This disconnect is not due to a lack of innovation. Rather, it reflects a deeper and more structural problem. Connected home technologies are not plug-and-play solutions. They demand shifts in culture, systems, procurement, data governance, tenant relationships, and organisational strategy. Without the alignment of these conditions, even the most well-intentioned projects can falter.

This Connected Homes research project was initiated in response to this challenge.

Its central aim was not to evaluate a specific product or solution, but to understand the wider system in which connected technologies operate, and to explore the conditions that enable or inhibit progress. Terms like ‘smart homes’, ‘Internet of Things (IoT)’, and ‘connected homes’ have circulated for over a decade, often with bold promises of transformation. But definitions vary, and progress has been fragmented. One of the project’s early aims was to establish a shared, working definition of what a ‘connected home’ means in the social housing context, to cut through the jargon and focus on practical realities.

Led by Bromford Flagship in collaboration with the Disruptive Innovators Network (DIN), the research was commissioned by and for the housing sector. It set out to answer a series of practical questions:

- What motivates landlords to adopt these technologies?
- Where have the benefits been realised?
- What have residents experienced?
- What’s holding deployment back?
- And what does ‘good’ look like when it comes to scale, integration, and tenant-centred delivery?

This work is taking place at a critical moment for the sector. Awaab’s Law and the evolving Decent Homes Standard are introducing stronger legal obligations to proactively address issues such as damp

and mould. The Warm Homes: Social Housing Fund (previously SHDF) and net zero commitments are raising the stakes for energy performance. At the same time, there is growing scrutiny around tenant voice, transparency, and data ethics, both in response to tragic cases and broader systemic concerns.

Against this backdrop, landlords are being asked to do more, with better outcomes, under tighter constraints. Digital and connected technologies are increasingly seen as part of the answer, but the reality on the ground is more complicated. Many providers are still grappling with legacy IT systems, fragmented data, low internal confidence in technology, and deep concerns about tenant trust and digital exclusion. Suppliers, meanwhile, often struggle to align their product and commercial models to the operational realities of housing management, leading to mismatches in expectations, delivery, and outcomes.

There is no shortage of enthusiasm or ambition. What is missing is a shared understanding of the conditions for success. How do you embed connected technologies into core service delivery rather than bolt them on? How do you engage tenants meaningfully and ethically when deploying in-home devices? How can landlords procure and integrate solutions in a way that works across their systems, teams, and geographies? And what does 'good' look like when it comes to digital maturity, interoperability, and accountability?

The Connected Homes project set out to explore these questions, not through abstract theorising, but through grounded, sector-facing research.

Rather than testing a single technology or supplier offer, the project took a deliberately wide-angle approach. It examined the broader ecosystem in which connected homes sit: from the drivers shaping landlord strategy, to the maturity of the supply chain, to the practical and emotional realities of residents living with connected devices. It recognised that the biggest barriers are often not technical, but relational, organisational, and cultural.

To that end, the project explored three core sets of relationships that determine whether connected home deployments succeed or stall:

- Between landlords and suppliers – including procurement, commercial alignment, product-market fit, and integration pathways.
- Between landlords and residents – including trust, consent, communication, digital inclusion, and day-to-day lived experience.
- Within the organisation itself – including strategic clarity, leadership buy-in, data systems, digital maturity, and capacity for transformation.

By focusing on these interlocking relationships, the research sought to understand not just “what’s happening” in the sector, but why. It also aimed to move beyond anecdotal success stories or disconnected reports and provide a coherent, cross-cutting picture of where the sector stands, what’s holding it back, and where the opportunities lie.

Crucially, this was not a supplier-led or commercially motivated exercise. The project was commissioned by and for the housing sector, with a focus on practical learning and long-term value. It involved nearly 39 interviews across landlords,

suppliers, and infrastructure enablers; engagement activities with residents; a cross-sector maturity assessment; detailed market analysis; and structured roadmap development with feedback from sector leaders. The emphasis throughout was on triangulation, realism, and inclusion, surfacing the real-world tensions, misalignments, and opportunities that shape connected technology adoption.

The result is a body of evidence that goes beyond the binary question of “do sensors work?” and instead examines what it takes to deliver impact at scale. This means recognising the importance of internal readiness, procurement reform, trust-building with tenants, common data standards, and genuine partnership between housing providers and solution providers.

This report brings together the findings and learning from that work. It does not offer easy answers, but it does offer clarity. Clarity on what needs to change, where the sector is getting stuck, and how we can move beyond pilot projects to build systems that truly serve residents, organisations, and the wider mission of housing justice.

How to use this Report

This report presents the full findings from the Connected Homes research project. It is designed for flexible use — whether as a reference document, a detailed evidence base, or a strategic planning tool.

A separate executive summary and recommendations paper is available alongside this full report. The shorter document summarises the overall aims, methods, findings, and core recommendations — for readers seeking a concise overview of what we did, what we found, and what it means.

The main report itself is structured to support both linear and non-linear reading:

- Each part opens with an executive summary to highlight key insights up front.
- Most sections include practical recommendations towards the end, though some — such as the literature review — follow a more research-focused format (with an abstract and conclusions).
- Individual methods summaries are included within each part, in addition to the full methodology outlined in the introduction, so readers can understand the context and limitations of each strand.

- Cross-referencing and theming have been used throughout to help draw connections across parts. For instance, recurring themes like tenant trust, procurement, or digital maturity are surfaced in multiple sections to aid synthesis.
- Case studies and direct quotes are used throughout to ground findings in real experiences and make the report more engaging and human-centred.
- The final section draws everything together, offering a consolidated set of recommendations for housing providers, suppliers, and sector bodies, supported by a practical maturity assessment framework.

Readers are encouraged to navigate the report in whichever way best suits their interests; whether they want to explore a particular topic (e.g. tenant engagement or supplier models) or build a full picture of what it takes to scale connected home technologies across the sector.

Research Design

This research was designed to generate grounded, sector-facing insights into how connected home technologies can be meaningfully and responsibly embedded in social housing. Rather than starting with a technical trial, the project prioritised understanding the broader organisational, relational, and systemic conditions that shape success or failure.

The research adopted a wide-angle, multi-method approach to explore the realities of connected home deployment across three domains: Landlord–supplier relationships, Landlord–resident relationships, and Internal organisational dynamics.

The research was conducted between February and June 2025 and followed a qualitative, exploratory design. It was shaped by the understanding that connected technologies in social housing do not succeed or fail on technical merit alone. Instead, their impact is shaped by organisational readiness, resident experience, supplier fit, and the wider policy and funding environment. The aim was not to evaluate individual products or test fixed hypotheses, but to examine the systemic, cultural, and operational conditions that enable or obstruct progress.

To investigate these areas, the research team conducted:

- A structured literature review of over 50 sources to capture current thinking, evidence gaps, and policy context;

- A digital maturity self-assessment, completed by participating landlords, to benchmark organisational readiness across key domains;
- Semi-structured interviews with 39 stakeholders across housing providers, technology suppliers, and infrastructure enablers;
- Tenant engagement, including interviews, workshops, and surveys across multiple organisations, focused on day-to-day experience, trust, and consent;
- A market analysis mapping current supplier offerings, gaps in provision, and common challenges in procurement and integration;
- Development of practical use cases and implementation roadmaps, refined through feedback loops with sector leaders.

Triangulation was central to the approach. Insights were gathered from multiple perspectives — landlords, residents, suppliers, and infrastructure enablers — using methods tailored to each group's experience and role in the ecosystem. Emphasis was placed on surfacing tensions, capturing variation, and building a joined-up picture of what is happening and why. The design was also iterative, allowing findings from one phase to inform and shape subsequent phases. This ensured the research remained grounded in real-world challenges while being responsive to emerging themes

The intention was not just to describe what's happening, but to explore why certain efforts succeed while others stall, and what it would take to move beyond

pilots to scalable, embedded, and tenant-centred practice.

Findings from this work are intended to support social landlords, policy-makers, and ecosystem partners by:

- Offering a clear picture of the current state of IoT deployment in the sector;
- Surfacing common barriers, tensions, and enablers across stakeholder groups;
- Identifying conditions for success and practical pathways for implementation;
- Informing future pilots, procurement models, and strategic planning;
- Contributing to a shared language and evidence base for connected home adoption.

While the findings are not statistically representative, they offer strong practical relevance, highlighting recurring challenges, promising practices, and sector-wide implications to support more informed, confident decision-making. The methods are outlined in more detail below.

Literature Review

The literature review served as the project's starting point, laying the foundation for subsequent phases. Its purpose was to synthesise existing knowledge and identify conceptual gaps related to IoT deployment in social housing, digital transformation, tenant participation, and organisational readiness.

Over 50 sources were reviewed, including academic papers, policy briefings, supplier case studies, government guidance, and white papers from think tanks and infrastructure bodies. Sources included peer-reviewed journal articles, DESNZ guidance, Connected Places Catapult reports, and publications from sector bodies such as the Regulator of Social

Housing and Housemark. Key databases included Google Scholar and Scopus.

The team began by reviewing recent systematic reviews and structured evidence syntheses where available, using these as anchors for further exploration. From this starting point, a snowballing approach was applied: reference lists and citations from core texts were followed to identify additional relevant material. This method ensured that the review covered both high-level overviews and more granular or emergent studies.

Rather than imposing pre-defined categories, the review followed a narrative synthesis model in which themes and patterns emerged inductively. Materials were read in full and summarised into a live evidence matrix.

Through this process, a set of cross-cutting themes emerged, often including but not limited to:

- Strategic intent and value proposition: why organisations invest in connected technologies and what outcomes they seek
- Organisational readiness: the structures, capacities, and change processes required for effective adoption
- Tenant trust and data ethics: consent, transparency, and co-design with residents
- Data integration and infrastructure: issues around interoperability, security, and analytics
- Supplier landscape and procurement: emerging archetypes, risks, and routes to market
- Evidence and outcomes: what is known about the efficacy of connected tech for damp, energy, compliance, and satisfaction

This thematic framework helped shape subsequent research instruments including the maturity self-assessment tool and the interview topic guides.

Importantly, the literature review played a foundational role in shaping the analytical structure of this research. Rather than relying on a single model, the review drew together a range of theoretical perspectives that together provided a multi-layered framework. At the resident level, models such as the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) helped unpack the factors influencing tenant engagement, highlighting the importance of perceived usefulness, trust, digital literacy, and social norms. At the organisational level, Rogers' Diffusion of Innovations theory was used to examine how connected technologies are adopted within housing providers, emphasising drivers such as relative advantage, compatibility with existing systems, and the importance of visible outcomes.

These theoretical foundations were not used in isolation. Rather, they helped inform the development of a practical maturity model and implementation roadmap, built in collaboration with sector stakeholders. This roadmap did not assume a single direction of travel, but recognised multiple starting points and progression pathways, depending on organisational context, digital readiness, leadership intent, and resident needs. In this way, the literature review shaped both the research design and the final outputs, providing a shared language to analyse, interpret, and act on findings across the sector.

The review also highlighted key gaps in the current evidence base. Notably, there is limited independent evaluation of connected home technologies beyond pilot

stage, a lack of consistent frameworks for tenant participation, and insufficient integration between housing, health, and energy research. These gaps reinforced the importance of designing the Connected Homes project as a sector-facing, practically grounded study.

Maturity Assessment

A digital maturity self-assessment was designed to benchmark organisational readiness across six key domains:

1. Strategy and leadership
2. Data quality and access
3. System integration
4. Digital workflows and automation
5. Resident-centric practices
6. Capacity for learning and adaptation

The tool was designed using a mix of closed questions with five-point Likert scales and open text responses to capture more nuanced perspectives. It drew directly on themes identified in the literature review and was tested internally with housing professionals for clarity and face validity prior to distribution.

The survey was circulated in February 2025 to 106 individuals across asset management, IT, innovation, and tenant services teams within participating housing organisations. Of these, 54 began the assessment and 31 completed it in full, representing a completion rate of 29%.

Respondents completed the assessment independently and anonymously. Responses were not intended to reflect formal corporate positions but instead captured the views of those actively involved in digital, data, and service transformation.

The results were aggregated to generate a heatmap of maturity across domains. These findings were not used as rankings or league tables but rather to identify common areas of strength and weakness, internal inconsistencies within organisations, and divergence across the sector.

This analysis provided a foundational evidence base for the Connected Homes project. It informed the design of follow-on interview topic guides, highlighted organisational dynamics to explore in more depth, and helped structure the subsequent roadmap development workshops.

Several key insights were also derived from the open text responses, where participants described barriers, enablers, and practical realities shaping their current level of maturity. These qualitative inputs were coded thematically and cross-referenced with the interview dataset to support triangulation and theory building.

Stakeholder Interviews

Semi-structured interviews were conducted with 39 individuals between April and June 2025. The aim was to capture a wide range of real-world perspectives across the connected homes ecosystem. Interviews sought to elicit deep, practice-based insights into how digital and IoT technologies are being implemented, experienced, and scaled across the housing sector.

Participants were selected using a purposive sampling approach that aimed to balance role level, organisational type, and degree of IoT maturity. The final sample included:

- Landlords (22 individuals from 9 organisations): including digital, innovation, asset management, sustainability, and compliance leads.
- Suppliers (11 individuals from 6 organisations): spanning commercial and technical leads from IoT and smart energy providers.
- Ecosystem enablers (5 individuals from 3 organisations): such as digital infrastructure specialists, integration consultants, and regulatory stakeholders.
- Tenants (1 individual): contributing lived experience of connected home devices and digital engagement.

Together, the interviews spanned 18 organisations and represented a spectrum of roles, from strategic leads to operational and frontline staff. A sampling matrix was used to ensure diversity across four variables: stakeholder group, department or function, role level (strategic to operational), and digital maturity (high to low).

Each interview lasted 60–90 minutes and was conducted remotely or in person. Interviews followed a topic guide, adapted slightly to each participant's background. Core themes included:

- Strategic intent and business case
- Organisational enablers and barriers
- Data systems and integration
- Tenant trust, consent, and usability
- Supply chain maturity and procurement routes
- Conditions for scaling and service transformation

Interviews were conducted with informed consent and summarised into detailed case records. No names or identifying details were retained.

Thematic analysis was carried out using an inductive coding process. Interview notes were coded line-by-line to identify emerging themes, repeated metaphors, and sectoral patterns. These were then grouped into

four primary clusters: landlords, suppliers, ecosystem enablers, and tenant/frontline voices. Verbatim quotes were anonymised and used to illustrate key points and test interpretations.

The interviews were not designed to produce statistically representative findings but to surface shared challenges, tensions, and emergent practices. They were analysed in tandem with the maturity assessment and literature review to support triangulation and deepen the theoretical framework.

Insights from these interviews formed the backbone of later analysis, use case development, and roadmap testing.

Tenant Engagement

Resident voice was a central pillar of the Connected Homes research. To ensure the lived experience of tenants informed both the framing and interpretation of findings, the team employed a multi-method approach across three engagement formats: interviews, workshops, and surveys. These activities were delivered in partnership with participating landlords and designed to elicit perspectives across different regions, tenures, and levels of digital familiarity.

All participation was voluntary, anonymous, and conducted with informed consent.

Workshops:

- An in-person co-design workshop involved 13 tenants and focused on repairs journeys, expectations around digital services, and principles of co-design. Participants engaged in mapping activities and facilitated discussions using open prompts.
- An online webinar/workshop held in Spring 2025 engaged 21 tenants

remotely. It explored views on digital technology, trust in landlords, data privacy, and the acceptability of in-home devices such as sensors and smart heating. Notes were taken with consent and anonymised.

- A second in-person workshop, organised with a landlord's resident engagement team, was conducted in the Summer 2025. A further 6 residents were engaged through this session.

Surveys:

- A large-scale survey run by one landlord was developed collaboratively with the research team. It received 760 responses, including 118 from tenants on engagement panels and 642 from the wider tenant base. Questions focused on digital tools, service expectations, and data ethics.
- A second survey distributed by another landlord was sent to 372 tenants and explored comfort with digital technologies, willingness to engage with data-driven services, and perceived risks or benefits of smart home devices.
- A final tenant survey, also co-designed with a tenant panel, was conducted in Summer 2025 Including both qualitative and quantitative insights with 80 responses.

Interview:

- A single interview was conducted with a tenant who had direct experience of connected home devices in their property. This provided detailed, narrative insight into day-to-day experience, usability, trust, and perceptions of landlord communication and data use.

Across all formats, engagement materials were designed to be accessible and inclusive. Surveys used a mix of closed and open questions. Workshops incorporated

visual prompts, interactive exercises, and structured facilitation. Some sessions were co-developed with landlord teams or tenant panels to ensure relevance and comfort.

While the activities were not statistically representative, they provided valuable insight into resident priorities, concerns, and ideas for service improvement. These insights informed the shaping of final use cases and implementation roadmaps, ensuring the research remained grounded in real tenant experience.

Market Analysis

To understand the broader landscape in which connected home technologies are being developed and deployed, the Connected Homes research included a structured market analysis. This component aimed to examine the current state of the UK IoT market for social housing, including its maturity, structure, alignment with customer needs, and potential for future growth.

The analysis was primarily qualitative and interpretive, drawing on five sources of data:

- Desktop research across published market reports, supplier websites, procurement frameworks, and sector publications;
- Interviews with suppliers and ecosystem enablers, which provided first-hand insight into how the market is currently functioning, where suppliers perceive barriers or gaps, and how the demand side is responding;
- Insights from housing providers, drawn from both interview and survey data, which shed light on current procurement practices, product fit, and integration challenges;

- Case study review of known pilot projects and technology deployments within the sector;
- Comparative benchmarking with more mature IoT markets in adjacent sectors such as utilities and logistics.

The method was designed to surface structural and relational dynamics, rather than quantify market share or predict future revenues. Themes were developed inductively through the synthesis of sources and tested in cross-stakeholder discussions.

Key dimensions examined included:

- Market structure – including the roles of frameworks, suppliers, and procurement intermediaries;
- Customer needs and articulation – particularly the capacity of landlords and tenants to express needs and shape product offerings;
- Product-market fit – whether current technologies match the operating models and systems used in housing;
- Supplier landscape – including the mix of startups, incumbents, and adjacent market players;
- Innovation drivers and constraints – such as funding availability, platform interoperability, and organisational readiness;
- System alignment – the extent to which technological, commercial, and cultural incentives are aligned between suppliers and landlords;
- Comparative sector insights – drawing on analogies from more mature IoT markets to identify enablers of scale and adoption.

This market analysis was not treated as a standalone activity. Rather, it was interwoven with other components of the research design, including interviews, tenant engagement, and the maturity assessment, to ensure that the findings were grounded in real-world context. Themes from the analysis helped shape the strategic framing of the final recommendations and roadmaps.

The outputs of the market analysis were used to interrogate key questions, such as:

- Why have certain technologies remained at pilot stage?
- Where are the mismatches between supply and demand?
- What structural reforms would support a more mature and resident-centred connected homes market?

This component of the research also contributed to the identification of “sector bottlenecks” explored later in the findings section, particularly those relating to procurement design, interoperability, and the lack of common standards or shared language across the ecosystem.

Roadmap Testing

The final component of the research was the development and iterative testing of strategic roadmaps - a process that sat between methodology and output. These roadmaps were designed to guide housing providers from fragmented pilots to embedded, scalable connected home programmes, grounded in organisational capability, resident priorities, and real-world constraints.

The roadmaps were not generated in isolation. Instead, they synthesised insights from the preceding research strands, literature review, maturity assessment, stakeholder interviews,

tenant engagement, and market analysis, to propose structured pathways for implementation. They were designed to be flexible frameworks, not fixed prescriptions, acknowledging the variation in organisational maturity and local context.

To test and refine these draft roadmaps, the research team engaged with:

- **Project Steering Committee (Steerco):** The roadmap was shared with key project stakeholders, including representatives from landlord organisations and partner agencies, who provided feedback on feasibility, relevance, and clarity.
- **Workshops and Interviews:** Elements of the roadmap were also tested informally through interviews and workshops with sector professionals. Participants reflected on the roadmap components, identified missing steps, and raised implementation risks based on their organisational experience.

Feedback from these engagements was used to adjust sequencing, clarify key milestones, and strengthen enablers and conditions for scaling. In some cases, elements of the roadmap were restructured to better reflect operational dependencies or to embed resident-facing considerations more clearly.

While full implementation of the roadmap was beyond the scope of this research, this method ensured that the outputs were stress-tested against the realities of social housing delivery and positioned for use in future strategic planning.

Research Limitations

While every effort was made to design a robust, inclusive, and methodologically sound study, several constraints and caveats must be acknowledged. These limitations do not undermine the validity of the findings but are important for contextualising how far they can be generalised, how they should be interpreted, and where further inquiry is needed.

Limitations of Research Scope and Design

Balancing breadth and depth: The research engaged a diverse range of stakeholder groups, housing organisations, geographies, and data types, providing a rich and triangulated evidence base. However, this breadth came with limitations. While the interviews and tenant engagement activities generated deep qualitative insight, the sample sizes, particularly for the digital maturity assessment, were not large or structured enough to be statistically representative. Some topics, such as financial modelling, technical integration detail, and long-term device performance, were also only lightly touched upon. As a result, the findings offer strong directional insight and practical learning, but should not be generalised across the entire sector without caution.

Time-bound insights: The research reflects a specific window in time (spring–summer 2025) during which policy, funding, and regulatory landscapes were evolving. The draft Awaab's Law guidance, Warm Homes: Social Housing Fund (previously

SHDF), and Net Zero funding decisions were all in flux, and landlord strategies may have shifted since interviews were conducted. Meanwhile, IoT technologies themselves are rapidly evolving, and some findings may date quickly. These insights should be seen as a snapshot of a moving system, not a fixed assessment.

Focus on early adopters: The landlord and supplier participants were largely those already engaging with digital and connected home technologies. As such, the findings may overrepresent the views of early adopters and underrepresent those of landlords who are more sceptical, resource-constrained, or digitally cautious.

Service-focused over technical: While technical issues were raised, the research focused more on organisational conditions and service design than on detailed engineering, firmware, or device-level analysis. As such, it should be read as a study of adoption and implementation, rather than of technology performance.

Methodological and Data Limitations

Interview sampling bias: Stakeholder interviews were conducted via purposive sampling, targeting professionals involved in innovation, digital, or sustainability roles. This means that frontline staff, repair operatives, or tenant-facing teams may be underrepresented. One tenant was interviewed directly, but resident voices were otherwise included via workshops and surveys led by partners.

Tenant engagement complexity:

Resident engagement proved challenging. Although multiple workshops and surveys were conducted, results were uneven across landlords, and the diversity of voices, across ethnicity, age, tenure type, or digital confidence, varied. This limits the representativeness of tenant insight.

Ethical and emotional sensitivities:

Connected technologies interact with tenants' private spaces, personal routines, and emotional sense of home. While the research sought to foreground these dynamics, it could not fully explore the ethical, psychological, or trauma-informed implications of monitoring devices, especially in vulnerable households. These areas warrant deeper attention in future research.

Device and supplier data: Much of the evidence about device performance and supplier behaviour came from landlord perspectives or publicly available information. Direct testing of devices or access to raw performance data was not within the project scope. As a result, certain claims, for example about battery life, data accuracy, or maintenance burden, are based on user perception rather than technical verification.

Workshop dynamics: Some roadmap workshops included stakeholders with differing levels of authority and expertise in the same room. In a few cases, participants may have deferred to others, and not all perspectives were shared equally. This may have influenced the strength or breadth of validation for certain recommendations.

Interpretive synthesis: The analysis involved inductive coding, thematic interpretation, and synthesis across qualitative and survey data. While every effort was made to remain faithful to participants' perspectives, interpretation

inevitably introduces subjectivity.

Researcher positionality, preconceptions, and framing decisions, particularly when grouping findings into themes or hypotheses, may have shaped emphasis or nuance.

Limitations in Representativeness and Generalisability

Tenant voice was partial, not representative: Although resident insights were gathered through structured activities, these were not representative samples. For example, some surveys relied on digital panels or self-selecting participants, which may skew results toward more digitally literate or engaged tenants.

Regional and demographic gaps:

While the study included a range of landlords from across England, it did not systematically include perspectives from Scotland, Wales, or Northern Ireland. Nor was there disaggregation of findings by ethnicity, disability, or household composition, which are critical to understanding digital inclusion and housing inequality.

Supply chain diversity: The supplier interviews included a mix of larger and smaller firms, but not the full spectrum of the supply chain. Key players in connectivity infrastructure, third-party data brokers, or interoperability standards bodies were not interviewed directly.

Limitations of Language and Framing

Terminology varies across

organisations: What counts as "IoT" or "connected" varies across organisations. Some define this in relation to smart sensors alone, while others include heating

controls, behavioural nudges, or advanced AI analytics. This variability may affect how findings are interpreted.

Sector defensiveness or optimism bias:

Several participants may have underplayed challenges in order to present their organisation positively. Others may have expressed frustration in ways that reflect temporary obstacles rather than structural ones. Caution is needed when interpreting individual quotes.

Language accessibility: While efforts were made to communicate findings clearly, some participants, especially tenants, may have found concepts such as “data ethics” or “predictive analytics” difficult to relate to. This may have influenced how freely or confidently they engaged in certain workshops or surveys.

Despite these limitations, the Connected Homes research provides a robust and timely contribution to the sector. Its strength lies not in claiming technical precision or statistical representativeness, but in surfacing the real-world tensions, patterns, and conditions that shape adoption across the connected homes landscape. By triangulating perspectives from landlords, suppliers, and residents, and combining practical insights with strategic analysis, it offers a grounded and actionable evidence base for sector leaders seeking to move beyond pilots towards embedded, ethical, and scalable deployment.

Conclusion

This research set out not to test a single product or measure isolated outcomes, but to understand the wider system in which connected home technologies are being introduced in social housing, and the conditions that determine whether these technologies genuinely deliver value for residents, landlords, and the sector as a whole.

The rationale for the work emerged from a clear and urgent disconnect. Despite growing policy pressure, investment in innovation, and a proliferation of pilot schemes, few connected technology initiatives have scaled or embedded successfully. Too often, the promise of proactive, preventative services has collided with organisational silos, low digital confidence, challenging procurement pathways, and a lack of clarity on what 'good' looks like, both for landlords and for tenants.

Recognising this, the Connected Homes project took a deliberately broad and relational view. Rather than focusing on devices in isolation, the research examined the ecosystem in which they are deployed, including commercial structures, resident relationships, internal strategy, and cultural readiness. This perspective was rooted in a sector-wide concern: that connected technologies must be integrated into service design and tenant experience, not bolted on as an afterthought.

To explore these dynamics, the project employed a robust and triangulated research design: a structured literature review; a digital maturity assessment; 39 stakeholder interviews; tenant workshops and surveys; market analysis; and roadmap co-development. This methodology provided a rich, layered evidence base, not only capturing what is happening across the sector, but why.

The findings surface a range of barriers and enablers, from trust and ethics to procurement and data infrastructure. But the most important insight is perhaps this: technology alone does not create impact. Change happens when systems, people, and purposes are aligned. Connected homes require connected thinking, across teams, across functions, and between residents and providers.

Throughout the research, the ethical and emotional dimensions of connected technologies were treated as central. Tenants were not framed as passive recipients of innovation, but as co-creators of home environments whose trust must be earned and sustained. Likewise, suppliers were seen not just as vendors, but as long-term partners, whose success depends on their ability to understand housing realities and support meaningful integration.

Of course, the research has its limits. Tenant voices, while heard, were not statistically representative. Some areas, such as technical validation or long-term cost-benefit modelling, fell beyond the project's scope. But what it offers is a sector-grounded contribution to a complex and evolving conversation, one that values realism over hype, context over quick wins, and partnership over procurement.

As the social housing sector confronts new legal duties, climate imperatives, and tenant expectations, connected home technologies will remain part of the solution. The challenge now is not simply whether to adopt them, but how to do so well: in ways that centre people, respect complexity, and support lasting service transformation.

This report offers a foundation for that journey.

Part 2

Primary and Secondary Research

The research involved primary and secondary research activities as follows:

A literature review of existing research on the topic was undertaken (Part 2a)

This was supplemented by primary research including:

- Quantitative research through a self-assessment by social landlords of their organisations maturity in the field of Connected Homes (Part 2b)
- Qualitative research through semi-structured interviews with key landlords, suppliers and other stakeholders (Part 2c)
- A research strand designed to engage residents through questionnaires, webinars and workshops (Part 2d)
- Desk based research into the nature and potential size of the Connected Homes market across the social housing sector (Part 2e)

Part 2a

Literature Review: Connected Home Technologies in Social Housing

Abstract

This literature review explores the potential of connected home technologies in social housing, examining their opportunities and challenges in housing management, tenant wellbeing, and organisational adoption. While IoT solutions such as environmental sensors, smart thermostats, and digital twins offer the ability to leverage real-time data, large-scale deployment remains limited and complex. Early trials of smart home technologies suggest potential benefits in areas like maintenance efficiency, energy optimisation, and regulatory compliance (e.g. Awaab's Law), but these have yet to translate into proven, large-scale implementation across the sector.

A key challenge is that both landlords and tenants must see clear, tangible benefits before committing to full-scale adoption. However, many implementations fail to translate technical capabilities into practical, everyday improvements. Financial constraints, system compatibility issues, and misalignment with organisational processes create barriers to scaling these technologies. Tenant engagement is equally crucial. These systems must work for tenants, ensuring they respond to real needs rather than being imposed top-down. Without well-designed, transparent deployment strategies that clearly demonstrate how they improve daily life, uptake is likely to remain challenging.

For landlords, IoT presents an opportunity to improve predictive maintenance, enhance energy efficiency, and enable data-driven decision-making – but only if there is a clear financial case that justifies long-term investment. For suppliers, the social housing sector represents a growing but underdeveloped market, yet many existing solutions fail to align with real-world housing needs, particularly in terms of ensuring devices work seamlessly across different systems. A shift is needed towards integrated solutions that prioritise compatibility with both housing management systems and other IoT technologies, rather than operating as standalone products.

This review highlights critical gaps that must be addressed for IoT in social housing to progress beyond isolated trials to meaningful, effective adoption. Ensuring that lessons from existing initiatives are shared and used to overcome common barriers is key to avoiding repeated challenges and identifying best practices. Key priorities for future research include evaluating large-scale implementations, improving tenant engagement strategies, and developing practical integration frameworks that ensure connected home technologies deliver real, measurable value for both landlords and tenants.

Introduction

Purpose of the Literature Review

The purpose of this literature review is to explore existing research on connected home technologies, particularly in the context of social housing. It aims to define key concepts, assess the current landscape, highlight benefits and challenges, and identify gaps in knowledge that will inform subsequent phases of the research project.

Connected home technologies are increasingly recognised as transformative tools within the social housing sector, promising significant improvements in operational efficiency, tenant well-being, and regulatory compliance (Rogage et al., 2022, Johnes et al., 2023, Kassem et al., 2019). However, the journey from small-scale pilots to wide-scale adoption remains fraught with challenges, ranging from technical interoperability to financial constraints and tenant trust issues (Adeyeye, 2024; Kassem, et al., 2019).

This review serves as a foundational step in the broader research initiative, “Exploring the Deployment and Impact of Connected Home Technologies in the Social Housing Sector”¹. The project is led by the Disruptive Innovators Network (DIN) and informed by key sector stakeholders, including landlords, tenants, and IoT suppliers, and aims to:

1. Define what constitutes a “connected home” within the social housing context.
2. Assess the current extent of connected home technology deployments, including their benefits and challenges.

3. Capture tenant perspectives on connected home technologies to ensure equitable and user-friendly implementations.
4. Evaluate the readiness of the sector to scale these technologies, focusing on organisational, technical, and financial factors.
5. Identify gaps in the market and opportunities for innovation, particularly in affordable and scalable solutions tailored for social housing.

By synthesising existing literature, case studies, and theoretical frameworks, this document provides an evidence-based starting point for identifying actionable insights and strategic priorities. The findings will underpin the research methodology for other research methods, including stakeholder interviews, surveys, workshops and market analysis, ensuring alignment with both sector-wide goals and localised needs.

Research Questions

This review is guided by three core research questions:

- 1. What are the current trends in connected home technologies in the social housing sector?** This question explores the types of technologies being adopted, their applications, and the extent of their integration within housing organisations.
- 2. What are the benefits and challenges of deploying connected home technologies?** This includes examining advantages such as cost savings,

¹ To view the project brief in full, please see [Appendix 1](#)

improved tenant outcomes, and regulatory compliance, alongside barriers like technical limitations, organisational readiness, and tenant acceptance.

3. How prepared is the sector for scaling these technologies? This question assesses the capacity of social housing providers to expand the adoption of connected home technologies, considering financial, technical, and human resource factors.

By addressing these questions, the literature review aims to establish a robust knowledge base that will inform the next stages of the research project, from data collection to actionable recommendations.

Scope

This review focuses on connected home technologies that provide landlords with data-driven insights into property performance and condition. Examples include environmental monitoring systems, energy management tools, and safety devices designed to enhance operational efficiency, ensure compliance, and improve asset management. While the emphasis is property-centric, tenant data is inherently intertwined, as these technologies often reflect interactions with living environments. This study prioritises practical strategies for scaling such technologies within social housing portfolios while ensuring tenant experiences remain integral.

Human-centred applications, such as assistive living or medical monitoring devices, are outside this review's scope (e.g., see Akhmetzhanov et al., 2024; Agee et al., 2021; Rock et al., 2024). However, studies from these domains provides useful insights into this research, such adoption barriers, user engagement strategies, and ethical considerations that can inform the property-focused implementations.

Similarly, while broader applications of IoT data, such as integration with indices of multiple deprivation or health datasets, fall outside the primary scope of this review, they present potentially valuable avenues for further research. Cross-sector collaboration, particularly in exploring how environmental improvements (e.g., increasing indoor temperatures) could yield measurable health benefits, might create opportunities for shared investment models involving health services or local authorities. Though not a direct focus here, such learnings could inform future discussions on maximising the societal impact of property-focused IoT solutions.

Ethical Considerations

The adoption of connected home technologies brings significant ethical considerations, particularly around privacy, trust, and transparency. These systems inevitably collect data that may reflect tenant behaviours, raising concerns about perceived surveillance. Previous studies (e.g., He et al., 2021; Balta-Ozkan et al., 2014) highlight that a lack of clear communication about data usage can lead to tenant resistance and concerns over autonomy. To avoid eroding trust, landlords must communicate clearly about how data will be collected, used, and protected, ensuring compliance with data protection regulations such as GDPR (Adeyeye, 2024).

Tenants' engagement and trust are critical for successful implementation. Misinterpretation of data or a lack of transparency risks fostering adversarial relationships, as demonstrated in Buckingham et al. (2022), where initial enthusiasm for smart monitoring systems declined when tenants felt excluded from decision-making. Instead, co-designing solutions with tenants and maintaining clear policies can help ensure the technology serves shared interests (Agee

et al., 2021; Walker et al., 2024). Research on the ethics of IoT in housing suggests that embedding principles of transparency and tenant agency can improve adoption outcomes (Johnes et al., 2023). By proactively addressing ethical concerns, landlords can mitigate risks and increase the likelihood of successful long-term implementation.

Additional ethical dimensions include:

- **Accessibility:** Tenants should easily access and understand their home's data (Adeyeye, 2024; Agee et al., 2021).
- **Inclusivity:** Smart home design must consider diverse needs, including age and digital literacy (Choi et al., 2020; Buckingham et al., 2022).
- **Accountability:** Clear mechanisms should allow tenants to challenge data use and decisions (Walker et al., 2024; Johnes et al., 2023).
- **Equity:** IoT deployments must avoid disadvantaging vulnerable tenants (Balta-Ozkan et al., 2014; He, Green & White, 2021).

To maximise benefits, ethical approaches must balance operational needs with tenant rights, fostering collaboration and ensuring technologies enhance both property management and tenant well-being.

Theoretical Framework

Key Concepts

Connected Homes

We define a connected home as a residence equipped with smart technologies (IoT devices) that enable real-time data exchange for enhanced living conditions and operational insight. These systems typically include technologies such as smart thermostats, environmental sensors, or automated appliances, all interconnected via the Internet of Things (IoT) (Biljana et al., 2016; Gaur et al., 2021). The goal is to create responsive living environments that adapt to residents' needs while optimising resource use and reducing costs (Aldrich, 2020; Maswadi et al., 2020). In social housing, connected home technologies can, in theory, improve tenant well-being, support regulatory compliance, and streamline property management processes (Davila Delgado et al., 2020; He et al., 2021). Additionally, they could play a crucial role in addressing sector-wide challenges, such as fuel poverty and housing quality disparities (Johnes et al., 2023; Walker et al., 2024).

Internet of Things (IoT)

The Internet of Things (IoT) refers to a network of physical devices, sensors, and software that communicate and exchange data via the internet. This interconnected system facilitates real-time monitoring and management of home functions, such as temperature, humidity, air quality, and energy usage. For social housing providers, IoT could enable a transition from reactive ("break-fix-model") to proactive ("predict-prevent-model") management by providing data-driven insights into maintenance

needs, energy efficiency, and tenant behaviours (Islam et al., 2015). Emerging IoT protocols like ZigBee and Z-Wave also enhance interoperability, addressing a key barrier to scaling these technologies across diverse housing portfolios (Maswadi et al., 2020).

Digital Twins

Digital twins are virtual replicas of physical systems or environments that are continuously updated in real time using IoT data. In housing, digital twins can simulate building performance, predict maintenance needs, and optimise resource allocation (Yossef and Aharon-Gutman, 2023). For example, a digital twin of a social housing property can model energy consumption patterns, identify inefficiencies, and recommend cost-effective upgrades. This technology is particularly valuable for retrofitting older housing stock to meet modern energy standards, such as achieving Net Zero goals (He et al., 2021). Moreover, digital twins can support large-scale asset management by integrating data from multiple properties into a centralised platform, enabling landlords to make informed decisions more efficiently. Beyond current conditions, digital twins enable "what if?" modelling to assess building performance under future climate scenarios, such as heatwaves, extreme weather, or shifting energy demands (Elghaish 2024). This helps housing providers test retrofit resilience, plan climate adaptation, and ensure long-term sustainability. As regulations tighten and energy targets rise, digital twins offer a proactive way to assess risks and optimise investment (Henriksen et al. 2022).

Theoretical Models

Technology Acceptance and Use

For connected home technologies to succeed, tenants must perceive clear, immediate benefits. If users do not see how these systems improve their daily lives, whether through lower energy bills, better home comfort, or faster maintenance response, they are unlikely to engage with them (Fard et al., 2021; Agee et al., 2021). Without these, even well-designed solutions may struggle to gain traction (He et al., 2021; Buckingham et al., 2022).

Building on the Technology Acceptance Model (TAM) proposed by Davis back in 1989, which emphasised the perceived usefulness and ease of use; more recent frameworks have expanded our understanding of tenant adoption. The Proposed Acceptance Model (Tetik et al., 2024; Maskeliūnas et al., 2019) integrates IoT-specific factors, while the Unified Theory of Acceptance and Use of Technology (UTAUT) (e.g., see Zhou et al., 2024) considers broader social and behavioural influences. These models highlight that beyond usability, factors such as trust, perceived risk, and habit formation are critical for widespread tenant adoption (Marikyan et al., 2019; He et al., 2021; Buckingham et al., 2022). The key aspects of these blended theories include:

- **Perceived Usefulness:** Tenants prioritise tangible benefits such as improved safety, comfort, and well-being. They are more likely to engage if technologies directly enhance their quality of life (Tetik et al., 2024).
- **Perceived Ease of Use and Effort Expectancy:** Tenants value simple,

intuitive systems that require minimal effort to use. User-friendly interfaces, automation, and clear instructions are particularly important for tenants with limited digital literacy (Maskeliūnas et al., 2019).

- **Social Influence and Trust:** Tenant perceptions of peer experiences, community norms, and trusted voices strongly shape adoption. Early tenant engagement, co-design processes, and transparent communication about data privacy are essential to building trust and fostering acceptance (Marikyan et al., 2019).
- **Facilitating Conditions and Support:** Adoption depends on accessible training, digital support, and affordability. If tenants lack guidance or resources, they may disengage. Clear communication, financial assistance, and technical support help remove barriers to participation (Fard et al., 2021; Sepasgozar et al., 2020).

Diffusion of Innovations

For connected home technologies to be widely adopted, landlords must see a compelling business case. Without clear financial, operational, and/or regulatory benefits, investment will likely remain slow. Decision-makers need confidence that cost savings, maintenance efficiencies, and compliance improvements justify the upfront costs (Davila Delgado et al., 2020; He et al., 2021). Beyond financial factors, ethical and reputational considerations, such as enhancements of tenant well-being or sustainability commitments, also shape adoption decisions (Adeyeye, 2024).

Rogers' Diffusion of Innovations theory (2003) provides valuable insight into how connected home technologies could spread within the social housing sector. Five key characteristics influence adoption:

- **Relative Advantage:** The perceived benefits compared to existing solutions, such as lower maintenance costs, improved energy efficiency, or better tenant retention (e.g., Aldrich, 2020; Doukari et al., 2022).
- **Compatibility:** Seamless integration with existing IT systems, housing management processes, funding models and other IoT technology (platforms) ensures smoother adoption (Davila Delgado et al., 2020; He et al., 2021).
- **Complexity:** Ease of deployment and use affects adoption, particularly in large housing portfolios. Solutions requiring minimal training and disruption are preferable (Sepasgozar et al., 2020).
- **Trialability:** Opportunities for small-scale pilots help mitigate risk and provide evidence of Return-on-Investment (ROI) before large-scale implementation (Buckingham et al., 2022; Walker et al., 2024).
- **Observability:** Demonstrating tangible benefits, such as energy savings, improved air quality, or reduced repair requests, encourages wider buy-in (Johnes et al., 2023; Walker et al., 2024).

Practical Relevance

These theoretical models provide a structured approach to understanding the adoption, implementation, and scaling of connected home technologies within social housing.

The Technology Acceptance and Use perspective incorporates multiple frameworks to explore tenant adoption behaviours. The Technology Acceptance

Model (TAM) (Davis, 1989) emphasises perceived usefulness and ease of use, which are essential for tenant engagement (Maskeliūnas et al., 2019). However, more recent models, such as the Unified Theory of Acceptance and Use of Technology (UTAUT) (Zhou et al., 2024), extend this understanding by incorporating social influence, facilitating conditions, and effort expectancy (Marikyan et al., 2019; He et al., 2021). These frameworks highlight that trust, perceived risk, digital literacy, and habit formation are equally critical to widespread adoption (Buckingham et al., 2022).

The Diffusion of Innovations Theory (Rogers, 2003) provides a landlord-focused lens, identifying key drivers for organisational adoption, business case justification, and strategic integration of IoT within housing portfolios. It highlights factors such as relative advantage (cost savings, operational efficiencies), compatibility (alignment with existing systems), and observability (demonstrable benefits like energy savings and improved air quality) (Davila Delgado et al., 2020; Buckingham et al., 2022; Walker et al., 2024). These elements are critical in shaping landlord investment decisions and accelerating sector-wide adoption.

Recognising that strategic policy alignment, staff training, and financial investment are critical enablers, this research examines how housing organisations can implement systemic changes to support IoT deployment at scale (Adeyeye, 2024; Sepasgozar et al., 2020). By leveraging these insights, this study will develop actionable recommendations to address adoption barriers, enhance tenant experiences, and optimise housing operations, ultimately supporting the scaling of connected home technologies within the social housing sector.

Current State of Connected Homes in Social Housing

The concept of connected homes has been gaining traction in social housing over the past decade. In response to policy drivers, decarbonisation targets, and the push for more efficient property management, housing providers are increasingly exploring IoT (Internet of Things) and smart home technologies.

However, the deployment of these technologies in social housing remains uneven, with adoption levels varying based on funding availability, digital infrastructure, and organisational priorities. This chapter outlines the current landscape, covering types of technologies, including hardware and software (3.1), as well as a real-world case study demonstrating their application in social housing settings.

Technology Types

1. Hardware

- **Environmental Sensors:** IoT-enabled environmental sensors provide real-time data on temperature, humidity, CO₂ levels, and air quality, allowing landlords to identify and mitigate issues such as damp, mould, and poor ventilation before they escalate. These systems support proactive maintenance strategies, reducing tenant health risks, particularly respiratory illnesses like asthma (Walker et al., 2024; Paterson et al., 2021). Research has demonstrated their impact in social housing: Walker et al. (2024) found that real-time monitoring in 280 homes helped housing providers identify high-risk properties and prioritise maintenance interventions. Paterson et al. (2021) highlighted the strong link

between elevated VOCs, PM2.5 levels, and asthma risks, reinforcing the need for integrated air quality monitoring alongside temperature and humidity tracking. Johnes et al. (2023) further emphasised that combining IAQ sensors with behavioural interventions, such as encouraging better ventilation habits, can enhance tenant well-being and reduce long-term health risks.

Some key examples include:

- o **Aico:** Monitors temperature, humidity, CO₂, and fire safety, offering early warnings for damp, ventilation issues, and other hazards.
- o **Switchee:** A smart thermostat with built-in environmental sensors, enabling tenants and landlords to track home conditions while optimising heating efficiency.
- o **Vericon (Surveyor Cube):** Monitors temperature and humidity via tamper-proof sensors and GSM gateway, helping identify damp risks without using Wi-Fi or capturing personal data.
- o **ZapCarbon:** Combines sensor-based assessments with in-home mould treatment and advice, supporting both prevention and behavioural change.
- o **IoTSG:** Deploys IoT-enabled environmental sensors to monitor damp and mould risks, integrating with data analytics platforms for proactive interventions.
- o **IOpt:** Uses smart environmental sensors to collect real-time indoor air quality and humidity data, helping housing providers target preventative maintenance efforts.

- **Energy Efficiency:** Smart home technologies, such as smart thermostats, energy management systems (EMSs), and AI-driven automation tools, have been piloted to optimise heating, reduce energy consumption, and address fuel poverty. These systems leverage real-time data analytics and machine learning algorithms to reduce waste and improve efficiency, ensuring that heating and energy use align with actual tenant needs (Sepasgozar et al., 2020). Research suggests that AI-enhanced EMSs can reduce energy consumption by 10–38% through automated optimisation and demand-response strategies. However, successful implementation depends on user engagement, as some tenants, particularly older or digitally excluded groups, may find these systems intrusive or difficult to use.

Examples include:

- o **Octopus Energy Smart Meters:** Provide real-time energy tracking and variable pricing, enabling tenants to better manage costs and consumption.
- o **Beanbag:** Monitors building fabric performance, detecting heat loss, damp, and mould risks, supporting targeted retrofits to enhance energy efficiency.
- o **Switchee:** Uses learning algorithms to optimise heating schedules, reducing energy waste while ensuring tenant comfort.
- o **IOpt:** Deploys real-time energy monitoring to assess property-level inefficiencies and provide data-driven recommendations for landlords.
- **Health and Well-being Support:** Ambient monitoring systems have been trialled to enhance tenant health and safety, particularly for vulnerable groups such as the elderly, those with mobility impairments, or tenants with pre-existing health conditions (Akhmetzhanov et al., 2024). These technologies allow landlords and care providers to detect potential risks early, enabling proactive interventions that support independent living and improve overall well-being.

Some examples include:

- o **CareTech Telecare Systems:** Support daily activity monitoring and remote assistance, ensuring timely interventions for tenants who may need additional care.
- o **Cognitive IoT Applications:** AI-powered solutions that adapt to tenant needs, optimising indoor conditions for individuals with respiratory conditions or early signs of illness (Maskeliūnas et al., 2019). Maswadi et al. (2020) highlight automated medication reminders and physiological tracking features that can prevent health complications.
- o **Fall Detection Sensors:** Lightweight, non-intrusive sensors that detect physical activity patterns and alert caregivers in the event of a fall, ensuring rapid emergency response (Maskeliūnas et al., 2019).
- o **Air Quality Monitoring:** Johnes et al. (2023) found that IAQ sensors play a critical role in mitigating respiratory health risks, especially when combined with behavioural interventions, such as encouraging proper ventilation practices.
- **Security and Access Control:** Smart security systems provide enhanced safety and accessibility for tenants, reducing unauthorised access risks and improving building security. These technologies are particularly valuable in high-density social housing, where traditional security measures may be insufficient.

Examples include:

- o **Intratone:** Provides contactless smart door entry systems, improving security and accessibility for tenants.

- o **Ring:** Video doorbells and motion-activated security cameras allow remote monitoring and provide alerts for suspicious activity.

- **Water Leak Detection & Property Protection:** Water leak detection technologies help prevent property damage, reduce maintenance costs, and improve tenant safety by identifying leaks before they escalate into serious issues.

Some examples are:

- o **LeakBot:** Monitors water flow anomalies, detecting leaks early to prevent costly damage.
- o **Guardian:** Combines remote water shutoff capabilities with leak detection, offering comprehensive property protection.
- Pest and Waste Management:
 - o **SMART Pest Control:** Automated IoT traps monitor and manage pest infestations.
 - o **Bigbelly Bins:** Fill-level sensors optimise waste collection schedules, reducing costs and environmental impact.
- Smart Lighting and HVAC:
 - **Philips Hue:** Adjusts lighting based on occupancy or natural daylight, improving energy efficiency.
 - **Nest Thermostat:** Learns occupant behaviour to automate heating and cooling, optimising comfort and energy use.
- **Integrated Systems & Smart Connectivity:** While some connected home solutions aim to integrate multiple functionalities, true interoperability remains rare. Most systems operate in silos, making data sharing and cross-platform functionality difficult. Challenges include incompatibility between devices, lack of standardisation,

and difficulties retrofitting older properties.

Key Examples

- o **ZigBee & Z-Wave:** Enable device interoperability, yet adoption varies across vendors.

2. Software

Software plays a crucial role in harnessing the full potential of IoT technologies in social housing, enabling data-driven decision-making, automation, and predictive maintenance. These solutions include data platforms, automation tools, predictive analytics, and AI-driven applications, each contributing to operational efficiency, energy optimisation, and proactive housing management.

- **Data Platforms & Cloud-Based Analytics:** Cloud-based platforms store, process, and visualise data collected from IoT devices, providing landlords with actionable insights to improve property management. These platforms aggregate data from multiple sources, allowing for better trend analysis, maintenance forecasting, and energy efficiency monitoring. Examples include the AWS IoT Core or Vericon Portals.
- **Automation & Smart Control Systems:** Automation tools enhance efficiency by responding to environmental conditions in real time, reducing manual intervention while improving tenant comfort. These systems integrate with heating, ventilation, and lighting to adjust settings automatically based on occupancy and environmental triggers.
- **Housing Management Integrations:** Automated controls optimise ventilation and heating based on real-time humidity, CO₂, and temperature data, ensuring energy savings and improved indoor air quality.

- **Predictive Analytics & AI-Driven**

Insights: AI-driven predictive analytics leverage historical and real-time data to forecast maintenance needs, optimise energy use, and enhance risk management. These systems help housing providers prioritise interventions, reducing reactive repairs and associated costs.

- **User Interfaces & Dashboards:**

Accessible web and mobile dashboards present IoT data in an intuitive format, allowing both landlords and tenants to monitor energy usage, indoor air quality, and maintenance needs in real time. These interfaces are essential for tenant engagement, ensuring users can see and act upon the data their homes generate.

Case Study: Smartline

A notable case study worth highlighting is the Smartline project, led by the University of Exeter in collaboration with Coastline Housing and Cornwall Council. It investigated how connected home technologies could improve health, wellbeing, and housing quality in rural social housing communities (Buckingham et al., 2022; Johnes et al., 2023). Funded by the European Regional Development Fund, the initiative ran from 2017 to 2022 and deployed IoT-enabled sensors across 279 households to explore the technological and social dimensions of connected homes (Menneer et al., 2023). While the project highlighted the transformative potential of data-driven solutions, it ended with the conclusion of its funding.

IoT sensors were employed to monitor indoor air quality, temperature, and humidity, addressing issues such as damp, mould, and energy inefficiency (Johnes et al., 2023; Menneer et al., 2022). The project also explored how digital tools could enhance tenant health and social

connectedness, particularly in rural settings (Buckingham et al., 2022; Long et al., 2022). Advanced sampling strategies optimised sensor placement, improving resource efficiency and deployment scalability (Menneer et al., 2023).

Key findings demonstrated strong links between relative humidity, temperature, and mould growth, enabling more targeted interventions (Menneer et al., 2022). Homes with inadequate heating commonly experienced poor air quality and damp, reinforcing the need for retrofitting to improve living conditions (Johnes et al., 2023). Barriers such as low digital literacy and limited broadband access, particularly among older tenants, reduced engagement with the technologies (Buckingham et al., 2022). However, tenants with stronger social networks reported higher levels of well-being, and many appreciated the transparency and responsiveness enabled by IoT solutions (Long et al., 2022). Privacy concerns and initial skepticism about data use underscored the importance of trust-building and clear communication (Buckingham et al., 2022).

Despite these successes, the project faced challenges. Aligning IoT technologies with legacy housing systems required significant adaptation (Johnes et al., 2023), and limited internet access in rural areas highlighted the need for infrastructure improvements to ensure equitable benefits (Buckingham et al., 2022). Additionally, cluster analysis methods proved effective in improving sensor placement efficiency and data reliability (Menneer et al., 2023).

Smartline demonstrates the transformative potential of connected home technologies in social housing. Key lessons include:

- Sensor data can enable predictive maintenance, improved energy efficiency, and targeted interventions.

- Tenant engagement in the design and deployment phases is crucial for trust-building and relevance.
- Advanced sampling strategies enhance the scalability and effectiveness of IoT deployments.

The Business Case for Scaling Connected Homes

For connected home technologies to transition from pilot projects to large-scale implementation, landlords and housing providers need a compelling business case. Without clear financial, operational, and regulatory incentives, investment in these technologies is likely to remain limited. Decision-makers must have confidence that upfront costs, whether for IoT hardware, software integration, or training, are justified by long-term financial benefits such as reduced maintenance costs, energy savings, and compliance with housing regulations.

Return on Investment (ROI) and Cost Savings

IoT solutions offer potential cost reductions by enabling predictive maintenance, thereby reducing emergency repairs and prolonging asset lifespans. Research suggests that predictive maintenance powered by IoT can lower repair expenses by up to 30% and reduce asset failures, leading to fewer tenant complaints and higher satisfaction rates. AI-driven systems enhance these efficiencies by identifying failure patterns, prioritising maintenance interventions, and automating repairs.

Smart energy management systems have also demonstrated energy consumption reductions through automated heating optimisation, occupancy-based adjustments, and AI-driven energy analytics. These savings directly translate into reduced fuel poverty risks for tenants

and operational cost reductions for housing providers.

Scalability Considerations

While small-scale pilots have demonstrated positive outcomes, scalability remains a key challenge. Larger deployments require integration with existing IT and housing management systems, ensuring interoperability between different IoT devices and platforms. The lack of standardisation across suppliers and devices often results in fragmented implementations that limit cross-system functionality.

Roger's (2003) Diffusion of Innovations Theory (Rogers, 2003) provides a framework for understanding how connected homes can be successfully scaled across the sector, including relative advantage, trialability and observability.

Funding and Investment Strategies

Many housing providers rely on grant funding or public-private partnerships to finance IoT deployments. For example, leveraging retrofit funding (Warm Homes: Social Housing Fund, Wave 3) allows landlords to integrate IoT technology alongside energy efficiency upgrades. However, sustained adoption requires strategic financial planning and clear metrics demonstrating return on investment.

Modular and phased implementation strategies can help mitigate the financial burden of upfront investment while ensuring long-term scalability and compatibility with evolving housing management practices.

Benefits of Connected Homes

Connected home technologies present numerous potential benefits for both landlords and tenants within the social housing sector. The prospective advantages span tenant well-being, operational efficiency, regulatory compliance, and long-term sustainability goals.

Improved Tenant Well-Being

Connected homes offer solutions that directly enhance the quality of life for tenants. For example:

- Monitoring:** Devices such as Aico environmental sensors and Vericon's Surveyor Cube monitor humidity and air quality, enabling early detection and prevention of damp and mould. Research highlights that early interventions can reduce respiratory health risks and associated healthcare costs (Balta-Ozkan et al., 2014). The LOTI review found that "63% of alerts from IoT devices related to properties where tenants had not reported any issues", demonstrating the potential of environmental sensors to enable proactive interventions and reduce harm before problems escalate (LOTI, 2023, p. 16). Walker et al. (2024) observed that consistent environmental monitoring significantly improved indoor air quality in social housing. Additionally, Johnes et al. (2023) emphasise that tenant behaviours, such as ventilation habits, can significantly influence air quality outcomes, underscoring the importance of combining monitoring technologies with tenant education and engagement strategies.
- Energy Efficiency:** Smart thermostats and energy management systems help tenants optimise heating schedules, reducing energy consumption and mitigating fuel poverty. Research shows that households using these systems experience improved thermal comfort and lower energy costs (Gaur et al., 2021). Studies indicate that smart energy systems can cut energy usage by 15–20%, benefiting both tenants and landlords (Balta-Ozkan et al., 2014; Aldrich, 2020). Additionally, automated systems requiring minimal tenant interaction have proven particularly effective for older residents, ensuring consistent comfort without manual adjustments (Choi et al., 2020). A recent case study by ZapCarbon and L&Q supports these findings: following the installation of environmental sensors and simple resident engagement, tenants reported improved warmth, reduced damp, and lower energy bills, even without major retrofit works (Healthy Home Hub, n.d.).
- Safety:** IoT-enabled safety systems, such as interconnected smoke detectors, provide real-time alerts and enable remote monitoring. These systems enhance tenant safety by notifying both residents and housing providers of potential hazards, facilitating quicker responses (He et al., 2021). Additionally, integrated systems that combine fire alarms with CO2 and smoke detection offer more comprehensive safety coverage (Yossef & Aharon-Gutman, 2023).
- Health and Wellbeing Support:** Ambient monitoring systems detect risks like prolonged inactivity or sudden

temperature drops, triggering welfare checks for vulnerable tenants. Choi et al. (2020) emphasise the importance of these systems for older adults or tenants with chronic conditions. Maskeliūnas et al. (2019) note that non-intrusive sensors and adaptive IoT technologies significantly enhance tenant health outcomes while reducing healthcare costs. Transparent communication about these systems' benefits, as suggested by Buckingham et al. (2022), fosters trust and encourages tenant engagement in health-focused initiatives. Evans et al. (2002) add that poor housing conditions, especially damp, noise, and inadequate heating, can cause psychological distress and feelings of helplessness. Connected technologies that address these environmental stressors proactively may help mitigate mental health risks, particularly for families experiencing long-term substandard housing.

Cost Savings for Landlords

The integration of IoT solutions into housing management systems has been shown to have the potential to reduce operational costs:

- **Predictive Maintenance:** IoT devices, such as smart sensors and boiler monitoring systems, enable real-time asset tracking, allowing landlords to detect issues before they escalate into costly repairs. Vericon's boiler monitoring systems help identify inefficiencies early, reducing emergency call-outs and unplanned maintenance costs. Research shows that predictive maintenance can lower repair expenses by up to 30% and extend asset lifespan (Doukari et al., 2022). AI integration enhances these capabilities by analysing large datasets to identify failure patterns and predict component wear, while environmental sensors improve alert accuracy and

repair prioritisation (Sepasgozar et al., 2020). Walker et al. (2024) emphasised the need for integrated IoT platforms that combine maintenance alerts with historical performance data, while scalable, interoperable systems are essential for seamless integration with housing management strategies.

- **Reduced Energy Consumption:** IoT-enabled smart meters and thermostats provide landlords with detailed insights into energy consumption patterns, enabling energy-saving measures across property portfolios. Sepasgozar et al. (2020) highlight that integrating AI with IoT devices further enhances these systems by enabling real-time optimisation and predictive adjustments, assuming even greater energy efficiency between 10-38%. Smart thermostats, such as those studied by Choi et al. (2020), effectively reduce energy waste by automatically adjusting settings based on occupancy and temperature preferences. Additionally, systems like Switchee optimise heating schedules and flag under-heated properties, supporting compliance with fuel poverty reduction initiatives (Gaur et al., 2021).
- **Operational Efficiency Gains:** Integrated IoT solutions that aggregate data from multiple sources allow housing providers to allocate maintenance resources more effectively, streamlining operations. Rogage et al. (2022) highlighted that automated data-driven workflows reduced manual inspections and freed up operational teams to focus on critical tasks. The use of digital twins, which create real-time simulations of property performance, can further enhance planning for retrofits and maintenance (He et al., 2021). Walker et al. (2024) found that real-time environmental monitoring in social housing enabled housing providers to identify at-risk homes, supporting

more proactive maintenance planning. However, their findings also suggest that while IoT data provides valuable insights, its effectiveness depends on how well housing providers integrate it into decision-making processes.

Regulatory Compliance

With increasing regulatory pressure to improve energy efficiency, reduce carbon emissions, and maintain safe living environments, connected home technologies offer prospectively transformative tools to support compliance efforts.

- **Energy Performance Targets:** IoT technologies such as smart sensors and digital twins enable real-time monitoring of energy performance, providing actionable insights to support compliance with regulations like Minimum Energy Efficiency Standards (MEES) and improve Energy Performance Certificate (EPC) ratings (Islam et al., 2015). Digital twins are particularly effective in simulating retrofitting scenarios, helping landlords identify cost-effective energy-saving upgrades tailored to individual properties (Menneer et al., 2023). These tools facilitate compliance with net-zero targets by optimising energy efficiency measures across housing portfolios. Rogage et al. (2019) underscore that IoT-enabled platforms aggregate data from multiple sensors to pinpoint inefficiencies, enabling housing providers to strategically plan retrofitting efforts, reduce carbon emissions, and meet broader sustainability goals.
- **Air Quality Standards:** Ensuring safe and healthy indoor environments is a key priority in social housing, with increasing emphasis on environmental monitoring and regulatory compliance. The introduction of Awaab's Law has heightened the urgency of addressing damp and mould, requiring landlords to take timely action (Housing Ombudsman, 2023). However, beyond moisture control, indoor air quality, ventilation, and temperature regulation also play crucial roles in tenant health. IoT monitoring systems enable real-time tracking of humidity, temperature, and air pollutants, allowing early intervention (Walker et al., 2024). Paterson et al. (2021) highlight that elevated VOCs and PM2.5 contribute to respiratory risks, reinforcing the need to monitor air pollutants alongside damp and humidity levels. Additionally, Johnes et al. (2023) stress that ventilation patterns and tenant behaviours significantly impact air quality, suggesting compliance strategies should integrate both environmental monitoring and behavioural insights. IoT systems support compliance by automating alerts, generating actionable insights, and improving transparency, helping landlords meet regulatory obligations (Yossef and Aharon-Gutman, 2023).
- **Fire Safety:** The integration of smart fire safety systems, such as interconnected smoke alarms and CO detectors, is instrumental in meeting fire safety standards. These systems offer features like remote monitoring, instant alerts, and system-wide diagnostics, enabling landlords to manage compliance across their property portfolios more efficiently (He et al., 2021). Combining fire safety data with centralised housing management platforms ensures real-time compliance monitoring and streamlines reporting for audits and inspections. This is particularly valuable for larger housing providers managing extensive portfolios. Zaidan and Zaidan (2020) emphasise the role of multi-layered IoT systems in enhancing the resilience and reliability of safety monitoring, particularly in mitigating risks from episodic device failures or network disruptions.

- **Water Compliance and Legionella Management:** Compliance with water safety regulations, particularly around Legionella prevention, is another area where IoT technologies are increasingly valuable. Smart water monitoring systems, such as Plexus Innovation's Guardian IoT-enabled sensors, provide real-time tracking of water temperatures and flow, ensuring compliance with water hygiene standards. Automated alerts can signal deviations from safe thresholds, prompting timely interventions and reducing risks associated with Legionella outbreaks (Rogage et al., 2019). These systems also allow housing providers to demonstrate proactive compliance during audits. IoT can simplify the management of water systems in large portfolios by aggregating data into centralised dashboards, providing housing providers with a comprehensive view of compliance status across all properties.
- Yossef and Aharon-Gutman (2023) highlight the ability of such platforms to visualise trends and inefficiencies, enabling landlords to allocate resources more efficiently and reduce operational costs. Tools that integrate with Building Information Modelling (BIM) further enhance data utility by linking IoT insights to lifecycle asset management, streamlining long-term planning (Rogage et al., 2019).
- Advanced IoT solutions can also monitor energy consumption patterns, detect inefficiencies, and provide recommendations for retrofitting, aligning with sustainability goals while improving operational effectiveness (Zaidan and Zaidan, 2020).
- Rogage et al. (2022) demonstrate how AI-driven automation enhances real-time monitoring and decision-making in large infrastructure projects. Applying similar AI-powered IoT data pipelines to social housing could provide near-instant visibility into asset performance, allowing for faster, data-driven interventions. Automated dashboards could support housing officers in monitoring real-time changes in environmental conditions, occupancy patterns, and potential risks (e.g., damp and mould) across multiple properties.
- Hnat et al. (2011) emphasise that the quality and placement of sensors significantly influence the reliability of actionable insights. Improper deployment can result in incomplete data or biases that compromise decision-making. Strategic placement methodologies, such as clustering or tenant-specific configurations, can optimise data accuracy.

Enhanced Data-Driven Decision Making

Connected home technologies empower housing providers to leverage real-time data for informed and strategic decision-making. These solutions support improved resource allocation, targeted interventions, and enhanced tenant experiences.

1. Actionable Insights

- IoT platforms such as AWS IoT Core and Vericon Systems aggregate data from multiple devices into centralised dashboards, providing real-time analytics to monitor building performance and prioritise interventions (Walker et al., 2024). These systems use predictive analytics to anticipate maintenance needs, shifting operations from reactive to proactive management.

2. Customised Tenant Support

- Connected home technologies enable housing providers to offer tailored support by tracking environmental and behavioural data, such as temperature irregularities, prolonged inactivity, or excessive humidity (Choi et al., 2020). These insights allow landlords to proactively identify vulnerable tenants and address potential risks, such as inadequate heating or poor air quality (Johnes et al., 2023). For instance, welfare checks can be automated through notifications triggered by anomalous patterns, improving tenant well-being and fostering trust.
- Aggregate data can also inform broader community-level strategies, helping housing providers identify common challenges, such as damp and mould, and design targeted interventions that improve overall living conditions (Islam et al., 2015). However, ensuring tenant acceptance requires robust data governance frameworks. Transparency around data collection, usage, and storage is essential to mitigate concerns about surveillance and misuse. Walker et al. (2024) emphasise that ethical data practices, including anonymisation and secure sharing, are critical to maintaining trust and compliance with regulations like GDPR.
- Hnat et al. (2011) note that episodic failures, caused by environmental disruptions or device malfunctions, can compromise tenant-specific insights. They recommend redundancy in data collection and automated failure detection systems to ensure continuous and reliable monitoring.

3. Operational Efficiency

- The integration of IoT data into real-time management platforms allows housing providers to optimise workflows

and improve efficiency. Predictive maintenance alerts generated by systems like Vericon or Switchee enable proactive interventions that reduce emergency repairs and associated costs (Walker et al., 2024).

4. Long-Term Planning

- Digital twins and historical data analysis allow landlords to simulate property performance under different scenarios, facilitating strategic planning for retrofits and upgrades. Hnat et al. (2011) underscore the role of robust data pipelines in supporting these models, ensuring that housing providers can confidently rely on projections and simulations.
- In infrastructure projects, Digital Twin applications have demonstrated their value in enhancing real-time monitoring and predictive insights (Rogage et al., 2022). They can also be used to test resilience against future climate scenarios, informing decisions about energy efficiency upgrades, retrofitting priorities, and sustainability investments (Elghaish et al. 2024). While the social housing sector has yet to fully implement Digital Twin technology, integrating IoT-based real-time data with predictive AI models could allow housing providers to simulate property performance over time, forecast repair needs, and optimise long-term investment strategies. Greenwood et al. (2017) highlight how BIM-based lifecycle planning improves asset management by standardising asset data and enhancing predictive maintenance. Applying similar principles in social housing could strengthen long-term retrofit strategies.

5. Overcoming Data Gaps

- IoT deployments in social housing can face data completeness issues, particularly in cases of sensor damage,

removal, or poor connectivity. Hnat et al. (2011) stress the importance of implementing automated health checks and adaptive systems that flag anomalies or gaps in data collection. These mechanisms enable landlords to address issues promptly, maintaining the integrity of their data-driven decision-making processes.

6. Future Opportunities

- Integrating IoT data with artificial intelligence (AI) capabilities offers opportunities for even greater precision and efficiency. For example, machine learning algorithms can analyse historical data to refine predictive models, further reducing maintenance costs and improving service delivery (Stojkoska and Trivodaliev, 2017). When integrated with digital twins, they can model future climate risks, identifying vulnerabilities in building fabric, ventilation, and energy efficiency that may emerge over time (Henriksen et al. 2022). Tenant-facing tools, such as mobile apps or dashboards, can empower residents by providing insights into their energy use or environmental conditions, fostering greater tenant engagement and shared responsibility for sustainability efforts.

Challenges and Barriers

While the benefits of connected home technologies in social housing are promising, significant challenges and barriers hinder their widespread adoption and effective implementation. These challenges span technical, organisational, and tenant-related dimensions, each of which requires targeted strategies to overcome.

Technical Challenges

1. Interoperability Issues

- One of the most persistent technical barriers in IoT adoption is the lack of interoperability between devices from different manufacturers. Proprietary protocols often hinder seamless integration, leading to inefficiencies and increased costs for housing providers (Fard et al., 2021).
- Rogage et al. (2019) emphasise that inconsistent data standards result in data silos, which limit cross-platform insights and prevent housing associations from obtaining a holistic view of their assets. Implementing common data environments (CDEs) can facilitate seamless data exchange and system interoperability, enabling actionable insights from collected data.
- Stojkoska and Trivodaliev (2017) advocate for the adoption of open-source frameworks and universal communication protocols, which could address the fragmentation at both device and platform levels. Such standardisation would significantly enhance the scalability and interoperability of IoT deployments. Similarly, Zaidan and Zaidan (2020)

suggest that collaborative industry-wide efforts to establish common standards are essential for avoiding vendor lock-in.

2. Connectivity Limitations

- Reliable connectivity is foundational for real-time IoT functionality, yet many rural areas and older housing estates suffer from inadequate internet infrastructure, resulting in delayed interventions and gaps in data transmission (He et al., 2021).
- Hybrid connectivity solutions, such as local hubs or mesh networks, can mitigate these challenges. Local hubs temporarily store data during outages, while mesh networks strengthen signal coverage in large housing estates (Rogage, 2020).
- Zaidan and Zaidan (2020) propose hierarchical control mechanisms, where local nodes (e.g., sensors or hubs) manage and store data temporarily during disruptions, and higher-level nodes coordinate the overall data flow. This layered structure ensures redundancy and reduces the risk of data loss in areas with inconsistent connectivity.
- Additionally, Stojkoska and Trivodaliev (2017) recommend employing adaptive communication protocols that dynamically adjust to varying network conditions in real-time, enhancing overall system resilience.
- Beyond infrastructure, Menneer et al. (2023) underscore the importance of designing robust network solutions to address common disruptions, such as unplugged devices, removed batteries, and weak signal coverage, which further jeopardise data reliability.

3. Deployment and Physical Challenges

- Strategic sensor deployment is critical to ensuring that data collected is representative, reliable, and actionable. Menneer et al. (2023) demonstrated the value of cluster analysis for optimising sensor placement, which enhances resource efficiency and scalability. Poor planning risks creating gaps in data collection, leading to underrepresentation of property types or tenant demographics.
- IoT devices often face risks such as tampering, removal, or damage, particularly when residents view them as intrusive or unnecessary (Johnes et al., 2023). Initiatives like rugged device designs and tenant education can mitigate these risks.
- Tenant dissatisfaction with the aesthetic appearance of IoT devices, often described as unattractive “plastic boxes,” can reduce engagement and acceptance over the long term (Buckingham et al., 2022). Collaborative efforts with manufacturers to design aesthetically pleasing devices can help address these concerns.
- Zaidan and Zaidan (2020) suggest prototyping and iterative design processes that involve tenant feedback, ensuring that devices meet both functional and aesthetic requirements. This participatory approach not only improves device design but also fosters trust and acceptance among tenants.

4. Data Security and Privacy Concerns

- IoT systems inherently collect and transmit sensitive tenant data, such as environmental conditions and energy usage patterns. Without adequate protection, these systems are vulnerable to cyberattacks, potentially compromising data integrity and tenant trust (Balta-Ozkan et al., 2014).

- Zaidan and Zaidan (2020) recommend multi-layered cybersecurity protocols, including robust encryption, secure authentication mechanisms, and regular system audits. These measures safeguard data while ensuring compliance with evolving cybersecurity standards.
- Real-time monitoring systems, as suggested by Stojkoska and Trivodaliev (2017), can proactively detect and neutralise potential security threats, thereby mitigating risks before they escalate.
- Compliance with regulations such as GDPR adds another layer of complexity, particularly when involving third-party vendors. Clear governance frameworks defining data ownership, access rights, and privacy-preserving techniques, such as anonymisation and secure sharing practices, are critical for maintaining tenant trust and ensuring accountability (Rogage, 2020).

Organisational Barriers

1. Skills Gaps

- **Specialised Expertise:** Effective deployment and management of connected home technologies require specialised skills in IoT architecture, data analytics, and system integration, areas where social housing providers can lack in-house expertise (He et al., 2021). This reliance on external vendors can increase costs and delay adoption.
- **Building Internal Capacity:** Rogage (2021) highlights the value of interdisciplinary training programmes that integrate technical and housing management skills to build data literacy across teams. Partnerships with technology providers and targeted training for existing staff can partially address this gap, though these initiatives require upfront investment. Sepasgozar

et al. (2020) further suggest that organisations foster collaboration between IT and housing teams to ensure smooth integration and management of IoT systems.

- **Tenant Collaboration:** Engaging tenants in the design and deployment of IoT systems is crucial to addressing usability concerns and fostering adoption. Marikyan et al. (2019) emphasise that tenant co-design initiatives help bridge gaps in understanding, ensuring solutions are practical and meet tenant needs.

2. Resistance to Change

- **Cultural Barriers:** The introduction of connected home technologies often disrupts established workflows, creating resistance among staff accustomed to traditional methods (Rogers, 2003). Organisational inertia is particularly pronounced when IoT solutions, such as predictive maintenance, require a shift from reactive to proactive management strategies.
- **Change Management:** Clear communication of benefits and tailored change management initiatives are essential to overcoming resistance. Marikyan et al. (2019) emphasise that involving staff early in the decision-making process and providing ongoing support during implementation builds trust and reduces pushback.
- **Ethical and Data Concerns:** Staff resistance may also stem from ethical concerns about data collection, ownership, and usage. Marikyan et al. (2019) suggest that developing transparent policies and governance structures to address these issues is essential to building organisational confidence in IoT solutions.

3. Financial Constraints

- **High Upfront Costs:** The expenses for IoT devices, installation, and subscriptions are significant barriers, particularly for

smaller housing associations (Fard et al., 2021). Tenants may also perceive these technologies as expensive luxuries, which can reduce acceptance (Marikyan et al., 2019).

- **Balancing Costs with Benefits:** Long-term savings must be demonstrated through clear cost-benefit analyses to justify investments (Sepasgozar et al., 2020).
- **Grant Funding and Sustainability:** While grants and incentives help offset upfront costs, sustained adoption requires strategic financial planning. Leveraging pilot results to secure further funding or partnerships can support long-term goals (Marikyan et al., 2019).
- **Scalability and Value:** Investing in scalable, interoperable systems reduces duplication and ensures long-term compatibility, offering better value for housing associations (Walker et al., 2024).

4. Time Constraints and Competing Priorities

- Social housing providers often face competing demands, such as compliance with regulations like Awaab's Law or addressing immediate tenant needs (Rogage et al., 2021, Housing Ombudsman 2023). These priorities can deprioritise IoT adoption, particularly when staff are stretched across multiple responsibilities. A phased implementation approach with realistic timelines can help balance these competing demands.

5. Cybersecurity Preparedness

- Organisations may lack adequate cybersecurity frameworks to protect against breaches, a risk that undermines tenant trust and creates reputational damage (Marikyan et al., 2019). Ensuring robust data security protocols, staff training, and ongoing system monitoring are critical organisational responsibilities that affect both adoption and compliance with regulations.

Tenant Concerns

1. Privacy and Trust Issues

- **Surveillance and Data Misuse**

Concerns: Tenants often view connected home technologies as intrusive, particularly when the benefits are unclear or poorly communicated (Marikyan et al., 2019; Walker et al., 2024). A lack of transparency around how data is used, who can access it, and what control tenants have undermines trust and reduces engagement (Balta-Ozkan et al., 2014; Sepasgozar et al., 2020). Buckingham et al. (2022) found that many social housing tenants were especially wary of surveillance when they lacked control or clarity over data use. Maskeliūnas et al. (2019) emphasise that trust and uptake depend on clear explanations of how IoT systems meet tenants' needs. This is echoed in the DLUHC (2023) review, which found widespread tenant mistrust, fuelled by past experiences of being ignored or blamed. Where tenants fear that data could be used against them rather than to support them, adoption of these technologies is likely to falter.

- **Transparent Communication:** Early engagement with tenants is critical. Providing clear, accessible information about data handling policies, such as anonymisation, encryption, and sharing practices, can alleviate privacy concerns and encourage trust (Rogage et al., 2020). Co-design processes that actively involve tenants in shaping data privacy measures, as suggested by Sepasgozar et al. (2020), help foster ownership and trust. Additionally, Maskeliūnas et al. (2019) highlight that building trust requires not just transparency but also a focus on empowerment, ensuring tenants understand their control over IoT data and how it is used. Long et al.

(2022) underscore that peer networks and a sense of community can foster trust in IoT systems. When tenants see their neighbours engaging positively with connected technologies, their own willingness to adopt increases. Pearce (2013) further supports this by highlighting the role of open-source systems in enhancing data transparency. These systems enable tenants and landlords to audit how data is collected, stored, and used, helping to reduce perceptions of hidden surveillance and fostering greater trust.

- **Privacy-Enhancing Technologies:** Advanced techniques, such as differential privacy and federated learning, enable robust analytics while minimising privacy risks (Stojkoska and Trivodaliev, 2017). Embedding these technologies into IoT systems ensures compliance with privacy standards and reduces data exposure, as recommended by Sepasgozar et al. (2020). Marikyan et al. (2019) also stress the need for systems to align with ethical frameworks, further reducing tenant mistrust. Maskeliūnas et al. (2019) add that user-centric designs that prioritise simplicity and clear feedback mechanisms for data usage further support tenant acceptance and trust.
- **Mitigating AI-Related Privacy Risks:** AI systems integrated with IoT devices amplify privacy concerns due to the large volumes of personal data required for machine learning. Sepasgozar et al. (2020) recommend designing AI algorithms to prioritise edge processing, where data analysis occurs locally on devices rather than being transmitted to centralised servers. This approach aligns with tenant preferences for control over their data, a critical factor identified by Marikyan et al. (2019). Maskeliūnas et al. (2019) further suggest that AI-driven systems include adjustable

privacy settings, enabling tenants to choose the level of data sharing they are comfortable with, fostering greater autonomy and trust.

2. Accessibility and Ease of Use

- **Design for Inclusivity:** Smart home systems must prioritise intuitive interfaces and accessibility features. Rogage et al. (2019) and Maskeliūnas et al. (2019) advocate for designing systems that cater to diverse tenant needs, from simplified controls to robust accessibility options. Maswadi et al. (2020) highlight the importance of training and ongoing support especially tailored to the needs of older and less tech-savvy tenants.
- **Comprehensive Support:** Providing multiple layers of support can significantly improve tenant confidence and engagement. Effective measures include:

Tailored Training: Offering workshops, onboarding sessions, and easy-to-understand training materials helps empower tenants with diverse digital competencies (Rogage et al., 2019).

Multi-Channel Assistance: Combining phone helplines, in-home support, and online resources ensures tenants have accessible avenues for resolving technical issues.

Community-Level Support: Translating guides into multiple languages and considering cultural contexts can remove barriers for tenants in multicultural communities (Rogage, 2021).

Community-Level Support: Long et al. (2022) highlight the role of peer networks and communal resources in bridging digital literacy gaps. Encouraging tenants to share experiences and support each other in adopting new technologies can foster greater confidence and sustained engagement.

- **Co-Design and Contextual Engagement:** LOTI (2023) recommends grounding IoT deployments in “contextual understanding of residents’ lived experiences” (p. 25). Involving tenants in device selection, placement, and dashboard design was shown to increase engagement and trust, particularly where landlords combined tech rollout with personal interaction and visible follow-up. The report cautions that over-reliance on digital data without human support may alienate tenants, especially those with low digital confidence. Embedding co-design within inclusive service delivery is therefore key to effective adoption.
- **Simplified Functionality:** Automation features, voice assistance, and preset controls can minimise cognitive load and improve usability for tenants with limited technical experience (Maskeliūnas et al., 2019). Marikyan et al. (2019) further emphasise the importance of balancing simplicity with functionality to ensure widespread adoption.
- **Challenges for Vulnerable Groups:** Limited digital literacy and usability concerns can hinder tenant engagement with IoT devices, particularly among older adults and vulnerable populations (Fard et al., 2021). Poor user experiences often lead to abandonment of technologies perceived as complex or unintuitive. Akhmetzhanov et al. (2024) stress that accessible, intuitive design is crucial to minimising training needs, while Buckingham et al. (2022) highlight that many social housing tenants lack confidence with digital tools, reinforcing the need for clear, hands-on support to ensure IoT adoption is practical and inclusive.

Physical Presence

The physical presence of IoT devices in tenants' homes introduces unique challenges that can influence long-term deployment and acceptance. These devices are not purely functional additions; their physical and visual impact can significantly shape tenant perceptions and engagement.

- **Tenant Buy-In:** Tenant acceptance depends on understanding how IoT improves their living conditions. Clear communication about tangible benefits, such as reduced damp, lower bills, and improved well-being, is key to building trust (Marikyan et al., 2019). Peer influence also matters: tenants are more likely to engage when they see others benefit (Long et al., 2022). Real-time data can help visualise mould risk and prompt action (Meneer et al., 2022), but only if systems are accessible and trusted. Buckingham et al. (2022) highlight that digital literacy and confidence in the technology are critical, and that simple dashboards support continued engagement. The ZapCarbon and L&Q case study reinforces this: when sensor data was paired with compassionate, hands-on support, tenant trust increased significantly. One resident described being “almost crying” due to the care shown, emphasising that relational support is as important as the tech itself (Healthy Home Hub, n.d.). Yet, as Evans et al. (2002) caution, tenants in poor housing may develop “learned helplessness,” disengaging after repeated inaction. Without visible follow-through, IoT alerts risk worsening mistrust. The DLUHC (2023) review echoes this: tenants consistently said genuine listening and clear action were essential to rebuild confidence.
- **Tampering and Damage Risks:** IoT devices may be at risk of being tampered with, removed, or damaged, either accidentally or intentionally, particularly in situations where residents feel the devices are intrusive or unnecessary (Johnes et al., 2023). Hnat et al. (2011) further highlight that children, pets, and routine household activities like cleaning can lead to unintentional sensor dislodgement or damage.
- **Operational Failures:** Poor sensor placement and environmental fluctuations can lead to inaccurate readings, limiting their reliability (Meneer et al., 2023). Their study found that mould risk models relying on high humidity thresholds (e.g., 80%) often underestimate actual hazards, as mould can develop at lower humidity levels in real-world housing conditions. This highlights the need for better calibration of IoT sensors and redundancy in monitoring systems to ensure reliable data collection.
- **Aesthetic and Spatial Concerns:** Many tenants express dissatisfaction with the visual impact of devices, often describing them as intrusive “plastic boxes” that clash with their home environments. These concerns can reduce tenant satisfaction and willingness to accept long-term deployment (Buckingham et al., 2022). Hnat et al. (2011) also suggest redundancy in sensing systems and automated failure detection to mitigate these challenges.
- **Iterative Design with Tenant Input:** Involving tenants in the design process ensures that devices meet both functional and aesthetic needs (Zaidan and Zaidan, 2020). Marikyan et al. (2019) note that co-design approaches improve trust, satisfaction, and the likelihood of long-term adoption.

Market Landscape

Market Gaps

Despite the growing market for connected home technologies, several challenges remain, particularly for the social housing sector.

- **Affordable and Scalable Solutions:**

Many IoT products remain cost-prohibitive for smaller housing associations, limiting their ability to scale deployments. Walker et al. (2024) note that high installation and maintenance costs often deter investment. Modular IoT solutions, which enable phased implementation and reduce upfront financial barriers, have been identified as a key opportunity to address this issue (Zaidan and Zaidan, 2020). Additionally, lightweight, non-intrusive sensors and solar-powered devices, as highlighted by Maskeliūnas et al. (2019), may provide cost-effective alternatives for large-scale implementation. Maswadi et al. (2020) emphasise that long-term financing models and partnerships with suppliers could further support affordability and sustainability in social housing deployments.

- **Flexible APIs and Data Integration**

Capabilities: Limited interoperability is a recurring issue, with many IoT systems lacking flexible APIs or standardised protocols (Eastman et al., 2011; Rogage, 2021). Stojkoska and Trivodaliev (2017) highlight that fragmented systems often lead to siloed data and reduced cross-platform insights. Standards like ZigBee and Z-Wave offer promising solutions by enabling communication between devices from different

manufacturers while maintaining low energy consumption, which is critical for large-scale deployments in social housing (Maswadi et al. 2020). However, as Greenwood et al. (2017) note in their study of Lean-BIM integration, a lack of standardised frameworks limits real-time data exchange across digital systems, mirroring the challenges seen in housing IoT ecosystems. To address this, open-source platforms and structured integration models could help mitigate vendor lock-in, ensuring seamless, scalable data interoperability between IoT, building management, and asset monitoring systems.

- **Intelligent Energy Management**

Systems: Intelligent energy management systems, such as real-time Demand Side Management (DSM), remain underutilised in social housing (Zaidan and Zaidan, 2020). These systems could optimise energy use and mitigate fuel poverty. Sepasgozar et al. (2020) demonstrate that AI-integrated IoT systems can reduce energy consumption by up to 38%. Additionally, solutions like SwitchEE, which adapt to user behaviour, highlight the importance of practical, accessible designs for energy-saving technologies (Choi et al., 2020).

- **Predictive Maintenance Solutions:**

Predictive maintenance technologies have shown significant promise in reducing operational disruptions and extending asset lifecycles (Davila Delgado et al., 2020). However, reactive approaches still dominate the sector, particularly in addressing damp and mould. The Housing Ombudsman (2023)

found that many landlords continue to rely on tenant-reported complaints rather than adopting preventative measures, despite growing regulatory pressure. This failure to act pre-emptively has led to severe maladministration findings, reinforcing the need for predictive IoT monitoring to identify risks before they escalate. As Yossef and Aharon-Gutman (2023) highlight, legacy infrastructure and limited analytics capabilities remain key barriers to the adoption of proactive maintenance strategies. To address this, machine learning algorithms integrated into IoT systems (Maskeliūnas et al., 2019) could enable landlords to prioritise maintenance interventions based on real-time risk analysis, reducing costs and improving tenant outcomes.

- **Intuitive Data Visualisation Tools:** IoT dashboards often prove overly complex for non-technical users, creating barriers to adoption (Rogage et al., 2021). Stojkoska and Trivodaliev (2017) stress the need for user-friendly, simplified interfaces to empower housing officers and decision-makers. Visualisation tools that provide actionable insights tailored to users' roles, whether tenants or housing staff, are particularly important in ensuring effective decision-making.
- **Lifecycle Management Systems:** Integrating IoT data with Building Information Modelling (BIM) platforms remains a significant gap, hindering comprehensive asset management (Eastman et al., 2011). Such integration would centralise data for proactive maintenance and long-term planning. Stojkoska and Trivodaliev (2017) advocate for smart ecosystems that combine BIM with IoT to improve efficiency, maintenance, and tenant outcomes. While BIM has been successfully implemented in construction and asset-heavy industries, its application in

housing remains underdeveloped. Rogage et al. (2022) demonstrate how Digital Twin approaches enhance large-scale infrastructure monitoring by linking IoT data with site models. In social housing, a similar integration of IoT with asset management platforms could improve maintenance strategies, especially in large property portfolios.

Sector Preparedness

The rapid expansion of the IoT market for social housing has led to a proliferation of providers offering diverse solutions, yet sector readiness varies considerably.

- **Affordable and Scalable Solutions:** High implementation costs remain a significant hurdle for smaller housing associations, which often operate under tight budgets and rely on grant funding to initiate IoT projects (Walker et al., 2024). Affordable and scalable options are critical to ensure that IoT adoption does not exacerbate inequalities between large and small housing providers. Zaidan and Zaidan (2020) argue that modular and cost-efficient IoT frameworks, combined with adaptive financing models, can facilitate broader adoption.
- **Customisation for Social Housing:** Off-the-shelf IoT solutions often fail to meet the unique challenges of social housing, such as multi-unit connectivity and high-density deployments (Choi et al., 2020). Tailored solutions that prioritise reliable infrastructure and tenant-specific needs, as discussed by Maskeliūnas et al. (2019), are critical for ensuring effective adoption.
- **Service Integration and Workflow Design:** The LOTI project (2023) highlighted the importance of robust internal processes to ensure that sensor data results in timely, meaningful action. "Simply installing sensors without a clear

plan for who will interpret the data and respond risks undermining tenant trust” (p. 18). Effective use of IoT requires not just technical deployment but service design, governance, and change management to embed insights into day-to-day operations. Without these, even well-placed devices risk becoming disjointed from meaningful service improvements.

- **Interoperability and Open Standards:**

The absence of universal standards for data formats and communication protocols continues to hinder seamless integration between IoT devices from different providers. Research from Davila Delgado et al. (2020) and Rogage (2021) highlights that vendor lock-in and fragmented systems limit the effectiveness of IoT deployments by creating silos of unconnected data. Stojkoska and Trivodaliev (2017) advocate for the adoption of open APIs and standardised communication protocols to improve system compatibility and foster collaboration across diverse platforms. Pearce (2013) argues that open-source smart home platforms can reduce commercial lock-in by providing flexible, transparent alternatives to proprietary systems. This may offer a viable path for social landlords seeking greater interoperability and long-term resilience, particularly if internal capacity is developed to manage open systems.

- **Tenant-Centric Design and**

Engagement: Many IoT solutions lack user-friendly interfaces and fail to adequately address tenant concerns, such as privacy, data security, and accessibility. Choi et al. (2020) and Buckingham et al. (2022) emphasise the need for co-designed solutions that involve tenants early in the development process. This approach builds trust and ensures systems meet tenant expectations. Incorporating

multilingual support, offline functionality, and accessible training materials can address the digital divide, particularly in communities with limited internet access or diverse demographics (Walker et al., 2024). Long et al. (2022) highlight the potential for community-level initiatives to complement IoT adoption, suggesting that tenant buy-in could improve through shared hubs or peer support networks that bridge gaps in trust and digital literacy.

- **Preparedness for Emerging**

Technologies: As IoT solutions evolve, housing providers must prepare for integrating advanced technologies such as digital twins, AI-driven analytics, and blockchain for enhanced data security. Zaidan and Zaidan (2020) stress that gradual implementation strategies are essential for reducing organisational risks while maintaining tenant trust. Building organisational readiness through infrastructure upgrades and staff training will be critical for ensuring these technologies are effectively adopted (Maskeliūnas et al., 2019).

By addressing these market gaps, IoT providers and housing associations can enhance the scalability and impact of connected home technologies in the social housing sector. Collaborative efforts to improve standardisation, affordability, and tenant engagement are critical for future progress.

Recommendations for Further Research

This literature review identifies several areas where further research is needed to advance the understanding and implementation of connected home technologies in social housing.

Gaps in Existing Literature

- **Tenant-Centric Studies:** Existing research disproportionately focuses on technical and organisational challenges while often overlooking tenant experiences. Studies rarely explore tenants' perspectives on privacy, ease of use, and the perceived value of smart home devices (Walker et al., 2024; Choi et al., 2020). Further work should examine tenants' needs and concerns, such as trust in data handling, usability preferences, and how connected home technologies can meaningfully improve daily life. Maswadi et al. (2020) underscore the importance of evaluating user-centric features, such as accessible interfaces and customisable data privacy settings, to ensure broader acceptance.
- **Large-Scale Evaluations:** Much of the research is limited to small-scale pilots, which fail to capture the complexities of larger deployments. Studies on wide-scale implementations could reveal insights into scalability, sustainability, and the operational impacts of connected home technologies. Additionally, such evaluations could identify regional differences in outcomes due to variations in infrastructure, housing stock, tenant demographics, and policy environments (Davila Delgado et al., 2020; Yossef & Aharon-Gutman, 2023).

- **Interoperability and Legacy Systems:** Research into interoperability is critical to understanding how IoT solutions can integrate with legacy systems commonly found in social housing (Eastman et al., 2011). Exploring the role of protocols like ZigBee and Z-Wave, as well as open standards, could support the development of more seamless IoT ecosystems. Studies should evaluate how cross-platform compatibility can streamline operations and enhance scalability (Rogage, 2021; Stojkoska and Trivodaliev, 2017).

Proposed Areas for Exploration

- **Stakeholder Interviews:** Qualitative research with key stakeholders, including landlords, technology providers, tenants, and policymakers, can offer nuanced insights into adoption challenges and opportunities. Topics could include the effectiveness of tenant engagement strategies, overcoming internal resistance to change, and forming partnerships with external service providers. For example, interviews could shed light on how housing associations balance operational efficiency with tenant satisfaction (Choi et al., 2020; Rogage, 2021).
- **Surveys and Case Studies:** Targeted surveys could quantify adoption levels, tenant satisfaction, and perceived barriers across different demographics. Complementary case studies, such as those examining the implementation of predictive maintenance or environmental monitoring systems, could provide practical lessons and highlight replicable best practices (Walker et al., 2024).

- **Emerging Technologies:** Research should examine cutting-edge IoT solutions, including AI-driven analytics, context-aware sensors, and digital twins, which can improve predictive maintenance, energy efficiency, and overall operational insights. Additionally, evaluating the scalability of interoperable platforms and their integration with smart ecosystems could inform adoption strategies in social housing (Eastman et al., 2011; Yossef & Aharon-Gutman, 2023).
- **Human-Centred Design and Usability:** Future research must prioritise human-centred design principles, particularly to address challenges related to digital literacy, accessibility, and tenant autonomy. Solutions co-designed with tenants, especially those from vulnerable groups, could enhance usability, build trust, and mitigate resistance to adoption. Maswadi et al. (2020) highlight the potential of simplified interfaces and customisable features to address the needs of elderly and digitally inexperienced tenants.
- **Cultural and Demographic Contexts:** Exploring how cultural differences and tenant demographics influence IoT adoption could provide more tailored and effective solutions. Studies that incorporate these variables would help ensure that connected home technologies are inclusive and sensitive to diverse tenant needs, as suggested by Long et al. (2022).

Conclusion

This literature review provides a comprehensive foundation for understanding the current state of connected home technologies in social housing, highlighting key benefits, challenges, and opportunities for innovation.

Key Insights

Benefits:

- Improved tenant well-being through early detection and prevention of issues such as damp and mould.
- Operational cost savings via predictive maintenance, reduced emergency repairs, and optimised energy management.
- Enhanced compliance with regulations like Awaab's Law and Minimum Energy Efficiency Standards.

Challenges:

- Technical barriers, including interoperability and connectivity limitations, which hinder the integration of IoT devices.
- Organisational constraints, such as a lack of in-house expertise, change management resistance, and financial limitations.
- Tenant-related challenges, including digital literacy gaps, privacy concerns, and resistance to new technologies.

Market Gaps:

- A lack of affordable and scalable IoT solutions tailored to the unique requirements of social housing, including high-density and multi-unit settings.

- Limited compatibility with legacy systems, creating data silos and integration challenges.
- Insufficient user-friendly tools and interfaces for non-technical stakeholders, including housing officers and tenants.

Implications for the Research Study

- **Tenant-Centric Focus:** Prioritising tenant concerns around privacy, usability, and trust is essential to the success of connected home technologies. Co-designing solutions with tenants can improve adoption rates and ensure inclusivity.
- **Organisational Capacity:** Housing providers need to develop skills, governance frameworks, and change management processes to enable IoT adoption. Partnerships with suppliers can support knowledge-sharing and implementation.
- **Scalability and Integration:** Identifying best practices for scaling IoT deployments, including system interoperability and seamless integration with housing management platforms, is crucial for long-term impact.
- **Market Innovation:** Technology providers must focus on creating affordable, interoperable, and tenant-centric IoT solutions tailored to the social housing sector. Addressing gaps in user experience and accessibility will unlock new opportunities.

The findings from this review will inform stakeholder interviews, surveys, and case studies, ensuring the research captures diverse perspectives and provides actionable recommendations. By addressing these challenges and gaps, this project aims to support the effective deployment of connected home technologies, delivering healthier homes, cost efficiencies, and improved tenant satisfaction. For landlords and suppliers alike, these innovations represent an opportunity to drive transformative change in the social housing sector.

References

- Adeyeye, K. (2024) 'From product to service-strategies for upscaling smart home performance monitoring', *Building Research & Information*, 52(1-2), pp. 107-128.
- Agee, P., Gao, X., Paige, F., McCoy, A. and Kleiner, B. (2021) 'A human-centred approach to smart housing', *Building Research & Information*, 49(1), pp. 84-99.
- Aldrich, D. (2020) 'Energy efficiency advancements in connected home technologies', *Sustainable Urban Living Review*, 45(1), pp. 67-82.
- Akhmetzhanov, B., Ozdemir, S. and Zhakiyev, N. (2024) 'Advancing affordable IoT solutions in smart homes to enhance independence and autonomy of the elderly', *Journal of Infrastructure, Policy and Development*, 8(3), p. 2899.
- Balta-Ozkan, N., Boteler, B. and Amerighi, O. (2014) 'European smart home market development: Public views on technical and economic aspects across the United Kingdom, Germany, and Italy', *Energy Research & Social Science*, 3, pp. 65-77.
- Biljana, L., Kumar, A. and Singh, R. (2016) 'A review of Internet of Things for smart homes: Challenges and solutions', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2016.10.006.
- Buckingham, S.A., Walker, T., Morrissey, K. and Smartline Project Team (2022) 'The feasibility and acceptability of digital technology for health and wellbeing in social housing residents in Cornwall: A qualitative scoping study', *Digital Health*, 8, p. 20552076221074124.
- Choi, J.H., Chen, Z. and Jiang, P. (2020) 'Aging and smart home technology adoption: A study of user preferences and barriers', *Journal of Aging Research*, 12(2), pp. 15-28.
- Davila Delgado, M., et al. (2020) 'Smart homes and digital transformation in social housing'.
- Davis, F.D. (1989) 'Perceived usefulness, perceived ease of use, and user acceptance of information technology', *MIS Quarterly*, 13(3), pp. 319-340.
- Doukari, E., et al. (2022) 'Advancements in predictive maintenance for social housing IoT systems', *Sensors*, 21(8), p. 7936.
- Eastman, C., Teicholz, P., Sacks, R. and Liston, K. (2011) *BIM handbook: A guide to building information modeling*.
- Elghaish, F., Matarneh, S., Hosseini, M.R., Tezel, A., Mahamadu, A.M. and Taghikhah, F. (2024) Predictive digital twin technologies for achieving net zero carbon emissions: a critical review and future research agenda. *Smart and Sustainable Built Environment*.
- Evans, G. W., Kantrowitz, E., & Eshelman, P. (2002). Housing Quality and Mental Health. *Journal of Consulting and Clinical Psychology*, 70(3), 611–619. <https://doi.org/10.1037/0022-006X.70.3.611>
- Fard, A.M., Hargreaves, T. and Wilson, C. (2021) 'A systematic review of smart home literature: A user perspective', *Future Internet*, 13(5), p. 127. doi: 10.3390/fi13050127.

Gaur, A., Scotney, B., Parr, G. and McClean, S. (2021) 'Smart homes and energy management: A systematic review', *Future Internet*, 13(5), p. 127.

Greenwood, D.J., Lou, T.J. and Rogage, K. (2017) 'An investigation into 'Lean-BIM' synergies in the UK construction industry', *International Journal of 3-D Information Modeling*, 6(2), pp. 1-17. doi: 10.4018/IJ3DIM.2017040101.

He, X., Green, R. and White, P. (2021) 'Challenges in IoT deployment for social housing: Insights from pilot studies', *Journal of Housing and Technology*, 29(3), pp. 215-229.

Healthy Homes Hub (n.d.) Pioneering data-driven housing solutions: A groundbreaking partnership delivering innovation and proactive mould prevention for healthier homes. Available at: <https://healthyhomes.org.uk/pioneering-data-driven-housing-solutions/> [Accessed 5 July 2025].

Henriksen, H.J., Schneider, R., Koch, J., Ondracek, M., Trolborg, L., Seidenfaden, I.K., Kragh, S.J., Bøgh, E. and Stisen, S. (2022) A new digital twin for climate change adaptation, water management, and disaster risk reduction (HIP digital twin). *Water*, 15(1), p.25.

Hildayanti, A. and Machrizzandi, M.S.R. (2020) 'The application of IoT (Internet of Things) for smart housing environments and integrated ecosystems', *Nature: National Academic Journal of Architecture*, 7(1), pp. 80-88.

Hnat, T.W., Srinivasan, V., Lu, J., Sookoor, T.I., Dawson, R., Stankovic, J. and Whitehouse, K. (2011) 'The hitchhiker's guide to successful residential sensing deployments', in *Proceedings of the 9th ACM Conference on Embedded Networked Sensor Systems*, pp. 232-245.

Housing Ombudsman Service (2023) Spotlight on damp and mould: It's not lifestyle – One year on follow-up report. Available at: www.housing-ombudsman.org.uk/wp-content/uploads/2023/02/Damp-and-mould-follow-up-report-final-2.2.23.pdf [Accessed 31 January 2025].

Islam, S.M., Kwak, D., Kabir, M.H., Hossain, M. and Kwak, K. (2015) 'The Internet of Things for health care: A comprehensive survey', *IEEE Access*, 3, pp. 678-708.

Johnes, C., Sharpe, R.A., Menneer, T., Taylor, T. and Nestel, P. (2023) 'Using sensor data to identify factors affecting internal air quality within 279 lower-income households in Cornwall, South West of England', *International Journal of Environmental Research and Public Health*, 20(2), p. 1075.

Kassem, M., Rogage, K., Huntingdon, J., Durojaye, G., Arena, N., Kelly, G., Lund, T. and Clarke, T. (2019) 'Measuring and improving the productivity of construction's site equipment fleet: An integrated IoT and BIM system', in *36th CIB W78 2019 Conference Advances in ICT Design, Construction & Management in Architecture, Engineering, Construction and Operations (AECO)*, pp. 901-911.

Kotter, J.P. (1996) *Leading Change*. Harvard Business School Press.

London Office of Technology and Innovation (LOTI). (2023). IoT Sensors for Damp and Mould Project: A Comprehensive Review. Retrieved from <https://loti.london/publication/iot-sensors-for-damp-and-mould-project-a-comprehensive-review/>

Long, E., Stevens, S., Topciu, R., Williams, A.J., Taylor, T.J. and Morrissey, K. (2022) 'Wellbeing and social network characteristics in rural communities: Findings from a cohort in social housing in Cornwall, United Kingdom', *International Journal of Community Well-Being*, 5(3), pp. 559-570.

Marikyan, D., Papagiannidis, S. and Alamanos, E. (2019) 'A systematic review of the smart home literature: A user perspective', *Technological Forecasting & Social Change*, 138, pp. 139-154.

Maskeliūnas, R., Damaševičius, R. and Venytė, J. (2019) 'A review of Internet of Things technologies for ambient assisted living environments', *Future Internet*, 11(259). doi: 10.3390/fi11020259.

Maswadi, K., Ghani, N.B.A. and Hamid, S.B. (2020) 'Systematic literature review of smart home monitoring technologies based on IoT for the elderly', *IEEE Access*, 8, pp. 92244-92261.

Menneer, T., Mueller, M., Sharpe, R.A. and Townley, S. (2022) 'Modelling mould growth in domestic environments using relative humidity and temperature', *Building and Environment*, 208, p. 108583.

Paterson, C.A., Sharpe, R.A., Taylor, T. and Morrissey, K. (2021) 'Indoor PM2.5, VOCs and asthma outcomes: A systematic review in adults and their home environments', *Environmental Research*, 202, p. 111631.

Pearce, J. M. (2013). *Open Source Smart Home Technologies: Opportunities and Challenges*. *Electronics*, 2(1), 1-10. <https://doi.org/10.3390/electronics2010001>

Rogers, E.M. (2003) *Diffusion of Innovations* (5th ed.). Free Press.

Tetik, G., Türkeli, S., Pinar, S. and Tarim, M. (2024) Health information systems with technology acceptance model approach: A systematic review. *International journal of medical informatics*, p.105556.

Walker, C., Smith, T. and Bailey, P. (2024) 'Indoor environment sensor systems for healthier homes: A feasibility study in social housing', *Building and Environment Journal*, 128(1), pp. 45-60.

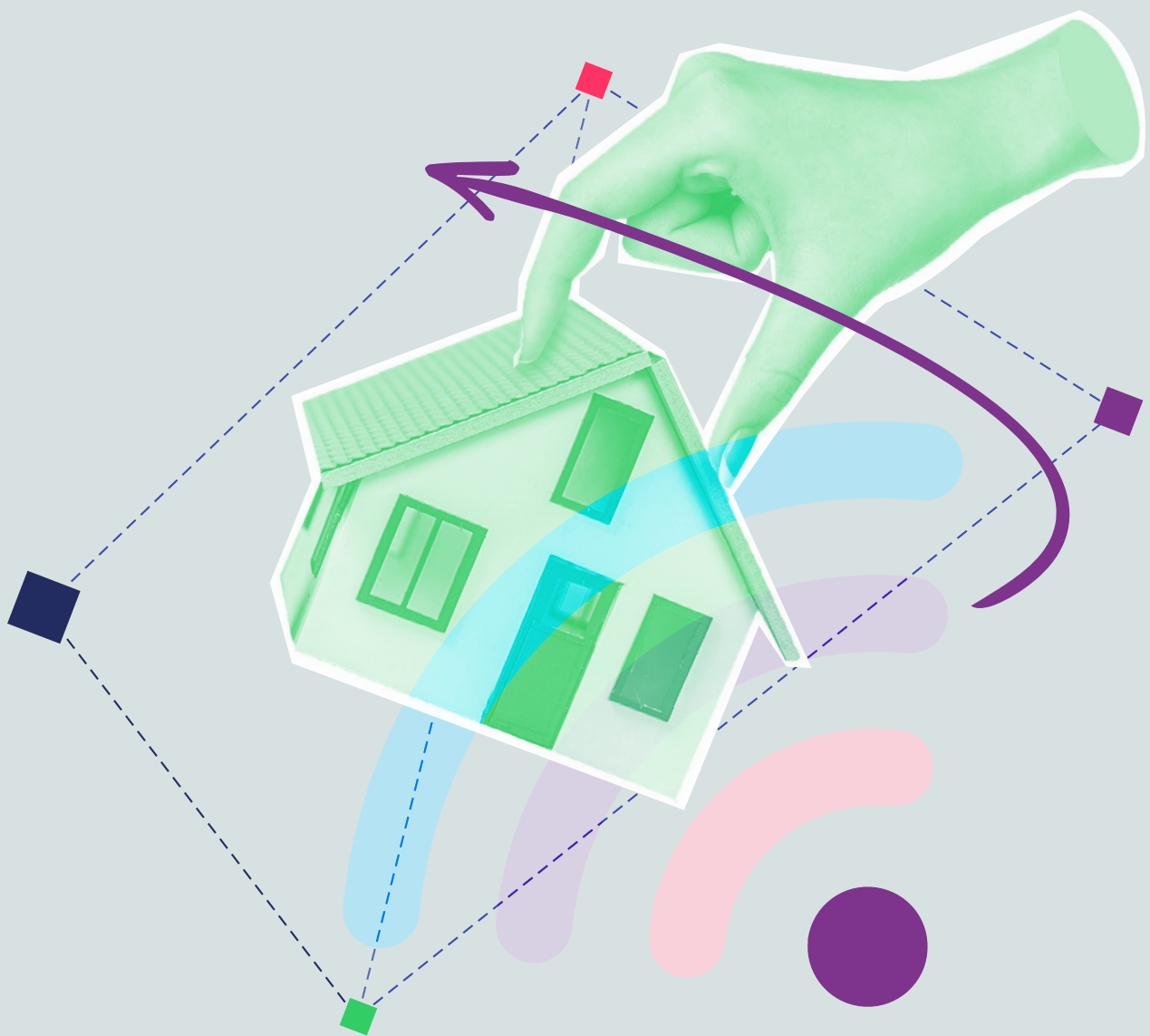
Yossef Ravid, B. and Aharon-Gutman, M. (2023) 'The social digital twin: The social turn in the field of smart cities', *Environment and Planning B: Urban Analytics and City Science*, 50(6), pp. 1455-1470.

Zaidan, A.A. and Zaidan, B.B. (2020) 'A review on intelligent processes for smart home applications based on IoT: Coherent taxonomy, motivation, open challenges, and recommendations', *Artificial Intelligence Review*, 53, pp. 141-165.

Zhou, C., Qian, Y. and Kaner, J. (2024) A study on smart home use intention of elderly consumers based on technology acceptance models. *Plos one*, 19(3), p.e0300574.

Part 2b

Landlord Maturity Assessment



Executive Summary

This report summarises findings from the Maturity Assessment Questionnaire, part of the Connected Homes research project. It explores how social landlords are engaging with Internet of Things (IoT) technologies, based on responses from 31 individuals across the sector. It shows:

1. **Limited Strategic Maturity:** Most rate their IoT knowledge as moderate (avg. 6.1/10), but deeper expertise is rare. Awareness is often limited to IT teams. Market monitoring is patchy, resulting in reactive adoption. Reliance on internal expertise can constrain strategic thinking.
2. **Few Formal Strategies:** Over two-thirds lack a defined IoT strategy, either none (41%) or still developing one (28%). Most activity is driven by specific pain points (e.g. damp, compliance) rather than long-term objectives. Strategic alignment is limited.
3. **Pilots Common, Scaling Rare:** Most landlords (86%) have run pilots, especially for environmental sensors and thermostats, but just 24% have scaled them. Perceived success is moderate (5.3/10). Barriers include integration issues, unclear ROI, technical setbacks, and tenant concerns.
4. **Capacity and Systems Gaps:** Funding is the most common barrier. IoT data is rarely integrated into core systems. Only 18.5% use automated analytics. Manual processes remain widespread, and confidence in strategic use of data is low.

5. **Weak Tenant Engagement:** Tenant involvement is limited (avg. 3.6/10). Fewer than half offer data access to residents, and communications about its use are inconsistent. Without clearer value and inclusion, trust remains fragile.
6. **Growing Ambition, Uneven Readiness:** Most plan to expand IoT over the next three years (avg. 6.4/10), but challenges remain. Few feel ready to adopt AI or predictive tools, and current use is limited. Readiness lags behind ambition.

To move beyond isolated pilots and realise the value of connected homes, the sector must address common pressure points:

- **Set clear IoT strategies** linked to wider business goals, moving from reactive adoption to long-term planning.
- **Strengthen funding models** by defining ROI, phasing investments, and exploring cross-sector collaboration.
- **Improve integration** through shared standards, open APIs, and interoperable systems.
- **Build capability** with training in data literacy, change leadership, and service-focused implementation.
- **Engage residents early** through co-design, transparency, and clear benefits, not just data sharing.
- **Collaborate across the sector** to share tools, templates, and lessons, reducing duplication and building momentum.

While many landlords are experimenting with IoT, progress is uneven. Addressing these shared challenges will be key to unlocking its full potential.

Survey Methods

As part of the Connected Homes research, the Disruptive Innovators Network invited individuals from social landlords to complete a questionnaire exploring current approaches to IoT deployment. The survey was issued in February 2025 to 106 staff members from landlords who had expressed an interest in the project. The format of the questionnaire is included as [Appendix 3](#).

The questionnaire aimed to support self-assessment, helping respondents reflect on how well-developed and informed their organisation's IoT strategy was. It was administered via Typeform, which ensured anonymity, provided contextual information, and supported initial data collection.

Responses were thematically coded and analysed by the research team to identify patterns and draw sector-wide insights. This report summarises findings from the 31 fully completed responses received by March 2025. Although the response window remains open, this interim analysis reflects the position at that time. The final research report will incorporate additional submissions where relevant.

Of the 106 individuals invited:

- The survey was viewed 103 times.
- 54 people began the questionnaire.
- 31 went on to complete it.

Most drop-offs occurred at the consent stage. While the reported average completion time was 28 minutes, this was skewed by a single extended session. Excluding that, most respondents took 12–15 minutes to complete the survey, typically using a desktop device.

Interestingly, the small group using mobile phones (6 respondents) had a notably higher start rate (67%) and completion rate (75%), and completed the survey much more quickly, in just over five minutes on average.

While the number of respondents was limited, and findings are not statistically significant, the assessment provides valuable early insight into sector trends and organisational readiness. Alongside the literature review, it serves as an initial framing tool for the project — highlighting indicative patterns, surfacing key challenges, and helping shape the subsequent research phases.

Analysis: Sector Readiness for IoT Adoption

Analysis of the first section (Questions 1-5) reveals a sector that is beginning to engage with IoT but is still at an early stage in terms of strategic readiness. While awareness is growing, adoption remains fragmented, and many organisations lack the internal capability, organisational alignment, and external scanning needed to make IoT deployment truly effective.

Limited Depth of IoT Knowledge

Respondents generally rated their organisation's understanding of IoT as moderate (mean score: 6.13), with only one individual selecting the highest score (10). This indicates that while most organisations are aware of IoT and its potential relevance, few have developed a sophisticated or strategic understanding of the technology.

Implication:

Without strong internal expertise, organisations may struggle to identify the most appropriate technologies, design effective pilots, or assess the long-term business case. This knowledge gap can undermine both the credibility of proposals and the ability to embed IoT within broader digital transformation programmes.

IoT Awareness is not yet Organisation-Wide

The level of awareness across organisations is uneven. While some specialist teams (most likely IT, innovation, or asset strategy) are engaged, responses

suggest that wider teams, including operational and frontline services, remain less familiar with IoT's potential or relevance (mean 5.23; mode 4). No organisation scored itself at the highest level.

Implication:

This lack of cross-organisational understanding risks siloed initiatives, where IoT remains the responsibility of a single team without support or integration across the business. In turn, this can limit buy-in, create resistance to change, and prevent adoption at scale.

Market Monitoring is Sporadic, Not Strategic

Survey responses suggest that while most organisations keep an informal eye on the market (mean score: 5.72), very few do so in a consistent, structured way. Most scores fell in the mid-range (4-7), and no one rated their organisation as highly proactive in tracking trends, suppliers, or innovations.

Implication:

A reactive stance means organisations may miss new developments, fail to spot emerging suppliers, or adopt technologies too late to secure early-mover advantages. It also reduces leverage in procurement and makes it harder to align innovation with strategic goals.

Internal Expertise is Relied Upon, But May Be a Weakness

The majority of organisations report relying on internal knowledge to evaluate IoT trends, with some drawing on external consultants when needed. However, few organisations appear to have dedicated

resources or structured processes for building and sustaining IoT capability. Sector networking and external learning opportunities are underused.

Implication:

While internal champions can play a valuable role, over-reliance on a small number of individuals can lead to inconsistent decision-making, gaps in knowledge, and a lack of organisational resilience. To scale IoT effectively, organisations need broader capability, supported by continuous learning and external insight.

Taken together, these findings highlight the importance of moving beyond early awareness to a more deliberate, whole-organisation approach to IoT strategy and capability development.

Recommendations to Strengthen Strategic Readiness:

To address these challenges and improve readiness for IoT adoption, the following actions are recommended:

- **Build internal capability:** Invest in IoT training and awareness-raising across the organisation, not just in IT teams, to ensure shared understanding and alignment.
- **Broaden awareness:** Ensure key departments, including operations, customer services, compliance, and finance, understand the potential of IoT and its implications for service delivery.
- **Structure market monitoring:** Move from ad hoc interest to a structured approach to horizon scanning, using supplier engagement, peer learning, and industry networks to track developments and inform strategy.
- **Balance internal and external intelligence:** Combine in-house expertise with active participation in sector events, working groups, and collaborative projects to avoid isolation and build shared knowledge.

Strategic positioning of IoT

Based on the next section (Questions 6-9), we have been able to analyse whether or not IoT deployments are integrated into the organisation's strategy, or whether they are opportunistic "side projects", most likely driven by individuals.

Formal IoT Strategies Are Still Emerging

Only 31% of respondents report having an established IoT strategy. A further 27.6% are in the process of developing one, while 41.4% have no formal strategy in place.

This means that nearly seven in ten organisations are either without a roadmap or still in the early stages of defining one.

Implication:

In the absence of a formal strategy, IoT activity risks being piecemeal and short-term. Without a roadmap to guide investment, integration, and evaluation, initiatives are likely to remain disconnected and fail to scale.

Limited Alignment with Organisational Priorities

Respondents rated the alignment between IoT and their organisation's broader goals at a moderate level (mean: 6.14). Only three respondents selected a score of 9 or 10, suggesting that few organisations view IoT as fully embedded in their strategic direction.

Implication:

While interest is growing, IoT is often treated as an add-on rather than a central enabler of service transformation. This weak alignment limits cross-departmental support, resourcing, and leadership engagement.

Operational Drivers Dominate

Open-ended responses revealed that most organisations are motivated by immediate and practical concerns. The most common drivers were:

- Cost savings and efficiency gains
- Improved customer experience
- Damp, mould, and cold home monitoring
- Asset and repairs optimisation
- Compliance and regulation
- A smaller number cited Net Zero goals or strategic positioning.

Implication:

Most organisations view IoT as a tool for resolving operational pain points rather than as a lever for innovation or future competitiveness. This limits its strategic value and reduces the case for long-term investment.

Long-Term Timelines, Limited Short-Term Planning

The most common timeframe given for full IoT integration was five years (median and mode), placing expected maturity around 2029. However, variation in responses and outliers suggest this is more of a broad aspiration than a clearly phased implementation plan.

Implication:

Without shorter-term milestones or defined targets, these long-term aspirations risk becoming stagnant. A clearer pathway, including early wins and staged implementation, will be essential to maintain momentum.

Recommendations to Strengthen Strategic Positioning:

To move from reactive to strategic adoption, we recommend:

- **Develop and publish formal IoT strategies:** Roadmaps should outline phased implementation, alignment with organisational objectives, and clear governance.
- **Embed IoT into business planning:** Ensure IoT is integrated into transformation, asset, and IT strategies, with clear ownership at executive and operational levels.
- **Clarify the value proposition:** Shift the focus from reactive fixes to long-term service improvement, Net Zero alignment, and tenant outcomes.

- **Set practical milestones:** Establish short- and medium-term goals that turn strategic intent into delivery, tracking progress and building the case for further investment.

Taken together, these findings point to a need for stronger leadership, clearer strategic framing, and more structured implementation plans to move IoT beyond the margins and into the mainstream of housing service transformation.

Testing and Pilots: The Sector's Experience to Date

Questions 17–23 explored how organisations are testing IoT solutions, what technologies are being piloted, how success is measured, and what challenges are being encountered. While pilots are widespread, few have progressed to full-scale deployment, reflecting a broader hesitation across the sector.

Most Organisations Are Still Testing

- 72.4% of respondents have ongoing IoT pilots
- 13.8% have completed a pilot
- 13.8% have not piloted any IoT solutions

Implication:

The majority of organisations are in the early stages of experimentation. The low rate of completed pilots suggests challenges in concluding, evaluating, and embedding IoT solutions at scale.

IoT Focused on Risk Rather Than Tenant Experience

Most pilots involve:

- Environmental sensors (for damp, mould, CO₂, temperature, fire, and energy use)
- Smart thermostats
- Common suppliers include Switcher, Aico, Vericon, IoT Solutions Group, IOPT, and HomeLINK.

Implication:

Pilots tend to focus on compliance, energy, and property risk. Less attention is given to enhancing tenant experience or unlocking

broader service transformation through IoT.

Deployment Scales Vary Widely

- Mean number of devices: 709, Median: 150
- Range: 5 to 5,000 devices

Implication:

While a few organisations are testing at scale, most are piloting cautiously. This reflects the need to understand value and manage risk before wider investment, but it may also indicate capacity constraints.

Perceived Pilot Success is Mixed

- Mean success score: 5.28 (out of 10)
- Most scores fall between 4 and 7
- Only two responses rated pilots as highly successful (9 or 10)

Implication:

Organisations are seeing some value, but few consider their pilots highly successful. Common issues include implementation challenges, difficulty demonstrating ROI, and problems using data effectively.

Benefits Focus on Efficiency and Insight

Themes from free-text responses included:

- More proactive repairs and improved asset management
- Better insight into environmental conditions and resident behaviours
- A few noted improved tenant engagement and reduced energy bills, though many said it was too early to confirm outcomes

Implication:

IoT is helping landlords understand their homes better and intervene earlier. However, the direct benefits to tenants, and their experience of the technology, remain less evident.

Barriers to Success Are Common Across the Sector

Respondents cited recurring issues:

- Overwhelming volumes of data, without sufficient internal capability
- Tenant resistance, digital exclusion, and privacy concerns
- Technical issues, such as poor interoperability and device reliability
- Unclear or unproven return on investment

Implication:

Pilots often reveal underlying structural challenges. Without stronger data management, tenant engagement, and system integration, even promising tests may stall.

Most Pilots Are Not Yet Scaling

- Only 24% of pilots have progressed to wider rollout
- 76% remain as isolated or small-scale tests

Implication:

Despite growing interest, the majority of organisations are struggling to move beyond the pilot stage. Challenges around cost, risk, integration, and capacity continue to limit wider adoption.

Recommendations to Strengthen IoT Piloting and Progress to Scale

To increase the effectiveness of IoT pilots and improve pathways to implementation:

- **Establish clear success metrics:** Define KPIs at the outset to assess outcomes

consistently and demonstrate impact.

- **Build internal analytics capability:** Ensure teams are equipped to manage and interpret data, not just collect it.
- **Co-design with tenants:** Involve residents early to reduce resistance, build trust, and ensure relevance of use cases.
- **Prioritise integration and interoperability:** Choose technologies that align with core systems and data strategies.
- **Plan for scaling from the start:** Treat pilots as a route to implementation, not isolated experiments, with defined criteria, governance, and funding for rollout.

The sector has made progress, but unlocking the full value of IoT will require moving beyond small pilots towards confident, integrated deployment.

Overcoming Internal Barriers to IoT Success

This section (Questions 24–30) explores the internal obstacles social landlords face in scaling IoT solutions, focusing on funding, systems integration, data handling, skills, and culture. While interest is growing, the internal infrastructure and capacity needed to support IoT at scale remains underdeveloped.

Funding is the Primary Constraint

- Funding was the most frequently cited barrier to scaling IoT.
- Responses ranged from “slightly limiting” to “massively restricting.”
- Many noted that IoT competes with other investment priorities, and recurring revenue costs (e.g. mobile data) add further pressure.
- Organisations largely view IoT as “invest to save”, but proving ROI before full deployment is challenging.

Implication:

Without clearer business cases and cost-benefit evidence, funding constraints will continue to limit uptake.

Integration with Existing Systems is Complex

- Mean integration difficulty: 5.66 (out of 10)
- Barriers include IT system compatibility, API limitations, and changes to workflows

Implication:

IoT is not easily embedded into existing systems. Success depends on dedicated resources for integration and close collaboration between IT, data, and operational teams.

IoT Data Is Not Yet Integrated or Actionable

- Mean score for data integration: 2.18
- 28.6% of responses rated integration as zero; only one rated it above 5

Implication:

Most organisations are not yet feeding IoT data into central systems or processes. As a result, valuable insights remain siloed and are not shaping decisions or service delivery.

Automation and Analytics Tools Are Underused

- 40.7% of organisations do not use APIs or analytics platforms
- A further 40.7% use them only partially
- Just 18.5% have fully adopted these tools

Implication:

Manual handling of IoT data is still the norm, limiting efficiency and impact. Without automation and real-time analytics, the value of the data collected is significantly reduced.

Confidence in Using IoT Data Remains Low

- Mean score for confidence in using IoT data: 3.2
- Most responses clustered between 2 and 4

Implication:

Low confidence in data use points to a broader skills gap. Many teams do not yet know how to turn IoT data into actionable insights that drive strategic decisions.

Skills Gaps Are Slowing Progress

- Mean confidence in IoT-related skills: 4.84
- Median and mode: 6, suggesting a modest level of internal capability

Implication:

While some in-house skills exist, many organisations lack the depth of expertise needed for full IoT deployment, particularly in data analysis, integration, and digital transformation.

Recommendations for Strengthening the Internal Foundations for IoT

Despite growing enthusiasm, most organisations lack the internal architecture to support IoT at scale. Funding gaps, integration challenges, limited use of analytics, and underdeveloped skills are acting as critical barriers.

To move forward, landlords need to strengthen their operational readiness:

- **Address funding uncertainties** with better cost modelling and staged investment approaches
- **Improve system integration** through better API adoption and cross-team collaboration
- **Invest in data infrastructure** to make IoT insights accessible and actionable

- **Develop internal capacity** through training, recruitment, and knowledge-sharing
- **Build organisational buy-in** by embedding IoT into strategic priorities and fostering a culture of innovation

Tenant Engagement with IoT Deployment

This section explores the role tenants play in IoT planning, the extent to which they can access data about their homes, and how openly organisations communicate about the technology and its benefits.

Tenant Involvement in Planning and Deployment

- Mean score: 3.64 | Median: 3 | Mode: 3 | Standard deviation: 2.72
- Most responses fall in the lower range (1–5), with only one response rating tenant involvement at 9 or 10.

Implication:

Tenant participation in shaping IoT rollouts is currently limited. Without meaningful involvement, organisations risk low acceptance, misunderstandings, or mistrust of the technology.

Tenant Access to Data from IoT Devices

- 40.7% of organisations provide tenants with access to their data
- Another 40.7% are developing access systems
- 18.5% currently do not provide any access

Implication:

While there is movement toward greater transparency, a substantial portion of tenants remain unable to view data about their own homes. Without access, tenants may not feel the benefit of IoT or be able to act on insights that could improve their comfort or costs.

Transparency About IoT-Driven Changes

- Mean score: 5.27 | Median: 4.5 | Mode: 4 | Standard deviation: 2.39
- Most responses cluster between 3 and 7, suggesting moderate transparency
- Only four organisations rated transparency at 9, with none at 10

Implication:

Few organisations are fully transparent about how IoT is used or how it benefits tenants. This may undermine trust, particularly where sensors collect environmental or behavioural data.

Recommendations to Strengthen Tenant Engagement

- Involve tenants earlier in the IoT journey, through consultation, co-design, or pilot feedback
- Provide tenants with clear, accessible data about their homes, including actionable insights
- Communicate transparently about what data is collected, how it's used, and what benefits it delivers
- Address concerns about privacy and control by explaining safeguards and giving tenants a sense of ownership

IoT can enhance services, but without trust and participation, the value for tenants may be lost.

Future Plans for IoT Deployment

The final set of questions explored future intentions for IoT deployment across the sector, particularly the likelihood of expanding beyond pilots and what types of support or capabilities would be needed to do so effectively.

Future Priorities for IoT Investment

Key themes emerging from free-text responses:

- **Scaling and Strategy Development (6 responses):** Several organisations are developing longer-term strategies and looking to scale IoT across their stock.
- **Data Management and Integration (5):** Improving internal data capacity and integration is a high priority for many.
- **Damp, Mould and Compliance Monitoring (4):** IoT is still primarily seen as a compliance and risk management tool.
- **Customer Engagement and Tenant Experience (3):** A smaller number of organisations are beginning to explore how IoT can be used to improve services and engagement with tenants.
- **Energy Efficiency and Retrofit (3):** Some are embedding IoT into wider retrofit strategies, including monitoring and verification.
- **AI and Predictive Maintenance (2):** A few are starting to explore how predictive analytics and automation could reduce costs and improve service outcomes.

Implication:

The majority of future plans still lean toward operational and compliance objectives rather than resident-facing innovation. However, ambitions to scale and integrate more sophisticated analytics suggest a maturing approach across the sector.

Support Needed to Scale IoT Deployment

Organisations were asked what support or enablers would help them grow their use of IoT technologies. Responses highlighted the following recurring needs:

- **Funding (12 responses):** The most common theme. Many respondents said that while there is clear potential, investment in IoT competes with more immediate priorities.
- **Training and Best Practice Guidance (5):** A call for practical support, case studies, and clear pathways to deployment.
- **API and IT Integration Support (4):** Persistent challenges around system interoperability and lack of technical alignment with housing systems.
- **Workforce and IT Capacity (2):** A shortage of internal resources to manage deployment and make use of the data.
- **Policy and Standards (2):** A few responses suggested that clearer national guidance or frameworks could help give organisations the confidence to invest.

Implication:

Although funding dominates, organisations also need access to shared learning, technical infrastructure, and clearer sector-wide standards. Integration challenges and a lack of internal capacity continue to stall progress.

Confidence is high, but without a shared framework for investment, learning, and integration, many organisations may struggle to move from aspiration to action.

Likelihood of Expanding IoT Over the Next 3 Years

- Mean score: 6.43, Median: 7, Mode: 7, Standard deviation: 1.99
- Most scores fell between 6 and 9, indicating moderate to high confidence.
- Very few respondents rated their likelihood below 4.

Implication:

Most organisations expect to expand their IoT efforts in the next three years, but actual delivery will hinge on resolving challenges around cost, integration, and internal capability.

Recommendations to Strengthen Future of IoT

- Develop clear and flexible funding models, including phased approaches or pooled trials, to lower entry barriers
- Create shared best practice resources across the sector, including deployment roadmaps, case studies, and toolkits
- Push for API standardisation and greater interoperability between IoT platforms and housing systems
- Invest in AI and automation tools that can translate raw data into actionable, timely insights
- Ensure that IoT strategies consider tenant outcomes and trust, not just compliance and asset management

Recommendations

Drawing on findings from across the questionnaire, this section sets out practical recommendations to support the wider and more effective adoption of IoT in social housing. The aim is to help organisations move from exploratory pilots to confident, integrated deployment that delivers both operational efficiencies and tenant-facing benefits.

Sector-Wide IoT Knowledge and Understanding

To build a stronger foundation for adoption, organisations need to broaden and deepen their internal understanding of IoT technologies.

- Invest in targeted IoT training to strengthen in-house technical and strategic knowledge.
- Ensure awareness extends beyond IT and innovation teams to include finance, operations, and service leaders.
- Adopt a more proactive approach to tracking emerging IoT solutions and market trends.
- Engage more actively with external networks, peer organisations, and suppliers to avoid knowledge silos.

Strategic Positioning of IoT

IoT needs to be embedded in long-term business planning rather than treated as a series of standalone pilots.

- Develop formal IoT roadmaps to structure activity across short-, medium-, and long-term horizons.
- Align IoT projects with broader organisational priorities, such as net zero, asset management, and customer service.
- Shift from reactive experimentation to proactive, strategic deployment.
- Establish interim milestones to track progress toward full integration.

Testing and Pilots

To increase impact and scalability, pilots must be more clearly defined, measured, and integrated into service transformation plans.

- Define success criteria and KPIs before launching pilots to evaluate outcomes meaningfully.
- Invest in data analytics tools that can turn sensor data into actionable insights.
- Engage residents early, co-designing pilots where possible to build trust and encourage adoption.
- Prioritise system interoperability, ensuring vendors support API access and integration with core housing platforms.
- Develop clear transition plans from pilot to scale, including budgeting, training, and risk mitigation.

Overcoming Internal Barriers

Organisations need to address technical, cultural, and operational challenges to enable successful IoT deployment at scale.

- Establish clearer ROI frameworks to support internal business cases and secure funding.
- Improve API use and system integration to ensure data flows seamlessly across platforms.
- Shift from manual data handling to automated dashboards and predictive analytics.
- Upskill staff in data analysis, integration, and strategic use of IoT insights.
- Build internal buy-in by linking IoT to organisational goals and ensuring strong leadership advocacy.
- Promote common standards for API and system integration to simplify technical delivery.
- Invest in AI tools to move from reactive data use to predictive, automated decision-making.
- Ensure that future IoT growth remains aligned with tenant priorities, not just asset compliance.

The sector is ready to scale, but success will depend on leadership, collaboration, and a focus on both people and systems.

Resident Involvement and Experience

IoT strategies will be more effective, and more trusted, when tenants are informed, involved, and able to benefit from the technology.

- Create opportunities for tenant input during planning and deployment.
- Provide tenants with clear, accessible data about their home environments.
- Communicate openly about how data is used and the value it delivers, especially around safety, comfort, and cost savings.
- Embed digital inclusion and privacy awareness into tenant engagement strategies.

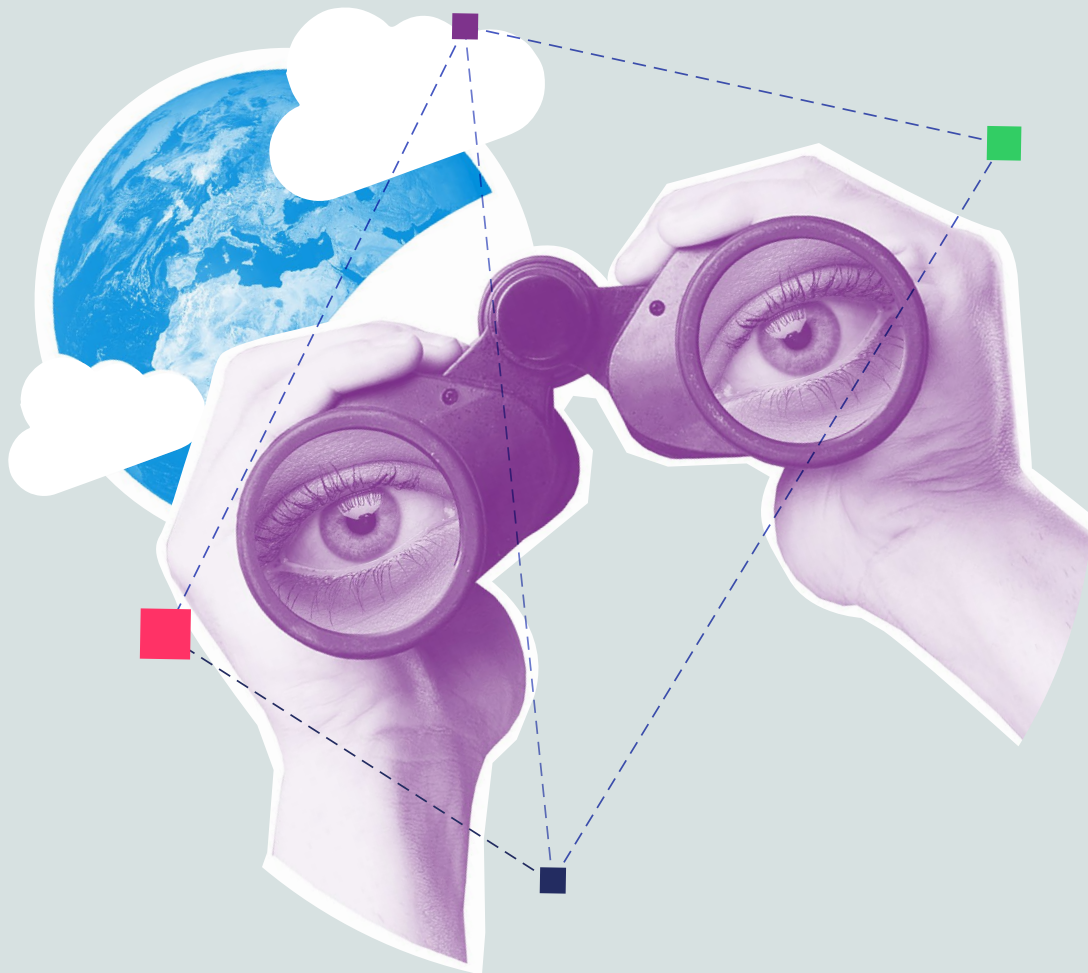
Supporting Future Expansion

As the sector looks to scale its use of IoT, practical and policy-level support will be critical.

- Develop flexible funding approaches, including phased investment and shared trials.
- Share best practice across the sector, covering deployment models, data use, and tenant engagement.

Part 2c

Semi-structured Interviews



Executive Summary

This report presents findings from a major qualitative study on the deployment of Internet of Things (IoT) technologies in social housing. Based on semi-structured interviews with 39 participants, including housing providers, suppliers, system enablers, and tenants, this research examines how connected home technologies are being adopted, the barriers that persist, and the conditions needed to scale these innovations meaningfully.

The report finds a sector in flux. While pockets of progress are visible-particularly where landlords have aligned connected technologies with core operational goals-most deployments remain isolated, small-scale, and disconnected from wider service transformation.

From the landlord perspective, interest in IoT is growing, but implementations are often hindered by low digital confidence, fragmented systems, limited in-house capability, and uncertainty about long-term value. Where IoT has worked better, it has typically been championed by committed individuals, focused on specific problems such as damp and mould, fire safety, or retrofit optimisation. However, the absence of end-to-end integration and a lack of follow-through on insights often means that data remains underused, and opportunities for prevention are missed.

From the supplier perspective, there is widespread frustration at structural inertia within the sector. Suppliers describe

housing providers as cautious, siloed, and constrained by outdated procurement frameworks. While they recognise progress in some areas, they emphasise that landlord readiness-culturally, operationally, and technically-remains a limiting factor. Critically, they highlight that meaningful outcomes depend not just on the technology but on the organisational systems surrounding it.

Key tensions also emerge around data ownership, platform control, and commercial models. Suppliers and landlords often have divergent expectations about integration, dashboards, and the handling of resident data. At the same time, both groups express a desire for more open, interoperable systems and clearer standards to guide development and procurement.

Resident engagement is a further area of concern. While IoT devices are increasingly installed in people's homes, tenants are often left out of the design and implementation process. Questions about data governance, informed consent, and resident control remain largely unresolved.

The report concludes that connected homes cannot be delivered through technology alone. Success depends on cross-functional leadership, investment in digital capabilities, reformed procurement processes, and joined-up delivery models that connect data with action. This will require both landlords and suppliers to shift from short-term pilots to long-term service transformation-grounded in trust, collaboration, and shared accountability.

Interview Methods and Analytical Approach

Methodology

This research was undertaken to better understand how connected technologies - such as environmental sensors, smart heating systems, and digital platforms - are being implemented, experienced, and scaled within the UK social housing sector.

The project employed a qualitative, semi-structured interview methodology, designed to elicit deep, practice-based insights rather than statistically representative findings. The emphasis was on lived experience, organisational context, and emerging patterns.

Participants were selected to reflect a wide cross-section of perspectives and organisations within the connected homes ecosystem. The sample included:

- **Landlord organisations (9)** – housing associations and local authorities with varying levels of digital maturity and stock complexity.
- **Technology suppliers (6)** – specialising in areas such as environmental monitoring, heating optimisation, and energy data platforms.
- **Ecosystem enablers (3)** – including integration specialists and digital infrastructure providers.
- **Tenants (1)** – providing first-hand insights into lived experience with in-home devices.

In total, **39 individuals** took part in interviews conducted between April and June 2025. Participants represented a wide range of roles - from senior leaders and innovation directors to surveyors,

data analysts, and compliance managers - spanning departments such as asset investment, sustainability, IT, housing management, and procurement. The group also reflected diverse stages of IoT maturity, from exploratory pilots to full-service deployment.

A simplified sampling matrix was used to track key variables across the group:

- Organisation type (landlord, supplier, enabler)
- Department/function (e.g. assets, compliance, IT)
- Role level (strategic, managerial, operational)
- IoT experience (high, medium, low)

Each interview lasted approximately **60–90 minutes** and followed a common topic guide, tailored slightly to reflect the interviewee's role and perspective. Key themes included:

- Strategic purpose of IoT and digital platforms
- Organisational readiness and operational barriers
- Data management, integration, and ownership
- Resident engagement, ethics, and trust
- Supply chain issues and procurement
- Visions for scaling and future ambition

All interviews were conducted with informed consent, recorded, transcribed, and checked for accuracy prior to analysis.

For full interview guides, as well as the sampling strategy, view [Appendix 4](#).

Analytical Approach

The analytical process was inductive and thematic. It combined individual case analysis with cross-case synthesis to surface both common patterns and sectoral differences.

Key steps included:

- **Close reading** of transcripts to identify repeated language, metaphors, and categories.
- **Thematic coding**¹ of interviews using a flexible framework that evolved as the dataset grew.
- **Triangulation** between landlord, supplier, ecosystem, and tenant perspectives to identify alignment and divergence.
- **Integration of verbatim quotes** to preserve nuance and support interpretation with direct evidence.

Importantly, interviews were grouped and analysed in four primary clusters:

1. **Landlords** – to identify shared challenges in internal workflows, integration, scaling, and resident engagement
2. **Suppliers** – to explore platform design, commercial models, and alignment with landlord needs
3. **Ecosystem voices and tenant experience** – to enrich the picture with views from beyond the core landlord-supplier dynamic
4. **Tenant** – The tenant perspective for this research was not planned to be captured during these interviews – instead these are captured via tenant workshops and surveys. However, an exception was made for this highly engaged tenant who provided valuable insights into the lived experience of connected device deployment in the home.

The analysis aimed to do more than catalogue challenges - it sought to map tensions, highlight emergent practices, and uncover structural mismatches that could hinder or enable progress toward scalable, ethical, and resident-centred connected home strategies.

All quotes included in this report have been anonymised to encourage open sharing and reflection, and to protect the confidentiality of interviewees.

1. The full coding framework can be viewed at [Appendix 2](#).

Landlord Interviews

Strategic Vision and Drivers

Across the interviews with housing providers, there is broad alignment around the strategic drivers underpinning interest in connected home technologies. Most providers cite regulatory compliance (including damp and mould obligations), decarbonisation, and a shift toward proactive services as central motivations. The move from reactive to preventative service delivery was frequently referenced as a desired long-term outcome.

One landlord described their aim as “getting ahead of the curve - not waiting for problems to come to us, but seeing them coming.” Another referenced the need to “triage risk” more efficiently across a complex housing portfolio, with connected technologies framed as part of a wider toolkit for asset and tenant risk management.

The Net Zero agenda emerged repeatedly, with connected devices viewed as complementary to retrofit strategies. As one interviewee put it: “You can’t decarbonise without understanding performance - and you can’t understand performance without data.” Another participant argued for expanding the role of IoT beyond compliance or asset monitoring, framing it instead as a foundation for unlocking ESG-linked finance and delivering long-term energy services: “If you put this in and let us do what we need to do, we’ll cap your energy price... it’s a service offer, not just a sensor.”

Several landlords emphasised the importance of aligning connected

technology with broader organisational goals. One participant reflected: “We’re not doing tech for tech’s sake. It needs to support what we’re trying to achieve as a landlord – safer homes, warmer homes, and better service.”

While regulatory pressure (e.g. Awaab’s Law) has accelerated interest in sensors, the long-term ambition is broader: to integrate real-time data into strategic asset planning, housing management, and customer experience. As one senior leader explained: “The data can be a catalyst; it can connect compliance, asset management, and housing in a way we haven’t managed before.”

However, despite the language of strategy, most organisations remain in an exploratory or opportunistic phase. Rather than embedding IoT in strategic asset plans or operational workflows, deployments are often driven by innovation funding, supplier offers, or the enthusiasm of individual leaders. This results in fragmented pilots with limited scalability and organisational learning. There is a visible gap between the strategic aspiration for proactive services and the operational systems needed to deliver them.

Current Position and Use Cases

Most landlords interviewed are still in pilot or exploratory phases. Some are trialling sensors in a few hundred homes, often aligned with damp and mould interventions, SHDF/Warm Homes-funded retrofit work, or complex case management. These pilots are typically time-limited and linked to specific objectives.

In several cases, IoT deployments have been tied to understanding retrofit efficacy. One participant noted: “We installed sensors in the homes before and after retrofit to see what changed. That helps us justify the investment.”

Others are using sensors to improve repairs diagnostics and reduce unnecessary call-outs. “We’re trying to cut down no-access visits. If we know what’s going on in the property, we can make better decisions about when and whether to attend,” said one operational lead.

A few providers are experimenting with proactive triage models. One asset manager described a small trial: “We set thresholds so that if temperature and humidity hit a certain pattern, it flags to the team. That way we can call before it becomes a full-blown complaint.”

However, these examples remain relatively rare. Most landlords described their current use as reactive or observational: “We’re still figuring out what the data means and how to use it.”

Pilots, in many cases, function as a form of reassurance or delay rather than transformation. There is a tendency to run multiple trials without clear pathways to scale. Sensor data often remains siloed in dashboards with no clear ownership or operational response plan. One insight emerging across interviews is that the pilot phase risks becoming a cul-de-sac - producing learning without embedding it.

Operational Gaps and Internal Challenges

Despite strategic enthusiasm, most landlords describe internal readiness as partial or underdeveloped. The most commonly cited challenges relate to integration - specifically the difficulty of

feeding sensor data into existing systems (e.g. NEC, Salesforce, Power BI).

One landlord described it plainly: “We don’t need another portal. We need the data in the systems we already use.” Another added: “Every new system wants to show you their dashboard. But we’ve already got five.”

Ownership and governance also emerged as major concerns. Several interviewees mentioned uncertainty about who should act on sensor alerts or how new data streams fit into existing workflows. “The install is easy,” said one asset lead. “The hard part is making the data usable and making sure someone is responsible for doing something with it.”

This was echoed by another participant: “There’s still a culture gap. Housing officers are wary of data they don’t understand. Asset teams are focused on programmes, not daily alerts. So who picks it up?”

Capacity is another barrier. While some landlords have internal data teams, many rely on stretched operational staff to interpret alerts. This can lead to under-use or abandonment of dashboards. “We had a pilot, but there wasn’t the time to look at the data, let alone act on it. It just sat there.”

IoT is exposing deeper organisational issues. The deployment of sensors reveals long-standing problems with data governance, role clarity, and internal fragmentation. In many cases, internal teams do not agree on who owns the alerts, how they should be triaged, or how they relate to housing management priorities. One interviewee summarised it: “IoT is showing us where the cracks are.”

Transformation often depends on a few internal champions, usually based in digital, innovation, or hybrid roles. These individuals

frequently lack the authority to drive cross-departmental change. Their influence is substantial but precarious - without structural embedding, momentum risks collapsing if key staff move on.

Resident Engagement

Tenant engagement is widely seen as essential. Landlords report better acceptance when technology is introduced as part of a wider home improvement offer. “If we’re doing insulation and ventilation and giving you something that helps you manage that, it lands better,” noted one interviewee. Another explained: “When it’s framed as part of a broader investment, tenants are more receptive. But if it’s just a sensor on the wall, they ask, ‘What’s this watching me for?’”

Despite this recognition, resident engagement is often limited to communications or consent - framed more as risk mitigation than partnership. Most interviewees acknowledged that residents are not actively involved in shaping deployments or interpreting data. This passive model can reinforce scepticism or disengagement.

Several examples, including one engaged tenant, point to the transformative potential of co-production. In this case, the resident proactively requested additional sensors, shared their data with surveyors, and used the insights to advocate for remediation. These cases highlight what’s possible when residents are viewed not just as data subjects but as informed partners.

The prevailing engagement model remains procedural and risk-averse. Without a shift toward shared ownership and co-design, the full potential of IoT to improve household outcomes and build trust may remain unrealised.

Landlord Expectations of Suppliers

Landlords expressed a strong preference for interoperability. Open APIs, simple data exports, and minimal reliance on standalone dashboards were repeatedly mentioned. As one manager put it, “We want to buy capability, not lock ourselves into one interface.”

Suppliers that offered flexible integration options were viewed more favourably. One landlord described their positive experience as follows: “They didn’t push their platform; they asked how we worked and adapted to that.”

Conversely, landlords expressed frustration with closed platforms or “black box” analytics. Some raised concerns about future costs or being dependent on a single supplier for insights or support. “If we need to change provider later, I don’t want to have to rip everything out and start again,” one asset lead explained.

There is also appetite for more than just data - landlords want guidance on interpretation, triage, and operational integration. “It’s not just the tech,” one said. “We need partners who understand housing.” Another summed it up succinctly: “Don’t just sell me sensors. Help me build the service around them.”

However, several interviewees noted that current procurement frameworks often inhibit the kinds of relationships they are seeking. Rigid tendering processes make it difficult to reward innovation or long-term partnership. Some landlords reported relying on incumbent suppliers despite better options being available, simply because the procurement routes are too inflexible.

Suppliers are sometimes seen as more technologically advanced than landlords' systems can handle, leading to frustration on both sides. As one participant observed: "They're trying to sell us 2030 tech, but we're still working with 1990s workflows."

Ultimately, landlords want scalable solutions that work with their internal systems, allow for organisational learning, and avoid creating parallel processes. The message across interviews was clear: integration, support, and flexibility matter more than flashy dashboards or features.

Supplier Interviews

Product Strategies and Offers

Across the supplier interviews, organisations consistently described their core offerings as extending well beyond hardware. Sensors, alarms, or control devices were typically framed as entry points into broader solutions focused on analytics, behavioural change, integration, and long-term asset optimisation.

One supplier described their evolution from being a “detector company” to a “data and analytics provider,” with growing emphasis on predictive capabilities and housing-specific insights. Their ambition was to help landlords transition from reactive to preventative services.

Another supplier highlighted their role in “supporting decarbonisation by helping landlords get more from their retrofit investment,” pointing to strategic alignment with funding cycles and net zero targets. For some, especially those offering heating and hot water solutions, digital twin modelling and machine learning were key differentiators. Others prioritised usability and tenant experience:

“We put user experience at the centre. If tenants hate it, it won’t work - and the landlord will be left with complaints.”

Suppliers also described adapting to sector needs in real-time, with examples including:

- Developing mobile-friendly dashboards for operatives and tenants
- Creating custom alert triage systems to reduce information overload

- Expanding API capabilities to better support integration
- Supporting landlords to develop use cases beyond damp and mould, including energy efficiency, fuel poverty, and health-linked outcomes

Several suppliers mentioned their efforts to provide co-designed solutions in partnership with housing associations. In particular, IoT platforms were seen not only as devices or dashboards but as ongoing service models that required shared ownership:

“We see ourselves as service partners, not just device vendors. If you’re not responding to what housing teams actually need, you’re not going to last.”

Perceptions of Sector Readiness

Supplier views varied significantly on the sector’s readiness to implement connected home technologies. Several expressed frustration with organisational barriers to uptake:

“We’ve had to learn to go at their pace. You can’t sell an analytics solution to a team that doesn’t yet have anyone to act on the data.”

Others recognised encouraging signs of progress:

“Some landlords are really pushing boundaries - thinking about integration, data governance, triage models. That’s where we see traction.”

The presence of internal champions was consistently flagged as a critical factor:

“Most of our projects survive because there’s one person inside the housing association who gets it. But it’s fragile-if they leave, so does the momentum.”

Suppliers noted a general lack of digital maturity across the sector, often within the same organisation. Disconnections between asset management, housing, and customer service teams were commonplace:

“The asset team might be switched on, but housing officers aren’t looped in. That creates disconnects in how the data is used.”

Organisational culture was frequently cited as a barrier to innovation. Suppliers observed that many housing providers remain reactive in their operating models:

“IoT doesn’t fit easily into the reactive culture. Landlords are set up to respond after failure, not prevent it.”

This was reinforced by reflections on structural inertia and risk aversion:

“It’s not just the tech - it’s the mindset. Too often, there’s fear of knowing. If you detect damp, then you’re accountable for fixing it. That’s why some landlords used to shy away.”

Recent regulatory shifts have changed this to some extent:

“They’ve been led that way by the regulator. There’s no hiding behind ‘we didn’t know’ anymore.”

Integration, Lock-In, and Commercial Models

Supplier interviews revealed varied approaches to integration and commercial openness, often shaped by whether the offer was hardware-led, software-

only, or hybrid. While many suppliers expressed a willingness to integrate with housing systems, several acknowledged commercial limitations:

“We’re happy to integrate, but it depends on the business case. If we open up too much, we lose the value we’ve built.”

Many positioned their analytics platforms as essential to delivering value:

“You don’t just want the raw readings - our models give context, risk scores, actionable prompts.”

This emphasis, however, sometimes clashed with landlord expectations:

“Everyone wants to own the dashboard, but nobody wants to own the process that follows. That’s the real gap.”

Concerns around vendor lock-in were well recognised. Some suppliers actively promoted open APIs and data standards as part of their value proposition, while others were more cautious - citing IP risks and limited incentive to support interoperability in a fragmented market.

One SaaS-based supplier without proprietary hardware noted that assumptions around integration often default to physical devices: “We don’t install anything - we just need smart meter data. But many landlords assume integration always means kit on the wall.” This disconnect can be especially pronounced where internal teams are unfamiliar with energy APIs or open data infrastructure.

Another supplier described how they deliberately embedded IoT costs within broader service lines, bundling them into retrofit or remediation budgets to sidestep procurement hurdles: “If you say you need to spend £750 instead of £50, people fall off their chair. But if it’s part of the overall

service cost, it's fine - like your Sky box, it just comes with everything else."

This strategy - treating IoT as an embedded enabler rather than a standalone product - was echoed by others trialling deferred payments, turnkey packages, or outcome-linked pricing. As one participant explained: "We've created financing models where our fees ride on the back of capital works - because that's what makes it viable at scale."

Commercial models varied considerably. While some suppliers offered hardware-as-a-service or subscription pricing, others preferred traditional capex-based approaches. There was little consensus across the sector:

"Procurement processes just aren't set up to buy outcomes - they're still buying kit."

One SaaS-based provider reiterated the scalability advantage of not relying on hardware: "We don't install anything - we just need access to smart meter data." Yet others went further, repositioning IoT not as a product but as a data infrastructure underpinning wider services such as insurance, ESG finance, and retrofit optimisation. As one interviewee put it: "We call ourselves a fintech. The data underwrites everything - from retrofit decisions to capped energy tariffs." This reflects a shift toward service-led models where sensors are simply the entry point to broader, data-driven value propositions.

Short-term procurement cycles were a recurring concern:

"Some landlords run a three-year pilot, then re-procure the same device from a different supplier who undercuts on price. There's no continuity, no learning."

Ecosystem Outlook and Risk Framing

Supplier perspectives on the ecosystem reflected a mix of optimism and exasperation. Many saw strong alignment between their technology offers and the sector's stated priorities-such as compliance, net zero, and resident wellbeing-but felt that delivery capacity was not yet in place.

"The appetite is there, but it's hard to scale when every landlord wants a different pilot and nobody wants to commit."

Others warned of lost momentum:

"If the sector doesn't move from pilot to platform, we'll lose the innovation window. Tech companies can't hang around forever."

One supplier noted that many landlords were still "very early in the maturity curve" when it came to using energy data operationally. This gap made it difficult to scale even promising technologies. "Some have loads of data and don't know what to do with it - others have none and want us to create magic."

Suppliers generally called for more coordinated leadership, clearer standards, and shared infrastructures. Suggestions included open data frameworks, neutral integration layers, and cross-sector governance for interoperability:

"We're all trying to solve the same problems. But we're doing it in silos, and that's holding everyone back."

Resident Engagement and Data Governance

Another consistent theme was resident engagement. Suppliers noted that few landlords had robust tenant engagement plans for IoT deployment, leading to mistrust or underutilisation:

“There’s a real lack of clarity about data ownership. Tenants don’t know what’s being collected or how it’s used-and neither do landlords, half the time.”

Another supplier noted that landlords often struggled to explain the purpose of energy data collection - both internally and to residents. “When we ask who’s using this data and what they’re doing with it, the answers are vague. That undermines trust.” Attempts to give tenants more control over energy data through dashboards or mobile access were rebuffed by some landlords concerned about reputational or legal risks.

Some had developed resident-facing platforms or mobile apps to share data directly with tenants, but uptake was limited:

“We tried putting data directly into residents’ hands through a mobile app. The idea was great, but landlords wouldn’t support it-too risky, they said.”

One supplier added an additional layer of critique here, noting that requests to co-design with residents were often ignored:

“We asked to co-design the rollout with tenants. The landlord said they’d ‘get back to us.’ That was 18 months ago.”

Structural Capacity and Organisational Fragility

The challenge of embedding IoT into day-to-day operations was underscored. Several organisations described housing providers that struggled to turn insights into action due to fractured workflows:

“The insights are there-about which buildings are failing, which tenants are struggling. But unless you have a team ready to act on it, it’s just noise.”

Suppliers described how even clear signals of risk-like persistent high humidity or missing fire alarms-could fail to trigger timely intervention because of rigid service processes:

“What good is a sensor that flags high humidity if it takes six weeks and three job tickets to get a repair booked?”

Several referenced the fragility of projects that depend on individual champions:

“You can spot the landlord that’s going to succeed-they’ve got someone who really understands data, someone who knows housing ops, and someone senior who’s backing them. Without that triangle, it falls apart.”

Until such change happens, the consensus was clear:

“The technology is ready. The sector is not.”

Tensions and Divergences

This section explores the key fault lines that emerged across the interviews - especially where landlord and supplier perspectives diverge. These tensions are not necessarily oppositional, but they reflect different operating realities, commercial incentives, and organisational priorities. Recognising and addressing these differences will be critical to building more coherent and scalable connected homes ecosystems.

Control vs. Lock-In

Perhaps the most visible and persistent tension centres on control. Landlords consistently expressed concerns about being locked into proprietary platforms that restrict flexibility and increase long-term risk. By contrast, some suppliers, particularly those offering bundled hardware, analytics, and interfaces, saw vertical integration as a route to product reliability, speed, and value.

As one landlord put it: “We want to own the insight, not just rent it from someone else.” Another noted: “If it doesn’t integrate with what we already use, it’s a no. We can’t afford to have five dashboards and a team babysitting each one.”

On the supplier side, the response was more varied. Some actively embraced integration, offering open APIs and supporting custom pipelines. Others were more cautious, citing the cost of supporting diverse use cases. One supplier

said: “We’re happy to integrate, but there has to be a business case. It’s not plug-and-play for us either.”

Ecosystem enablers highlighted that while landlords often seek ownership over dashboards and data flows, they may simultaneously lack the infrastructure or resourcing to manage them effectively. One integration partner noted: “Landlords want the power but not the overhead, and the real challenge is agreeing who maintains the connective tissue.”

This tension is ultimately about power and agency: who owns the data, who gets to act on it, and who controls the value chain. Without alignment here, collaboration risks becoming transactional or brittle.

Business Model Misalignment

Closely linked to the issue of control is a deeper misalignment between organisational business models. Most housing providers operate within the constraints of public sector procurement, fixed budget cycles, and cautious governance. In contrast, suppliers are shaped by commercial imperatives—growth targets, investor expectations, and customer acquisition pressures.

This creates conflicting rhythms and differing appetites for risk. Landlords typically seek assurance, flexibility, and ongoing support, while suppliers often depend on volume, standardisation, and predictable revenue. As one supplier put it: “They want a partner, but also want to be free to leave whenever. That makes investment tricky.”

In some cases, this disconnect has been managed through phased engagement or joint piloting. But without a clearer mutual understanding of each other's commercial drivers, innovation often stalls after the pilot stage.

Some suppliers suggested that linking IoT to measurable financial outcomes could help bridge this divide. One observed: "If you use IoT to validate outcomes, your retrofit budget [across the UK] doesn't need to be £270 billion - it could be £170 billion." This reframes IoT not as a cost burden, but as a financial enabler that supports smarter investment and long-term value.

Integration Capacity: Technical and Organisational

Many suppliers framed integration as a technical challenge - about APIs, data formatting, and platform interoperability. However, interviews with landlords revealed that the real bottlenecks are often organisational: unclear data ownership, low internal capacity, and misaligned workflows.

One landlord explained: "The data was great. But it landed in a system nobody owned, triggered alerts nobody was trained to read, and caused more noise than action."

Ecosystem enablers repeatedly emphasised that integration success depends less on APIs and more on internal capability and decision clarity. One technical consultant explained, "We've built integrations, but they get stuck in limbo when no one internally owns the workflow. It's not about whether we can, it's about who follows through."

They also flagged common blind spots around data governance, such as overlapping responsibilities across IT,

assets, and housing teams, leading to "good intentions lost in translation."

This gap between data and response emerged repeatedly. Suppliers may believe they've delivered a usable solution, but if landlords lack the infrastructure, triage models, or change management support to operationalise it, impact remains limited.

Language and Power

Finally, several interviews hinted at more subtle tensions around language, framing, and implicit power dynamics. Terms like "insight", "support", or "partnership" were used by both sides - but not always with shared meaning.

A supplier might describe its portal as delivering actionable insight; a landlord might view it as another interface demanding time and training. One landlord remarked: "Everyone wants to be a partner until something goes wrong. Then we're just the client again."

These misalignments in framing can erode trust and lead to mismatched expectations. They also reflect a broader asymmetry in technical expertise, procurement leverage, and market visibility. If not surfaced and addressed, these underlying differences risk undermining collaboration.

Landlord vs Supplier Tension Matrix

Supplier Offers	Landlord Needs / Perceptions
'Actionable insight' via dashboards and risk scores	Additional interfaces requiring time, skills, and resources
Framing IoT as 'support' for compliance and prevention	Need for clear accountability and compliance defensibility
Describing commercial deals as 'partnerships'	Desire for reliable service and responsiveness when things go wrong
Push for standardisation and platform control	Concern about vendor lock-in and loss of control
Flexible business models and outcome-based pricing	Budget certainty, alignment with procurement cycles

This tension map should not be seen as a barrier to progress. Instead, it highlights the areas where more explicit dialogue, better design, and sector-level coordination are needed to translate ambition into scale.

Shared Challenges and Common Ground

Despite divergences in priorities and models, several shared challenges and points of agreement emerged across landlord and supplier interviews. These include common frustrations around systems integration, procurement barriers, tenant trust, and the need for clearer standards and guidance. Below, we summarise the most prominent areas of convergence, illustrating them with verbatim quotes and detailed insights from the interview data.

Compliance and Risk Management as Shared Drivers

Landlords and suppliers consistently identified risk management-particularly around regulatory compliance-as the primary driver for IoT adoption in social housing. Pressure has intensified in areas such as damp and mould, building safety, and decarbonisation, with technology increasingly seen as a means to demonstrate due diligence and proactively manage liability.

As one asset manager put it: “We don’t want to be the next case study in the press. Sensors are part of showing we’ve done what we can - that we’re being proactive.” Another added: “The real push came after Awaab’s Law - now there’s a legal imperative to monitor conditions, not just fix problems when tenants complain.”

Suppliers confirmed this shift, noting a growing demand for tools that help evidence compliance. “Landlords aren’t calling us about dashboards anymore. They’re calling us because they’re being told they need to prove they’ve acted.

The whole conversation has changed.” Many said their messaging had evolved accordingly – moving away from themes of innovation or efficiency and instead foregrounding defensibility and risk reduction.

Some suppliers viewed this as a catalyst for more creative and preventative models. One described using room-by-room mould risk data to support an insurance-backed product, explicitly designed to reduce landlord exposure under Awaab’s Law.

While this shared focus on compliance has opened new opportunities for collaboration, it also raises the stakes-particularly around data quality, system integration, and clarity of service-level expectations.

Integration Friction: A Mutual Pain Point

Integration emerged as one of the most consistent shared frustrations. Landlords spoke at length about the challenge of incorporating sensor data into existing IT ecosystems, including NEC, Salesforce, Dynamics, and Power BI. As one digital lead said: “The data is there – but if it’s not in our CRM, it doesn’t exist operationally. No one has time to check a separate portal.”

Suppliers, for their part, acknowledged these limitations but also pointed to the diversity and fragmentation of landlord systems as a challenge in its own right. “There’s no consistency. Every housing association has a different setup, different data priorities, different stakeholders. That makes it hard to build scalable integrations,” said one CTO.

An ecosystem enabler interviewee framed integration less as a technical challenge and more as an organisational one.

“We’ve delivered dozens of integrations, but the success rate depends entirely on whether there’s an internal owner who champions it through.” They argued for clearer onboarding frameworks and cross-departmental governance to avoid stalled rollouts.

While some landlords are developing bespoke APIs or middleware solutions, most do not have the internal capacity or technical support to do so. This results in what one interviewee called “data siloes by default,” where valuable insights remain unused because they are not visible within day-to-day operational tools.

Both sides expressed frustration with this situation and called for sector-level guidance or common integration frameworks. One landlord suggested: “What we need is a shared blueprint. A simple way to say: if you’re a supplier, here’s how you feed into our ecosystem.”

Procurement and Path Dependency

Procurement was repeatedly described as a structural barrier to innovation. Landlords reported long lead times, inflexible frameworks, and limited opportunities to experiment or iterate. As one put it: “The procurement process is set up to buy boilers, not sensors. There’s no allowance for learning as you go.”

Suppliers expressed similar frustrations. One commercial lead said: “We often find ourselves reverse-engineering our offer to fit the procurement brief, even when that’s not the best way to deliver the service.” Another observed: “The frameworks prioritise risk reduction - which is fair - but they end up excluding newer,

better solutions that don’t yet have three references and a G-Cloud listing.”

There was particular concern about the impact of procurement on data ownership and system lock-in. Several landlords reported situations where they felt pressured into choosing full-stack solutions due to procurement constraints. “We didn’t want their dashboard, but it came bundled with the only sensor that met the spec. Now we’re stuck with it,” said one.

Both suppliers and landlords expressed interest in more agile procurement approaches - including innovation partnerships, dynamic purchasing systems, or outcome-based models - that would better reflect the evolving nature of connected home technologies.

Trust and Tenant Engagement

Trust was described by nearly every interviewee as a non-negotiable condition for deployment. For landlords, this meant ensuring transparency, offering clear consent mechanisms, and providing tenants with meaningful information about how data would be used.

As one housing officer shared: “We’ve learned the hard way - if tenants think it’s about catching them out, they’ll unplug it. But if they see it as something that helps them, they’re onboard.” This aligns with feedback from a tenant interviewee, who said: “I wouldn’t mind a sensor if I understood what it did and if it actually made things better. But you have to explain it - don’t just say it’s good for you.”

Suppliers similarly recognised the importance of tenant framing. “It can’t feel like surveillance. It has to feel like support. And that means involving tenants early and building the story together,” said one engagement lead.

Several successful examples were cited where connected devices were introduced alongside retrofit measures or damp and mould remediation. “When it’s part of a wider home improvement offer, people are far more accepting,” said one landlord. Others are using co-design workshops, in-home visits, or tenant panels to shape communications.

Need for Standards and Shared Language

A final, cross-cutting challenge is the lack of shared language and standards. Both suppliers and landlords reported confusion or misalignment over key terms - including “insight”, “triage”, “analytics”, and even “support”.

One supplier reflected: “When we say insight, we mean predictive analytics. But some landlords think it’s just a humidity alert. That’s a big gap in expectation.” Landlords agreed, with one noting: “We’ve had suppliers promise us triage capability, but what they meant was coloured graphs. We need clarity on what these terms actually mean in practice.”

There is strong appetite for sector-wide standards - not just technical ones, like open APIs or data formats, but also conceptual standards around roles, responsibilities, and workflows. Several participants called for guidance or templates that could support consistent deployment and evaluation.

“The tech’s not the hard part. It’s aligning the people, the processes, and the expectations. That’s where things fall down,” summarised one senior leader.

Overall, while there are genuine tensions and misalignments between suppliers and landlords, there is also clear common ground. Shared frustrations, shared hopes, and a shared recognition that progress will require new forms of collaboration and sector-wide scaffolding.

Tenant Perspective

The Connected Homes research included a single in-depth interview with a tenant, providing a valuable case study of how connected devices are experienced from the user perspective. While the original research design did not focus on tenant interviews, with wider tenant engagement taking place through surveys, focus groups, and co-designed workshops, this opportunity offered particularly rich insight and was therefore included. The reflections gathered help ground the strategic and operational discussion in lived experience. This section draws exclusively on that interview, with a tenant living in a property equipped with IoT monitoring.

Consent, Framing and Transparency

The tenant emphasised that the framing of the devices mattered greatly. He described how initial communication lacked clarity, particularly about what the devices were for, what data would be collected, and how it would be used. He noted: “At first I thought it was just to keep an eye on the house. I didn’t really know if it was about damp, or energy, or what.”

Despite this initial confusion, he expressed openness to the technology when it was presented in the context of improving his home. “I think if you told people it was for making the home warmer, or spotting problems earlier, people would be more for it. But if it feels like spying, you push back.”

Consent was described not as a one-off act but as a process. The tenant noted the importance of ongoing transparency and having a clear point of contact. “If I get a

letter or a message saying ‘your sensors have picked something up, here’s what we’re doing’, that would be fine. It’s about knowing what’s going on, not being left in the dark.”

Value Perception and Feedback Loops

The tenant had not received feedback about what the sensors had detected or whether they had made any difference. This lack of visibility eroded his sense of value. “You just kind of forget they’re there. And then you wonder, are they doing anything?”

They suggested that even simple communications would make a difference. “If I got a message saying, ‘Hey, we noticed your humidity was a bit high and we adjusted your ventilation’, that would make it feel like it matters. Right now, it doesn’t feel connected to anything.”

Framing Interventions with, not for, Tenants

The tenant expressed a preference for being involved in conversations about interventions. He spoke about a previous damp issue and how disempowering it felt not to understand what was happening. “They did loads of work on the flat, but I didn’t really know what it was. I just let them in and they did it. It felt like I wasn’t part of it.”

He contrasted this with the idea of using data collaboratively. “If it was more like, here’s what we’re seeing, what do you think is going on? That would make it more equal.

Like you're working together, not just being managed."

Trust and Experience of Housing Services

Underlying the tenant's reflections was a broader concern about housing services more generally. He described feeling let down or unheard in previous repairs interactions, which shaped his perception of any new technology. "If you're already not sure they listen, then a sensor doesn't make you trust them more. It just feels like another thing they might ignore."

This highlights the importance of embedding connected technologies within trusted service frameworks. Technology cannot replace the need for responsive, empathetic, and well-communicated support. As he put it: "Tech's not the problem. It's whether you feel like someone's actually listening."

Implications

The tenant's reflections suggest that tenant acceptance of connected devices is not simply a matter of technical functionality or consent at point of install. It involves sustained communication, demonstrable benefit, and integration with services that already feel trustworthy.

To build acceptance and value, landlords should:

- Frame connected devices clearly and positively
- Provide regular, personalised feedback
- Include tenants in interpreting data and decision-making
- Align sensor use with high-quality, responsive service delivery

This interview illustrates the risks of poor communication but also the potential for connected technologies to enhance the tenant experience when introduced in a transparent and collaborative way.

Strategic Implications

The Connected Homes interviews provide a rare cross-sectional view of the sector, capturing how landlords, suppliers, tenants, and enablers perceive the future of connected housing technologies. The interviews reveal strong areas of alignment but also deep-seated tensions that, if unaddressed, could slow or distort progress.

A Crossroads for the Sector

There is widespread agreement on the why: the need to shift towards proactive, data-informed, tenant-centred services that support compliance, decarbonisation, and better living conditions. However, the how remains contested. The sector stands at a crossroads between fragmentation and integration, between closed ecosystems and open data, between reactive procurement and long-term strategy.

Several ecosystem enabler interviewees warned that unless data infrastructure and governance frameworks mature alongside pilots, many innovations will “struggle to scale beyond the sandbox.” One noted that while landlords and suppliers may agree on ambition, “the plumbing isn’t in place” to support consistent delivery. Their perspective highlights the risks of advancing digital services without aligning the operational and architectural underpinnings that sustain them.

Divergences Matter

The most consistent fault line lies in control - who controls the data, the insights, and

the user interface. Landlords demand modular, interoperable systems that fit into their existing workflows and platforms. Suppliers, especially those with strong hardware or analytics offerings, often favour end-to-end environments that maximise product stickiness and control over data flows. This results in a risk of digital lock-in - not just technologically, but strategically.

One supplier noted:

“We’re happy to integrate, but it depends on the business case.”

These commercial realities clash with landlords’ calls for open APIs, common data models, and integration into core systems like Power BI, NEC, and Salesforce. The divergence isn’t simply about preferences; it reflects incompatible business models and different definitions of value.

Tenants as the Missing Piece

Tenants were rarely centred in strategic conversations, even when providers described their offers as tenant-focused. The single in-depth tenant interview conducted reminds us that trust, transparency, and mutual understanding are non-negotiable. Consent is not just about ticking a box; it’s about designing services with, not for, residents.

As one tenant put it:

“If it helps people and you’re explaining what it does, I think most people would be fine with it. But if it just shows up and no one explains anything, that’s when it becomes a problem.”

The Importance of System Enablers

Ecosystem actors play a crucial but often under-recognised role. Their focus on infrastructure, language alignment, and cross-sector collaboration is essential to move from pilots to scalable solutions. They described their work as “connecting the dots” – between disparate systems, organisations, and data pipelines.

One enabler reflected: “People talk about platforms, but few talk about the pathways. That’s where we come in; not owning the stack, but helping others navigate it.” They emphasised that the success of connected homes will depend as much on invisible plumbing – governance, interoperability, shared protocols – as on visible devices and dashboards.

Without this layer, innovation risks remaining siloed and difficult to operationalise. Elevating the role of these actors is not just a technical question, but a strategic one – ensuring that ambition is matched by the tools, partnerships, and infrastructure needed to deliver at scale.

Looking Ahead

To progress strategically, the sector must navigate three critical tensions:

1. **Support vs. Dependency** – How can suppliers enable rather than capture value?
2. **Interoperability vs. Integration** – Can open standards coexist with commercial differentiation?
3. **Speed vs. Alignment** – Will innovation outpace governance, or can a shared roadmap emerge?

These questions are not easily resolved, but they are central to whether Connected Homes will remain a patchwork of pilots or evolve into a coherent, tenant-focused system of care.

The research underscores the need for collective action - across procurement, data standards, digital ethics, and tenant engagement - to build the connective tissue the sector currently lacks. Some participants argued that financial institutions could help accelerate this shift. One supplier suggested that ESG-linked finance might do more to align innovation and governance than policy alone: “If the banks are behind it, everything else follows.” This underscores the potential for alignment not only through governance and procurement reform, but also through financial mechanisms that reward long-term outcomes.

Recommendations

This part of the Connected Homes research highlights key priorities for stakeholders across the connected homes ecosystem. The following recommendations are designed to move the sector from pilot thinking to integrated, predictive practice. They are rooted in frontline experiences gathered from interviews with landlords, suppliers, ecosystem enablers, and one tenant participant.

For Landlords:

- **Move from isolated pilots to operational pathways.** Ensure that connected home projects are tied to a long-term strategy, with clear integration into business-as-usual services.
- **Prioritise interoperability and systems readiness.** Invest in mapping legacy systems, identifying integration gaps, and building internal digital capacity.
- **Embed co-design into practice.** Go beyond one-off consultations and make tenants part of ongoing decision-making and data interpretation processes.
- **Link IoT deployment to core outcomes.** Align technology rollouts with wider goals around damp and mould, disrepair, compliance, fuel poverty, and decarbonisation.
- **Support the people side of transformation.** Change management, staff training, and new workflows are as important as the tech stack.

For Suppliers:

- **Design for openness from the start.** Offer standard APIs, clear

documentation, and systems that can integrate flexibly within different housing contexts.

- **Build in support for integration and service design.** View implementation as a collaborative process, not simply a handover at install.
- **Respect and enhance the tenant relationship.** Design with transparency, permissions, and human-centred feedback loops as core features.
- **Engage in sector-wide standards efforts.** Participate in efforts to build shared definitions, formats, and service benchmarks.

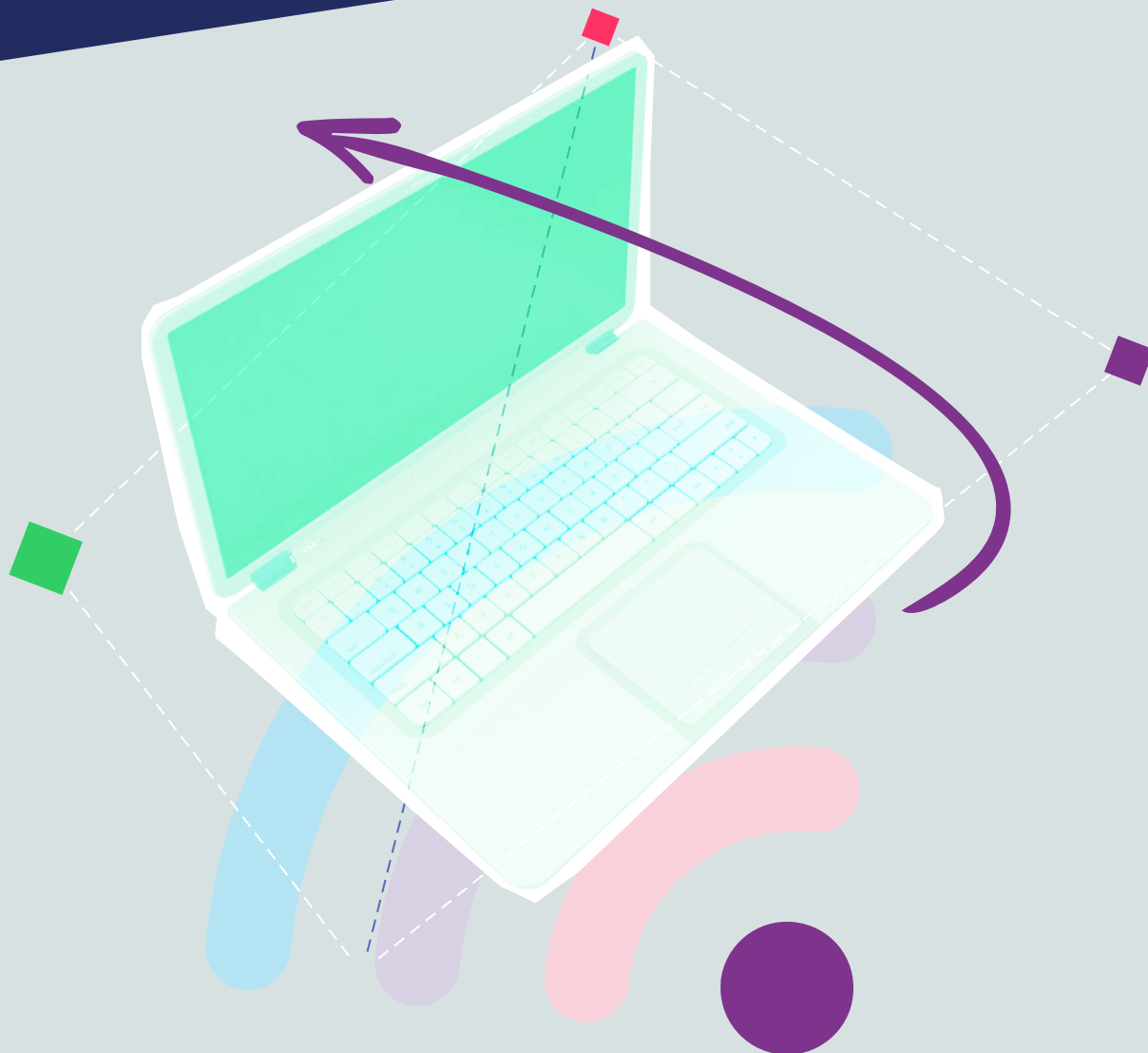
For Sector Bodies and DESNZ:

- **Fund integration, not just sensors.** Support projects that bridge data, teams, and services, not just hardware procurement.
- **Champion a common digital standard for housing.** Establish voluntary frameworks for ethics, interoperability, and data sharing to avoid fragmentation.
- **Commission more tenant-focused research.** Deepen understanding of consent, digital trust, and lived experience in connected environments.
- **Convene cross-functional leadership.** Align digital transformation, decarbonisation, compliance, and tenant engagement agendas at a national level.

These recommendations reflect the collective insights of practitioners, technologists, and residents. They offer a foundation for shifting from reactive, disconnected efforts to a more joined-up, human-centred digital future.

Part 2d

The Views of Tenants



Executive Summary

This report draws on the experience of over 1,200 social housing tenants to explore how connected home technologies are perceived, experienced, and understood. It brings together findings from tenant surveys, online workshops, and an in-depth interview with a resident living in a highly connected home. The research is part of a wider national project exploring the future of connected homes in social housing and how these technologies can be deployed fairly and effectively.

The report highlights a core finding: while many tenants see the potential benefits of connected home technologies, such as improved warmth, damp and mould prevention, and better energy efficiency, these benefits are not guaranteed. In practice, the success of these systems depends as much on relationships, consent, communication, and trust as it does on technical performance.

Tenant responses ranged from enthusiastic engagement to uncertainty and scepticism. Some described clear improvements in comfort, air quality, and energy use. Others expressed confusion, discomfort, or opposition, particularly where devices were installed without clear communication or consent. Many remained unsure of what had been installed, what data was being collected, or how it might be used. In some cases, scepticism stemmed not from the technology itself, but from past experiences of being let

down, which shaped how new initiatives were received.

While reactions varied, the research surfaced several consistent themes:

- Awareness of smart systems is often low, and many tenants are unfamiliar with the terminology used by landlords or suppliers.
- Privacy and autonomy matter deeply. Devices that feel imposed, particularly in private spaces, can provoke concern or resistance, even if well-intentioned.
- Functioning and easy to use technology alone was necessary but not sufficient. Using the technology had to answer the “what’s in it for me?” question
- Digital confidence and infrastructure vary. Some tenants embraced dashboards and data; others lacked broadband access or preferred to be left alone.
- Trust is critical. Tenants’ views of connected systems are shaped not just by the devices themselves, but by their existing relationship with their landlord, especially past experiences with repairs and communication.

The findings also indicate that how technologies are introduced is just as important as what is installed. Tenants who were consulted or involved in the process reported more trust and comfort, while those who felt bypassed were more likely to resist or disengage.

This report offers practical recommendations for landlords and technology providers, including:

- Start with clear communication and meaningful consent.
- Design for inclusion, flexibility, and opt-out options.
- Use pilots to learn, not just to demonstrate.
- Treat tenants as partners, not passive recipients.

By foregrounding tenant voices and placing relationships at the centre of rollout strategies, connected homes can deliver tangible benefits, not just for the housing provider, but for the people who live in them.

Context and Methods

Context

The project examines the adoption and impact of Internet of Things (IoT) technologies across the social housing sector. These technologies, including humidity sensors, smart heating systems, energy monitors, and environmental sensors, are increasingly being used to support goals such as improving housing conditions, enhancing energy efficiency, and meeting Net Zero targets. However, their success depends not only on technical performance, but on resident experience.

While earlier phases of the research explored the perspectives of landlords, suppliers, and policy stakeholders, this phase places tenants at the centre. As the people living with connected technologies in their homes, tenants' perceptions, trust, concerns, and expectations are critical to any successful deployment.

Tenant engagement in this context is not simply about user satisfaction or customer service. It speaks directly to questions of data ethics, digital rights, power dynamics, and the emotional and symbolic meanings of "home". Whether connected technologies are experienced as agency or intrusive is shaped not just by the technology itself, but by how it is introduced, governed, and maintained, and whether tenants feel informed, respected, and in control.

This research therefore aims to provide a nuanced understanding of tenant perspectives across different housing contexts, with a view to shaping ethical, inclusive, and effective strategies for connected home deployment.

Methodology

This phase of the Connected Homes research employed a mixed-methods approach to capture a broad and nuanced picture of resident views. The methodology combined large-scale quantitative surveys with in-depth qualitative engagement, ensuring both statistical reach and lived experience insight¹.

Resident Surveys

Three housing providers shared tailored tenant surveys, focusing on awareness, perceived benefits, concerns, trust in data use, and willingness to engage with connected home technologies.

- **Total survey responses:** 1,212
 - o 760 responses from one provider (primarily general needs and mixed tenure)
 - o 372 responses from a second provider (including supported housing residents)
 - o 80 responses from a third provider (targeting digitally engaged residents)

Surveys included both multiple-choice and free-text questions, allowing for both quantitative analysis, as well as some qualitative coding of tenant narratives.

Resident Workshops and Focus Groups

Interactive group sessions were delivered to explore themes in more depth, including trust, consent, perceived intrusiveness, digital access, and desired levels of involvement in future deployments. These sessions used guided discussion, stimulus materials (e.g. device photos, scenario

1. For full resident engagement methodology and survey questions, see [Appendix 5](#).

prompts), and in some cases included short pre- or post-session surveys to capture quantitative reflections.

- **Total participants:** 40 residents across three sessions
 - o 21 participants in an online session with one provider
 - o 13 participants in an in-person session with a second provider
 - o 6 participants in an in-person session with a third provider

Participants were selected to ensure a range of experiences and digital literacy levels, including both residents with and without connected devices in their homes.

In-Depth Interview

A long-form qualitative interview was conducted with a highly engaged and informed resident living in a property with an extensive suite of connected home technologies. The interview explored the resident's journey over time, day-to-day interactions with the technology, perceptions of agency and trust, and reflections on the wider potential and risks of connected systems in social housing. This case offered rich, detailed insight into the tenant-side experience of full integration and long-term engagement.

Limitations

While this research engaged a broad and diverse group of residents, participation was mediated through landlord-led recruitment and voluntary opt-in, which may have introduced selection bias, particularly towards those with stronger views or higher levels of digital engagement. Not all demographic groups were equally represented, and response rates varied between methods. As such, the findings offer valuable insight into patterns and perceptions but should not be taken as statistically representative of all social housing tenants.

Tenant Awareness and Understanding

Tenant awareness and understanding of connected home technologies varies considerably across the social housing sector. While some residents are digitally confident and actively engaged, many are unfamiliar with the terminology, unsure how the technologies work, or unaware that any such devices are operating in their homes.

Awareness and Exposure to Connected Technologies

Across the three resident surveys, most respondents had heard of smart or connected devices. However, many associated these technologies with familiar consumer products, such as Alexa, Hive, or Ring, rather than with landlord-installed systems like damp sensors, heating controls, or energy monitors. As a result, some tenants were unsure whether they had any connected technology installed in their homes, particularly where installations had not been clearly communicated.

Some only became aware of devices after spotting unfamiliar equipment, experiencing changes in their heating controls, or encountering follow-up visits. Even then, they were not always clear on the purpose or function of the technology.

That said, many tenants showed a willingness to engage and a strong interest in the benefits. During workshops, once facilitators introduced the topic using relatable examples, such as detecting damp or improving heating efficiency,

participants quickly grasped the concept and asked practical, informed questions. Comments included:

- “Is that the box they put in for damp?”
- “Does it help with the heating bills?”
- “Can I see the data too?”

Exposure to connected systems also varied significantly across landlords. In one large-scale survey, around one-third of tenants reported having at least one connected device, including both landlord-installed and personal technologies. Another survey, involving tenants already engaged in digital initiatives, showed higher levels of awareness and use. A smaller survey revealed lower levels of exposure, with many respondents either unaware of any connected devices in their homes or unsure what had been installed.

Qualitative data reinforced this variation. Some tenants described having environmental sensors or heating controls and appreciated the improvements, particularly when information had been shared and follow-up was visible. Others expressed uncertainty about how the devices worked or whether landlords were making use of the data. A few tenants had no exposure to connected technologies at all and were more cautious or resistant to the idea.

One in-depth interview illustrated the potential of proactive engagement. A tenant living with a suite of connected technologies, including solar PV with battery storage, a Mixergy hot water cylinder, air quality monitoring, and smart

heating controls, had taken an active role in shaping how the systems were used and described feeling confident in managing their home environment due to real-time data and regular feedback.

Language and Terminology

Language proved to be a key theme and potentially, a major barrier to tenant understanding and engagement. Across all workshop sessions, the terms “connected home” and “IoT” was mostly unfamiliar to participants at the outset. Facilitators often needed to explain the concept in simple, tangible terms, such as:

“Devices that monitor things like temperature, damp, or energy use, and send that information to you or your landlord to help improve the home.”

Once explained in this way, tenants engaged more confidently, asking detailed questions about functionality, cost, privacy, and the impact on their daily lives:

- “Will it cost me anything?”
- “Will the landlord actually use the data?”
- “What happens if I don’t have internet?”

Across both qualitative and survey data, the message was consistent: tenants want clear, honest, jargon-free communication that focuses on the benefits to them and avoids technical abstraction. Terms like “IoT” or “connected system” mean little without practical context.

Key Implications

- Terminology matters. Engagement improves when language is simple, relatable, and focused on everyday outcomes like warmth, health, and energy savings.
- Assumptions about awareness can be misleading. Even where digital literacy is high, without clear explanations about which systems are installed, what they do, and how they work, understanding will suffer.
- Visibility and clarity are critical. Connected technologies are more likely to succeed when it's clear what is in the home, why it matters, and whether anyone is acting on the data.
- Experience shapes attitude. When clear communications are received, positive outcomes are created, or opportunities to take part in system design are provided, greater trust and acceptance tend to follow. Where communication is poor or benefits unclear, scepticism tends to grow.

Perceived Benefits and Motivators

Tenant endorsement of connected home technology is shaped not just by what the technology does, but by what it delivers, and whether tenants can see the value for themselves. Across surveys, workshops, and interviews, it became clear that tenants are more likely to support connected solutions when the benefits are clearly explained, personally relevant, and demonstrably realised.

Tenant engagement is not a peripheral concern. Without tenant understanding, trust, and buy-in, the potential of connected systems will be limited, regardless of technical performance. Where tenants saw tangible improvements in their comfort, safety, or costs, they were more inclined to welcome further use of technology. Where they had not, or where communication had been lacking, scepticism remained.

These findings reflect key principles from Technology Acceptance and Use models (e.g. Davis, 1989; Tetik et al., 2024), which suggest that adoption depends not only on usability, but also on tenants' perceptions of benefit, trust in the system, and the presence of meaningful support. Without clear communication, intuitive design, and social reassurance, even helpful technologies may face disengagement or resistance.

Commonly Valued Benefits

The following benefits emerged most frequently across all engagement methods:

- **Early detection of damp and mould:** This was one of the most consistently

valued benefits, particularly in workshops and survey free-text responses. Tenants appreciated the idea of devices identifying issues before visible damage or health concerns arose, especially in homes where damp had previously gone unnoticed.

- **Energy efficiency and cost savings:** Many hoped that smart devices could reduce bills by detecting wasteful patterns or helping landlords address insulation and heating issues. This was especially important for tenants on lower incomes, prepayment meters, or living in older homes. Several respondents explicitly linked this benefit to fuel poverty.
- **Comfort and warmth:** Tenants expressed interest in technology that could help maintain stable temperatures and reduce the need for constant manual adjustments. Some mentioned avoiding cold spots, others highlighted the potential of smart heating to make energy use more efficient without sacrificing comfort.
- **Safety and fault prevention:** Devices such as smart smoke alarms, leak sensors, or temperature monitors were welcomed by many, particularly older residents or households with children. These were viewed as potentially useful for early warning and peace of mind.
- **Support for independent living:** Although applications for social care were not a central focus of this research, several tenants identified potential benefits for people with mobility or health challenges. Examples included automatic alarm checks, indoor environmental

monitoring, or remote alerts that could assist carers and reduce reliance on emergency services.

- **Faster or more accurate repairs:** The idea that connected systems could lead to quicker, more targeted repairs resonated with many tenants, even those who were otherwise sceptical. Some viewed having data to hold their landlord to account as being of major benefit. While not all believed landlords would act on the data, the principle of fewer call-outs and better issue resolution was strongly supported.

Case Study: Tangible Benefits in Practice

One resident, interviewed in depth as part of the research, shared their experience of living in a home equipped with multiple connected systems, including a smart hot water cylinder, air quality monitoring, smart heating, solar panels with battery storage, and a heat pump. They described significant improvements in quality of life and cost savings, attributing these directly to the technology.

The resident estimated that their household energy costs had dropped by more than two-thirds over the past 18 months and noted improvements in indoor air quality, warmth, and humidity control. They also described a stronger sense of agency and involvement, having helped inform some of the landlord's decisions around monitoring and response.

While this case represents a best-case scenario, it offered a powerful example of the technology's potential when deployed at scale and supported by active tenant engagement.

Emotional and Social Motivators

While most tenants focused on practical benefits, a smaller number described broader motivations, including:

- **Environmental values and climate goals:** In survey responses and workshops, a minority of tenants said they were motivated by the role connected technologies could play in reducing emissions or helping housing providers achieve net zero targets. This view was particularly common among digitally confident tenants or those already involved in community or energy-related initiatives.
- **Contributing to learning and improvement:** Some participants said they were willing to trial new technologies if it meant helping others or improving future service. This included tenants who saw themselves as early adopters or were motivated by a desire to support their housing provider in testing new approaches.

These findings highlight that tenants are not opposed to innovation, but their support depends on credibility. Promises must be matched with delivery. If the benefits are real and visible, trust can grow over time, even among initially sceptical residents. Clear communication about what's being installed, why it matters, and how it will help them is not just good practice, it is essential for successful adoption and lasting tenant support.

Concerns, Barriers and Conditions for Trust

While many tenants see the potential value of connected home technologies, their support is not guaranteed. Across the research, tenants raised concerns that extended well beyond the technology itself. For some, these concerns stemmed from prior negative experiences with their landlord, such as unresolved repairs, poor communication, or lack of follow-through, which created a generalised mistrust. This often translated into resistance or reluctance towards any new offer, however well-presented.

Issues such as privacy, landlord accountability, digital exclusion, and autonomy all shaped perceptions. For connected systems to be accepted, and effective, tenants need to feel informed, consulted, and in control.

This aligns with established technology acceptance frameworks, which emphasise perceived usefulness, ease of use, social influence, and trust as essential enablers of engagement (Marikyan et al., 2019; Maskeliūnas et al., 2019; He et al., 2021).

Privacy, Intrusion, and Surveillance

The most consistently voiced concern was that connected devices could feel invasive, particularly when installed without explanation or consent.

- Tenants worried about being monitored, especially in private areas like bedrooms.

- Devices such as CO₂ or humidity sensors raised suspicion when their purpose and use weren't clearly communicated.
- Questions such as "Why is it there?", "What's it measuring?", and "Who sees the data?" were common, reflecting an underlying unease about surveillance and data misuse.

These concerns reflect deeper emotional and psychological dimensions of home life. Tenants described feeling unsettled by unfamiliar devices and unsure whether their homes were truly private. Even well-meaning technologies were viewed with caution when transparency was lacking.

Trust and Landlord Accountability

Trust in the housing provider played a decisive role in how connected technology was received. For many tenants, scepticism was not simply about data or devices, it reflected a deeper sense of distrust built up over years of unmet expectations. Poor experiences with repairs, communication, or landlord decisions had created a baseline of caution. As a result, even well-intentioned initiatives were often met with suspicion.

- Tenants who had positive relationships with their landlord, marked by clear communication and reliable service, were more open to connected systems.
- Where trust was lacking, devices were often dismissed or resisted, regardless of their intended benefit.
- Many questioned whether data would actually be acted upon: "They don't

respond to repairs now, how will they manage more alerts?”

A recurring theme was that connected technology will only succeed if landlords prove they can and will act on the insights these systems generate. This includes:

- Communicating what data is collected and why
- Acting on findings in a timely and visible way
- Respecting tenant preferences and privacy

Some tenants noted that trust could be rebuilt if they were given access to the data, or if they saw that technology led to faster repairs and better living conditions. But without clear, tangible outcomes, smart systems risked reinforcing, rather than resolving, long-standing frustrations.

Consent, Control, Autonomy

Tenants emphasised that how connected technologies are introduced matters just as much as what is introduced. Consent was not viewed as a one-off formality, but as an ongoing, meaningful process grounded in transparency, choice, and mutual respect.

- Tenants consistently called for early consultation, not simply being informed at or after installation.
- They wanted clear, jargon-free explanations about what devices do, what data is collected, and who has access.
- Crucially, even tenants who supported the idea of connected technology strongly asserted the right to say yes or no. There was broad agreement that opting out should always be an option, and that respecting individual choice was central to building trust.

Control, in this context, was not about rejecting technology outright. It was about being informed, having a say, and retaining a sense of agency over one's home environment.

- “They need to listen to me, not just the devices.”
- “I’m okay with the landlord having the data, because it’s helped us. But that only works because I know what’s being measured, and I can see the data too.”

When tenants felt informed and involved, they were not only more accepting, many became supportive advocates. This underscores the link between autonomy and trust: when people understand the purpose and feel respected in the process, consent becomes a foundation for cooperation.

Digital Exclusion and Practical Barriers

Not all tenants had the tools or confidence to engage with connected technologies.

- Some lacked internet access, or did not want to connect devices to their Wi-Fi.
- Others felt overwhelmed by apps or digital interfaces, particularly in multigenerational or lower-income households.
- Concerns about reliability were also raised: “If I change my broadband, does it stop working?”

Many tenants favoured systems that were either hardwired or used mobile data (e.g. SIM-based), requiring minimal tenant interaction. There was also a preference for “fit and forget” devices that did not demand digital skills or upkeep.

Cost, Reliability, and Technical Doubts

Concerns about cost and reliability featured across workshops and survey responses:

- Tenants wanted reassurance that they would not be charged for installation, maintenance, or device failures.
- Some questioned whether devices would work long term, or feared that smart systems could increase energy bills.
- Past experience with overpromised “smart” initiatives fuelled doubts about whether this new wave would be any different.

These concerns highlight the importance of upfront clarity, durability of devices, and follow-through.

Cultural and Emotional Resistance

In a few cases, opposition to connected technologies was not rooted in cost or data concerns, but in deeper cultural or emotional resistance.

- Some tenants simply did not want technology in their homes, fearing judgement or loss of autonomy.
- One focus group had a 50% refusal rate, “with participants unwilling to discuss the prioritisation of benefits – as they didn’t feel there were any”.
- Concerns included fears about eviction or demolition based on data, or embarrassment about heating patterns being visible to others.

These reactions underline that technology cannot be separated from context. The home is a deeply personal space, and technological imposition without consent risks eroding trust further.

Conditions for Success

Across all findings, three conditions emerged as essential for any successful deployment of connected home systems:

- Trust must be actively built through an open approach, visible follow-through, respectful communication, and transparent governance.
- Consent must be ongoing and meaningful, not just a one-off notice, but an invitation to participate.
- Control must rest, at least in part, with tenants. This means giving tenants access to their own data, the ability to ask questions or raise concerns, and, crucially, the option to opt out where appropriate. The ability to decline certain devices, or to disengage from data sharing, is fundamental to safeguarding autonomy and maintaining trust.

If these conditions are not met, even well-intentioned technology can come to feel intrusive, extractive, or imposed. But when tenants are treated as partners, informed, involved, and respected, the same technology can be embraced, even championed.

Involvement and Co-Design

A consistent message across the engagement work was that the success of connected home technologies depends as much on tenant involvement as on technical performance. Tenants wanted to be informed, consulted, and treated as partners, not passive recipients. Where this happened, trust grew, and the rollout was smoother.

The Value of Tenant Involvement

Tenants across all methods of engagement indicated that involvement in decision-making made them more open to connected technologies. Survey respondents highlighted clear explanations and choice as key to building trust. In workshops, participants wanted input into where devices were placed, what they monitored, and how data was used, especially when technologies affected day-to-day life.

This was reinforced by an in-depth interview with a tenant who had helped shape the rollout of multiple devices in his home. His motivation extended beyond personal benefit:

“It’s not just about my house. I want to help other tenants too, and show the housing association what works.”

Involvement transformed his experience into a collaborative project that benefited others, not just himself.

Workshop and Group Feedback

Group sessions echoed this appetite for co-design. Tenants shared ideas on sensor

placement, accessibility, and how insights should be communicated. While some were sceptical, many said they would support connected technologies if their feedback was genuinely valued.

In one workshop, over half the participants said they’d like to be involved in future decisions. In another, tenants provided detailed suggestions on data presentation and device integration. These discussions reflected a practical understanding of their homes, and a willingness to co-create solutions when given the chance.

Involvement as a Trust-Building Tool

The desire to participate was not only rooted in practicality, it was also about fairness and agency. In multiple sessions, tenants raised concerns about decisions being made without their input. Being included in the process was seen as a sign of respect, which, in turn, increased trust in both the landlord and the technology.

As one tenant said:

“They can’t just do this to us. They need to do it with us.”

This emphasis on being consulted reinforces a key theme: co-design is not simply a means to better functionality, but a way to address power imbalances and strengthen relationships between landlords and tenants.

When co-design is done well, it can lead to:

- Higher acceptance of devices

- Fewer misunderstandings or complaints
- Better placement and usage of technology
- A sense of shared purpose

From Engagement to Agency

Participation also created opportunities for peer support and leadership. In some cases, tenants with lived experience of smart technology became informal champions, explaining systems to others, hosting visits, or providing feedback to landlords.

This kind of tenant-led sharing was seen as particularly effective in building trust, especially in communities where word-of-mouth carried more weight than formal communications.

Tenants also emphasised that participation needed to continue beyond initial rollout. Suggestions included:

- Involvement in pilot evaluation
- Feedback sessions after installation
- Access to their own data
- A role in shaping future rollouts and guidance materials

Participation, in this sense, was not just a stage in the project, it was a way of doing things differently. For many tenants, it offered a chance to have a say in how their home is managed and to influence change in a system where they often feel overlooked.

Digital Inclusion and Infrastructure

The research highlights that the success of connected home technologies depends not just on devices working well, but on the digital environments into which they are deployed. Many assumptions, about internet access, digital confidence, or willingness to engage with smart systems, do not hold true for all tenants. Addressing these digital inclusion and infrastructure challenges is essential for equitable and effective implementation.

Connectivity Gaps and Wi-Fi Dependency

Tenants across all engagement methods raised concerns about devices relying on their personal Wi-Fi. Not all households have broadband access, and even where it is available, some tenants are unwilling to connect landlord-installed equipment to their networks.

Comments from focus groups included:

- “I don’t want it using my internet.”
- “I don’t have internet, and I don’t want it.”

Others flagged the unreliability of Wi-Fi-dependent systems, particularly when tenants move or change providers. In such cases, devices may stop working, and reconnection processes were unclear or unsupported.

In contrast, one tenant interviewed described a more robust solution:

- “We hardwired everything. No Wi-Fi dropouts. No hassle.”

They noted that other properties without broadband had been provided with mobile-network-based connectivity, ensuring consistency without relying on tenants’ digital access.

Need for SIM-Enabled or Dual-Connectivity Devices

Tenants and practitioners alike identified the need for alternatives to tenant-provided Wi-Fi. These included:

- SIM-enabled devices with dedicated data plans
- Dual-SIM options offering signal redundancy
- Low-bandwidth backup systems (e.g. LoRaWAN or cellular failover)

These options were seen as not only more reliable but also more equitable, ensuring that tenants with limited or no internet access could still benefit from the protection and insight connected technologies offer.

Digital Confidence and User Interfaces

While access to digital infrastructure is a core issue, equally important is the experience tenants have when interacting with technology. Even among those with internet access and basic digital tools, confidence levels varied widely.

Many tenants expressed discomfort or frustration with apps that were confusing, overloaded with information, or

poorly designed for their needs. This was especially true for older residents or those with limited experience using smartphones.

Common interface concerns included:

- Overly complex or cluttered apps
- Notifications that were excessive or unclear
- Worries about “doing something wrong”
- Poor accessibility for tenants with visual impairments or low literacy

Rather than abandoning digital features altogether, tenants called for interfaces that matched their confidence levels, or systems that worked passively in the background unless attention was needed.

Design suggestions included:

- Optional, simplified app versions
- Colour-coded indicators or printed summaries
- Clear explanations using plain language
- Minimal interaction required for basic functionality

These insights highlight the importance of user-centred design: smart systems should not assume digital fluency but should accommodate a range of preferences and abilities, ensuring that all tenants can benefit, regardless of how much they engage.

Infrastructure Readiness in Landlord Systems

Some tenants questioned whether landlords had the infrastructure and capacity to manage the data generated by connected devices. In workshops and webinars, concerns were raised about alerts being missed or not acted upon in time.

Key landlord-side requirements include:

- Reliable data handling and storage
- Integration with existing systems
- Clear protocols for interpreting and responding to alerts
- Adequate staff resource to manage and follow up on issues

Without these, tenants worried that smart devices might raise expectations without delivering real improvements, creating more frustration than benefit.

Recommendations

This research shows that connected home technologies will only deliver real value if deployed with care, clarity, and collaboration. For many tenants, trust must first be rebuilt, shaped not just by the promise of new technology, but by consistent follow-through where previous expectations may have been unmet. While most residents can be engaged with the right approach, a small number may still choose to opt out, and that choice must be respected. The quality of the technology matters, but how it's introduced, explained, and supported matters more. Based on the views of over 1,200 tenants, the following recommendations reflect both what to do and how to do it.

Start with Consent, Clarity, and Communication

Across all research activities, tenants emphasised the importance of how technologies are introduced. The level of explanation, timing of communication, and tone of engagement shaped perceptions, sometimes more than the devices themselves.

Many respondents said they'd be more likely to trust connected devices if they were clearly explained in advance. Others described frustration when installations occurred without notice or consultation.

- “It's not the device I mind, it's the way they go about it.”

- “They can't just turn up and fit stuff, there has to be a conversation first.”

Recommendations:

- Communicate early, using clear, jargon-free language.
- Ensure consent is meaningful, not implied, tenants should have the option to decline or opt out.
- Provide opportunities for follow-up conversations once devices are installed and producing data.

Build Trust Through Action, Not Promise

For many tenants, scepticism about smart technology wasn't about the devices, it was about history. Years of poor communication, unresolved repairs, or feeling ignored had eroded trust in the landlord. In this context, even well-designed initiatives were often met with resistance, because tenants assumed nothing would change.

This mindset was particularly strong among those who had previously reported issues that were not fixed or had experienced a lack of follow-up. For them, new technology felt like “just another promise”, one likely to disappoint.

“They already ignore my repair report, what makes me think they'll act on a sensor?”

To overcome this, landlords must demonstrate, not just claim, that things are different. Trust has to be rebuilt through visible, consistent action.

Recommendations:

- Ensure devices feed into defined, responsive workflows, not generic dashboards.
- Act on insights promptly, and tell tenants what's been done.
- Share regular updates that show the impact of the technology in clear, everyday terms.
- Recognise and address the “we’ve heard this before” mindset, rebuilding trust may take time, but it starts with proof.

Design for Inclusion, Not Assumption

One of the clearest findings was that one-size-fits-all approaches do not work. Tenants varied significantly in their digital access, confidence, and willingness to engage.

Some were comfortable with apps and dashboards. Others had no internet or preferred not to use their broadband for landlord-installed devices. Several wanted passive systems that “just work” without requiring interaction:

- “I just want it to work in the background. I don’t need another app.”

Recommendations:

- Avoid assuming tenants will provide connectivity. Use SIM-based, dual-connectivity, or hardwired systems.
- Offer a range of interface options, from full digital control to simple visual indicators or printed summaries.
- Design for different levels of digital confidence and accessibility needs.

Involve Tenants Early and Often

When tenants were involved in shaping pilots or communication materials, they were more likely to engage positively, even if initially sceptical.

Group discussions showed that co-design improved not just acceptance, but trust and understanding. Involvement made people feel respected and gave them a stake in the process.

- “They can’t just do this to us. They need to do it with us.”
- “I want to help others too, and show what works.”

Recommendations:

- Involve tenants in selecting devices, testing locations, and designing guidance materials.
- Use workshops, peer-led sessions, or surveys to gather feedback and adapt delivery.
- Ensure participation is voluntary and accessible to different engagement levels.

Strengthen Internal Systems and Workflows

Some of the most pressing concerns were about whether data from devices would be seen, and acted on, by landlords. Tenants worried about alerts going nowhere, or devices failing quietly due to poor connectivity or back-end integration.

“I don’t want something in my home that doesn’t even work half the time.”

Recommendations:

- Ensure reliable connectivity (e.g. SIM, LoRaWAN, wired systems) to avoid dropouts.
- Integrate alerts into clear triage and response processes.
- Provide visibility to both staff and tenants, so issues are tracked, prioritised, and resolved transparently.

Use Pilots to Learn, Not just Prove

Tenants valued being part of well-run pilots. They saw these as opportunities to shape technology, not just test it.

Where pilots included feedback loops and co-design, outcomes improved. But where pilots felt like top-down tests, tenants felt excluded.

Recommendations:

- Use pilots to trial not only devices, but delivery models, engagement strategies, and consent processes.
- Evaluate the pilot collaboratively, asking tenants what worked, what didn't, and what could be improved.
- Share lessons across the organisation and the wider sector.

Embed Equity and Opt-Out Options

Finally, and critically, success requires recognising the diversity of tenants' needs, expectations, and boundaries. For connected homes to be genuinely inclusive, tenants must be given agency, including the right to opt out.

- "They need to ask, not assume."

Recommendations:

- Ensure all tenants have the opportunity to decline or withdraw without penalty.
- Recognise that control, visibility, and data access are as important as technical performance.
- Centre inclusion and equity in every stage of deployment, from procurement to post-installation support.

Ultimately, delivering connected home technologies in social housing is not just a technical upgrade, it's a shift in how landlords and tenants work together. When tenants are informed, involved, and respected, technology can help create safer, warmer, and more responsive homes. But success depends on doing this with tenants, not to them. The foundations are trust, clarity, and care, without these, even the smartest systems will fall short.

Part 2e

Smart Devices in Social Housing: Market Analysis



Executive Summary

The smart device market in UK social housing is no longer in its infancy, but nor is it functioning as a coherent, mature ecosystem. Instead, it is best described as a market in transition, rich in potential, but constrained by structural misalignment between technology suppliers, landlords, and the institutional conditions required for effective scaling.

On the supply side, the market is fragmented and heterogeneous. It includes innovative startups, legacy safety device manufacturers, Original Equipment Manufacturer (OEM) platforms, data integrators, and large contractors. Yet this diversity has not led to a flourishing ecosystem. A lack of common standards, variable procurement frameworks, and limited cross-sector coordination have resulted in duplication, inefficiency, and slow progress. Product innovation is strong, particularly in environmental sensing and energy insight, but integration into landlord systems and workflows remains weak.

On the demand side, landlords are engaged but underpowered. Interest in IoT is widespread, driven by compliance, net zero targets, and a desire to improve resident outcomes, but capability to execute is uneven. Strategic digital leadership is limited, data governance is immature, and legacy systems often prevent meaningful use of sensor insights. Resident engagement, a critical success factor, is frequently overlooked or treated as secondary.

When compared with other sectors, such as energy, logistics, or manufacturing, the housing sector stands out for its lack of technical coherence, market coordination, and institutional incentives. Yet it also holds unique promise: a clear social mandate, a captive building stock, and a growing body of practice from which to learn. The challenge now is not to test whether the technology works, it does, but to build the frameworks, partnerships, and capabilities that allow it to work at scale and in context.

A Market in Formation, not yet in Function

The smart device market in UK social housing is not yet a mature ecosystem. Instead, it is better described as an emergent landscape, defined more by its promise than by its performance. While the broader smart home market has developed steadily over the past decade, driven by consumer demand for convenience, energy savings, and security, the application of these technologies in social housing has followed a very different trajectory. Here, adoption has been shaped largely by compliance obligations, retrofit funding, and a growing awareness of the risks posed by damp and mould.

These dynamics echo the conditions outlined in Rogers' Diffusion of Innovations theory (2003), which suggests that the widespread adoption of new technologies depends not only on technical performance but also on organisational readiness, perceived value, ease of integration, and demonstrable outcomes.

Much of the early deployment activity occurred in the form of isolated pilots. These were typically led by a single department, often asset management or energy, and focused on solving discrete problems: identifying persistent condensation, improving boiler efficiency, or demonstrating compliance with heating standards. This fragmented approach was often encouraged by the structure of available funding, which

prioritised delivery of short-term outputs over the development of scalable, long-term infrastructure. In many cases, the pilots were technically successful but organisationally unsustainable. Without a clear strategy, defined roles, or robust data pathways, insights remained siloed and failed to inform wider transformation.

At present, the market still operates as a patchwork. Devices are deployed, but their data is often underused. Suppliers offer innovative technologies, but struggle to navigate complex procurement processes and demonstrate long-term value. Landlords express enthusiasm for IoT's potential but lack the systems and structures to harness it. As a result, the sector finds itself in a transitional phase, neither a blank slate nor a functioning marketplace, but a domain of repeated experimentation without institutional memory.

Market Size and Demand Forecasts: Substantial, but not yet Unlocked

Quantitative forecasts point to strong growth in the UK smart home market over the next five to ten years. In 2023, the UK smart home market generated roughly £3.6 billion. Forecasts project it to reach between £12–16 billion by 2030, implying a compound annual growth rate in the region of 10–23 % depending on the source. (Grandview research, Mordor Intelligence). Although social housing represents only a fraction of this total, its specific needs, particularly around regulation, fuel poverty, and decarbonisation, make it one of the most strategically important verticals.

Previous estimates indicate that around 150,000 IoT devices are installed (Aico / Homelink 2022) in social housing stock, serving purposes such as temperature monitoring, CO detection, leak detection, and energy metering. By 2025, this figure is expected to reach one million (Aico. / Homelink 2022), with many landlords targeting entire archetypes of housing for sensor rollout. Using conservative pricing assumptions, £200–£300 per property, including hardware, installation, connectivity, and data services, this translates to a market size of £200–£300 million annually. If deployment rates continue and platform services expand, the sector could support a market in excess of £600 million by the end of the decade.

Yet this growth is not guaranteed. It depends not only on procurement and installation capacity, but also on the development of supportive institutional, operational, and commercial conditions. Unlike the consumer smart home market, where purchases are made by individual households, the social housing smart device market is driven by institutional procurement and shaped by compliance obligations.

Enabling foundations that allow smart technologies to scale beyond isolated deployments are required. Institutionally, this includes leadership commitment, defined strategies, and governance models that integrate IoT into wider business planning. Without these, adoption remains opportunistic and short-lived. Operationally, it demands systems capable of ingesting, interpreting, and acting on device data, requiring investment in IT integration, digital skills, and workflow redesign. Many landlords still rely on manual processes or legacy platforms that cannot support real-time decision-making. Commercially, the market needs procurement practices that reward long-term value over short-term cost, viable business models for suppliers, and funding mechanisms that support infrastructure rather than episodic pilots. Together, these conditions form the connective tissue that transforms promising technologies into embedded, sustainable improvements.

The Supplier Landscape: Diverse, Dynamic, and Disjointed

The present supplier landscape has emerged from a decade of uneven evolution. Initially dominated by compliance-driven technologies such as smoke alarms, fire detectors, and carbon monoxide sensors, the market has gradually broadened to include energy monitoring, environmental sensing, and connected asset management. This expansion has been shaped by a combination of technological innovation, funding availability, and rising expectations around resident wellbeing and building performance.

The market is split between established players, many of whom have evolved from analogue safety or maintenance backgrounds, and new entrants who bring cloud-native, data-driven approaches to sensing and analytics. The former offer reliability, scale, and brand recognition. The latter offer agility, tailored services, and predictive capability. But few provide both.

The result is a landscape comprising:

- Specialist startups often focused on environmental insight, predictive maintenance, and integration with retrofit strategies.
- Established device firms, now retrofitting their legacy safety products with connectivity and analytics features.

- White-label OEMs, who enable others to package and deliver sensor solutions with varying degrees of integration.
- Data platform providers and integrators, who offer backend systems to visualise and interpret sensor outputs.
- Contractors and utilities with national footprints, who are beginning to embed smart devices into routine installation and maintenance programmes.

The innovation curve is steep but scattered. While many suppliers are investing in API layers, predictive modelling, and integration toolkits, few of these are designed with housing's unique constraints in mind. Meanwhile, landlords often lack the capacity to differentiate between competing offers or demand deeper system integration. In the absence of common standards, every deployment becomes a bespoke exercise, inhibiting scale and inflating cost.

Without a coordinating body or shared reference architecture, the supplier landscape continues to operate as a loose federation rather than a functioning ecosystem. In the sections that follow, we explore how this disjointed market affects the technologies available, the capabilities of landlords, and the possibilities for future convergence.

Product Typologies: A Growing but Fragmented set of Capabilities

The typology of smart devices available in the social housing sector has evolved rapidly in recent years, reflecting both broader technological advancements and the sector's shifting regulatory and operational priorities. However, the development of this offer has not followed a coherent path. Instead, it has mirrored the stop-start character of funding, policy initiatives, and organisational readiness within the sector.

Historically, early adopters focused on discrete, single-function devices, such as fire alarms and carbon monoxide detectors, that fulfilled specific statutory obligations. These technologies were often stand-alone and required minimal integration with existing systems. As connectivity costs fell and new low-power networks emerged (e.g. LoRaWAN, Zigbee, NB-IoT), a wave of environmental sensors entered the market, capable of monitoring temperature, humidity, air quality, and mould risk in real time. Startups such as Switcher and IoTSG capitalised on this shift by offering smart thermostats and multi-sensor platforms aimed at damp prevention and fuel poverty reduction.

Alongside this, energy-related technologies have become increasingly prominent, driven by net zero commitments and the availability of decarbonisation funding. Devices that enable heat loss detection, monitor boiler cycling, or interface with communal heating systems are now common in pilots. Some also offer live tenant-facing insights to encourage energy

behaviour change. Meanwhile, the safety and compliance category has remained stable, dominated by established players like Aico. These firms are now retrofitting their core detection devices with cloud connectivity and edge-processing capabilities to align with housing's shifting expectations.

A newer class of infrastructure technologies, gateways, routers, and connectivity hubs, has emerged to support the reliable transmission of data from homes to cloud platforms. This is a vital but often overlooked component of any viable IoT architecture. Similarly, analytics and data insight platforms are increasingly marketed as part of the solution, promising landlords real-time dashboards, predictive alerts, and integration with existing asset management systems. However, many of these promises remain underdelivered due to poor system compatibility and unclear organisational workflows.

The result is a product landscape that is both rich and fragmented. Few suppliers offer fully integrated stacks that include sensors, gateways, platforms, and integrations. Most systems are modular, relying on open APIs or third-party dashboards. As a result, landlords must construct solutions from multiple vendors, often facing integration challenges, interoperability gaps, and unclear data ownership protocols. In future, the market is likely to favour either aggregators who can stitch together multiple device classes into seamless systems, or vertically integrated players who offer full visibility and control across the technology chain.

Landlord Capabilities and Internal Constraints

The ability of landlords to absorb and operationalise smart device technologies is constrained by a series of persistent capability gaps. Although interest in IoT is widespread, particularly in response to compliance risks and public scrutiny, strategic readiness remains low. Our maturity assessment has already shown that the majority of landlords lacked a formal IoT strategy, and many of those with strategies acknowledged they were still in early development.

This strategic shortfall has deep roots. Many housing providers historically outsourced IT functions and did not develop strong internal capabilities in data science, systems integration, or digital transformation. Where pilots have been successful, they are often dependent on a small number of internal champions. Once those individuals move roles or funding ends, initiatives stall. Furthermore, IoT is frequently viewed through an asset management lens, rather than as a cross-cutting enabler of organisational improvement.

The operational realities compound these difficulties. Most asset management systems in social housing are not designed to ingest high-frequency, real-time data. Manual interventions remain common, and alerts generated by sensors often bypass core housing systems altogether. In such contexts, data becomes more burden than benefit, generating alerts that cannot easily be triaged, understood, or acted upon.

Landlords also face considerable financial and structural constraints. Retrofit

programmes are time-limited and funding-dependent, and often prioritise physical upgrades over digital infrastructure. Procurement frameworks still tend to favour short-term price over lifecycle value, making it difficult for landlords to select vendors offering longer-term strategic benefits. In addition, cross-departmental collaboration is often weak, meaning that insights from IoT data are not routinely shared between property services, tenancy teams, and customer contact centres.

Landlords vary significantly in digital maturity and scale. Larger organisations tend to have in-house data teams and greater procurement leverage, while smaller ones have less scope for the specialist teams required and the very smallest may rely on third-party asset managers and lack dedicated digital roles entirely. Data governance remains a critical gap for many, with landlords unclear on where data is stored, who has access, how long it is retained, what legal obligations arise in the event of a breach – even before any smart home data is collected.

Finally, digital inclusion and tenant engagement remain underdeveloped areas. Although many IoT systems are designed to be passive, from the tenant's perspective, issues of trust, transparency, and perceived surveillance remain live. Landlords report a lack of established good practice in involving tenants in design, consent, or data sharing decisions. Where attempts have been made to co-design or test resident-facing interfaces, these are often small in scale and not yet embedded into core service offers. In this context, building resident trust and understanding remains a critical but still largely unmet challenge.

Comparative Lessons from Other Sectors

Comparing the social housing IoT market to other sectors highlights the extent to which housing lacks many of the structural enablers that underpin successful digital transformation. In manufacturing and logistics, for example, industrial IoT systems are supported by long-standing standards such as OPC UA and Modbus, which allow disparate devices to communicate through common protocols. This technical coherence is reinforced by sector-specific integrators and shared performance frameworks.

In energy and utilities, regulation has played a significant role in catalysing IoT adoption. Whilst not always having been particularly well-delivered, the roll-out of smart meters in domestic settings was driven by government mandate, backed by supplier obligations and regulatory oversight. This created clear commercial necessity for firms to invest in interoperable systems and robust data infrastructures. Moreover, in those sectors, the value of real-time data is often intrinsic to the service model, whether that is dynamic load balancing in electricity grids or predictive maintenance in industrial machinery.

By contrast, social housing has no overarching digital framework or mandate. Regulatory drivers such as Awaab's Law are increasingly demanding evidence of environmental conditions within homes, but there is no common platform for doing so. Each landlord must interpret requirements

independently and procure accordingly. Procurement cycles are often slow and highly fragmented, making it difficult for suppliers to scale efficiently. Innovation cycles are mismatched: start-ups evolve their products in months; landlords plan in years.

The cultural context is also different. In logistics and utilities, data and automation are viewed as strategic levers. In housing, they are often viewed with caution, as sources of reputational risk, privacy concern, or operational complexity. Few housing organisations have executive-level champions for digital transformation. Digital projects are frequently initiated at service line level and struggle to gain sustained leadership attention.

These sectoral differences are not immutable. In fact, they help illuminate the pathways through which housing might evolve: by building common technical standards, developing shared procurement frameworks, improving integration capacity, and reframing data not as surveillance but as service improvement. However, achieving this will require cross-sector coordination, trusted intermediaries, and investment in the digital maturity of the housing sector as a whole.

Recommendations

For landlords:

1. **Develop formal smart technology strategies** linked to organisational priorities, especially around compliance, fuel poverty, and net zero targets.
2. **Build digital capability in-house**, particularly in data interpretation, system integration, and change management.
3. **Invest in integration and interoperability**, ensuring that new device deployments can feed into core housing and asset management platforms.
4. **Standardise data governance practices**, including protocols for data ownership, consent, storage, and resident communication.
5. **Involve residents meaningfully** from the outset, not just as recipients but as co-designers and evaluators of services.

For suppliers:

1. **Design for integration**, develop open APIs, interoperable systems, and modular architectures suited to varied landlord contexts.
2. **Prioritise evidencing of outcomes**, not just device functions. Demonstrate how technology drives value across compliance, resident wellbeing, and efficiency.
3. **Collaborate to create shared technical frameworks** (e.g. data schemas, connector templates) that reduce bespoke implementation costs.

4. **Engage in joint learning initiatives**, partnering with landlords on post-install evaluation, user testing, and system refinement.

For policymakers and funders:

1. **Support shared infrastructure**, such as integration frameworks, certification schemes, or common procurement templates, to improve market coherence.
2. **Align funding streams to long-term smart home capability**, not just device installation, requiring landlord investment in systems, skills, and organisational redesign.
3. **Introduce light-touch regulatory expectations** around data standards, interoperability, evidencing of outcomes from connected systems and real-time knowledge of property condition
4. **Back convening bodies or digital intermediaries** to bridge the gap between supplier innovation and landlord uptake, building shared confidence in scaling.

The market for smart devices in social housing is approaching a tipping point. The technology is available, the motivations are clear, and the early adopters have shown what is possible. But until landlords, suppliers, and system enablers align their approaches, the market will remain fragmented, fragile, and prone to stall.

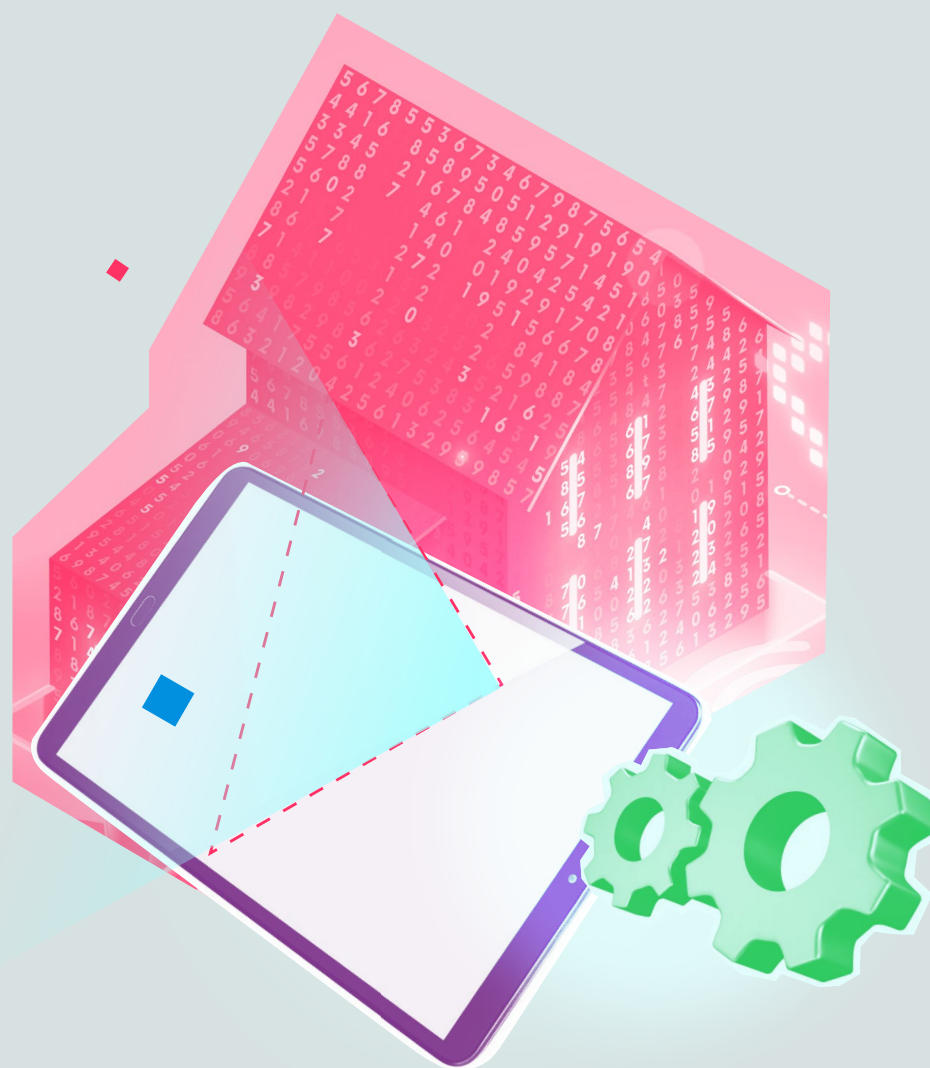
This is not simply a call for more pilots or better devices. It is a call for structural coherence: for strategies that embed digital transformation into housing

management; for standards that allow technologies to interoperate; for skills that enable data to become action; and for systems that centre the resident, not the device.

With coordinated effort, this is achievable. The building blocks are already present across the sector. The task now is to join them into something greater than the sum of their parts, a functioning, fair, and future-ready digital housing ecosystem.

Part 3

Barriers to Scale:



Executive Summary

Connected home technologies promise a fundamental shift in housing management – from reactive fixes to predictive, data-driven services that improve resident experience and reduce cost. Yet despite widespread experimentation, progress across the sector has stalled. What begins with pilot projects too often fails to translate into business-as-usual.

The research shows that this is not a problem of technology. The devices work. What holds the sector back are the conditions into which those devices are introduced: legacy operating models, fragmented systems, limited skills, transactional procurement, and relationships with both suppliers and residents that are shaped more by caution than by confidence. These factors interact, creating a reinforcing loop in which progress in one area is constrained by the absence of progress in others.

The result is that connected technologies remain peripheral – deployed in pockets, reliant on a small group of internal champions, and viewed by many residents as something done to them rather than with them. Data sits in silos, trust remains conditional, and operational teams are rarely equipped or mandated to turn new insights into action. Even where early benefits are evident, they are not sustained or scaled, leaving landlords exposed to the risk of investing in technology without changing the service models required to make it count.

At the same time, this research points to clear points of leverage. The same organisational gaps that slow progress also identify where the sector's focus must shift. Stronger leadership, deliberate investment in capability, reformed commissioning practices, and a more transparent relationship with residents can turn isolated pilots into an integrated part of core service delivery.

The evidence is clear: the barriers to scale are not fixed constraints, but design challenges. They reflect a sector that has not yet aligned its culture, systems, and partnerships with the demands of data-led housing management. Until it does, connected homes will remain a series of promising experiments. Addressing these barriers in combination, rather than in isolation, is what will unlock their full potential.

Introduction

This section identifies the most significant barriers preventing the scaling of connected home technologies across the UK social housing sector. These barriers have been derived from triangulated evidence across four primary sources: (1) in-depth interviews with landlords participating in the research; (2) interviews with suppliers operating in the IoT space; (3) a review of relevant literature on digital transformation, housing technology, and organisational change; and (4) tenant engagement activities including workshops, qualitative focus groups, and quantitative surveys.

Rather than viewing barriers as isolated or technical issues, this framework treats them as interdependent features of a broader sociotechnical system. Each barrier not only reflects a gap in readiness but also offers a point of leverage: a place where targeted intervention could unlock wider adoption. We provide clear and evidenced insight into the problem, highlight its consequences, and outline how it might be overcome.

Barrier 1: Lack of Organisational Readiness

Introduction

Connected home technologies promise a shift from reactive to proactive housing management, but the majority of landlords are not yet equipped to deliver this at scale. Organisational readiness goes beyond willingness or experimentation, it demands alignment across strategy, governance, systems, and skills. Where this alignment is missing, even promising pilots fail to progress beyond isolated use cases.

Even the most well-intentioned and successful pilots fail to progress to scale when wider systems, governance, and culture are unprepared.

1. Evidence from Literature Review

The literature emphasises that digital readiness is a precondition for successful scaling of IoT solutions. Key enablers include clear ownership, change-capable governance, and cross-functional working. Studies consistently highlight the “pilot-to-scale gap” as a result of weak alignment between innovation teams and core service delivery units.

One study cited in the review stresses the need for “an adaptive, whole-organisation model of readiness” where digital tools are supported by leadership, accountability, and culture change, not treated as peripheral IT experiments.

2. Evidence from Landlord Interviews and Maturity Assessment

The maturity assessment reveals a fragmented picture of preparedness. While 86.2% of landlords have run pilots, only 24% have scaled them across their stock. Formal strategies remain rare: 41.4% of organisations have no IoT strategy, and 27.6% are still developing one. Strategic oversight is typically concentrated within IT teams, while organisational-wide understanding remains weak.

Operational integration is also limited. Only 18.5% of landlords are using automated analytics. The rest rely on manual handling of data, undermining the timeliness and relevance of insight. Skills gaps in data interpretation and cross-team collaboration are frequently reported.

Landlords appear not ready yet to operate differently, too many systems are manual, and the team structures to make use of the data, even if it was available, don't yet exist.

3. Evidence from Supplier Interviews

Suppliers describe working with landlords who often lack the internal mechanisms to absorb and operationalise sensor-derived insights. A recurring theme is the difficulty in sustaining progress beyond pilots due to internal disconnects and unclear ownership.

One supplier noted that although the company had built APIs to enable integration, “most of the time those systems can’t even ingest the data in real time” This reflects systemic unreadiness, not just technical incompatibility.

From another interview, a supplier described their experience of how landlords were hesitant to adopt devices even where value was clear:

These responses point to deeper issues of organisational structure, confidence, and capacity, not simply procurement choices.

4. Evidence from Tenant Engagement

Tenants’ perceptions often mirror and amplify concerns about organisational competence. In one focus group, one resident asked, “They can’t do the repairs now, how will they be able to do all the other ones these sensors show need to be done?” This reflects a perception that the basic service model is not yet fit to absorb additional insight and respond with appropriate action.

Data from the resident surveys shows that while most residents are open to smart devices, trust in landlord capacity is conditional. In a large scale survey, 40% of respondents said they trusted their landlord “a fair amount,” while 17% were “not sure.” When asked what would help build trust, residents most frequently chose: “A clear explanation of what devices do” and “Being able to see the data myself.”

These responses highlight the expectation that if digital technologies are to be adopted, landlords must be ready to deliver on the promises they make, both operationally and in terms of accountability.

Implication for Scale

Without internal alignment, ownership, and capacity to act, connected home technologies risk becoming expensive white elephants, useful in theory, but marginal in practice.

How this Barrier might be Overcome

Overcoming this barrier requires a deliberate focus on building digital operational maturity:

- Assign executive accountability for IoT strategy, with delivery embedded in corporate objectives.
- Build organisational structures that bring together IT, asset management, compliance, and housing operations as joint owners of IoT impact.
- Invest in skills development for data interpretation, workflow redesign, and resident engagement.
- Move from project-based innovation to a pipeline model with clear evaluation, review, and integration gates.
- Position connected devices as part of core business transformation, not as a technological add-on.

In short, treat readiness not as a static attribute, but as a capability that must be cultivated, measured, and led from the top.

Barrier 2: Fragmented Procurement and Short-Term Commissioning

Introduction

While connected technologies are typically introduced through pilot projects or one-off funding streams, long-term success depends on integrated, strategic procurement. Yet across the housing sector, procurement remains dominated by short-term, compliance-driven mechanisms that struggle to accommodate the complex, data-led nature of IoT solutions. Frameworks often exclude newer suppliers, reinforce risk aversion, and fail to incentivise learning or outcomes. This barrier shapes what gets bought, from whom, and under what terms, and ultimately limits both innovation and value for money.

Summary

Innovation is blocked by rigid frameworks, low-trust relationships, and transactional logic.

1. Evidence from Literature Review

The literature highlights a consistent pattern: in complex public service environments, procurement acts as a bottleneck when it is treated as a rules-based compliance function rather than a strategic enabler of service transformation. Several studies point to the “procurement paradox,” where frameworks are designed to manage risk but end up excluding innovation by making it difficult for new or smaller suppliers to enter the market.

There is also evidence that traditional housing procurement is poorly suited to outcomes-based contracting. As one review noted, “Most public sector frameworks are designed around buying static goods or commoditised services, not dynamic, integrated digital systems.” As a result, suppliers are selected on price rather than performance, and contracts do not support learning, iteration, or adaptation.

2. Evidence from Landlord Interviews and Maturity Assessment

Several landlords described their own commissioning processes as inflexible, slow, and misaligned with innovation goals. In one case, a senior housing leader acknowledged: “Our procurement is still focused on kit, we’re not yet set up to commission for outcomes or service impact.” Although many landlords expressed interest in doing things differently, they reported that organisational appetite for reforming procurement was low.

The maturity assessment findings corroborate this: while 86.2% of landlords have conducted IoT pilots, only 24% have scaled them. One reason repeatedly cited in the free-text responses was difficulty sustaining supplier relationships beyond pilot phases. Several landlords mentioned challenges aligning internal procurement rules with fast-evolving IoT propositions.

3. Evidence from Supplier Interviews

Suppliers were often more direct. One interviewee from a sensor platform company noted, “Procurement processes just aren’t set up to buy outcomes, they’re still buying kit.” supplier described being excluded from tenders not because of performance or price, but because their company was deemed too new for an established framework: “The whole framework system is broken. We’re either excluded for being too new, or we’re forced to go through pointless hoops that don’t value what we do.”

Another interviewee illustrated the long-term impact of poor procurement decisions: “Some landlords run a three-year pilot, then re-procure the same device from a different supplier who undercuts on price. There’s no continuity, no learning.”

This environment discourages long-term supplier investment and limits the sector’s ability to build cumulative knowledge about what works across the purchaser : supplier ecosystem.

4. Evidence from Tenant Engagement

While tenants are not usually privy to procurement detail, the downstream effects are visible to them. In focus groups, tenants expressed scepticism about consistency, follow-through, and value. One resident questioned whether smart devices would really be sustained after installation: “It’s a great idea on paper, but will it be acted upon?”

A common theme was frustration with reactive or broken repairs processes, raising concerns that connected devices would reveal more problems than landlords were able to address. These doubts may

partly stem from procurement models that deliver devices without ensuring long-term service integration.

Implication for Scale

Disconnected, transactional procurement models restrict the landlord’s ability to build long-term partnerships, learn from pilots, or commission for whole-life outcomes, blocking the sector from realising the full benefits of connected homes.

How this Barrier might be Overcome

To overcome this barrier, landlords must reposition procurement as a lever for innovation and learning:

- Commission for outcomes, not just for devices, linking procurement decisions to service objectives like warmth, safety, and responsiveness.
- Reform frameworks to allow for supplier agility, innovation, and ongoing improvement, especially in data-driven services.
- Involve procurement professionals early in pilot design and scaling discussions to align contracting with long-term strategy.
- Share learning between landlords on what contract structures and commissioning approaches have worked.
- Engage suppliers in co-designing service models that go beyond “kit” and create integrated, trackable improvements.

Done well, procurement can become an engine of transformation, not a blocker to it.

Barrier 3: Insufficient Resident Trust and Conditional Consent

Introduction

The connected home cannot succeed without a willing resident. For smart devices to deliver value, through energy insights, earlier repairs, or improved safety, they must be accepted, trusted, and understood by the people living with them. Yet across interviews and engagement sessions, residents consistently expressed unease about how these technologies are introduced, what data is collected, and whether landlords can be relied upon to act fairly, transparently, or at all. Trust is not a given. It is conditional, and currently, it is fragile.

Summary

Without consent, participation drops, and so do the benefits. Trust must be earned, not assumed.

1. Evidence from Literature Review

The literature underscores that trust is central to digital adoption in housing contexts. Studies highlight that residents are more likely to accept connected technologies when they feel in control, understand the purpose, and believe their data will be used responsibly. Without these preconditions, even well-designed systems face rejection or disengagement.

Research also suggests that tenant trust is shaped not just by the technology itself, but by the landlord's broader track record, on repairs, communication, and fairness. In this

way, concerns about sensors often act as a proxy for deeper questions about power, control, and institutional behaviour.

2. Evidence from Landlord Interviews and Maturity Assessment

Landlords recognise trust as a limiting factor. Several reported that residents were wary of smart technologies unless they had been clearly explained and shown to work in others' homes. One housing professional noted: "When residents hear 'data' they think of surveillance. We have to work hard to reassure."

The maturity assessment scores this challenge clearly. Tenant involvement in planning and deployment scored a mean of just 3.64 out of 10, and 40.7% of landlords reported that they do not provide residents with access to IoT data collected in their homes. Free-text responses often mentioned the need to "do more on the trust side" before attempting scale.

3. Evidence from Supplier Interviews

Suppliers also see trust as a prerequisite, highlighting that consultations often have not been either as thorough as they had been led to believe. Others noted that when installations are framed as surveillance or imposed without explanation, resistance is high.

Another supplier described how a pilot failed due to poor engagement: "The

devices worked technically. But they'd been installed with no introduction, no consent process. People just unplugged them."

Although the technology was sound, the lack of trust made it unusable in practice.

4. Evidence from Tenant Engagement

Across all tenant engagement activities, trust and consent were dominant themes. In one focus group, a resident said: "I don't want it spying on me," while another asked: "Will I have a choice about having it? When asked to prioritise key statements, 75% of participants selected: "They mustn't install devices unless I agree." Trust was further shaped by broader concerns: "They can't do the repairs now, how will they do all the extra ones these sensors show?"

The survey data reinforced these themes. While most residents said they were "very" or "fairly" comfortable with the idea of landlord-installed smart devices (31% and 24% responses respectively), 17% respondents were "not sure" whether they could trust their landlord to use data responsibly, and 10% said they trusted them "not very much" or "not at all".

Asked what would help build trust, the top responses were: "A clear explanation of what devices do," and "Being able to see the data myself."

Implication for Scale

Where trust is low, residents are less likely to consent, less likely to participate, and more likely to reject or disable the technology, eroding the viability of connected home services at scale.

How this Barrier might be Overcome

Trust cannot be mandated, it must be cultivated through respect, transparency, and inclusion:

- Always seek informed, opt-in consent, with accessible information about what is being installed, what it does, and what it means for the resident.
- Design engagements that treat tenants as co-creators, not passive recipients, particularly during pilot phases.
- Provide real-time visibility of data to residents, framed around benefit and empowerment.
- Embed trust-building as a project stream in its own right, with measurable objectives and feedback loops.
- Acknowledge and address concerns about surveillance and data use directly, not defensively.

Trust is slow to build but easy to lose. For connected homes to succeed, it must be treated as a core infrastructure, just like the sensors themselves.

Barrier 4: Data Infrastructure is Fragmented and Immature

Introduction

The promise of connected homes lies not in the devices themselves, but in what landlords can do with the data they generate. To deliver earlier interventions, targeted investment, or responsive services, housing organisations must be able to collect, integrate, and interpret large volumes of sensor data in real time. Yet current infrastructure - both technical and organisational - often falls short. Disparate systems, manual processes, and poor interoperability mean that valuable insights go unused, and data-led decision-making remains elusive.

Summary

Disconnected systems mean that even good data goes unused or under-leveraged.

1. Evidence from Literature Review

The literature identifies data integration as one of the defining challenges of smart service environments. Studies emphasise that effective use of IoT data depends on the ability to feed it into core operational systems in a structured and timely way. Without this, housing providers face what one paper called “insight without action”; an accumulation of information that is not embedded into workflow, investment decisions, or compliance regimes.

Several sources also note that housing management systems are often legacy platforms not designed for high-frequency,

multi-source sensor data. In the absence of middleware or data lakes, IoT data risks remaining siloed, used for reporting but not operational improvement.

2. Evidence from Landlord Interviews and Maturity Assessment

The maturity assessment data makes this fragmentation visible. While 62.1% of landlords said they had some ability to analyse IoT data, only 18.5% reported using automated analytics. Most organisations still rely on spreadsheets, basic dashboards, or manual analysis to interpret sensor inputs.

Landlords also reported that their core housing or asset systems are not equipped to handle real-time data. One respondent noted: “We have data, but we can’t really use it yet - there’s nowhere for it to go that triggers action.” Free-text comments raised repeated concerns about interoperability between asset management systems and sensor platforms, particularly when suppliers offer proprietary interfaces.

3. Evidence from Supplier Interviews

Suppliers echoed these concerns. One explained, “Landlords don’t know what to do with the data. They collect it, but it just sits there.” Another stated that although their platform was capable of sharing information, most landlords were not equipped to receive it: “We’ve built APIs to integrate with asset systems, but most of

the time those systems can't even ingest the data in real time."

A further issue raised was duplication: landlords using multiple disconnected sensor solutions for different asset types or departments, each producing siloed data that cannot be aggregated. As a result, the value of the whole is less than the sum of its parts.

4. Evidence from Tenant Engagement

Tenants may not use the term "data infrastructure," but they notice its absence when things break down. In both surveys and focus groups, tenants expressed a desire to see and use the data themselves, suggesting frustration with one-way flows of information.

In surveys, 90% of respondents said they would find it helpful to see information from smart devices, either on a phone or through a website. Yet 40.7% of landlords reported not providing this access. This gap creates confusion and suspicion, especially where data is collected but not acted upon.

One workshop participant summarised the risk: "They can't do the repairs now, how will they be able to do all the other ones these sensors show need to be done?" The issue is not just what data is collected, but whether it flows to the right place, at the right time, in a form that can support action.

Implication for Scale

Without integrated systems and automated processes, connected devices generate noise instead of insight, and landlords miss the opportunity to act early, act fairly, or act at all.

How this Barrier might be Overcome

Maturing data infrastructure requires a coordinated, long-term investment, not just in technology, but in architecture, governance, and use:

- Audit existing systems and interfaces to map integration gaps and priorities.
- Establish a centralised data lake or middleware platform to manage sensor data alongside traditional housing data.
- Design data flows that support action, linking triggers from smart devices to repairs, compliance, and resident communication workflows.
- Require suppliers to meet open standards and publish APIs as a condition of procurement.
- Build organisational capability to manage data as a shared asset, not a specialist function.

Better infrastructure doesn't just enable better decisions, it creates the foundation for smarter, more accountable services.

Barrier 5: Skills Gaps Across the Organisation

Introduction

Scaling connected homes is not only a technical task, but also a people challenge. From front-line operatives and housing officers to IT teams, asset managers and senior leaders, the successful deployment and use of smart technologies depends on widespread capability to interpret data, act on insight, and communicate with residents. Yet skills development has lagged behind device rollout. Where organisational confidence is low, adoption slows, risks go unmanaged, and the transformational potential of connected homes remains untapped.

Summary

The workforce is underprepared for data-led services, limiting impact and increasing risk.

1. Evidence from Literature Review

The literature identifies workforce capability as a critical enabler for smart housing adoption. Several studies warn that when digital tools are introduced without investment in human capacity, the result is underuse, poor decisions, and staff disengagement. In particular, the skills required to analyse and act on sensor data, combining technical fluency with service knowledge, are rarely found in existing housing roles.

Moreover, transformation literature stresses the need for “whole workforce”

approaches. Digital confidence should not be confined to IT or innovation teams; it must be embedded across functions to ensure new ways of working take hold at scale.

2. Evidence from Landlord Interviews and Maturity Assessment

The maturity assessment highlighted skills as a core weakness. While some landlords reported growing confidence in IoT pilot teams, few believed their wider workforce was ready. Only 18.5% of organisations said they used automated analytics, and several admitted that they “rely on a small group of digital enthusiasts” to make sense of the data.

One respondent noted: “We don’t yet have the skills to interpret the data at scale or to know what action to take based on it.” Another flagged the operational challenge: “Even if the system flags something important, it’s not clear whose job it is to deal with it.” These gaps reflect not just technical shortages, but a lack of clear roles, responsibilities, and cross-functional collaboration.

3. Evidence from Supplier Interviews

Suppliers frequently encounter the skills barrier in their work with landlords. One commented, “Landlords often ask for the data feed, but when we give it to them, there’s no one there who knows what to do with it.” This echoes the concerns raised

by landlords themselves: a recognition that data infrastructure without human capability leads nowhere.

Another supplier noted that even well-designed platforms require some level of training: “We build intuitive dashboards, but there’s still a learning curve. If the teams aren’t trained, the tech doesn’t get used properly.” In some cases, suppliers reported requests to reframe reporting outputs for simpler internal use, indicating a mismatch between tool complexity and user confidence.

4. Evidence from Tenant Engagement

Skills gaps also affect resident-facing roles. In focus groups, tenants questioned whether housing officers and contractors would know how to respond to alerts or interpret data meaningfully. One participant observed: “If the devices say something’s wrong, I still want to talk to someone who understands what that means.”

From the surveys, many residents expressed interest in seeing their own data, but several also implied that support would be necessary. The most frequently selected trust-building factors included “A clear explanation of what devices do” and “Being able to speak to someone knowledgeable.” This underlines the importance of skilled human contact, even in a digitally enabled service.

Implication for Scale

Without confident, capable staff across the organisation, smart devices risk becoming isolated artefacts, generating data no one can act on, explain, or trust.

How this Barrier might be Overcome

Closing the skills gap means embedding digital capability into every part of the housing organisation, not just innovation teams:

- Develop a cross-functional IoT skills framework, tailored to different roles.
- Provide training not only in technical systems, but in interpreting data, engaging residents, and taking action.
- Establish clear operational pathways that define who responds to what, and when, based on sensor outputs.
- Use pilots to test not just the technology, but the workforce’s ability to adapt to it.
- Create communities of practice where digital learning can be shared across departments and job grades.

Smart services demand smart teams. Without investment in people, the potential of connected homes will remain unrealised.

Barrier 6: Unclear Ownership and Accountability

Introduction

As connected technologies are introduced into housing stock, a fundamental question emerges: who is responsible for what? When devices generate alerts, surface risks, or indicate failure, someone needs to be accountable for interpreting the data and acting on it. Yet across the sector, there is widespread ambiguity about ownership, of systems, of data, of processes, and of outcomes. Without clarity, action is delayed, responsibility is blurred, and smart technology risks becoming a passive observer rather than an active agent of change.

Summary

No single team owns the outcomes, so devices become ‘someone else’s problem’.

1. Evidence from Literature Review

Digital transformation research stresses the importance of defined accountability when embedding new technologies into legacy systems. Smart service models typically cut across traditional departmental boundaries, requiring new governance structures to coordinate action. Studies note that IoT success depends not just on who installs the technology, but on who owns the consequences of what the technology reveals.

In housing, this challenge is amplified by structural silos, where asset teams,

compliance, IT, housing management, and customer services operate with different goals and data systems. Without cross-cutting accountability, smart tools can fall into organisational gaps.

2. Evidence from Landlord Interviews and Maturity Assessment

The maturity assessment highlights the governance gap clearly. Only 24% of respondents said they had scaled connected technologies beyond pilots, and free-text responses repeatedly mentioned uncertainty around who “owns” smart technology internally.

One respondent described the situation succinctly: “We don’t know if it’s IT, compliance, asset or customer services who should own it. So no one does.” Another noted that alerts often get passed around between teams, with no defined process for resolution. Several landlords raised concerns that sensor data might generate liabilities no one had the authority, or the resources, to address, whilst imposing the obligation to act through possessing knowledge of the problem.

3. Evidence from Supplier Interviews

Suppliers encounter similar confusion in practice. One noted that different teams within landlords have different expectations of what the technology will do for them, and often front line staff’s needs are met only poorly. They observe

that communication is fragmented and decisions are delayed.

Another supplier described a situation where alerts from devices were not actioned because “there was no agreement about who did what with the data.” This left risks unresolved and tenants without follow-up. The absence of clear internal ownership turns smart infrastructure into a source of friction rather than insight.

4. Evidence from Tenant Engagement

Residents notice when accountability is lacking, even if they describe it differently. In one focus group, participants expressed frustration with a lack of follow-through: “They can’t do the repairs now, how will they be able to do all the other ones these sensors show need to be done”. The concern is not just whether someone receives the data, but whether anyone is responsible for turning it into action.

Through survey responses, residents repeatedly emphasised the importance of trust and responsiveness. When asked what would help build confidence, top responses included: “Knowing what happens after the data is collected” and “Being able to speak to someone knowledgeable.” These reflect a desire for visible accountability, not just technical functionality.

Implication for Scale

Without clear ownership, smart devices become inert, capable of seeing problems, but powerless to resolve them.

How this Barrier might be Overcome

Clarifying accountability is essential to operationalising connected technologies:

- Establish formal governance for IoT oversight, with cross-departmental representation and executive sponsorship.
- Map out data flows and define decision rights, who sees what, who acts, and within what timeframes.
- Create single points of contact for operational alerts, with clear escalation routes.
- Embed ownership into job roles, service level agreements, and performance frameworks.
- Ensure residents have a clear pathway to query data or raise concerns, linked to accountable staff.

Smart systems need smart accountability. Only then can insight lead to action.

Barrier 7: Limited Strategic Alignment

Introduction

Many landlords experimenting with smart technologies still treat them as peripheral to core business strategy. IoT deployments often begin in response to a specific pressure, such as damp and mould, fuel poverty, or regulatory compliance, but are not integrated into broader organisational goals or transformation plans. This lack of strategic alignment means connected home initiatives struggle to secure long-term investment, executive focus, or cross-functional coordination. The result is fragmentation, underuse, and missed opportunities to unlock system-wide value.

Summary

IoT remains peripheral, rarely linked to core business objectives or performance metrics.

1. Evidence from Literature Review

Digital innovation in housing is most effective when it is embedded into the organisation's overall strategic direction. The literature highlights that smart technologies deliver most value when used to transform end-to-end services, not when bolted onto existing systems. Researchers warn against a "project mindset" that isolates digital trials from the operating model, resulting in stalled pilots and minimal return on investment.

Strategic alignment is described as a key success factor for technology scaling.

One framework referenced in the review argues that "digital transformation must be anchored in business objectives, not novelty", emphasising the importance of clarity about why and where connected homes fit within housing provider missions.

2. Evidence from Landlord Interviews and Maturity Assessment

The maturity assessment reveals how limited this alignment often is in practice. Just 31% of landlords reported that their smart home activities were currently linked to strategic or business plan priorities. Most indicated that deployment was being led by individual departments or reactive pressures, rather than a coordinated strategy.

One respondent admitted: "At the moment it's mainly about keeping up with compliance. There's no real roadmap." Others suggested that while senior leaders were supportive of innovation in principle, there was little clarity on how IoT should contribute to wider service redesign, cost reduction, or customer satisfaction goals.

Some organisations had struggled to maintain executive focus. One commented: "Once the pilot is over, it's hard to keep it on the agenda." Without a direct link to strategic targets, connected home initiatives risk fading into the background once initial enthusiasm passes.

3. Evidence from Supplier Interviews

Suppliers are acutely aware when strategic alignment is missing. One observed, “We often see tech trials happening in isolation, there’s no plan for what happens next, or how it links to the rest of the business.” In these cases, suppliers described delivering working systems that were never scaled because the organisation had no strategic framework to absorb them.

Another supplier reflected on the consequences: “We’ve had deployments that delivered savings, but no one internal had the remit to champion it. It just stopped.” This points not to technical failure, but organisational misalignment: a lack of strategic grip to turn success into system change.

4. Evidence from Tenant Engagement

Tenants are unlikely to comment directly on strategy, but they notice when activity feels disconnected or short-lived. At one focus group, one participant asked whether this was just “another initiative that’ll go away in a few months” Others questioned whether smart devices would lead to lasting improvements, or just generate more data with little follow-up.

In the surveys, several residents described wanting “devices that make a difference, not just gadgets,” and expressed hope that changes would be meaningful and long-term. These sentiments imply that residents, too, are attuned to whether digital interventions feel embedded, or tokenistic.

Implication for Scale

Without integration into strategy, smart technologies remain peripheral experiments, lacking the sponsorship, resources, and relevance needed to drive lasting change.

How this Barrier might be Overcome

Strategic alignment requires more than executive endorsement, it demands embedding smart home work into the organisation’s core narrative:

- Define clear outcomes for connected home initiatives, linked to strategic goals like safety, decarbonisation, and tenant satisfaction.
- Assign executive-level sponsorship to ensure continued visibility and prioritisation.
- Integrate IoT metrics into business planning, risk management, and performance dashboards.
- Use pilots not only to test devices, but to surface insights that inform long-term service and asset strategies.
- Make “smart” a cross-cutting theme in organisational transformation, not a standalone project.

Only when digital deployment is aligned with business purpose can it fulfil its potential as a lever for system-wide change.

Barrier 8: Digital Exclusion and Connectivity Barriers

Introduction

Smart home technologies depend on digital connectivity. Whether devices report data via Wi-Fi, cellular networks, or mesh protocols, some level of digital infrastructure is essential. But many tenants face barriers to digital access, including affordability, connectivity, and digital confidence, while housing providers often underestimate the complexity of managing these variables at scale. When connectivity fails or digital skills are absent, smart technologies cannot function reliably, and equity gaps widen.

Summary

Devices fail in practice when tenants lack internet access or digital literacy.

1. Evidence from Literature Review

The literature is unequivocal: digital inclusion is a prerequisite for the effective deployment of smart technologies. Reports consistently identify connectivity gaps as a major obstacle in both urban and rural housing contexts. Even where mobile or broadband coverage is technically available, tenants may be digitally excluded due to cost, mistrust, or limited confidence with technology.

A number of studies call attention to the “hidden dependencies” of IoT rollouts, such as the need for stable Wi-Fi, mobile data plans, and usable interfaces. Without landlord-provided infrastructure and

resident support, exclusion risks reinforcing disadvantage rather than alleviating it.

2. Evidence from Landlord Interviews and Maturity Assessment

In the maturity assessment, landlords frequently cited connectivity as a weak point in their pilot programmes. One respondent noted: “Some properties don’t have broadband or even decent mobile coverage. We’ve had to change our plans based on that.”

Only 35% of landlords said they had considered digital inclusion as part of their IoT planning process. Others acknowledged the issue, but lacked a clear strategy to address it. One commented: “We’ve thought about inclusion in general, but haven’t mapped it specifically to connected devices.”

For some, assumptions about tenant access proved optimistic: “We initially expected people would use the app, but lots didn’t have smartphones or didn’t want to use them.” This gap between planned functionality and practical reality is a recurring theme.

3. Evidence from Supplier Interviews

Suppliers reported similar experiences. One stated, “We get a lot of calls about devices not working, and it turns out the tenant’s Wi-Fi has dropped or they’ve changed router.” Others mentioned that

their products had to be redesigned or reconfigured to work with low-connectivity households.

A supplier offering cellular-connected sensors noted that even 4G coverage wasn't always sufficient: "We've had installations where we needed to install additional signal boosters because coverage in the building was so poor." In blocks of flats and remote rural homes, signal degradation was a common issue. One supplier described digital exclusion as "the number one silent killer of our pilots."

4. Evidence from Tenant Engagement

Tenant concerns about digital access were both vocal and specific. In one focus group, participants raised clear objections: "I don't have any internet, and I don't want it," and "I don't want it using my internet." Others asked whether the devices would be visible, consume electricity, or require apps they didn't feel comfortable using.

From the surveys, 31% respondents said they would like to help design how the devices are used, but 32% said no, and "not confident with technology" was one of the most common reasons cited in open-text feedback. Many also expressed a preference for devices that "just work in the background," without requiring smartphone apps or user input.

When asked about trust, multiple respondents linked their concerns to digital unfamiliarity: wanting more support, simpler information, or the ability to opt out.

Implication for Scale

If digital access and confidence are not addressed up front, connected home technologies will embed inequality, functioning well for some, failing silently for others.

How this Barrier might be Overcome

Digital equity must be designed into connected home programmes from the outset:

- Map digital access and skills across the tenant base before deployment, not after.
- Choose technologies that are connectivity-flexible, able to operate via Wi-Fi, cellular or mesh networks depending on context.
- Provide in-home connectivity options (e.g. cellular hubs) for tenants without broadband.
- Design user interfaces for low digital confidence, clear, optional, and easy to ignore if preferred.
- Build digital support into long-term service models, not just installation visits.

Smart doesn't mean complex. In many cases, the simplest digital pathways are also the most inclusive.

Barrier 9: Weak Post-Installation Pathways

Introduction

Installing smart devices is only the beginning. The real value of connected homes lies in what happens next, how alerts are triaged, how services respond, and how residents experience the outcomes. Yet across the sector, many IoT deployments falter not at the point of installation, but in the operational follow-through. When processes are unclear, action is delayed, or communication breaks down, the promise of smarter services is undermined, and resident trust is lost.

Summary

Sensors are installed, but action is slow, unclear or absent, eroding tenant confidence.

1. Evidence from Literature Review

The literature on smart systems stresses that the effectiveness of IoT interventions depends on closing the loop between insight and action. Devices can provide high-quality data, but unless organisations are operationally ready to respond, rapidly, appropriately, and consistently, the impact remains limited.

Studies describe a “last mile” failure in many public service applications, where sensors generate alerts but workflows remain manual, unclear, or under-resourced. Success depends on well-defined operational protocols, clear roles, and integrated digital-to-human handoffs.

2. Evidence from Landlord Interviews and Maturity Assessment

The maturity assessment revealed that many landlords have yet to define end-to-end pathways for how sensor insights are acted upon. Only 18.5% reported using automated analytics, and fewer still had standard operating procedures for responding to device alerts.

One respondent noted: “We know when the alert triggers, but we don’t have a defined process for follow-up, especially across different teams.” Another commented: “We’ve got the data, but it’s not always clear what we’re supposed to do with it, and by who.” These gaps create risk: both of inaction and of inconsistent service delivery.

In free-text responses, several landlords reflected on missed opportunities to involve frontline teams in workflow design, leading to friction between technical insight and operational practice.

3. Evidence from Supplier Interviews

Suppliers were candid about the breakdown between technical delivery and service response. One shared, “In some cases, we see alerts go nowhere. The data is working, but there’s no assigned follow-up inside the organisation.” Another described frustration when repeated alerts were raised for the same issue, with no apparent action: “We can see the problem

escalating, but the landlord's internal process isn't keeping pace."

Some suppliers have adapted by building additional follow-up tools, but this often duplicates effort and increases cost. One observed that "post-installation support is the most neglected part of the process, but it's where all the value is."

4. Evidence from Tenant Engagement

Residents are highly attuned to whether smart technology leads to meaningful action. In a focus group, one participant asked: "Will this be like other things, where they tell us they're monitoring, but then nothing happens?" Another reflected a common concern: "I want to know what's being done when something is picked up."

In the surveys, nearly half (48%) of residents said they would be happy to engage with smart devices if it required "a little effort, like checking a screen or app now and again." But in open-text feedback, many stressed that effort must be met with action: "If I report something, or if the device picks it up, I want it fixed fast."

A recurring theme across engagements was scepticism about follow-through. Residents expressed support for technology in principle, but doubted whether landlords would respond in practice.

Implication for Scale

Without robust post-installation processes, connected technologies become performative, seen but not felt, heard but not believed.

How this Barrier might be Overcome

Post-installation success depends on clear, consistent, and visible pathways from alert to resolution:

- Co-design standard operating procedures with input from frontline teams, IT, and residents.
- Define what constitutes an alert, who receives it, and what the response timeframe should be.
- Integrate device alerts into existing case management or repairs systems, not standalone dashboards.
- Communicate with residents when action is taken, and when it isn't, with reasons why.
- Monitor follow-up rates and outcomes as core performance metrics, not just technical uptime.

Smart devices can surface problems faster, but it's how landlords respond that defines whether residents experience real change.

Barrier 10: Cultural Resistance and Organisational Inertia

Introduction

Digital technologies can be installed quickly, but cultural change moves at a different pace. Connected home programmes challenge long-standing assumptions about how housing services are delivered, how risk is managed, and what roles staff play. For many organisations, the deeper barrier to scaling smart technologies lies not in the kit or the cost, but in embedded ways of thinking. When staff are unconvinced, cautious, or unsupported, connected homes struggle to gain traction beyond small-scale pilots.

Summary

Established norms, workflows, and mindsets resist the operational shift that IoT requires.

1. Evidence from Literature Review

The literature points to culture as a decisive factor in digital transformation. Technical infrastructure may be necessary, but it is not sufficient. Smart systems challenge existing patterns of accountability, service delivery, and decision-making. Without cultural alignment, resistance emerges, not always overtly, but through hesitation, delay, or passive non-compliance.

Studies describe “organisational immune systems” that react defensively to unfamiliar tools or externally driven change. Successful transformation, by contrast, is

marked by leadership that frames digital shifts as part of the organisation’s core purpose, not an add-on or experiment.

2. Evidence from Landlord Interviews and Maturity Assessment

The maturity assessment identified culture as one of the most persistent challenges to scale. One respondent commented: “We’re still quite cautious, we don’t want to promise things we can’t deliver, and staff are nervous about relying on systems they don’t fully understand.” Others highlighted friction between teams: “There’s interest from leadership, but frontline teams are more sceptical. They don’t want to be blamed if something goes wrong based on a sensor.”

Only 34.5% of landlords reported that IoT projects were supported by change management or culture-shaping activities. Several noted that while technical pilots were relatively easy to set up, building belief and ownership across departments remained much harder.

3. Evidence from Supplier Interviews

Suppliers regularly described encountering organisational inertia. One commented, “We’ve had cases where the tech works, the data’s there, but nothing changes because people are afraid to shift the process.” Another described frustration with decision-making: “You get stuck in

loops where people say they support it, but then ask for another review, another check, it's always easier to do nothing."

Some suppliers have responded by offering direct operational support, but this too can backfire if it's seen as overstepping internal teams. The result is a limbo where potential is visible, but progress is slow.

4. Evidence from Tenant Engagement

Residents also picked up on this inertia. In one focus group a participant questioned whether the organisation would "actually change the way they work, or just add more tech on top". Others raised concerns that promises made during pilot stages would not translate into long-term action, suggesting low expectations about the organisation's capacity to change.

In another focus group, one resident observed: "They say they're listening, but I don't think they really change anything based on what we say or what the tech says." These views imply not only scepticism about technology, but a broader doubt about organisational responsiveness and openness to change.

Implication for Scale

Without cultural readiness, smart technologies may be installed, but they will not be embedded, trusted, or acted upon at the scale required to realise their value.

How this Barrier might be Overcome

Cultural resistance must be addressed as deliberately as any technical challenge:

- Involve staff at all levels in the design and testing of new IoT-enabled workflows.
- Use storytelling and real-world examples to demonstrate benefits and build belief.
- Identify and support champions across departments who can bridge the gap between strategy and day-to-day delivery.
- Frame connected homes as a long-term service transformation, not a short-term tech initiative.
- Measure and recognise behavioural shifts as part of project success criteria, not just technical deployment.

Changing culture takes time, but without it, no digital system can succeed.

Conclusions

These ten barriers represent the most significant structural, operational, and cultural challenges facing social housing organisations seeking to scale connected home technologies. They are drawn from a rigorous synthesis of interviews, resident engagement, supplier insight, and literature review, and reflect the complex interdependencies that characterise real-world transformation.

Crucially, none of these barriers is fixed. Each offers a point of leverage, a place where intentional design, strategic clarity, and human-centred practice can unlock progress. Taken together, the barriers show that technology alone will not deliver the future of social housing. What's required is a systemic shift: in mindset, in process, in accountability, and in trust.

We have also revisited the three key hypotheses posited at the start of this research. That three relationships lay at the heart of scaling smart homes and that the inter-relationship of the three was the cause of lack of scale.

1 That the Landlord-Supplier Relationship is a barrier to scale

The original research hypothesis proposed that the relationship between landlords and suppliers is an impediment to the scaled deployment of connected homes technologies. The evidence from this study supports that proposition, but with important caveats and areas of progress that should be acknowledged.

There is a clear and recurring pattern of misalignment between the expectations, capacities, and institutional environments of landlords and suppliers. Suppliers describe a market that remains risk-averse, slow, and process-heavy, constrained by procurement frameworks that reward low-cost transactions over long-term outcomes. Landlords, for their part, describe a supplier market that can be opaque, fragmented, and overly focused on technical features rather than strategic alignment with housing priorities. Both parties express frustration, but also a shared desire for better ways of working.

This is not a case of mutual antagonism. It is a relationship shaped by structural legacy, organisational constraint, and the novelty of the technology itself. The problem is not that landlords and suppliers are adversaries. The problem is that they are too often miscast in roles that limit the potential for partnership. Landlords remain stuck in old procurement and contract management models; suppliers are pitching 21st-century service innovations

into a 20th-century commissioning environment.

Despite these challenges, the research also identified encouraging signs of evolution. There are emerging examples of co-designed deployments, where the supplier is embedded in a wider service transformation effort, and landlords are increasingly recognising the need for longer-term commercial models that reflect total value, not just upfront cost. The desire to move beyond short pilots toward scalable, integrated solutions is growing on both sides, but is not yet supported by the structural mechanisms needed to make it the norm.

The research therefore substantiates the hypothesis: the landlord-supplier relationship, as currently configured, is indeed a barrier to scale. But it is not an immovable barrier. Rather, it is a site of potential transformation, one that will require new commissioning models, shared standards, and a shift in trust and risk between parties. As later sections will explore, this transformation must occur in parallel with internal changes to landlord systems and culture, and with a redefinition of the resident's role in the value chain.

In summary, the evidence points to a relationship that is neither broken nor benign, but underpowered. Until landlords and suppliers begin to act as interdependent partners in a shared delivery ecosystem, the full promise of connected homes will remain unrealised.

2 That the Landlord-Resident relationship is a barrier to scale

The evidence supports the hypothesis, but requires nuance. Residents are not barriers in themselves. What impedes adoption is the absence of a robust, trust-based, and responsive relationship between landlords

and their residents. The barrier is not resistance to technology, it is resistance to technology delivered without clarity, without choice, and without care.

Where that relationship is strong, where residents are informed, involved, and see real benefit, support for connected devices is high. But where that relationship is weak or fractured, even beneficial technologies are treated with suspicion.

This pattern is not unique to connected homes. It echoes long-standing research on tenant engagement, which consistently finds that trust is relational, not transactional, and must be built before it is needed. The Connected Homes research does not suggest that landlords must achieve perfection before deploying devices. But it does show that scaling adoption without relational readiness is unlikely to succeed.

If smart devices are to move from pilot to platform, from gadget to system, they must do so within a social contract that residents recognise, value, and consent to. That contract is not written in policy, but in every interaction between landlord and tenant. At present, that contract is too often missing, unclear, or broken. Until it is repaired, the landlord-resident relationship will remain a bottleneck to scale.

3 That the Landlord's organisational readiness and ability to change is a barrier to scale

The evidence from the research strongly substantiates the hypothesis. While there is growing appetite for connected home technologies, landlords' internal operating models have not kept pace with the demands these systems place on data flow, service integration, and workforce capability. The limiting factor

is not technology itself, but the ability to transform structures and behaviours around it.

This is not a question of blame or inertia. Most landlords interviewed were clear-eyed about the challenges they faced and recognised the need for significant internal change. But without a compelling cross-organisational vision, dedicated leadership, and reconfigured systems, the benefits of IoT are likely to remain isolated or symbolic, useful in pilots, but incapable of being scaled.

Organisational readiness, then, is not a background factor. It is a frontline determinant of success. Until housing providers can retool not just their assets but their assumptions, the transition from reactive management to predictive, insight-led services will remain an ambition rather than a norm.

The rest of this report moves beyond the diagnosis to propose the practical building blocks of that shift. But the message is clear: the path to scale is not just technical, it is organisational. Connected homes require connected systems, connected teams, and connected purpose.

Part 4

Roadmap and Implementation



Executive Summary

Connected home deployment is no longer a question of if, but how. The research shows that while landlords, suppliers, and residents all recognise the value, progress has been constrained by fragmented leadership, piecemeal delivery, and a failure to treat this work as the deep organisational transformation it is. Scaling cannot be achieved through isolated pilots or opportunistic projects. It demands a fundamental shift in how housing organisations align strategy, data, governance, and culture so that connected technologies become a routine part of how homes are managed and residents are supported.

This roadmap sets out how to achieve that shift. Leadership must define a clear organisational purpose for connected homes and ensure that this intent is translated into real-world decisions: budgets then need to be reallocated, governance restructured, and roles redefined to reflect this intent. The internal machinery of change must then build the capability to deliver at scale through rigorous programme management, readiness assessments that expose the gaps in systems and skills, and the creation of cross-functional delivery teams able to act on data rather than merely collect it.

Alongside this, resident trust and participation has to be built and

maintained. Successful programmes are not just installed; they are understood, accepted, and experienced as credible improvements in people's lives. This means treating resident engagement as a core delivery stream, not a communications exercise, and ensuring that data transparency and clear feedback loops are built into the operating model. The roadmap also affects practical architecture of change: how technology stacks should be designed for interoperability and control, how use cases can be sequenced to build confidence and momentum, and how benefits must be tracked and evidenced in ways that drive further investment and sector-wide learning.

What follows is not a checklist but a structured approach to transformation, informed by evidence from across the sector. It shows how to replace one-off pilots with a sustainable model for scaling, one that combines strong leadership with organisational discipline, transparent resident relationships, and technology choices that do not close down future options.

Scaling connected homes will not be easy. It will test the sector's willingness to lead decisively and invest in change. But the conditions for success are now clear, and the cost of delay will only grow. The opportunity is to act now—coherently, visibly, and at pace—so that connected homes move from experiment to operating reality.

Introduction

It is clear from the research findings and analysis that landlords, suppliers and residents (albeit to different extents and with different priorities) would support and benefit from increasing the rate at which smart devices are deployed across the social housing estate. The decision to deploy is, in all practical ways, down to the landlord and so this Roadmap section is primarily aimed at those organisations. However, two important findings emerge from the research : that residents have a real interest in how this is approached and that the supply chain's appetite to create new products and offers will depend on the scale which landlords collectively offer.

This part has the following sections:

- Vision and strategic intent
- Change methodology and change capacity
- Resident considerations
- Use cases
- Business Case
- Technology stack
- People considerations
- Timeline

Vision and Strategic Intent

The deployment of smart home technologies across the social housing sector is no longer a speculative innovation, it is an operational and strategic necessity. The ambition to scale adoption must be matched by clarity of intent and coherence of action at all levels of the organisation. For landlords seeking to harness the full benefits of connected devices: improved compliance assurance, increased resident safety, reduced carbon emissions, better asset performance, and more efficient

service delivery, the question is not whether to adopt, but how to do so decisively, coherently, and at pace.

A shared strategic vision is the essential starting point. Organisations that succeed in embedding connected home capabilities at scale will not have treated them as an add-on to business-as-usual. Instead, they will have defined a future operating model in which connected data flows continuously inform frontline service delivery, asset management decisions, resident engagement, and regulatory compliance. That model is then not to be owned by a single department, but from the executive as a whole, with visible support from the most senior levels of leadership.

This level of alignment cannot be assumed, it must be engineered.

Many social landlords express high-level support for smart technology in principle, but fail to back that up with consistent action across governance, staffing, budgets, systems, and supplier relationships. The result is a pattern of small-scale pilots, unclear benefits, and institutional drift. Where the strategic intent is not translated into a shared understanding of direction, roles, and resourcing, even the most promising innovations stall. Vision alone is not enough; ambition must be operationalised.

This means that executive leadership teams should not only endorse a smart homes agenda, but actively lead its framing and internal negotiation. In some organisations, IoT remains the preserve of the IT function or asset management teams. In others, it emerges opportunistically, tied to a single funding stream or compliance crisis, without any long-term articulation of its strategic role. A mature approach recognises that

connected technologies touch multiple aspects of the organisation, and so the vision must be framed as a whole-system transformation.

Three strategic commitments are essential:

1. A clearly defined organisational purpose for smart home adoption

The first task of leadership is to define the “why”. A credible and shared purpose aligns internal stakeholders, informs investment decisions, and guides supplier selection. Whether the driving force is compliance, decarbonisation, cost efficiency, or resident wellbeing, organisations must be explicit about their intended outcomes and the contribution of connected technologies toward them. Vague or multiple aims lead to dilution. Clarity creates traction.

This purpose should be formally documented and communicated, forming the top level of a cascading strategy that links operational plans and digital transformation efforts. A smart home deployment plan without a clear theory of change, without an articulation of how and why the devices will create value, is unlikely to command sustained attention or resource.

2. Senior leadership accountability for outcomes, not just oversight

Successful transformation depends on more than governance structures. It requires a visible shift in leadership behaviour. Executives must not only approve the roadmap, but model the behaviours and decisions it requires: prioritising cross-functional integration, challenging legacy ways of working, and protecting the focus of delivery teams. Where needed, they must also be willing to

make difficult trade-offs between short-term pressures and long-term strategic gain.

Accountability for outcomes should be assigned clearly, ideally to a named executive sponsor who is empowered to broker decisions across silos. Their role is not just to manage risks, but to keep the organisation focused on what success looks like, and to hold it to account for progress. Without this clarity, smart home efforts risk becoming fragmented, deprioritised, or devolved into technical projects with little strategic connection.

3. Realignment of resources and operating assumptions

It is a common error to announce a change of strategic direction without altering the underlying conditions that determine organisational behaviour. New ambitions require new resources, financial, human, technical, and a willingness to challenge old assumptions about how work gets done. In the case of smart homes, this includes rethinking how repairs are scheduled, how compliance is evidenced, how resident contact is handled, and how asset data flows across systems.

Leaders must be prepared to redirect budgets, create space for experimentation, invest in skills, and, critically, signal that this agenda is a priority across competing demands. Too often, the transformation is expected to occur within the constraints of existing staffing levels, legacy processes, and siloed systems. This leads to under-delivery and organisational fatigue. A more effective approach begins with a frank assessment of what must change, and a deliberate plan to make those changes real.

In short, strategic intent is not a document, it is a set of decisions, behaviours, and investments that give direction and shape

to the future. The leadership task is to provide coherence: across vision and action, across teams and timeframes, and across internal and external expectations. Without that coherence, attempts to scale smart home deployment will struggle to overcome the organisational inertia, misaligned incentives, and structural fragmentation that the research has consistently identified.

Organisations that succeed will be those who treat connected homes not as a technology initiative, but as a defining feature of how they intend to operate in the future: smarter, safer, fairer, and more responsive. That future will not arrive by chance. It must be designed, owned, and led from the top.

Change Methodology and Change Capacity

The transition to a connected homes model is a major organisational shift. It alters how services are delivered, how risks are managed, how information flows, and how value is defined. As such, it must be treated not as a technology roll-out but as a strategic change programme of high complexity and significance. To succeed at scale, landlords need a deliberate approach to change, one that is governed with rigour, resourced appropriately, and supported by a cross-organisational capability for delivery.

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This work cannot be absorbed into business-as-usual. Nor can it be delegated entirely to an innovation team, an IT function, or an external supplier. Instead, it requires whole-system coordination, anchored by robust change methodology and underpinned by real organisational

readiness. That readiness must be actively built, starting before deployment begins, not retrofitted once challenges emerge.

1. Building Capacity to Deliver

Before implementation, landlords must assess and develop their internal capacity to plan, manage and embed change. This includes three core areas:

- Leadership capacity: Are senior leaders clear on their role in driving the change? Do they have time and authority to resolve cross-cutting issues?
- Programme delivery: Is there a skilled change team with experience of complex, multi-stakeholder programmes? Are programme management tools and disciplines in place?
- Functional readiness: Are frontline services, data teams, compliance functions, procurement, and resident engagement staff prepared for the operational shifts that will follow?

One of the most consistent findings from the research is that organisations underestimate the internal coordination required to move from pilot to scale. Many assume that a small-scale success can be expanded linearly. In practice, scaling smart home technologies will expose any structural weaknesses: inconsistent data ownership, lack of shared metrics, outdated process maps, and siloed accountability. Identifying these early and addressing these in advance increases the likelihood of a successful transition.

A good starting point is a formal change readiness assessment (an example is included at [Appendix 7](#)) This should be structured, evidence-based, and honest, identifying not only areas of strength, but also latent risks that may undermine delivery. Findings should feed into a tailored change capability plan, setting out what needs to be developed, over what timeframe, and with what support.

2. Structuring the Change Programme

Smart home transformation requires more than coordination; it requires structured programme management that aligns effort with purpose. This means defining a change architecture that integrates technology deployment with cultural, procedural, and behavioural change.

Effective programmes share the following characteristics:

- **Clear scope and phasing:** They break the transformation into coherent workstreams, such as data infrastructure, device installation, resident engagement, workforce training, and define realistic timelines for each.
- **Strong interdependencies mapping:** They actively manage the connections between those workstreams, ensuring that, for example, new data systems are operational before alerts are used to trigger resident visits.
- **Defined success measures:** They agree early on how success will be judged, not just in terms of device installation, but in terms of sustained service improvement, resident benefit, and organisational learning.
- **Iterative learning:** They create feedback loops between pilots, live operations, and strategic planning, allowing the approach to adapt based on what is learned.

The operating model of delivery must itself reflect the connected nature of the future service. Isolated or over-engineered programme structures risk becoming bottlenecks. Instead, delivery should be lean, agile, and embedded, bringing together the right people from across the business and the supply chain to make decisions quickly, respond to data, and resolve issues as they arise.

3. Governance for Transformation

Governance must be more than oversight. It must support decision-making, resolve ambiguity, and provide assurance that the programme remains aligned to strategic intent. At its best, governance brings together diverse perspectives, executive, operational, technical, and resident, and helps convert them into shared judgement.

A sound governance framework for connected homes should include:

- **An Executive Sponsor:** With overall accountability for delivering outcomes, not just overseeing process. This should be someone with enough seniority to unblock barriers and enforce cross-functional discipline.
- **A Delivery Board or Steering Group:** With representation from all critical functions (assets, IT, compliance, resident services, finance), convened at appropriate frequency to track progress, surface risks, and ensure alignment.
- **Resident Representation:** Embedded into the governance structure itself. Residents should not only be consulted but should participate in shaping the delivery and evaluation of the programme. Their presence signals that trust, usability, and lived experience are non-negotiable components of success.

- Clear escalation routes: So that issues and risks are resolved swiftly and do not drift in operational ambiguity.

This model of governance reflects the reality that connected homes span traditional organisational boundaries. A narrow governance model, focused only on cost or technical performance, will not capture the systemic implications of this work.

4. Ownership and Accountability

One of the recurring barriers to successful change in the sector is blurred accountability. When smart home deployment is treated as “everyone’s job,” it often becomes no one’s priority. Effective change programmes are precise about who owns what.

Every part of the organisation must understand its role. But the centre of gravity should sit with a dedicated programme lead or transformation manager, empowered to hold teams to account and to integrate delivery across functions. This role should not be buried in middle management but should have direct reporting lines into the executive sponsor and regular access to the delivery board.

Crucially, accountability must extend beyond delivery into adoption. It is not enough to install devices or switch on data flows. Organisations must take responsibility for ensuring that connected systems are used, by the right people, at the right time, in the right way. This includes responsibility for unintended consequences: such as increased demand on staff, miscommunication with residents, or under-utilised data.

5. Preparing the Organisation for What Comes Next

Perhaps most importantly, organisations must prepare not only for delivery but for the new normal that follows. Connected homes will generate new forms of insight, trigger new operational workflows, and prompt new questions about risk, privacy, and consent. Preparing for change means preparing for continual adaptation.

This calls for a deliberate investment in culture and capability. Staff must be supported to interpret and act on device data. Residents must be engaged not just once, but continuously, as systems evolve. Governance structures must remain agile, able to learn and adapt as new use cases emerge. And systems must be designed with flexibility in mind, ready to integrate new technologies and partners over time.

The next section will explore how resident perspectives must be integrated into this process, not only to secure consent or manage reputational risk, but to ensure that smart homes deliver real value for the people who live in them. But that value will only be realised if the internal machinery of change is in place: competent, committed, and coordinated.

In short, there is no shortcut to organisational readiness. Without it, connected home ambitions will remain stranded between aspiration and delivery. With it, they become an engine for long-term transformation.

Resident Considerations

The deployment of smart home technologies within social housing is not only a matter of devices and data, it is a matter of relationships. At the centre of this transformation are residents whose trust, cooperation, and lived experience will determine whether these systems succeed or stall. The evidence is clear: without active resident involvement, even technically successful deployments can fail to deliver meaningful outcomes. For this reason, resident considerations must be embedded at every stage of the smart homes journey, not as a communications afterthought, but as a foundational pillar of the approach.

This section sets out the broad requirements for resident engagement and trust-building as part of a successful smart home deployment. It complements the detailed Engagement Strategy found in the appendix, and reinforces the need for a culture of respect, transparency, and shared benefit.

1. Culture First: Trust as the Foundation

Resident engagement begins not with a leaflet or a pilot invitation, but with an organisational mindset. Landlords must enter this work with humility, recognising the legacy of past experiences that many residents carry, experiences of being ignored, underserved, or feeling under surveillance. Without acknowledging that history, attempts to build support may appear insincere.

Trust and respect are not simply about tone. They are about acknowledging that

residents are the primary stakeholders in this transition. Their homes, their routines, and their sense of autonomy are being affected. As such, they have a right not only to be informed but to shape the process. This calls for a cultural shift in how landlords approach technology: from provider-led rollout to co-produced transformation.

Leaders set the tone. An organisation that speaks confidently about digital transformation but has not invested in resident relationships will face resistance. A culture that values listening, responsiveness, and mutual respect is more likely to generate not just consent, but enthusiasm.

2. More than just a Strategy

All landlords undertaking smart home deployment at scale should develop and follow a resident engagement strategy. This should cover the full lifecycle of engagement: before, during, and after deployment. It should be psychologically informed, culturally sensitive, and co-developed where possible with resident input.

However, a strategy is only a starting point. What matters is execution: the tone of conversations, the credibility of messengers, the responsiveness to concerns. Landlords must avoid treating engagement as a communications campaign. It is better understood as a sustained relationship-building exercise, which adapts over time and is integrated into the wider transformation programme.

Crucially, the engagement strategy must be resourced appropriately. Too often, resident communication is underfunded, under-skilled, or deprioritised in the pressure to meet technical deadlines. This undermines the wider programme and increases long-term cost through delays, complaints, or reputational damage. Investment in good engagement is not a cost, it is a precondition for success.

3. Communications that Work

The language of connected homes must be accessible, meaningful, and values-driven. Residents are not motivated by technical specifications or regulatory compliance, they care about warmth, safety, cost, and control. These values must be central in all messaging.

Some practical principles include:

- Start with benefits, not features: Emphasise outcomes like reduced damp, quicker repairs, or lower bills.
- Avoid jargon: Terms like “IoT”, “data integration”, or “predictive analytics” have little resonance and can be alienating.
- Use human stories: Peer testimonials and relatable case studies are more powerful than generalised claims.
- Show, don’t tell: Let residents see the devices, handle them, and understand what they do, and don’t, monitor.

Clarity also extends to data: what is collected, how it is used, who sees it, and what rights residents have. Privacy concerns are legitimate and must be treated with care. Landlords should err on the side of transparency, using plain language to build trust.

4. Resident Participation, not Passive Consent

Residents should not merely be consulted once decisions have been made. Their input should help shape deployment plans, inform messaging, and influence which use cases are prioritised. This is particularly important where trust is low or previous initiatives have failed.

Practical steps include:

- Involving resident panels in shaping pilot designs and rollout approaches.
- Creating opt-in options wherever possible, especially in early stages, to foster autonomy.
- Embedding resident voices in programme governance structures (as discussed in Section 2), so that the resident perspective is present in decision-making, not just feedback loops.

This participatory approach is not just good practice; it improves outcomes. Residents who understand and shape a deployment are more likely to engage with it, maintain the devices, and act on alerts.

5. Reward and Recognition

A subtle but powerful lever in resident engagement is recognition. Where residents are asked to participate, provide feedback, or tolerate disruption, landlords should acknowledge this as a contribution, not an obligation.

Forms of reward need not be financial (though in some cases this may be appropriate). Recognition might include:

- Early access to beneficial technologies

- Public celebration of positive stories
- Involvement in redesign teams for subsequent phases
- Opportunities to shape future offers to the wider community

Respect and recognition go hand in hand. Together, they signal that residents are not passive recipients of technology, but active partners in shaping the future of housing.

6. What Happens after Matters most

Too often, engagement is strongest before and during deployment, and fades after the devices are installed. Yet it is what follows that determines whether the resident experience is positive. Residents need feedback: What happened as a result of the sensor being installed? Was an issue found? Was it fixed?

Closing the feedback loop builds trust. Celebrating small wins, “a sensor prevented a serious leak”, reinforces the value of the system. Creating low-friction channels for feedback, QR codes, textbacks, short interviews, signals that the organisation is still listening.

Residents should also retain a degree of control. Offering a “re-set button”, the ability to opt out, pause, or adjust, respects autonomy and reduces the risk of silent resentment.

7. Handling Resistance

Even the best-designed programme may encounter resistance. The critical variable is not whether resistance occurs, but how it is handled. Dismissiveness breeds escalation. Respectful responsiveness builds credibility.

If problems arise:

- Pause and listen: Run empathy audits with neutral facilitators.
- Redesign openly: Invite critics into co-design groups to improve the approach.
- Be visible: Demonstrate that feedback has led to change.

This approach requires confidence, not defensiveness. It also requires leadership that sees residents not as obstacles, but as co-creators of progress.

Resident considerations are not a soft layer around a technical project. They are integral to what smart homes mean and how they function. A connected home is not defined by the presence of sensors but by the quality of connection, between people, systems, and purpose.

In the next section, we turn to those purposes in detail, by exploring the range of use cases that smart home technologies can support, and the implications of selecting, sequencing, and scaling them in a way that delivers maximum benefit to both residents and the organisation.

Use Cases

The long-term vision for connected homes in social housing is expansive. It involves continuous environmental assurance, intelligent asset management, predictive safety interventions, and seamless resident experience. But this vision cannot be achieved all at once. The breadth of application must not be lost, but neither can transformation be allowed to collapse under its own weight. Progress depends on structuring the work into coherent, well-scoped units of value. That is the role of use cases.

A use case is more than a technology application. It is a discrete, outcome-driven area of transformation where connected data can deliver measurable improvements to landlord operations, resident experience, or regulatory assurance. It acts as a boundary object, clear enough to guide delivery, flexible enough to evolve. Use cases enable strategic intent to be translated into operational programmes of work, and allow organisations to build capability incrementally while maintaining momentum.

By chunking the agenda in this way, landlords avoid the risk of trying to “boil the ocean.” Use cases provide a structured path through complexity. They allow for prioritisation, sequencing, and learning. Importantly, they enable multi-disciplinary teams, across asset management, compliance, IT, resident engagement, and finance, to align around shared objectives and measurable impact.

This section focuses on two foundational use cases that have emerged as both high-priority and high-value in the current context: **environmental sustainability** and **compliance assurance**. While not exhaustive, these areas provide a logical starting point for scaled deployment. Each is supported by mature technology designs, pressing regulatory or policy drivers, and a growing body of operational learning.

Environmental Sustainability: Enabling Smarter, Greener Homes

Environmental sustainability is no longer an optional agenda for social landlords. Net zero targets, energy efficiency mandates, and fuel poverty concerns are converging into a structural imperative. Smart home technologies offer a pathway to address all three, by providing the real-time, property-level insight that traditional asset data cannot.

This use case focuses on the deployment of modular environmental sensor suites across two property archetypes, 3-bed semi-detached houses with Air Source Heat Pumps and 3-storey blocks of flats with communal heating, but is designed to scale across any stock profile.

Sensors monitor a range of variables including:

- Indoor temperature and humidity (to track thermal comfort and mould risk)
- CO2 and VOC concentrations (to assess ventilation adequacy)
- Particulate matter (to monitor air quality)

- Heat and electricity flow (to evaluate energy supply, system efficiency and detect loss)
- Occupancy patterns (to contextualise energy demand)
- External and surface temperatures (to identify cold bridges and damp-prone areas)

These sensors feed into a layered technical architecture that allows for real-time analytics, integration with repairs and asset management systems, and optional resident-facing interfaces. The data generated supports multiple outcomes:

- Targeting retrofit and energy efficiency investments more effectively
- Evaluating post-retrofit effectiveness
- Reducing damp and mould through early detection and intervention
- Optimising performance of low-carbon heating systems
- Enabling fairer and more intelligent approaches to fuel poverty risk

By delivering environmental insight that is both granular and actionable, this use case positions landlords to move from reactive to proactive management. It also lays the groundwork for deeper resident trust. As the Future Vision documents illustrate, the experience of living in a connected home becomes qualitatively different when issues are prevented, not just fixed, and when support feels collaborative rather than extractive.

Importantly, this use case is technically and organisationally scalable. It is designed around interoperable platforms, protocol-agnostic gateways, and modular sensors. It can be deployed incrementally, starting with high-risk properties or vulnerable residents, and expanded as capability and confidence grow.

Compliance Assurance: Shifting from Inspection to Continuous Proof

Landlord compliance regimes have historically relied on scheduled inspections, manual checks, and document-based reporting. While legally required, these approaches create inherent risk: gaps between inspections, limited audit trails, and delayed response to failure. They also consume significant resource and often fail to reassure residents that their homes are being managed proactively.

The compliance assurance use case aims to change this paradigm. It deploys connected sensors to detect risk, validate critical systems, and evidence statutory compliance obligations in real time. Where full automation is not yet legally permitted, the system provides strong supplementation, helping landlords to prioritise, triage, and target manual inspections more effectively.

Sensors include:

- Smoke, heat, and CO alarms with remote status monitoring
- Fire door sensors (open/close cycle tracking, latch verification)
- Hot water temperature sensors (to validate delivery within safe ranges)
- Electrical safety monitors (to detect socket overheating and circuit faults)
- Water stagnation and pipe flow sensors (for Legionella risk management)
- Emergency lighting and lift function monitors in communal areas

Together, these create a system of continuous assurance. Not just monitoring, but structured accountability. Faults can be detected before harm occurs. Validation events can be logged as digital records for regulators. Interventions can be evidenced

with time-stamped confirmation. The system architecture is aligned with core landlord systems, housing management, compliance reporting, and work order management, ensuring that insight leads directly to action.

The benefits are immediate:

- Reduced risk exposure through earlier fault detection
- Improved regulatory confidence through real-time evidencing
- Streamlined audit processes
- Reassurance to residents that safety is continuously monitored, not periodically inspected

This use case does not eliminate the need for human inspection. But it reduces its burden, raises its effectiveness, and creates a platform for more dynamic, data-informed compliance strategies. It also integrates well with environmental monitoring, enabling a joint view of both safety and sustainability across the housing stock.

A detailed guide into this use case is included as [Appendix 6](#).

Use Case Sequencing and Expansion

Use cases are not static. As capability grows, so does scope. From the foundational use cases above, landlords may choose to sequence into further areas such as:

- **Remote repairs diagnostics and triage**
- **Predictive maintenance of lifts, pumps, and plant rooms**
- **Behavioural insight for energy advice and fuel poverty support**
- **Adaptive living environments for older or disabled residents**
- **Real-time void management and anti-social behaviour detection**

Each of these will require its own architecture, engagement strategy, and benefit model. But by anchoring transformation in defined, manageable use cases, landlords retain the ability to scale with purpose rather than drift through complexity.

Strategic Framing

Use cases offer more than operational convenience. They offer strategic clarity. They help organisations:

- Align cross-functional teams on tangible goals
- Phase investment and procurement with measurable return
- Develop in-house capability through targeted delivery
- Build resident trust through meaningful outcomes
- Evaluate supplier performance against use-case-specific metrics

They also provide a coherent path from current capability to future vision. We have set out narratives from residents and asset leaders that describe a 2035 world where homes are responsive, predictive, and deeply integrated into both human and digital systems. Use cases are the stepping stones toward that world, grounded in the real, sized for delivery, and framed for impact.

Business Case: A Framework

A well-constructed business case for the deployment of smart home technologies must look beyond the immediate costs of devices and installation. It must account for the full set of organisational consequences, financial, operational, reputational, and strategic, of shifting from a reactive to a connected operating model. It must also interrogate the costs of maintaining the status quo. These are often obscured by fragmentation: buried in repair budgets, legal settlements, reputational damage, or staff time spent firefighting symptoms rather than addressing causes.

This business case framework is not intended to provide a single ROI model or national cost estimate. The conditions for connected home deployment vary significantly by landlord, driven by existing systems, procurement strategies, and stock characteristics, as well as the chosen IoT deployment methods. Instead, this framework sets out the critical components that any local business case should consider, helping organisations build a credible, context-specific value proposition that avoids hidden costs, overpromises, or missed benefits.

In practice, most smart home use cases do not deliver their full value through direct cost savings alone. They create benefit through early intervention, systems integration, resident trust, and service transformation. A credible business case

must therefore incorporate both tangible and intangible outcomes, and be capable of articulating them clearly to executive teams, boards, and external stakeholders.

An example of a business case for the Connected Compliance use case is included at [Appendix 11](#).

1. The Case Must Match the Scope

Each use case, be it environmental monitoring, compliance assurance, predictive maintenance, or resident wellbeing, requires its own business case. While shared principles apply, the logic model, benefit profile, and investment risk will vary. Some use cases, such as connected compliance, have mature frameworks for evidencing impact. Others, such as AI-based triage or behavioural nudging, may rely on emerging indicators and staged benefit tracking.

What matters is proportionality. The business case must be rigorous enough to support investment, but not so exhaustive as to stall delivery. It should focus on the real levers of value for the specific use case and resist the urge to generalise.

At the same time, leadership must step back periodically to reassess the broader transformation case. Many of the greatest gains, organisational agility, data maturity, cross-silo coordination, emerge cumulatively, not from isolated implementations. The business case process must allow space for this wider perspective.

2. A Full Cost Lens: Visibility, Not Just Numbers

Traditional business cases often underestimate the true cost of existing systems. They count what is easy to count, inspection cycles, repair call-outs, procurement line items, but overlook systemic inefficiencies and avoidable harms.

A more complete cost model must include:

- Disrepair claim settlements and associated legal costs
- Staff time spent triaging, chasing, and duplicating effort
- Missed interventions due to lack of real-time data
- Inspection overlap across compliance, repairs, and housing officers
- Resident churn and complaints due to unresolved issues
- Loss of reputational capital, particularly where high-profile failures occur

These are not speculative costs. They are real, recurring, and, crucially, unevenly distributed across the organisation. By surfacing them, the business case reframes transformation not as a luxury or side project, but as a structural solution to embedded inefficiency and risk.

The same principle applies to benefit: the value of predictive maintenance, early warning systems, or digital assurance, at least in the early years, lies as much in cost avoidance and service stability as in direct budget savings.

3. Framing Benefits: Tangible and Intangible

Benefits should be categorised and tracked across short-, medium-, and long-term horizons. For example:

- Short-term: Reduced inspection volume, earlier fault detection, improved compliance visibility
- Medium-term: Decreased repair demand, more efficient resource allocation, enhanced resident satisfaction
- Long-term: Strategic asset management, improved ESG performance, strengthened organisational resilience

Not all benefits will be immediately cashable. Some, such as trust, transparency, or workforce morale, are best seen as enablers of future value. Long term, though, these become significant cash generators within a reformed delivery model. The business case should avoid false precision and instead provide reasoned estimates supported by benchmarks, pilot data, or logic-based extrapolation.

It should also include a plan for benefit realisation. Without this, good business cases can result in underwhelming delivery. This includes defining:

- Who owns each benefit
- How it will be tracked
- What will trigger course correction if outcomes diverge from plan

4. Comparative Assessment: The Case for Action vs Inaction

A key strength of the Connected Compliance framework ([Appendix 10](#)) is its comparative lens: contrasting the cost of doing something against the cost of doing nothing. This principle applies across all use cases.

Decision-makers should be supported to ask:

- What risks do we carry by maintaining current practice?
- What is the cumulative cost of inefficiency, delay, and duplication?
- What future requirements, regulatory, environmental, financial, are we not preparing for?
- What is the reputational impact of falling behind the curve?

These questions do not argue for indiscriminate action. But they ensure that inaction is treated as a decision with consequences, not a neutral default. Many organisations incur greater long-term cost by delaying action than by getting started with a well-scoped, learning-oriented deployment.

5. Organisational Readiness as Part of the Case

The best technology in the world will fail in an unprepared organisation. Business cases must therefore consider internal readiness, not just IT infrastructure or procurement capacity, but cultural willingness to act on data, to coordinate across silos, and to engage residents meaningfully.

This includes:

- Skills and training gaps (e.g. in data interpretation, system integration)
- Governance and decision-making clarity
- Resident consent and trust frameworks
- Supplier partnerships and procurement adaptability

A business case that ignores these issues will overstate benefits and underestimate risk. A strong case makes them visible and plans accordingly.

6. Standard Domains, Flexible Approach

A mature business case process for smart home deployment should cover at least the following domains:

- **Strategic alignment:** Fit with organisational priorities and policy direction
- **Financial case:** Costs, savings, and cost of inaction
- **Resident value exchange:** What residents get, what is expected of them
- **Technology and supplier ecosystem:** Interoperability, scalability, support
- **Data and infrastructure:** Readiness for data volume, velocity, and security
- **Workforce and operating model:** Skills, roles, and service redesign
- **Risk and assurance:** What could go wrong, and how will it be mitigated

Each domain should be adapted to the specific use case. For mature use cases like compliance or sustainability, detailed frameworks may already exist. For emerging cases, more flexible narrative approaches may be appropriate.

The goal is not standardisation for its own sake, but disciplined thinking.

Conclusion

Smart home transformation is not an IT project. It is a whole-system shift with cross-cutting implications for cost, risk, service quality, and strategic resilience. Business cases must rise to meet that complexity, clear enough to guide decision-making, rich enough to capture value, and flexible enough to support iterative learning.

Crucially, they must help organisations move from narrow, short-term framing to long-term institutional value. That value lies not just in devices installed, but in trust earned, risks reduced, and systems reimagined.

In the next section, we explore the technology stack that underpins this value creation, examining how architectural decisions, interoperability, and security shape both the delivery and sustainability of smart home programmes.

Technology Stack

A connected home programme is only as effective as the technology architecture that underpins it. The choices made about data, devices, infrastructure, and integration shape not just how the system performs, but how it evolves, how it supports service transformation, and how much control the landlord retains. Yet across the sector, there is no single ‘right’ architecture, because landlords differ widely in their digital maturity, organisational capacity, and strategic priorities.

This section outlines the principles that should guide technology stack decisions, explains why a single model cannot be universally recommended, and sets out how executive teams can approach these decisions in a structured, future-resilient way. The detailed models are provided at [Appendix 12](#), to support comparative evaluation across a range of scenarios.

1. Why the Stack Matters

In traditional ICT projects, technology architecture is often treated as a technical matter, delegated to IT teams or vendors. But in connected home programmes, the stack is a strategic asset. It determines:

- What data is captured and how reliably
- How quickly and flexibly services can respond to that data
- Whether landlords remain in control of their own ecosystem

- How easily additional use cases can be layered over time
- Whether procurement fosters innovation or entrenches dependency

In this context, the technology stack must be treated as a leadership concern. Decisions made now will either constrain or enable the next five to ten years of connected service delivery.

2. One Size Will Not Fit All

The research reviewed several viable technology models, ranging from fully managed service stacks to modular, open architectures. Each has trade-offs. For example:

- Managed stacks can accelerate deployment and reduce operational burden, but risk vendor lock-in and limited customisation.
- Modular, standards-based architectures promote flexibility and supplier competition, but require stronger in-house integration capacity and governance.
- Platform or shared infrastructure models offer system-wide benefits at scale, but need alignment between multiple organisations and careful data stewardship.

Different models suit different operating contexts. A small housing association with limited IT capacity may prioritise simplicity and speed. A larger or more digitally mature landlord may prefer flexibility, interoperability, and long-term ecosystem control. What matters is that the choice is deliberate, and aligned to strategic intent.

3. Common Principles, Diverse Routes

Despite the diversity of models, the research identified several shared principles that should underpin any well-designed stack:

- **Interoperability:** The ability to integrate across systems and suppliers must be prioritised. This helps to prevent lock-in and futureproofs the investment.
- **Modularity:** Landlords should be able to scale incrementally, by use case, geography, or property type, without having to reconfigure the entire system.
- **Security and privacy:** Data must be protected by design. This includes encryption, secure authentication, and clear protocols for consent and access.
- **Insight delivery:** The stack must not just collect data, but ensure it is delivered in usable form, timely, contextualised, and linked to action.
- **Resident-centred design:** Systems should support transparency, consent management, and options for resident feedback or opt-out.

These principles allow for different implementations without compromising on core values or outcomes.

4. Strategic Considerations for Executive Teams

For executive leadership, the decision about stack architecture is not just a technical procurement, it is a strategic framing of how connected services will be delivered and governed. The following considerations should guide decision-making:

a. Control vs Convenience

What balance does the organisation want between direct control and operational

simplicity? Managed services offer ease; open systems offer autonomy.

b. Speed vs Sustainability

How fast does the organisation need to deploy, and what compromises are acceptable to meet that timeline? Rapid rollouts may restrict long-term adaptability.

c. Cost vs Capability

How do short-term costs compare to the internal capacity needed to operate or extend the system? Are there budget pressures that distort good architectural decisions?

d. Alignment with Broader Digital Strategy

Does the proposed stack align with the organisation's data strategy, CRM roadmap, or wider transformation programme? A disconnected stack can undermine coherence.

e. Scalability and Future Use Cases

Can the architecture support additional sensors, new analytics, or emerging use cases without requiring wholesale redesign?

f. Supplier Landscape

Is there a healthy market of suppliers who can work within the chosen model, or is the organisation exposed to dependency on a single provider?

These questions require informed judgement. The [Appendix 12](#) provides a structured comparison of six stack models, each drawn from real-world examples and reviewed against these criteria.

5. Procurement Is Strategy

It is not only architecture that matters, it is how it is acquired. Procurement approaches should reinforce the desired model. For example:

- If interoperability is a priority, procurement documents must specify open APIs, data exportability, and avoidance of proprietary lock-in.
- If insight delivery is critical, contracts must define performance not just in terms of uptime, but in the usefulness and timeliness of alerts or recommendations.
- If resident privacy is essential, procurement must include explicit controls on data sharing, storage, and access.

Done well, procurement becomes a tool for enforcing strategic intent. Done poorly, it can bind organisations into systems that frustrate their ambitions.

6. Governance and Learning

Whatever architecture is chosen, it must be actively governed. This includes:

- Routine review of system performance and responsiveness
- Updating integration protocols and security standards
- Managing version control and lifecycle costs
- Engaging staff and residents in feedback about usability and value

Technology stacks are not static, they evolve. A robust governance model ensures that evolution stays aligned to purpose.

Conclusion

There is no universal answer to the technology stack question. But there is a universal risk in treating it as a technical afterthought. Architecture shapes possibility. It must be chosen with care, governed with rigour, and aligned to the future the organisation wants to build.

The [Appendix 12](#) provides a comparative review of six stack models, including their strengths, risks, and contextual fit. It is intended as a practical guide to support local decision-making, not to enforce conformity.

In the next section, we explore the people considerations that make this transformation real, how workforce roles, skills, and culture must shift to enable the connected home vision to be delivered and sustained.

People Considerations

Connected homes are not delivered by devices alone. They are delivered by many people: by the technicians who install the kit, the officers who respond to alerts, the analysts who interpret the data, the customer service officers who answer calls, the housing officers who speak to tenants in the field, the comms teams who speak to tenants, the IT teams who integrate the data with existing systems and build internal, integrated dashboard, and the leaders who decide what action to take. As such, the success or failure of smart home programmes depends as much on workforce capability and culture as on architecture or infrastructure.

The shift to connected systems requires a shift in the workforce. This is not an optional adjustment, it is a strategic necessity. It will mean new skills, new ways of working, and, in some cases, new people. Transformation on this scale demands clarity of intent, investment in people, and, when necessary, hard choices.

To counter the experience of many we interviewed, where a single middle manager tried to drive smart technologies forward in the absence of strong Executive leadership and support, we emphasise again the vital importance of strategy being led – and seen to be led – from the very top of the organisation.

1. What the Future Workforce Needs

The connected home operating model is data-led, digitally mediated, and cross-functional. It demands that staff at all levels are:

- Digitally dexterous: able to work confidently with new tools, interfaces, and systems
- Data-literate: able to interpret sensor-driven insight and use it to inform action
- Outcome-oriented: focused less on completing tasks and more on achieving results
- Collaborative: able to work across functions and break down legacy silos
- Resident-conscious: alert to how new systems affect trust, consent, and lived experience

These requirements apply not just to new hires but to existing staff in core roles, housing officers, repairs operatives, compliance leads, customer service teams, and managers. Everyone in the organisation will need to operate in a more connected, responsive, and accountable environment. This will be challenging for many roles.

2. Development Without Blame

It is essential to distinguish between skills that are missing and people who are failing. Many in the workforce have built their careers on strengths that remain valuable, relationship building, field knowledge, trustworthiness, but which now need to be supplemented, not replaced.

Organisations must therefore invest in development without blame. That means:

- Clear expectations: Staff must understand what new competencies are required and why they matter
- Supportive pathways: Training should be practical, embedded, and available to all, not a one-off event or bolt-on module
- Safe environments: Staff must be able to learn without fear of embarrassment or penalty
- Peer learning: Champions and early adopters should be encouraged to mentor others and share success stories
- Feedback loops: Training and support should evolve in response to staff experience and feedback

This is not about soft-peddalling change, it is about delivering it effectively. People are more likely to grow when they are trusted, respected, and equipped to succeed.

3. Cultural Resistance: Understanding and Acting

Not everyone will adapt. Some staff will resist, not just the technology, but what it represents: visibility, accountability, the loss of discretion, the fear of redundancy. This resistance must be understood, but not indulged indefinitely.

Leaders need to distinguish between three groups:

- The willing: Those who embrace the change and lead others
- The hesitant: Those who are unsure but can be supported to adapt
- The obstructive: Those who actively undermine or avoid change

The first group should be empowered. The second group supported. The third group, if persistent, must be challenged. There is no

room for sustained resistance in roles that affect resident safety, data integrity, or service quality.

Organisations that avoid difficult conversations risk trapping themselves in a halfway house, where the technology is installed but the benefits are not realised. As the saying goes: if you can't change the people, change the people.

This does not mean immediate dismissal. It means clear performance standards, robust HR processes, and a leadership culture that protects ambition from being diluted by inertia.

4. Leadership and Middle Management

Transformational change does not flow smoothly if the middle tier is not aligned. Frontline teams look to middle managers for permission, modelling, and protection. If those managers are sceptical, overloaded, or unclear on the strategy, the change stalls.

Landlords must therefore treat middle management as a critical intervention point. This includes:

- Involving them early in the design of new workflows
- Equipping them with the tools to lead hybrid teams, part digital, part relational
- Holding them accountable for adoption, not just activity
- Actively developing their digital leadership capabilities

Executives, in turn, must model the behaviours expected across the organisation: prioritising data-driven decision-making, collaborating across silos, and speaking plainly about both progress and obstacles.

5. Role Redesign and Job Crafting

Many roles will need to evolve. The housing officer who once relied on site visits now receives sensor alerts. The repair operative who used to diagnose on arrival is now briefed in advance. The compliance lead who relied on scheduled inspections now manages real-time alerts and exceptions.

Rather than layering new expectations onto old job descriptions, landlords should undertake deliberate role redesign:

- What is the core purpose of each role in a connected system?
- What data does each role need to access, interpret, and act on?
- What relationships must the role manage differently?
- What systems and tools does the role now depend on?

Where possible, organisations should involve staff in redesigning their own roles. This builds ownership, surfaces practical insights, and supports a smoother transition.

Job crafting also enables staff to bring their strengths into the new system. The housing officer who builds trust can still do so, now with better insight. The data analyst who once built reports can now shape strategy. The change is not just functional, but motivational.

6. Managing Out Legacy Behaviours

Some legacy practices will not survive. Blanket inspection schedules, reactive-only repair models, data silos, and culture of discretion over accountability, these are incompatible with a connected operating model. As transformation progresses, it is important to be explicit about what must stop, not just what must start.

Organisations should:

- Review standard operating procedures to remove obsolete steps
- Rebalance performance metrics toward proactive and predictive action
- Set non-negotiables, for example, actioning sensor alerts is not optional
- Provide coaching to help staff move through the “letting go” phase of change
- Monitor team behaviours and reinforce new norms publicly and consistently

Where the measures of success are showing that “old” behaviours are persistently undermining the new model, decisive action is required. This is not cruelty, it is stewardship. The responsibility of leadership is to use the evidence of benefits realisation or not to protect the integrity of the transformation, not the comfort of those who resist it.

Conclusion

People make the difference. But not just any people. The connected home transformation will be delivered by a workforce that is digitally capable, data-literate, purpose-driven, and ready to grow. Organisations that invest early, set clear expectations, and make hard decisions when needed will succeed. Those that avoid conflict, delay upskilling, or lower the bar will fall short.

There is no middle ground. The future is arriving. The people who meet it with confidence, competence, and clarity are the ones who will define what that future looks like.

The final section will explore what it takes to deliver that future at pace: a timeline that matches ambition with realism, and enables organisations to go faster without losing coherence.

Timeline

Transformation at scale does not occur all at once. The deployment of connected home technologies requires a phased, deliberate approach, one that balances pace with precision, and ambition with organisational readiness. While each landlord will start from a different point, and aim at a different end-state, the order in which certain capabilities are developed will determine the likelihood of success.

This section outlines a staged sequence of action that, if followed with discipline and adapted to local context, provides the greatest chance of delivering meaningful and sustainable change. It does not replace the detailed project plan, but abstracts its lessons into a more generally applicable model.

Phase 1: Mobilisation, Decide to Change, then Prove you Mean it

All transformation begins with a decision. But the decision to act must be followed immediately by visible and structured mobilisation. This is not a planning exercise, it is a declaration of intent, internally and externally.

This phase includes:

- Establishing senior-level governance that includes operational, technical, compliance, and resident voice functions
- Appointing a named programme lead with the authority to coordinate cross-organisational delivery
- Defining success criteria that are

measurable, meaningful, and linked to strategic purpose

- Running a rapid “data reality check” to assess the quality, completeness, and usability of current records
- Creating a first-cut risk register that forces attention to access, consent, supply chain, and data ownership

Without this foundation, later stages will falter. A lack of early coherence in leadership, purpose, or data quality will compound downstream inefficiencies. Rushing into device procurement or installations without this groundwork is one of the most common, and avoidable, causes of failure.

Phase 2: Foundation Building, Design Before you Deploy

Before any devices are installed, the core building blocks must be put in place. This is not a delay, it is what enables scale. These foundational efforts can and should run in parallel, but must be managed with careful sequencing.

Key actions include:

- **Assessing organisational readiness: using a tool similar to Appendix 7 to identify areas which if not addressed could delay or derail deployment**
- **Device strategy and specification:** Finalising use cases, defining functional requirements, and initiating outcome-focused procurement. Cutting corners here leads to technical mismatch, supplier misalignment, or unmanageable data flows.

- **Identifying priority properties / estates.** Deployment cannot happen “all at once”. Using data analytics can exclude those properties least likely to require sensors in the short-and medium-term, allowing energy and resources to be directed at areas of greatest risk
- **Resident engagement preparation:** Segmenting resident groups, testing communication approaches, and preparing consent processes. The tone of this work sets the tone for the whole programme.
- **Operating model redesign:** Mapping current service processes and designing new workflows that can act on live data. This includes drafting revised roles and accountabilities, even if only as an interim overlay.
- **Systems and data readiness:** Building or upgrading the data infrastructure, integration architecture, and event-processing capabilities. Cleansing and validating property records is non-negotiable; dirty data will pollute the entire stack.

These activities are the **enablers** of deployment. Organisations that attempt to shortcut this phase risk creating performance gaps that require extensive rework later. Every day spent here is a day saved during deployment.

Phase 3: Early Deployment, Test, Learn, Adjust

With foundations in place, controlled deployment can begin. This should be phased by geography, archetype, or resident cohort, and designed explicitly as a **learning process**. It’s “Test and Learn” not a pilot.

Priorities include:

- Ensuring install teams are trained not just technically, but in communication and safeguarding
- Establishing live feedback loops from field to programme team, with clear success measures, regular reviews of progress, refusal rates, and emerging issues
- Integrating install reporting into central systems from day one, avoiding paper trails or parallel processes
- Testing the entire service loop, from alert detection to resolution, to surface unseen operational tensions

This phase is where theory meets practice. If earlier design work was rushed or superficial, cracks will begin to show. Strong governance, agile decision-making, and a clear mandate to pause and adjust are essential.

Phase 4: Scaling with Confidence, don’t ignore any negatives

Once systems, processes, and people are shown to function at small scale, expansion can proceed. The key here is disciplined scaling, not simply multiplying outputs, but ensuring that **the underlying system is elastic** enough to handle more volume, more complexity, and more interdependence.

At this stage:

- Installations should proceed according to a clear phasing plan
- Resident support teams should be fully operational, with escalation routes established
- Dashboards and reporting should transition from “in development” to live, with operational use embedded
- Benefits tracking should begin, not just activity counts, but early signals of outcome (e.g. alerts resolved, damp incidents reduced, complaints pre-empted)

This phase requires visible leadership focus. Momentum can cause complacency. The temptation to skip evaluation, ignore outliers, or push ahead despite unresolved issues must be resisted.

Phase 5: Institutionalising the Model, Lock in the Gains

Deploying devices is only the beginning. The true value of connected homes lies in **how the organisation changes in response** to the data they generate. This final phase is about embedding new ways of working, reinforcing capability, and ensuring benefits are realised long after installation is complete.

Critical actions include:

- Formalising new roles and workflows into business-as-usual
- Updating job descriptions, KPIs, and service standards to reflect the new model
- Scaling benefit tracking from pilot indicators to system-wide impact
- Conducting post-implementation reviews across all functions, not just technical, but resident satisfaction, workforce experience, and strategic alignment
- Sharing learning internally and externally, contributing to sector-wide capability

Importantly, this phase must also include a decision on next steps. Having demonstrated capability in one or two use cases, organisations must now decide how and where to expand. Do they add new sensor types? Extend to new property archetypes? Integrate with planned investment programmes?

The answer will differ, but the question must be asked. The risk otherwise is stagnation: connected homes as a completed project, rather than an evolving system.

Recommendations

The preceding sections have shown that smart home deployment in social housing is not simply a matter of installing sensors, it is a whole-system transformation that cuts across leadership, process, technology, resident relationships, and workforce practice. To move from vision to sustained delivery, landlords must commit to the following strategic and operational recommendations.

Each is grounded in evidence from the research and reflects the barriers observed in failed or stalled deployments. These are the moves that differentiate pilot activity from organisational transformation.

1. Establish Executive-Level Ownership and Coherence

- **Assign a named executive sponsor** with responsibility for outcomes, not just delivery.
- Ensure strategic purpose is explicit, agreed across functions, and embedded into corporate planning.
- Frame smart homes as core business transformation, not a technology side project.

Why it matters: Without visible leadership and coherent direction, initiatives drift, become siloed, or stall under competing priorities.

2. Treat Connected Homes as a Strategic Change Programme

- **Use structured change management methods**, not informal coordination.
- Invest in programme delivery capacity, supported by robust governance.
- Clarify ownership and accountability at every stage, from vision through to adoption.

Why it matters: Too many organisations underestimate the complexity of scaling. Without structure, delivery is fragmented and unsustainable.

3. Build Change Readiness before you Deploy

- Conduct a formal change readiness assessment using a structured framework.
- Use the results to inform investment in systems, skills, and cross-functional ways of working.
- Align technology and operating model design before procurement.

Why it matters: Retrofitting change after deployment leads to rework, disengagement, and weak return on investment.

4. Prioritise use Cases that Build Capability and Confidence

- Focus initial deployments on well-scoped, high-impact use cases like compliance assurance or damp/mould prevention.
- Sequence rollout to allow for learning, iteration, and workforce adjustment.

- Treat use cases as stepping stones toward a broader connected service model.

Why it matters: Trying to “do everything at once” fragments focus and creates delivery risk. Use cases allow for strategic sequencing.

5. Embed Resident Engagement as a Core Delivery Stream

- Develop a resident engagement strategy that spans pre-deployment, deployment, and post-deployment.
- Resource it adequately and treat resident participation as a right, not a courtesy.
- Close the feedback loop with residents, what action was taken, what changed, and why.

Why it matters: Trust is foundational. Without it, resident consent, cooperation, and long-term use of systems will falter.

6. Design the Technology Stack Around Purpose and Control

- Make deliberate architectural choices based on organisational capacity and strategic goals.
- Prioritise interoperability, modularity, and resident-centred data controls.
- Use procurement as a tool to enforce open standards and avoid vendor lock-in.

Why it matters: Poor architectural decisions now will limit flexibility, increase costs, and constrain future innovation.

7. Invest in Workforce Capability and Role Redesign

- Define what success looks like in each role under a connected model.
- Provide skills training in data interpretation, digital tools, and cross-team collaboration.

- Tackle cultural resistance early, enable the willing, support the hesitant, and challenge the obstructive.

Why it matters: Devices don't deliver value. People do. And people need support, clarity, and consequences to change.

8. Sequence Implementation with Discipline, Not Urgency

- Follow the five-phase timeline: Mobilise → Build Foundations → Test and Learn → Scale with Confidence → Institutionalise.
- Monitor early deployments rigorously, using them to refine processes and build organisational confidence.
- Don't confuse speed with success. Rushing leads to rework.

Why it matters: The order of delivery actions is critical. Getting the sequence wrong is a major contributor to programme failure.

9. Track Benefits Realisation as a Leadership Function

- Link deployment to clearly defined outcome metrics across safety, cost, trust, and sustainability.
- Monitor not just activity (installs) but impact (e.g. reduction in damp cases, increased first-time fix).
- Assign benefit ownership and review performance regularly at leadership level.

Why it matters: Without benefit tracking, smart home programmes risk becoming tech for tech's sake, with no accountability for real-world outcomes.

10. Learn Publicly and Lead Collectively

- Share insights, mistakes, and learning across the sector.
- Collaborate with suppliers, other landlords, and residents to shape a maturing ecosystem.
- Use your experience to influence procurement frameworks, regulation, and innovation agendas.

Why it matters: The sector will scale more effectively if learning is treated as a collective asset, not private capital.

Conclusion

The responsibility is not simply to manage a project, but to steward a transformation that will define the next decade of housing operations. This means aligning teams, preparing systems, challenging assumptions, and measuring what matters. The recommendations above provide a pragmatic blueprint to support that work.

The journey to connected homes is neither linear nor uniform. But the sequence matters. Success depends not on speed alone, but on the careful ordering of action, ensuring that each step enables the next, and that each risk is addressed before it compounds.

There is no single starting point and no universal endpoint. But there is a common logic: build strong foundations, learn deliberately, scale with discipline, and embed change with integrity. That is how transformation becomes not just possible, but inevitable.

Part 5

Conclusions and Next Steps

The research project has taken more than six months to complete. This section attempts to summarise it – not in the form of an Executive Summary (that can be found in a separate, much smaller, document), but as a reflection on what it did or did not achieve. Building on the research work we also identify some next steps for those who are interested in taking this work forward.

5a. What the Research set out to do, and what it Achieved

The Connected Homes research project set out with a deceptively simple question: Why has the deployment of IoT in social housing stalled? It did not seek a narrow technical or policy answer but instead took a systems-based approach, recognising that progress would depend not just on technology or cost but on the interplay between people, organisations, relationships, incentives, and beliefs.

Three core hypotheses guided the inquiry:

1. That the trust relationship between landlords and residents was not yet strong enough to support large-scale roll-out of devices perceived by some as intrusive.
2. That internal landlord capability, both technical and organisational, was inadequate to support strategic, integrated, and at-scale deployment.
3. That the relationship between landlords and suppliers remained transactional and poorly adapted to long-term collaborative innovation.

To test these hypotheses, the project adopted a deliberately multi-dimensional method, combining a literature review with a maturity assessment of landlords, detailed interview analysis (with both landlords and suppliers), tenant engagement workshops and surveys, and an implementation roadmap. The intention was not just to understand the state of play but to create shared insight that might help to unblock the path to scale.

The research achieved its goals in five important ways:

1. It grounded the connected homes debate in system realities, not future visions.

Rather than begin with idealised models of connected living, the research started with what landlords, residents, and suppliers are actually doing, or struggling to do. It exposed, for instance, that:

- 86% of landlords have run IoT pilots, yet only a quarter have scaled them
- Tenant engagement is still limited and ad hoc
- Supplier-landlord relationships are constrained by broken procurement frameworks

2. It mapped out the actual maturity of the sector with clarity and nuance.

The Maturity Assessment provided not only an average view (e.g., mean IoT knowledge score of 6.13/10) but a granular breakdown across strategic vision, data capability, governance, and tenant engagement. Crucially, it showed that most landlords are stuck between pilot and scale due to systemic, not individual, limitations.

3. It gave voice to the different constituencies of the ecosystem.

From residents who demanded more transparency and control, to suppliers who called out weak landlord operating models, to asset directors frustrated with internal IT bottlenecks, this research has captured perspectives that too often sit in separate silos.

4. It challenged the sector's assumptions about readiness.

One of the most critical insights is that many organisations have overestimated their own preparedness. A large proportion see IoT as a technical bolt-on rather than an operating model transformation. The gap between aspiration and capability, in IT integration, workforce skills, supplier management, and tenant communications, remains wide.

5. It built a practical roadmap to scale.

The project concludes not just with diagnosis but with direction. The implementation roadmap outlines the concrete steps needed to move from small-scale pilots to full operating model integration, and provides sector actors with a shared vocabulary for what must be done.

In sum, the research has delivered on its central aim: to understand why the promise of connected homes remains largely unfulfilled, and what needs to change for that to shift. It does not offer false certainty or universal blueprints, but it offers something better, a rigorous, grounded, and collaborative framework for action.

5b. What the Research did not fully address: Gaps, Unknowns and Emerging Issues

No research project can answer every question, and this one is no exception. The depth and scope of the Connected Homes inquiry has been substantial, but there are **important limitations** and **unanswered questions** that merit acknowledgement.

1. The Long-Term Resident Experience Remains Underexplored

While resident views were captured through surveys and facilitated sessions, the data remains relatively shallow compared to what will be required to design truly user-centric connected homes. The project surfaced residents' anxieties and hopes, about intrusion, control, cost, and trust, but not their evolving experiences of living with connected devices over time. Nor did it investigate the **real-world behavioural responses** to device alerts, or the **emotional impact** of continuous monitoring.

Further longitudinal, ethnographic work is needed to explore:

- How residents change their behaviour (or don't) in response to data
- How perceptions of surveillance evolve over time
- Whether and how trust in the landlord improves or deteriorates through IoT deployment

2. The Implications for the Workforce are only Partially Understood

The research touched on the need for new skills and new team structures, particularly in IT, data, and housing operations. But it stopped short of a full exploration of the **workforce implications of connected services**:

- How will job roles change, especially for housing officers and repairs operatives?
- What will new multidisciplinary teams look like, and who leads them?
- How should unions, HR functions, and training bodies be engaged?

At present, most landlords are **tinkering at the edges** rather than rethinking workforce design for a data-driven service model.

3. Regulatory Direction and Policy Alignment are Uncertain

Multiple interviewees, especially from the supplier side, highlighted the absence of a clear regulatory steer. There is **no current mandate** to collect or act on real-time environmental data in general needs housing, and the regulator's past actions (e.g. damp and mould data collection via Google Docs) have not inspired confidence

The research did not directly engage with central government or regulatory bodies, and so cannot claim to have resolved:

- What a proportionate, risk-based regulatory model for connected homes might look like
- Whether landlords should “comply or explain” against a future IoT code of conduct
- How data protection and resident rights frameworks need to evolve

This remains a **critical unknown**, especially if large-scale deployment is to proceed without legal ambiguity or reputational risk.

4. The full range of Devices and Use Cases was narrowed by Scope

The research deliberately focused on **building-related IoT** (e.g. temperature, humidity, CO2, boiler performance), excluding **person-centred or care-based technologies**. This made the analysis sharper, but also means:

- No findings on sensors for falls, movement, or daily activity patterns
- No evaluation of hybrid models integrating housing and social care
- No insights into the convergence between connected home and health ecosystems, which several suppliers expect to accelerate

Future phases will need to widen the aperture, or risk missing the adjacent systems into which housing IoT is already bleeding.

5. Cost-Benefit Quantification is Still Immature

While the roadmap identifies value creation opportunities, this research did not produce a quantified business case or a worked financial model. In part, this is because the data to do so is scarce, and because many pilots have not yet delivered clear or consistent results. It remains unclear:

- What the payback period is for different types of deployment
- How to price the benefits of avoided damp, reduced complaints, or increased tenant trust
- How best to fund, phase, or de-risk large-scale roll-out

Without stronger cost-benefit analysis, the business case will remain vulnerable to scepticism, especially from finance directors.

6. Sector-Wide Infrastructure is Still a Blank Sheet

The interviews raised the idea of shared platforms, open data standards, and perhaps even a supplier-led IoT standards body. But there is no consensus yet on:

- Who should convene and govern such infrastructure
- Whether landlords trust suppliers to lead it
- What incentives (or carrots and sticks) would drive adoption

This is both a **gap** and a potential **next frontier**.

Taken together, these six areas are evidence of **where the field is moving next**. Connected Homes is no longer a hypothetical proposition, but its institutional, human, and infrastructural foundations remain incomplete. These gaps shape the recommendations and next steps that follow.

5c. Next Steps: From Isolated Innovation to Coordinated Progress

This report has set out the opportunities and challenges associated with scaling connected home technologies across the social housing sector. It draws on direct testimony from landlords, suppliers, and residents, as well as evidence from practice. The next phase must be one of collective learning and structured action, informed by what the research has uncovered.

A clear message emerging from this work is the need for sustained collaboration at sector level. While many housing providers are exploring connected devices in isolation, there is little evidence of systematic coordination or shared infrastructure. Yet many of the barriers to progress, such as fragmented data standards, duplication of procurement effort, and inconsistent approaches to resident communication, would benefit from a collective response. There is now a case for forming permanent or semi-permanent coalitions to work on shared technical, operational and ethical challenges, particularly in relation to interoperability, data governance, and assurance frameworks.

This collaborative approach should be extended to funders and regulators. Several interviewees noted that government policy has, so far, played only a limited role in incentivising adoption of smart technologies. Where it has done so, such as in the Welsh retrofit programme,

progress has been more structured. There is scope to work more closely with policy-makers to ensure that funding models reward long-term outcomes rather than short-term outputs, and that regulatory frameworks reflect the potential of real-time data to improve safety, sustainability, and accountability. At present, policy and regulatory mechanisms tend to lag behind technological capability. This gap needs to close.

It is also important to recognise the value of external learning. Connected home innovation is not unique to housing. Other sectors, particularly healthcare, energy, and infrastructure, have relevant experience in deploying sensor networks, using predictive analytics, and navigating complex consent frameworks. Within housing itself, there are organisations who have made quiet but significant progress. Their models are worth studying, not because they are easily replicable, but because they demonstrate that different routes to scale are possible.

This research has also highlighted the importance of staying attentive to developments at the edge of current practice. The rapid pace of innovation in sensing, connectivity, and data analytics means that the technologies deployed today may not be the same ones relied upon tomorrow. Continued engagement with researchers, innovators, and system integrators will be essential if the sector is to avoid locking itself into rigid solutions or closed architectures. More fundamentally, it will be important to keep asking what

problems technology is being used to solve, and whether better tools or approaches may be emerging.

Also, further work is needed to understand how smart technologies affect different groups of residents. While there is a growing body of work on digital inclusion, relatively little of it focuses on the specific dynamics of connected devices in the home. The risk is that resident engagement is treated as a communications exercise rather than a substantive part of design, evaluation, and governance. This report recommends a more participatory approach, in which the impacts of connected homes are understood not only in aggregate, but across the full range of households, including those who may face particular vulnerabilities.

Finally, the scope of our research was deliberately restricted to building based devices and data – although inevitably this also encompasses some resident data too. We excluded an area of great potential – the way that smart homes can support the person living in the home. We are aware that both social care and clinical care are experimenting with technology-enhanced service delivery in people's homes. We think the housing sector should be a part of this and further research studying that specific aspect of smart homes would be both timely and worthwhile.

Taken together, these next steps point to a long-term programme of research, practice, and policy development. It will require organisations to move beyond pilots, and to engage seriously with the operating model and cultural shifts that full-scale adoption entails. But it also offers the potential to build a more responsive, data-informed, and resident-focused model of social housing provision, one that is capable of meeting the demands of the coming decade.

Part 6

A Call to Action: Recommendations for Delivering at Scale



Introduction

The case for connected homes has been made. The opportunities are real, the pilots have proven the point, and the technology is ready. What's holding the sector back is not belief but delivery.

The research has surfaced the lessons, barriers and breakthroughs from across landlords, suppliers and residents. What emerges is not a need for more evidence but for more intention. Scaling smart home deployment is not a question of whether, but of how, and how fast.

This final part sets out a clear and practical agenda for senior leaders, policymakers, funders and delivery teams. These recommendations are not abstract ambitions: they are the next actions needed to convert potential into performance. They touch every part of the system, from boardroom strategy to frontline delivery, from resident engagement to procurement practice, from system design to regulatory reform.

They are also interdependent. Leadership without capability won't deliver. Procurement without strategy won't scale. Technology without resident trust will fail.

Smart homes are not a side project. They are infrastructure.

Throughout the previous sections of this report, we have made detailed observations and recommendations about how the transition at scale to Smart, Connected Homes can best be achieved. Here, those detailed recommendations have been summarised. These are the things that we consider senior leaders in the sector should now prioritise.

1 Strategic Leadership

1. **Frame smart home programmes as core business transformation, not a technology side project.**

Position connected homes within the strategic priorities of the organisation and embed them in corporate planning.

2. **Ensure strategic purpose is explicit, agreed across functions, and embedded into planning frameworks.**

All departments must share a clear vision of the role of smart homes, linking initiatives to core objectives and risks.

3. **Assign a named executive sponsor with responsibility for outcomes, not just delivery.**

Strategic leadership must be accountable for results and value, not only overseeing project activity.

4. **Align funding streams to long-term smart home capability.**

Strategy must consider full lifecycle costs and long-term capability, not just short-term capital spend.

5. **Support shared infrastructure and standards to enable market coherence.**

Develop and participate in sector-wide integration frameworks, certification schemes, and procurement standards to reinforce consistent governance across the sector.

2 Skills, Training and Workforce Readiness

1. **Invest in workforce capability across data, systems, and resident engagement.**

Develop skills in data interpretation, systems integration, consent management, and resident co-design – make them non-negotiable.

2. **Train staff in practical application, not just awareness.**

Ensure training addresses real-world implementation: device data interpretation, privacy risks, user interaction, and system workflows.

3. **Use structured change readiness assessment to plan skills development.**

Identify gaps in knowledge, cross-functional coordination, and confidence early. Use structured tools to prioritise where support is needed.

4. **Embed new workflows, not just knowledge.**

Skills development should be linked to actual process redesign. Train teams on new roles, responsibilities, and integrated ways of working.

5. **Build digital confidence across all staff, not just specialists.**

Help all roles, from housing officers to customer service, to engage with smart home data and tools, even if they're not technical leads.

6. **Learn from delivery, not just theory.**

Capture lessons from each stage, what worked, what didn't, and why, and feed them back into training design and support planning.

7. **Include cultural and behavioural change alongside technical upskilling.**

Training must address resistance, misunderstanding, and fear, not just knowledge gaps. Support staff to become champions of change.

8. **Support leadership development to drive organisational readiness.**

Equip leaders to guide transformation, set expectations, and provide clarity of purpose across departments and teams.

3 Resident Engagement

1. **Position resident participation as a right, not a courtesy.**

Design engagement strategies that treat residents as decision-makers and co-creators, not just recipients of technology.

2. **Co-design with residents throughout the process.**

Involve residents in selecting devices, testing locations, designing materials, and refining service models. Go beyond one-off consultations.

3. **Be honest, specific, and jargon-free in all communications.**

Use plain language, explain benefits and risks, and avoid vague promises. Acknowledge past failures and show how things will be different this time.

4. **Make consent voluntary, meaningful and never implied.**

Residents must be able to opt out without penalty. Differentiate between consent to install and consent to share or act on data.

5. **Respect diversity of digital access and confidence.**

Offer different interface types, communication formats, and engagement routes for varied digital literacy and accessibility levels.

6. **Use multiple feedback methods to learn and adapt.**

Gather insights via peer-led sessions, surveys, workshops, and feedback loops. Let residents see what changed as a result of their input.

7. **Make data visible and useful to residents.**

Ensure residents can access their own home data in understandable formats, with clarity about what is being recorded and why.

8. **Clarify the value proposition for residents.**

Explain exactly how smart home devices will improve safety, reduce costs, or enhance daily life, and back it with follow-through.

9. **Include residents in defining success.**

Measure success based on what matters to tenants, not just operational metrics. Include them in setting expectations and reviewing outcomes.

For the full engagement strategy for scaling smart device deployment, see [Appendix 9](#).

4 Operating Model and Accountability Recommendations

1. **Redesign operating models to embed smart homes into core business functions.**

Treat connected homes as part of business-as-usual, not as standalone pilots, by integrating them into compliance, repairs, sustainability, and customer operations.

2. **Establish clear accountability for outcomes, not just delivery.**

Assign responsibility across leadership, programme, and operational levels for delivering tangible results from connected home deployments.

3. **Use smart home data to drive operational decisions, not just reporting.**

Embed data into live workflows so that frontline teams, contact centres, and service planners act on insights in real time.

4. **Support cross-functional delivery, not siloed initiatives.**

Break down barriers between asset, IT, customer, and compliance teams to ensure shared ownership and coherent execution.

5. **Define success metrics that reflect organisational impact.**

Evaluate progress not by number of devices deployed, but by improvements in compliance, cost avoidance, resident outcomes, and service efficiency.

5 Project Management and Governance

1. **Treat smart home rollout as structured transformation, not informal coordination.**

Apply structured change management methods with clear programme governance from inception through to adoption. Avoid relying on informal relationships or siloed initiatives.

2. **Embed clarity of ownership and accountability at every stage.**

Define responsibilities clearly from strategy to implementation. Ensure decision-makers are accountable for both process and outcomes.

3. **Use full lifecycle project planning to manage risk and learning.**

Design projects in phases, mobilise, build, test, scale, institutionalise, to support iteration, adaptation, and long-term sustainability.

4. **Embed governance, resourcing, and oversight at programme level.**

Back delivery with structured change governance, secure programme funding, and senior oversight throughout the lifecycle.

5. **Evaluate project success against system-wide, not local, metrics.**

Don't judge success based solely on isolated pilots or installations. Use system-wide KPIs and delivery goals to track progress and adjust approaches.

6. **Invest in delivery capability and apply robust governance.**

Build capacity in programme delivery through training, structured frameworks, and strong governance oversight at board and operational levels.

7. **Plan for change at technical, organisational, and cultural levels.**

Address not just the tech stack, but staff readiness, workflows, communications, and stakeholder engagement as part of governance planning.

8. **Report and act on insights transparently.**

Track delivery progress and feed insight into governance and resident loops to adjust plans, celebrate success, and rebuild trust where needed.

6 Data Architecture and Use

1. **Design for interoperability from the outset.**

Require open APIs, common data formats, and modular systems to ensure integration across platforms and avoid vendor lock-in.

2. **Adopt shared data standards and common frameworks.**

Use national integration standards, certification schemes, and collaborative infrastructure to ensure consistency and trust across the ecosystem.

3. **Enable residents to access, understand, and control their data.**

Design data interfaces for clarity, transparency, and usability, making it easy for residents to know what's collected and how it's used.

4. **Separate consent to install from consent to act on data.**

Make consent meaningful by allowing granular control and ensuring residents can withdraw consent without penalty.

5. **Use digital data as a trusted compliance mechanism.**

Build confidence in using real-time data as evidence for regulatory and safety compliance, reducing reliance on episodic inspections.

6. **Design for whole-system visibility, not siloed dashboards.**

Build data models that support integration across compliance, sustainability, asset, and customer services, not single-point solutions.

7. **Ensure ethical data use and privacy by design.**

Apply privacy protections at every stage, embedding data ethics, minimisation, transparency, and tenant control from device to dashboard.

7 Procurement

1. **Align procurement with strategic goals, organisational capacity, and smart home priorities.**

Procurement strategies should be clearly linked to organisational outcomes, such as compliance, damp/mould prevention, fuel poverty, and decarbonisation, and informed by cross-functional strategic planning.

2. **Use structured change management methods, not informal coordination.**

Procurement must be embedded within broader organisational change processes and support readiness assessment, programme governance, and staged implementation from vision to adoption.

3. **Support shared infrastructure to improve market coherence and reduce friction.**

Adopt integration frameworks, certification schemes, and common procurement templates that support interoperability and supplier consistency across the sector.

4. **Design procurement to enable interoperability, modularity, and resident-centred data controls.**

Prioritise open APIs, modular architecture, and procurement models that support integration with core housing systems and avoid vendor lock-in.

5. **Avoid lowest-cost procurement traps.**

Evaluate tenders based on long-term value and ability to support success metrics across the full connected model, not just installation costs.

6. **Use procurement to build collaboration, not confrontation.**

Emphasise supplier engagement, co-design, data sharing, and resident inclusion as essential delivery principles embedded from procurement stage onwards.

7. **Apply procurement levers to enforce standards and reduce vendor lock-in.**

Require adherence to open standards, enforce modularity, and define procurement success based on outcomes, not transactions.

8 Policy and Regulation

1. **Align regulation to require continuous digital compliance, not episodic inspection.**

Update standards to expect landlords to use trusted, verifiable digital data for demonstrating compliance, replacing physical checks where appropriate.

2. **Enable adoption of open platforms and shared infrastructure.**

Fund and mandate use of interoperable systems that avoid vendor lock-in and support long-term value and flexibility.

3. **Create standards and certifications to increase sector confidence.**

Introduce national integration standards, vendor accreditation, and certification schemes that help landlords and suppliers align around trusted solutions.

4. **Mandate resident rights in smart homes policy.**

Ensure legislation protects resident choice, consent, access to data, and opt-out rights, especially for vulnerable tenants.

5. **Incentivise delivery through phased funding models tied to maturity.**

Link funding eligibility (eg SHDF) to demonstrable readiness and progression through defined deployment phases, not just capital bids.

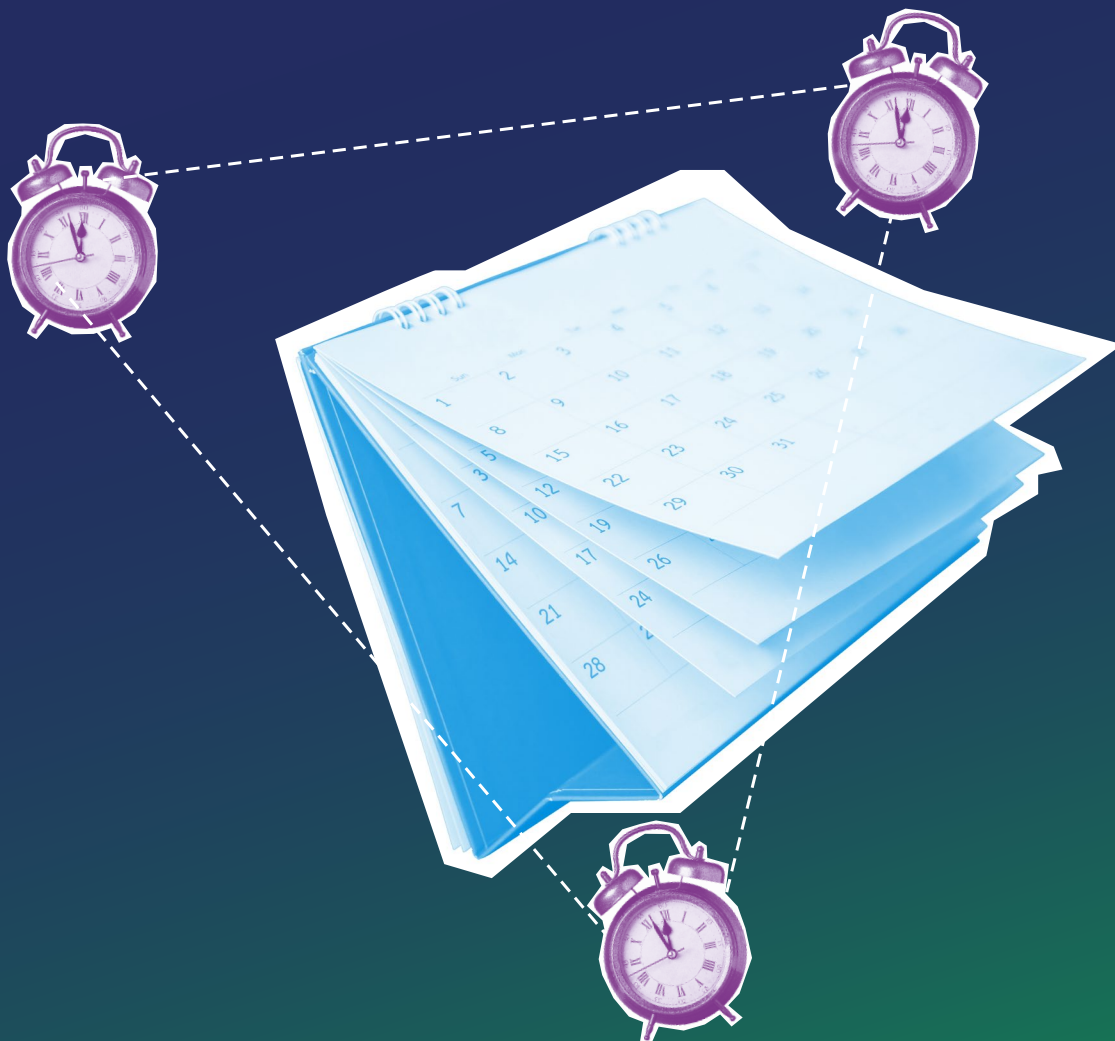
6. **Use national policy to drive collective impact.**

Align smart home deployment with climate targets, fuel poverty reduction, and regulatory priorities, positioning connected homes as infrastructure.

7. **Provide long-term clarity and confidence.**

Offer consistent policy signals, funding pathways, and regulatory timelines so landlords and suppliers can plan investment with certainty.

Appendices



Appendix 1 – Project Brief

Exploring the Deployment and Impact of Connected Home Technologies in the Social Housing Sector.

Project Objectives

This project aims to explore the current landscape, challenges, benefits, and future opportunities related to the deployment of connected home technologies in the social housing sector.

The detailed objectives are:

- a. To define what we mean by a 'connected home' so that we have a common language across the social housing sector.
- b. To determine the motives behind, and the extent and type of connected home technologies deployed to date by the social housing sector including the extent to which deployment has been driven by opportunity or strategy.
- c. To document and quantify both the benefits realised to date and the difficulties encountered during pilot or scaling phases of deployment.
- d. To capture the reactions of residents to various technologies and methods of deployment.
- e. To evaluate the preparedness of the sector for further deployment and scaling of connected home technologies, in particular its skills to analyse and ability to respond appropriately to real time data.
- f. To determine the priorities landlords and tenants would give to the deployment of further connected home technologies.
- g. To describe the “ideal”: a suite of technologies, architectures, deployment methods, and new business and tech operating models and to identify skills and culture changes that would be required to maximise the benefit of future deployments.
- h. To assess the current market of connected home technology providers within and outside of the sector and identify any gaps where the market is not yet meeting the requirements of landlords and residents.

Tasks and Methodology

Task 1: Literature Review

- **Objective:** To establish a foundation by analyzing existing research on connected home technologies in social housing.
- **Method:** Systematic review of academic articles, policy papers, industry reports, and case studies.
- **Output:** Literature review document summarizing current trends, challenges, and gaps in knowledge.

Task 2: Stakeholder Interviews

- **Objective:** To gain insights from landlords, policymakers, and technology providers regarding current motivations and experiences with connected home technology.
- **Method:** Semi-structured interviews with representatives from social housing providers, technology companies, and relevant regulatory bodies.
- **Sample:** Target 15-20 stakeholders to ensure diverse representation.
- **Output:** Qualitative data on motivations, challenges, and perceived benefits of connected home technology deployment, including whether the approach is opportunistic or strategic.

Task 3: Survey of Social Housing Residents

- **Objective:** To capture residents' experiences and reactions to connected home technology.
- **Method:** A structured survey distributed to residents across multiple social housing providers, with questions on technology types, ease of use, and overall satisfaction.
- **Sample:** Minimum 300 residents, ensuring diversity in age, socioeconomic background, and technology adoption level.

- **Output:** Quantitative and qualitative data on residents' reactions and satisfaction with connected home technology.

Task 4: Quantitative Analysis of Deployment Extent and Benefits

- **Objective:** To document and quantify benefits and issues faced in deploying connected home technologies.
- **Method:** Data collection from social housing providers on current technology usage, cost-benefit analysis, and maintenance/operational challenges.
- **Data Points:** Type of technology, initial costs, operational costs, energy savings, and reported technical issues.
- **Output:** Statistical analysis report detailing current deployment levels, financial implications, and technical hurdles.

Task 5: Assessment of Sector Preparedness for Scaling

- **Objective:** To evaluate the readiness of the social housing sector to expand connected home technology deployment.
- **Method:** Workshops with social housing providers to discuss current capacity, skill levels, and perceived barriers to scaling.
- **Output:** Report summarizing the sector's readiness for scaling, including technological, financial, and skill-based constraints.

Task 6: Prioritization Workshops with Stakeholders

- **Objective:** To understand the priorities of landlords, tenants and Government for future technology deployment.
- **Method:** Focus groups with social housing landlords and residents to rank the importance of various connected technologies and deployment considerations. Discussions with MHCLG and other government departments to identify operational or regulatory benefits of connected home deployments.
- **Output:** Prioritized list of technology features and deployment strategies, including user-centric, cost-effective solutions.

Task 7: Market Analysis of Connected Home Technology Providers

- **Objective:** To assess the current market, procurement methodologies and identify gaps in product offerings relevant to social housing needs.
- **Method:** Review of leading connected home technology providers, including product offerings, adaptability for social housing, and pricing structures.
- **Output:** Market analysis report identifying strengths, limitations, and gaps in the connected home technology market for the social housing sector, and identifying likely procurement approaches in future.

Expected Outcomes

1. A definition of “Connected Home” to be used across the social housing sector.
2. Current state report on motivations, types, and extents of connected home technologies deployed so far in social housing.
3. Assessment of “What works and what doesn’t”: Quantified costs and benefits and documented challenges from current technology deployments.
4. Insight into residents’ reactions and factors influencing their acceptance of connected technologies.
5. Evaluation of sector readiness for scaling, identifying areas requiring further action or investment.
6. A prioritized list of connected home features as indicated by landlords, tenants, government and stakeholders to aid future deployment programmes.
7. A model of an ideal connected home technology suite for social housing, including recommended skills and culture shifts that will ensure its full utilisation.
8. A market analysis highlighting gaps and opportunities for providers to better serve the social housing sector.

The completed work will ideally be launched both on a specific website and with stakeholder events. These could be on line but also potentially via a conference. We should also seek platforms at major Asset and Technology conferences run by and for the sector in the weeks following publication.

Appendix 2 – Thematic Coding in Literature Review

Theme	Sub-Themes	Key Insights	Source Examples
Purpose & Framing	Defining connected homes, sector priorities	Connected homes positioned as transformative tools; review framed around deployment, impact, and tenant experience	Rogage et al., 2022; Johnes et al., 2023; Kassem et al., 2019
Research Questions	Trends, benefits, readiness	Review structured to explore current deployments, benefits/barriers, and scalability	Section 1.2
Scope	Property-focused IoT, exclusion of assistive tech	Emphasis on landlord-facing tech like sensors, meters, and compliance tools; excludes medical/health-focused devices	Section 1.3; Akhmetzhanov et al., 2024; Agee et al., 2021
Cross-Sector Opportunities	Public health, shared investment	Environmental gains could offer health benefits and attract co-investment	Section 1.3
Ethical Concerns	Privacy, transparency, autonomy	Key risks include perceived surveillance, unclear consent, and unequal power dynamics	Balta-Ozkan et al., 2014; He et al., 2021
	Accessibility, inclusivity, equity	Challenges in digital literacy, age/diversity considerations, fair rollout	Choi et al., 2020; Buckingham et al., 2022
	Accountability and co-design	Importance of tenant agency and clear redress mechanisms	Walker et al., 2024; Johnes et al., 2023
Strategic Relevance	Use in compliance, asset mgmt., energy savings	Technologies seen as enablers of net zero, damp/mould prevention, and cost control	Johnes et al., 2023; Adeyeye, 2024
Technology Landscape	Hardware – environmental, energy, health, security	Broad range of devices: IAQ, thermostats, fall detection, leak sensors, etc.	Walker et al., 2024; Paterson et al., 2021; Akhmetzhanov et al., 2024

Theme	Sub-Themes	Key Insights	Source Examples
	Software – analytics, automation, UX	Platforms support maintenance, efficiency, tenant engagement	Sepasgozar et al., 2020; Vericon Portal; AWS IoT Core
Case Evidence	Smartline case study	Demonstrated health links, predictive potential, tenant insight, barriers	Johnes et al., 2023; Menneer et al., 2023; Buckingham et al., 2022
Business Case	ROI, cost savings, maintenance, fuel poverty	Financial rationale: fewer repairs, energy savings, regulatory compliance	Menneer et al., 2022; Sepasgozar et al., 2020
Landlord Cost Savings	Predictive maintenance, energy savings, efficiency	IoT reduces unplanned repairs, enables automation, extends asset life	Doukari et al., 2022; Sepasgozar et al., 2020; Vericon; Switchee
Regulatory Compliance	Net zero, air quality, fire safety, Legionella	IoT supports EPC upgrades, Awaab's Law, fire systems, water monitoring	Housing Ombudsman, 2023; Paterson et al., 2021; Yossef & Aharon-Gutman, 2023
Tenant Wellbeing	Air quality, energy comfort, safety, mental health	Environmental monitoring reduces damp/mould; smart energy cuts costs and improves comfort; tech boosts tenant safety	Balta-Ozkan et al., 2014; Choi et al., 2020; LOTI, 2023; Walker et al., 2024
Decision-Making & Data Use	Actionable insights, tenant support, planning	IoT dashboards inform maintenance, welfare checks, retrofit strategy	Walker et al., 2024; Zaidan & Zaidan, 2020; Rogage et al., 2022
Long-Term Strategic Value	Digital twins, data pipelines, future modelling	Simulation and lifecycle tools enable climate resilience, cost forecasting	Greenwood et al., 2017; Elghaish et al., 2024
Innovation Opportunities	Interoperability, behavioural integration, co-design	Opportunities to evolve beyond silos and embed user-centred design	Johnes et al., 2023; Maskeliūnas et al., 2019
Scaling Conditions	Integration, funding, standardisation	Importance of IT alignment, phased rollout, use of grant funding	Rogers, 2003; Warm Homes Fund Wave 3
Adoption Challenges	Digital infrastructure, tenant engagement, interoperability	Barriers include poor internet access, device silos, trust concerns	Johnes et al., 2023; Buckingham et al., 2022

Theme	Sub-Themes	Key Insights	Source Examples
Technical Barriers	Interoperability, connectivity, sensor placement	Device silos, poor connectivity, risk of damage; need for standardisation and resilience	Fard et al., 2021; Rogage et al., 2020; Zaidan & Zaidan, 2020; Stojkoska & Trivodaliev, 2017; Menneer et al., 2023
Organisational Barriers	Skills gaps, change resistance, financial constraints	Internal capacity, cultural resistance, high costs; need for partnerships and change management	He et al., 2021; Marikyan et al., 2019; Sepasgozar et al., 2020; Walker et al., 2024
Tenant Concerns	Privacy, trust, accessibility, device aesthetics	Transparency, co-design, inclusive design, peer support critical to uptake	Maskeliūnas et al., 2019; Marikyan et al., 2019; DLUHC, 2023; Long et al., 2022; Hnat et al., 2011; Buckingham et al., 2022
Market Gaps	Affordability, interoperability, energy and maintenance	High costs, lack of standardisation, underused DSM and predictive tools	Maswadi et al., 2020; Eastman et al., 2011; Greenwood et al., 2017; Rogage et al., 2021; Housing Ombudsman, 2023
Sector Preparedness	Workflow, customisation, digital readiness	Internal process design, tailored solutions, skills for new tech	LOTI, 2023; Maskeliūnas et al., 2019; Zaidan & Zaidan, 2020; Walker et al., 2024
AI and Future Tools	Machine learning, resident dashboards	AI refines predictions; tenant-facing tools support engagement	Stojkoska & Trivodaliev, 2017; Henriksen et al., 2022
Data Integrity	Sensor reliability, connectivity, redundancy	Data quality depends on deployment, uptime, and automated monitoring	Hnat et al., 2011; Menneer et al., 2023
Future Research Priorities	Tenant voice, case studies, human-centred design	Literature lacks tenant-centred analysis; usability, equity, and scale are key gaps	Choi et al., 2020; Maswadi et al., 2020; Yossef & Aharon-Gutman, 2023

Appendix 3 - Landlord Maturity Assessment Questionnaire

Introduction and Consent

“How comprehensive has the sector’s approach to smart home deployment been?”

Please answer all questions honestly based on your organisation’s current position and your personal judgement.

The survey takes approximately 15 minutes. Your responses will be anonymised.

If you have any queries as you go through the survey please contact either **matthew.gardiner@disruptiveinnovatorsnetwork.co.uk** or **Philippe.Demougin@flagship-group.co.uk**.

Questions

Section 1 - Readiness

1. How well does your organisation understand IoT/Connected Home technologies?
2. Is awareness of IoT technology widespread across your organisation?
3. Do you actively monitor the market for emerging IoT solutions? (
4. What are the primary sources of your IoT knowledge?
5. Does your organisation have a formal IoT strategy or roadmap?

Section 2 - Strategy

6. How well does your IoT vision align with your organisation’s broader goals?

7. What is the main driver for IoT adoption in your organisation?
8. If you have one, what is your target timeline for fully embedding IoT within your organisation’s operations?
9. Have you conducted pilots or initial deployments of IoT technologies?

Section 3 - Pilots

10. What type of technologies did you deploy and who was the supplier?
11. How many devices have you installed during your pilot(s)?
12. On a scale of 1 to 10, how successful do you consider your pilot(s)?
13. What were the primary benefits observed?

Section 4 - Barriers

14. What risks or issues did you observe?
15. Were any of the pilots scaled to wider deployment?
16. What are the biggest barriers to IoT adoption? (If you’ve not piloted or scaled IoT yet, why not?)
17. To what extent do funding constraints limit your ability to scale IoT initiatives?
18. How challenging is it to integrate IoT solutions with your existing systems and workflows?

19. Did you change your operating model to make use of IoT devices and the data they create?
20. How concerned are you about data privacy, security and compliance when using IoT technologies?
21. How well integrated is IoT data with your systems?
22. Do you use APIs or analytics platforms to process IoT data?
23. How competent is your organisation in using IoT data to make informed decisions?
24. How confident are you that you have the right skills in the organisation to make best use of IoT devices and the data they create?

Section 5 – Tenant Engagement

25. Have tenants been involved in IoT planning and deployment?
26. Do tenants have access to IoT data about their homes?
27. Are you transparent in the ways you inform tenants about what you have changed as a result of having and using IoT data?
28. To what extent has IoT improved operational efficiency?
29. How has IoT affected tenant satisfaction?
30. What are the key success metrics you use to evaluate IoT initiatives?

Section 6 – Future Plans

31. What are your top priorities for IoT in the next 3 years?
32. What support would enable you to scale IoT solutions?
33. How likely are you to expand IoT initiatives in the next 3 years?

Appendix 4 – Semi-structured interviews methodologies

Appendix 4.1 Semi-structured Interview Guide: Landlords and housing providers

Interview Purpose

This interview explores landlords' experiences, challenges, and perspectives on connected home technologies (IoT) in social housing. The aim is to understand the barriers, benefits, and practical considerations in adopting and scaling these solutions, particularly in relation to predictive maintenance, energy efficiency, regulatory compliance, and tenant engagement. Additionally, we seek insights into how landlords perceive the long-term role of IoT in housing management, its integration with existing systems, and the key factors influencing decision-making and investment in these technologies.

Consent

1. Voluntary Participation & Informed Consent

- Participation in this interview is entirely voluntary.
- Interviewees can choose to skip any question or withdraw at any time without providing a reason.

2. Confidentiality & Data Protection

- Responses will be kept confidential and will only be used for the purposes of this research.
- No personally identifiable information (such as names, job titles, or organisation names) will be disclosed in reports or publications.
- All data will be stored securely in accordance with GDPR (General Data

Protection Regulation) and institutional ethical guidelines.

3. Recording & Data Usage

- The interview may be recorded (with consent) for accuracy in analysis.
- Transcriptions will be anonymised before analysis.
- Data will only be retained for as long as necessary for research purposes and will then be securely deleted.

4. Right to Withdraw

- Participants can withdraw their data up to 10 days after the interview by contacting the research team.
- Any data linked to them will be deleted upon request.

Section 1: Background & Organisational Context

1. Can you briefly describe your role and responsibilities in your organisation?

Prompts: decision-making, leadership, budget, strategy

2. How many properties does your organisation manage, and what types of housing do you oversee?

Prompts: stock profile, tenure mix, urban/rural, demographics

3. What are your organisation's current priorities in terms of property management, maintenance, and tenant well-being?

Prompts: decarbonisation, compliance, affordability, digitalisation, resident engagement

4. Does your organisation have a digital strategy, and if so, how does IoT fit within it?”

Prompts: strategy, leadership buy-in, resource allocation, competing priorities

Section 2: Experience with IoT & Connected Home Technologies

4. What are your perceptions of how IoT solutions could improve housing management?

5. Has your organisation trialled or implemented any IoT-based solutions (e.g., environmental sensors, smart thermostats, predictive maintenance tools)?

Prompts: pilots, trials, scale, funding, results, barriers, integration

- If yes: Prompts: which technology/ technologies? key objectives? effectiveness, cost, tenant feedback, data insights, decision-making
- If no: Prompts: cost, complexity, scepticism, infrastructure, training, priorities

6. How scalable do you see IoT solutions within your portfolio, and what factors influence this?

Prompts: scaling pilots, cost, workforce capability, IT infrastructure

Section 3: Key Benefits & Challenges

7. What are the most compelling reasons for adopting IoT technologies in social housing?

Prompts: efficiency, compliance, cost, sustainability, tenant safety, insights, predictive

8. What are the biggest challenges or barriers you’ve faced (or anticipate) in adopting IoT solutions?

Prompts: cost, infrastructure, buy-in, training, data security, integration, funding, scalability

9. How important is integration with existing housing management systems when considering IoT solutions?

Prompts: compatibility, interoperability, procurement, automation, investment, digital strategy

10. How do you perceive tenants’ acceptance and engagement with these technologies?

Prompts: trust, privacy, transparency, usability, digital literacy, accessibility, feedback

11. Have you seen any measurable improvements in tenant well-being, comfort, or cost savings as a result of IoT?

Prompts: energy bills, home comfort, maintenance, safety perceptions, engagement levels

12. Have there been concerns around privacy, data sharing, or digital literacy?

Prompts: consent, control, misconceptions, education, behaviour change, ethical risks

13. Have tenants been involved in the selection, design, or feedback process of IoT solutions? If not, should they be?

Prompts: co-design, consultation, pilot testing, feedback loops

Section 4: Compliance, Regulation & Funding

- 11. How do regulatory requirements (e.g., Awaab's Law, EPC targets, fire safety regulations) influence your organisation's interest in IoT?**

Prompts: compliance, enforcement, risk, accountability, data, reporting, urgency

- 12. Have funding opportunities (e.g., SHDF, local grants) played a role in your decision-making for IoT investments?**

Prompts: grants, budgets, return on investment (ROI), prioritisation, barriers, eligibility

- 13. Do you think compliance-driven IoT adoption is a short-term fix or a long-term strategic shift for the sector?**

Prompts: sustainability, policy, reactive, proactive, future-proofing, culture change

Section 5: Future Outlook & Recommendations

- 14. What would make IoT solutions more viable for your organisation?**

Prompts: cost, integration, training, tenant trust, scalability, evidence, procurement

- 15. What advice would you give to other landlords considering connected home technologies?**

Prompts: lessons learned, challenges, benefits, engagement, funding, implementation

- 16. What are you prepared to change about the way you have approached IoT deployments to date?**

Prompts: bringing in new skills, being more adventurous with initial tests, learning from external evidence, adjusting procurement strategies

- 17. What changes from the supply chain would encourage you to buy more IoT solutions, more quickly?**

Prompts: cost reduction, standardisation, interoperability, better support, improved evidence of impact, easier procurement processes

- 18. Looking ahead, what role do you see IoT playing in social housing over the next 5–10 years?**

Prompts: transformation, standardisation, automation, AI, predictive, regulatory shifts

Closing

- 19. Is there anything else you'd like to add about your experiences or expectations for IoT in social housing?**

Prompts: gaps, future needs, industry collaboration, concerns, opportunities

Appendix 4.2 Semi-Structured Interview Guide: Suppliers & Technology Providers

Interview Purpose

This interview explores IoT suppliers' experiences, challenges, and perspectives on the adoption of connected home technologies in social housing. The aim is to understand the barriers, benefits, and practical considerations from a supplier perspective, including product development, integration with housing management systems, scalability, regulatory challenges, and tenant engagement. Additionally, we seek insights into how suppliers perceive the evolving role of IoT in housing, what landlords are asking for, and how solutions can better align with real-world needs.

Consent & Ethical Considerations

1. Voluntary Participation & Informed Consent

- o Participation is entirely voluntary.
- o Interviewees can choose to skip any question or withdraw at any time.

2. Confidentiality & Data Protection

- o Responses will be kept confidential and only used for research purposes.
- o No personally identifiable information (names, job titles, or organisation names) will be disclosed in reports or publications.
- o Data will be stored securely in accordance with GDPR and institutional ethical guidelines.

3. Recording & Data Usage

- o The interview may be recorded (with consent) for accuracy.

- o Transcriptions will be anonymised before analysis.
- o Data will only be retained as necessary and securely deleted afterward.

4. Right to Withdraw

- o Participants can withdraw their data up to 10 days after the interview by contacting the research team.
- o Any data linked to them will be deleted upon request.

Section 1: Background & Organisational Context

1. Can you briefly describe your role and responsibilities within your organisation?

Prompts: Product development, business strategy, sales, innovation, customer engagement

2. What types of IoT solutions does your company develop or provide?

Prompts: Sensors, automation, data platforms, energy management, compliance solutions

3. Which industries or sectors do you primarily serve? Where does social housing fit within your business model?

Prompts: Private housing, commercial property, public sector, other markets

Section 2: Experience with IoT in Social Housing

4. Has your company worked with social housing providers before? If so, in what capacity?

Prompts: Pilots, full-scale deployments, consultancy, research partnerships

5. What specific challenges have you encountered when working with housing associations or councils?

Prompts: Procurement processes, funding constraints, slow adoption, integration issues

6. How do landlords typically use the data and insights provided by your IoT solutions?

Prompts: Predictive maintenance, compliance, tenant engagement, cost reduction

Section 3: Product Development, Integration & Barriers

7. What are the key technical or operational barriers to large-scale IoT adoption in social housing?

Prompts: Infrastructure, legacy systems, security, interoperability, affordability

8. How well do your products integrate with existing housing management systems?

Prompts: APIs, automation, real-time data exchange, software compatibility

9. What feedback have you received from housing providers about what they want or expect from IoT solutions?

Prompts: Customisation, tenant engagement features, automated alerts, ROI expectations

10. How does tenant engagement factor into your product design or deployment strategies?

Prompts: User-friendly interfaces, accessibility, digital literacy considerations

Section 4: Compliance, Regulation & Market Viability

11. How have regulatory changes (e.g., Awaab's Law, EPC targets, fire safety regulations) influenced demand for your solutions?

Prompts: Compliance-driven adoption, risk mitigation, audit readiness, evolving standards

12. How do funding mechanisms (e.g., SHDF, government grants) affect your ability to scale solutions in social housing?

Prompts: Affordability, procurement cycles, public vs. private sector investment

13. Do you see IoT in social housing as primarily a compliance tool or a long-term strategic asset?

Prompts: Short-term fix, future-proofing, data-driven asset management

Section 5: Future Outlook & Recommendations

14. What innovations or advancements in IoT do you see as most promising for social housing in the next 5-10 years?

Prompts: AI, automation, digital twins, smart grids, next-gen sensors

15. What would make it easier for IoT suppliers to collaborate with housing providers?

Prompts: Procurement reform, better data sharing, clearer ROI metrics, partnerships

16. What are you prepared to change about how you engage with social housing providers to improve adoption?

Prompts: simplifying deployment, improving support services, refining pricing models, enhancing interoperability

17. What changes from landlords and housing providers would encourage you to offer more solutions, more quickly?

Prompts: clearer demand signals, streamlined procurement, better data-sharing practices, collaborative innovation pilots

18. How do you see your company's role evolving in the social housing sector moving forward?

Prompts: Expansion, partnerships, product diversification, customisation for landlords

19. Is there anything else you'd like to add about your experiences or expectations for IoT in social housing?

Prompts: Industry trends, policy changes, unmet needs, emerging challenges

Appendix 4.3 Semi-Structured Interview Sampling Strategy

Sampling Methodology

A purposive sampling approach will be used, selecting participants based on their relevance to the study objectives. To enhance representation, quota sampling will ensure coverage across key categories.

Sampling Categories and Quotas

Participants will be selected to ensure balance across:

Category	Subcategories	Quota Target
Organization Type	Social Housing Providers, Local Authorities, IoT Suppliers, Policy Makers	25-30% per category
Seniority Level	Senior Leadership, Mid-Level Management, Technical Staff	Balanced mix
IoT Experience	High (active deployment), Medium (exploring/testing), Low (minimal involvement)	At least 30% high, 40% medium, 30% low
Departmental Expertise	Assets, IT, Compliance, Finance, Customer Service, Sustainability (Retrofit)	Ensure perspectives from different functional areas

Recruitment Methods

- **Direct Invitations:** Targeted outreach to key stakeholders.
- **Snowball Sampling:** Participants refer others in relevant roles.
- **Industry Networks:** Engagement through relevant sector groups and conferences.

Ensuring Scientific Rigor

To enhance validity and reliability, we will:

- Document recruitment efforts and participation rates to track bias.
- Regularly review the sample composition to identify and address gaps.
- Mitigate selection bias by ensuring diversity in IoT maturity, organization type, and role.

- Standardize interview questions to maintain consistency across responses.

Tracking and Monitoring

A sampling matrix will be maintained to log participant details, including:

- Organization type
- Role and seniority level
- IoT experience level
- Key themes covered in the interview

This structured approach will ensure a scientifically sound and representative sample, supporting meaningful insights into the state of IoT adoption in the sector.

Appendix 5 – Tenant Engagement

Appendix 5.1 Methodology

Surveys

Distributed via three housing providers to explore awareness, perceptions, and trust in connected home technologies. Included both closed and free-text questions.

- **Total responses: 1,212**
 - o 760 (general needs / mixed tenure)
 - o 372 (including supported housing)
 - o 80 (digitally engaged residents)

Workshops and Focus Groups

Used to explore themes such as trust, consent, privacy, and digital access through guided discussion and visual prompts.

- **Total participants: 40**
 - o 21 (online session)
 - o 13 (in-person session)
 - o 6 (in-person session)

In-Depth Interview

Conducted with a tenant living in a fully connected home (PV, battery, Mixergy, smart heating, air quality), offering detailed insight into long-term use and resident experience.

Appendix 5.2 Survey Questions

1. Completion time
2. Email
3. Have you heard of connected or “smart” home devices before today?
4. Do you currently have any smart devices in your home (whether installed by you or your landlord)?
5. How comfortable would you feel having smart devices installed by your landlord?
6. Overall, do you think smart devices could improve your experience of living in your home?
7. Please tell us why you answered that way
8. Which of the following would you be interested in smart devices helping with? (Tick all that apply)
9. How important is it to you that smart devices help reduce energy bills?
10. Would you find it helpful to see information from these devices yourself, for example on your phone or through a website?
11. Do you have any concerns about having connected devices in your home? (Tick all that apply)
12. How much do you trust your landlord to use data from connected devices responsibly?
13. What would help build your trust? (Tick all that apply)
14. Would you like to be involved in helping design how these devices are used?
15. Would you prefer to be told in advance exactly what’s being installed and when?
16. How much effort do you think it should take for you to benefit from smart devices?
17. If you could change one thing about your home or service with the help of smart devices, what would it be?
18. Is there anything else you’d like to say about connected devices in your home?

Appendix 5.3 Thematic Coding Framework

Open-text survey responses and workshop transcripts were coded into themes using an inductive approach. Key themes included:

- Awareness and understanding
- Trust and accountability
- Privacy and surveillance
- Consent and autonomy
- Comfort, warmth, and energy savings
- Digital exclusion and accessibility
- Reactions to data and alerts
- Conditions for acceptance and opt-out preferences

Quotes used in the report were selected to illustrate these themes. All quotes have been anonymised.

Appendix 6 Future Vision (2035)

Appendix 6.1 A Day in the Life of a Resident

Amanda Wright, Tenant, Veridia Connected Homes

It's 2035 and I wake up to the same walls I've lived in since 2012, but the experience of living here is completely different.

It's not just that the air feels warmer without blasting the heating, or that the window doesn't gather condensation the way it used to. It's the feeling that my home is looking after me now. That it knows when something's off, and someone will do something about it before I even notice.

I don't mean that in a creepy way. I was sceptical at first. We all were. When they talked about sensors back in the 2020s, it sounded like surveillance. Big Brother with a clip board. But that's not how it turned out. The tech got better. The people got smarter. And somewhere along the line, we stopped being tested on and started being listened to.

How It Used to Be (2025)

Back then, we had damp. Mould. Freezing bedrooms and boilers that cut out just when you needed them. You had to wait weeks for a repair, and half the time the problem came back. You were expected to prove things: take photos, make calls, explain yourself again and again. You always felt like you were being judged, like the problem was you.

They installed some sensors during a pilot project. No one explained why. They didn't show us what the data meant or what

it was for. When nothing happened, we unplugged them. Some of us threw them away.

I remember saying at a tenant meeting, "I'll trust the system when the system trusts me back."

How It Works Now

My home talks. Not out loud, thank God, but through its data. It knows the air quality, humidity, temperature, energy flow, even movement inside the walls. Last winter, a spike in indoor CO2 triggered a gentle nudge on my phone: "We're noticing low airflow. Would you like us to check your vents or suggest a change?" I tapped yes. Two days later, the maintenance team upgraded the extractors. I didn't have to argue. I didn't have to beg.

If something shifts under the floor, they know before I do. If there's a leak or an electrical fault or a pattern that suggests something's wrong with the heating system, I get a call or a message asking if I'm okay with a visit. And I am. Because it feels like help, not inspection.

I can see my home's health dashboard. It's part of my resident app, next to the rent balance and community bulletin board. It doesn't bombard me with numbers, just shows me if everything's green, amber, or red. I don't check it every day, but knowing it's there gives me peace of mind.

What Really Changed

We got involved. Not just as case studies or panels, but as partners. Tenants helped design the messaging, the app, the system rules. We told them what felt intrusive, and they listened. They removed the sensors that didn't feel right. They gave us data access. They made it optional, and more people opted in because it felt like ours, not theirs.

They started rewarding prevention. My neighbour across the hall, who used to get blamed for condensation, now gets support to adjust his heating habits. Not lectures. Not letters. Real support.

Repairs teams don't turn up and shrug anymore. They turn up with insight. They know what's happening behind the walls. They fix the root problem.

How It Feels

Safe. Respected. Predictable.

Like I matter. Not just to my housing officer, but to the whole system.

I still have issues. Everyone does. But they don't fester. They don't turn into battles. My home doesn't surprise me with failure. It catches problems early and helps us prevent them together.

That's the real change. It's not just smarter housing.

It's more human.

Appendix 6.2 A Day in the Life of an Asset Director

Sarah Malik, Director of Homes and Assets, Veridia Housing

It's 2035 and I start my day, not a coffee, but also with the estate's breath.

The digital twin of our 4,200-home community was once a planning model, but now it's a diagnostic tool and it loads onto my screen. Overnight, everything has been quiet, but I notice that the sensor suite has identified an unusual spike in airborne ammonia across five flats in a 1970s terrace. It's not urgent, just an early-stage indicator that would have gone unnoticed a decade ago. Now they're routine inputs into our morning dashboard.

This is what asset management has become: not just tracking decay, but sensing the health of the environment our homes provide for tenants.

The Sensor Suite: A Nervous System for Housing

Every home on the estate carries some part of the sensing web. We rolled it out in phases, starting with high-risk buildings and vulnerable households, and eventually reaching near-universal coverage. The suite is modular, tiered, and largely invisible. Residents barely know it's there. But for us, it's like the estate's nervous system.

We can detect a lot more things now than when we started – and we know that new sensors will keep adding to the knowledge we have about our buildings.

Air quality is where the change has been most dramatic. We can detect noxious gasses to a level more precise than anything we had before: we track levels of CO₂, nitrogen dioxide, formaldehyde, and mould precursors at parts-per-trillion

resolution. Data is anonymised at the unit level but flagged when cumulative exposure threatens health or breaches policy thresholds. Automatically, we trigger tiered responses: airflow adjustments via smart vents, suggestions to residents about what they can do to improve the situation, remote checks by building services, and, if needed, a housing officer visit to co-design improvements with the tenant.

There's no longer any guessing. We know when a home is healthy and when it isn't.

Automation, Trust, and Human Hands

Much of our work now begins without us. The system automates what used to take weeks of triage.

- When sensors detect excessive movement in a slab or balcony, the structural engineer receives a 3D stress map pre-rendered by the twin. A repair sequence is proposed, costed, and checked against budgets and compliance thresholds.
- When energy flow monitors identify unusually high thermal loss in a flat, a retrofit recommendation is queued automatically and prioritised by vulnerability, EPC rating, and fuel poverty risk.
- When signs of infestation are picked up (yes, we can now automatically detect the minuscule movements of rats behind walls), our pest control partners are notified before a complaint ever arises.

As Asset Director, I no longer chase work orders or fire-fight breakdowns. The system does that. My job is to curate the estate's future, using data not just to fix the past, but to imagine what's next.

Living with the Digital Twin

We call her Ayla, the digital twin of our estate. She's not sentient, of course, but she's responsive.

At any time, I can walk through her. Every flat, every roofline, every riser and meter cupboard. But more than a map, she holds time: snapshots of pressure, movement, temperature, gas levels, power flow. She can simulate the impact of upgrades before we commit, test emergency plans across every floor, and visualise how heat moves through brick, glass, and air.

Today, Ayla shows me a worrying pattern. There's a strip of homes across three streets - different build years, but same orientation - where internal humidity stays above 70% for 11 hours a day. This isn't just a ventilation problem. It's cultural, behavioural, possibly even policy-related. I make a note to bring it to our cross-team insight group. The sensors and their data shows the what. Understanding the why still needs people.

My Role: From Controller to Curator

It's hard to explain how much this job has changed. Asset management used to be physical: inspections, inventories, replacements, repairs. Now, it's interpretive. The systems handle condition. I handle meaning.

I've had to become skilled at:

- Pattern recognition: seeing beyond the dashboard to spot strategic risk.
- Cross-disciplinary fluency: talking as easily with physicists as with housing officers.
- Ethical framing: ensuring data doesn't become surveillance. We've drawn hard lines. No biometric monitoring, no individual behaviour tracking without consent.

- Scenario planning: using Ayla to model not just interventions, but futures.

More than anything, I've become a systems thinker. Not in the abstract. In the bricks, the wires, the people.

What We've Gained

The payoff has been profound.

- Complaints down 45%. Because we fix before fault.
- Unplanned maintenance down 60%. Because we know when systems are tired.
- Resident wellbeing up. Because the air is cleaner, the warmth more stable, the silence more consistent.
- Staff morale up. Because our teams do meaningful work, not endless firefighting.

We've even shifted language. We don't talk about "stock" anymore. We talk about homes with awareness. Homes that tell us when they're under strain. Homes that adapt.

Where We're Going Next

Later today I'm presenting to our board. I'll show them a new scenario Ayla has rendered: what happens if we add new ultra-precise moisture sensors to our timber-frame stock. Could we reduce long-term maintenance costs by 20%? Could we intervene in rot cycles before they start?

We'll debate it. We'll cost it. But I already know what we'll decide.

Because when your homes can whisper to you in real time, when the walls, the air, the electricity are no longer silent, you stop managing assets.

You start listening to them and the people who live there.

Appendix 7 - Change Readiness Assessment Tool

For Smart Device Deployment at Scale

Purpose

This tool is designed to help leadership teams, sponsors, and project managers assess organisational readiness to deploy smart devices at scale. It identifies strengths, gaps, and blockers across critical domains and prompts structured reflection, not just on technical capacity but on the real-world organisational factors that make or break transformation.

It is intended for use before deployment begins, ideally following confirmation of strategic intent and initial use case selection. It may also be repeated at key stage gates.

It is complementary to, and should be used before turning to the Toolkit in [Appendix 8](#) to help guide deployment.

How to Use This Tool

- Assemble a cross-functional team with representation from assets, housing, compliance, IT, data, procurement, communications, and where possible, resident engagement.
- Complete the assessment collaboratively, rating each item and discussing the evidence behind the score.
- Use the findings to prioritise actions, sequence activities, and allocate resources.
- Revisit the assessment at regular intervals (e.g. quarterly) as the programme progresses.

Scoring

Use a 5-point scale for each question:

Score	Description
1	No capability / Not started
2	Significant gaps / Major risks
3	Partially in place / Some risks
4	Mostly in place / Minor issues
5	Fully in place and embedded

Readiness Domains and Questions

1. Strategic Alignment

Question	Score
Is there a clear, shared organisational purpose for smart device deployment?	
Has executive sponsorship been secured and communicated across the organisation?	
Are expected outcomes defined, with a logic model linking devices to value?	

2. Governance and Accountability

Question	Score
Is there a multi-functional programme board in place with authority to make decisions?	
Are accountabilities for delivery, adoption, and outcomes clearly assigned?	
Is there a governance route for raising and resolving cross-functional blockers?	

3. Resident Trust and Engagement

Question	Score
Is there a resident engagement strategy covering before, during, and after deployment?	
Have potential trust issues (e.g. privacy, surveillance concerns) been identified and addressed?	
Are staff trained and confident in communicating with residents about the devices?	

4. Workforce Capability

Question	Score
Have the roles impacted by smart devices been identified and analysed?	
Is there a plan to develop digital and data skills across affected teams?	
Are staff open to change, or are there known areas of cultural resistance?	

5. Data Infrastructure and Quality

Question	Score
----------	-------

Are core property and asset records accurate, complete, and up to date?	
---	--

Is there a working data platform that can ingest, store, and process sensor data?	
---	--

Can data be shared securely across teams, and with suppliers where needed?	
--	--

6. Technology and Supplier Strategy

Question	Score
----------	-------

Have clear criteria been defined for device and platform selection (e.g. interoperability)?	
---	--

Are procurement routes identified and aligned with the operating model?	
---	--

Is there a plan for device lifecycle management (e.g. maintenance, upgrade, replacement)?	
---	--

7. Operating Model and Service Readiness

Question	Score
----------	-------

Are the business processes that will act on smart device alerts clearly defined?	
--	--

Are system integrations mapped and in progress (e.g. job ticketing, CRM, compliance)?	
---	--

Do frontline and back-office teams understand how workflows will change?	
--	--

8. Benefit Tracking and Evaluation

Question	Score
----------	-------

Is there a benefits framework that links use cases to measurable outcomes?	
--	--

Are baseline metrics being collected ahead of deployment?	
---	--

Is there a named owner responsible for tracking and reporting on benefits realisation?	
--	--

9. Risk Management

Question	Score
----------	-------

Is there a risk register covering resident opposition, technical failure, and data misuse?	
--	--

Are mitigation plans in place and resourced for high-impact risks?	
--	--

Are risks regularly reviewed and escalated through governance structures?	
---	--

10. Pace and Sequencing

Question	Score
----------	-------

Is there a realistic delivery timeline with clearly defined stages and phase gates?	
---	--

Are dependencies between activities (e.g. data quality before analytics) clearly understood?	
--	--

Is there a “go/no-go” point to test organisational readiness before scaling?	
--	--

Summary Table

After scoring each domain, summarise below:

Domain	Score	RAG Rating	Action Required
Strategic Alignment			
Governance and Accountability			
Resident Trust and Engagement			
Workforce Capability			
Data Infrastructure and Quality			
Technology and Supplier Strategy			
Operating Model Readiness			
Benefit Tracking and Evaluation			
Risk Management			
Pace and Sequencing			

RAG rating:

Score <9: Proceeding without filling gaps is high risk

Score 9-12: Better outcomes may be realised by filling gaps, but this is medium risk

Score 12-15: Low to very low risk. Safe to proceed

This tool is not a compliance exercise. It is a diagnostic mirror, designed to prompt honest discussion, identify blind spots, and prioritise effort. The organisations that succeed will not be the ones with the slickest strategy or newest kit, but the ones that know where they stand, and are willing to act accordingly.

Appendix 8 - Best Practice Toolkit for Smart Home Deployment

Introduction

This Best Practice Toolkit has been developed as part of the Connected Homes research programme to help social landlords overcome the practical barriers to deploying Internet of Things (IoT) technologies at scale. It draws directly from the lived experience of landlords, suppliers, and residents who have participated in the project, and consolidates the 50 most actionable recommendations identified through interviews, workshops, and maturity assessments.

The toolkit is designed not just to inspire but to guide. Every recommendation included here has been trialled, tested, or proposed within the social housing context. They are the building blocks of success for organisations that want to move from isolated pilots to sustained, strategic deployment of smart home technologies.

Rather than focusing solely on technical issues, the toolkit addresses the full organisational ecosystem, strategy, governance, procurement, data architecture, resident engagement, workforce capability, and inclusion. It reflects the complexity of real-world deployment and the need for coordinated change across multiple functions.

How to Use This Toolkit

This toolkit is organised into seven thematic sections, each addressing a major domain of organisational readiness for IoT deployment. Each section contains a cluster of best practices, not individual tasks, but strategic actions that can shape the conditions for successful delivery.

Step-by-Step Guide

1. Start with a Self-Assessment

Before diving into implementation, assess your organisation's current maturity against the seven domains. Which themes feel most advanced? Which are least developed? This will help you identify priority areas.

2. Use Each Section as a Design Brief

Each theme can be used to guide:

- Internal reviews or gap analyses
- Workstream design in transformation programmes
- Briefs to suppliers or delivery partners
- Staff development and change management planning

3. Build a Coordinated Delivery Plan

The actions across sections are mutually reinforcing. For example, changes to procurement strategy only deliver value if data integration and workforce capability keep pace. Use the toolkit to map interdependencies and develop a whole-system plan.

4. Adapt, Don't Adopt

The practices in this toolkit are based on real-world examples but will need tailoring. Adjust language, accountability, and sequencing to suit your structure and culture, but retain the intent. Every action is rooted in evidence from the sector.

5. Use It as a Learning Framework

The toolkit is ideal for supporting Communities of Practice, peer learning

sessions, or internal review cycles. Revisit it after pilots, procurement rounds, or organisational changes to maintain momentum and focus.

Intended Users

This toolkit is intended for use by a wide range of roles across the housing sector, including:

- Executive teams who need to align IoT initiatives with broader strategic goals such as safety, decarbonisation, compliance, or tenant satisfaction.
- Transformation and programme leads responsible for coordinating delivery across functions and scaling successful pilots.
- Heads of service in IT, asset management, housing operations, or compliance, who are responsible for embedding new capabilities into day-to-day practice.
- Procurement teams who want to commission for outcomes, not just kit, and design contracts that enable continuous improvement.
- Digital and data leads seeking to integrate IoT with core housing systems and analytics platforms.
- Resident engagement specialists focused on building trust, transparency, and inclusive access to technology.
- Suppliers and delivery partners who want to understand the expectations of forward-thinking landlords and align their service models accordingly.
- Board members or governance leads who require assurance that IoT deployment is being handled systematically and responsibly.

Toolkit Checklist

1 Strategic Leadership and Governance

- Assign executive-level accountability for IoT, with delivery embedded in corporate strategy and transformation agendas.
- Define and communicate clear strategic outcomes for connected home initiatives (e.g. safety, decarbonisation, cost, satisfaction).
- Integrate IoT into risk management, business planning, and organisational dashboards.
- Establish formal IoT governance structures with cross-departmental representation and decision-making power.
- Move from episodic pilots to a pipeline of projects, with gates for evaluation, learning, and scaling.
- Frame smart deployment as long-term service transformation, not tech implementation.
- Use pilot phases to surface insights that inform strategic decision-making across service and asset functions.

2. Operating Model and Accountability

- Build cross-functional delivery models spanning IT, housing, compliance, and asset teams.
- Embed ownership of sensor-triggered workflows into roles, SLAs, and team structures.
- Define operational pathways and escalation routes for responding to alerts.
- Create single points of contact for operational data flows and assign time-bound responsibilities.
- Co-design operating procedures between IT, operations, and frontline teams to align practice and intent. Test them with residents.

- Include IoT behaviours and response metrics in job descriptions and performance frameworks.

3. Procurement and Commercial Innovation

- Commission suppliers for outcomes (e.g. warmth, safety) rather than devices.
- Bring procurement into pilot and scaling conversations early.
- Reform frameworks to reward agility, service integration, and continuous improvement.
- Work with suppliers to co-design service models that go beyond “kit”.
- Share learning across landlords on effective contracting models.

4. Data Architecture and Use

- Audit legacy systems to map integration needs and prioritise investment.
- Design integrated data flows that trigger workflows, evidence compliance, and enable communication.
- Create a centralised platform (e.g. data lake or integration layer) to manage IoT alongside housing data.
- Mandate open standards and published APIs in supplier contracts.
- Map who sees what data, when, and what their decision rights and accountabilities are.
- Build organisational capability to treat data as a shared asset, not a siloed function.

5. Skills, Training and Workforce Readiness

- Develop an IoT skills framework tailored to technical, operational, and engagement roles.
- Deliver training in interpreting data, taking action, and working with residents.

- Use pilots to test team adaptability, not just tech viability.
- Set up communities of practice to support cross-role learning.
- Identify and support “digital champions” who can connect day-to-day practice with strategic intent.
- Recognise behavioural shifts in how staff respond to sensor data as success metrics.

6. Resident Engagement and Trust

- Always seek opt-in, informed consent, clear, accessible, and honest.
- Treat tenants as co-creators from the outset, especially prior to pilot phases.
- Make data visible and useful to residents in real time.
- Embed trust-building as a standalone workstream with objectives and feedback loops.
- Acknowledge and address concerns about surveillance and data use directly.
- Create simple, accountable pathways for residents to query their data or raise concerns.
- Use real-world stories to build understanding and belief in the system.
- Communicate clearly when action has or hasn't been taken, and why.

7. Inclusion, Digital Confidence, and Infrastructure

- Map digital access and confidence across tenant base before rollout.
- Choose devices flexible to connectivity contexts, Wi-Fi, cellular, mesh.
- Provide in-home connectivity (e.g. cellular hubs) where broadband is lacking.
- Design interfaces that are clear, optional, and usable by those with low digital confidence.

- Build digital support into long-term service models, not just installation visits.

Final Note

The smart home agenda in social housing is no longer a speculative future, it is a practical present. But scaling deployment beyond pilots demands more than enthusiasm or funding. It requires coordination across disciplines, a shared understanding of purpose, and a willingness to challenge traditional delivery models.

This toolkit provides the scaffolding for that shift.

Use it as a living reference. Use it to open conversations across teams. Use it to spot weaknesses, double down on strengths, and build momentum.

Use it to ensure that connected homes deliver lasting value, for landlords, for staff, and above all, for residents.

Appendix 9 - Resident Engagement Strategy for Scaling Smart Device Deployment

Introduction

The deployment of smart home devices across social housing at scale offers considerable potential benefits, from increased safety and energy efficiency to predictive maintenance. However, behavioural evidence gathered during our research highlights that uptake and acceptance hinge not only on the technology itself, but on residents' perception of trust, control, and meaningful value. We therefore suggest a psychologically informed approach to engagement before, during, and after deployment, with contingency steps if the roll-out meets resistance.

1 Before Deployment: Build Trust, Not Just Awareness

Residents do not start from a blank slate. Many bring past experiences of being ignored, experiencing poor maintenance service, or feeling powerless. This creates what behavioural science terms a **“negativity bias”**- where a single poor experience can disproportionately shape attitudes.

Recommendations:

- 1.1 Start with values, not devices.** Frame the programme in terms residents care about: warmer homes, peace of mind, faster repairs. Avoid technical jargon.
- 1.2 Use trusted messengers.** Peer champions, residents already using a smart thermostat or mould sensor, should tell their own stories.

1.3 Invite opt-in to pilots. Autonomy is a key predictor of psychological comfort. Pilots should be positioned as co-experiments, not trials on people.

1.4 Rehearse the end state. Use visual materials and home visits to show what the devices will look like, do, and not do. Let residents handle the devices physically.

2 During Deployment: Normalise, Humanise, Simplify

This phase carries the highest psychological risk. Miscommunication, delays, or clunky interfaces can quickly erode trust. Cognitive load must be minimised.

Recommendations:

- 2.1 Make installation frictionless.** Clear, short appointment windows. Friendly, trained installers. A “leave-behind” welcome pack with contact info.
- 2.2 Acknowledge concerns in real time.** Don't ignore or over-reassure. If someone raises a privacy concern, validate it, then explain safeguards plainly.
- 2.3 Use behavioural prompts.** Stickers near devices explaining what they do. SMS alerts reinforcing positive outcomes (“Sensor helped detect leak: repair booked”).
- 2.4 Position it as a shared system.** Use language that highlights collective gain: “Together we're reducing damp in 200 homes.”

3 After Deployment: Close the Feedback Loop

Psychologically, what happens after deployment is often what residents remember most. Without feedback, users may assume the devices are ineffective or invasive.

Recommendations:

3.1 Celebrate early wins. Publicise where a device prevented costly damage or enabled faster repairs, especially using resident testimonials.

3.2 Create a channel for reflection. Allow residents to comment on their experience in a low-friction way, QR codes, textbacks, or short calls.

3.3 Offer a re-set button. Residents should be able to opt-out, request adjustments, or ask for retraining.

4 If Deployment Is Poorly Received

If resistance rises, either publicly or silently, the key is not to double down, but to course-correct visibly and credibly.

Recommendations:

4.1 Initiate an empathy audit. Run a short series of listening sessions led by neutral facilitators. Treat all feedback as signal, not noise.

4.2 Suspend future installs if needed. A short pause demonstrates responsiveness, not weakness.

4.3 Redesign with the resident. Invite three to five critics into a redesign group with decision-makers. Co-production restores dignity and often generates better solutions.

5 Conclusion

Smart device deployment is not a technical rollout, it is a social transition. Success lies in creating an experience that residents feel part of, not subjected to. With careful sequencing, transparency, and emotional intelligence, landlords can assist residents to move from passive acceptance to active enthusiasm.

Appendix 10 - Digitising Compliance in Social Housing Using IoT

This appendix is designed as an outline guide for landlords who wish to move from episodic inspection and reactive maintenance to a system of continuous, automated compliance assurance that provides transparency, safety, and peace of mind for both landlords and residents.

Context and Challenge Social landlords are required to comply with a wide range of statutory and regulatory obligations concerning the safety, quality, and condition of their homes. These include, but are not limited to:

- Gas and electrical safety
- Fire and building safety
- Water hygiene (legionella)
- Damp, mould, and indoor air quality
- Smoke and CO alarms
- Asbestos and lift safety
- Energy efficiency and climate adaptation
- Resident engagement and satisfaction
- Accessibility and emergency planning

At present, most assurance is episodic, based on visual inspections, manual servicing, and paper-based reporting. This approach is resource-intensive, prone to human error, and fails to provide the continuous assurance now expected by regulators, residents, and the public, particularly in light of Grenfell, Awaab's Law, and the push toward Net Zero.

The Opportunity: IoT-Enabled Assurance

A growing suite of IoT devices offers the potential to transform housing compliance. These include:

- Smart gas valves, pressure sensors, and CO detectors
- Electrical load monitors and smart breakers
- Networked smoke and heat detectors
- Humidity, temperature, and moisture sensors for damp/mould
- Pipe temperature and flow sensors for legionella control
- Structural movement and vibration sensors for building integrity
- Smart meters, solar/PV monitors, and indoor climate tracking

These sensors can feed into cloud-based platforms that:

- Provide real-time compliance status per property
- Trigger alerts for emerging risks
- Automatically record compliance data for audit purposes
- Visualise performance using traffic-light systems (green = compliant, red = breach, grey = data missing)

System Vision A digital compliance map where every home a landlord owns is represented and colour-coded would be created:

- **Green:** Fully compliant in all monitored respects
- **Red:** Non-compliant in one or more areas (e.g. overdue gas check, unsafe humidity level)
- **Grey:** Data unavailable due to sensor fault, lack of coverage, or device failure

This map would be underpinned by a central platform integrating:

- Device-level sensor data
- Asset and repairs systems
- Resident engagement tools
- Automated rules engine aligned with compliance thresholds

System Design: What Must Be True To realise this vision, several elements must align across technology, operations, and culture.

A. Building Services Safety

Compliance Area	Devices / Sensors	Operational Needs / Gaps
Gas Safety	Smart gas leak sensors, CO detectors, boiler diagnostics	Link sensors to automated alerts and shutoff; integrate into boiler servicing cycles
Electrical Safety	Smart meters, breaker load monitors, energy disaggregation tools	Move from fixed 5-year checks to exception-based alerts; current retrofit cost still high
Fire Safety	Smoke, heat detectors, exit sensors	Auto test logging; schedule maintenance only when sensors flag issues
Water Hygiene (Legionella)	Pipe temperature and flow sensors, usage data	Replace manual flushing with automated routines; monitor inactivity
Lift Safety	Lift telemetry, door sensors, vibration/strain gauges	Integrate OEM diagnostics into compliance dashboards
Smoke/CO Alarms	Interlinked, monitored alarms	Shift from visual “button tests” to remote status reports

B. Structural and Building Integrity

Compliance Area	Devices / Sensors	Operational Needs / Gaps
Building Safety (HRBs)	Structural movement sensors, fire door sensors, digital access logs	Must integrate with Building Safety Case & golden thread; specialist setup needed
Structural Integrity	Vibration, crack, moisture sensors	Deployment best for high-risk or ageing stock; data must trigger engineering review
Cladding / External Wall Systems	Surface temperature sensors, external fire detection, thermal drone data	Data needs to feed into PAS 9980 assessments; currently underused in low-rise stock
Asbestos Management	RFID/NFC tagging; QR code-linked registers; geofenced mobile apps	IoT not used for live sensing, solution is around traceable tagging and mobile alerts
Emergency Planning / Incident Readiness	Emergency lighting monitors, smart locks, panic buttons, occupancy sensors	Must feed into emergency planning frameworks and trigger instant response plans

C. Environmental and Health Risks

Compliance Area	Devices / Sensors	Operational Needs / Gaps
Damp and Mould	Humidity, temperature, moisture sensors	High potential for automation of Awaab's Law response times
Indoor Air Quality (incl. Radon)	CO2, PM2.5, VOC, radon sensors	Radon detection needs careful zoning; data informs retrofit and health decisions
Overheating & Climate Resilience	Ambient temperature, solar gain, airflow sensors	Overheating data supports climate resilience strategies and tenant safety measures
Smart Metering & Energy Use	Gas/electric/water smart meters; sub-metering	Integrate meter data into asset risk scoring and detect over/under-use anomalies
Energy Efficiency / Net Zero	Monitoring of insulation, PV, heat pumps, storage	Integrates with SHDF and retrofit assurance; few landlords link sensor data to EPCs yet

D. Resident Safety and Interaction

Compliance Area	Devices / Sensors	Operational Needs / Gaps
Resident Engagement / Transparency	Resident app with compliance view; fault-reporting tools	Promotes trust and shared accountability; must be inclusive and GDPR-compliant
Repairs, HHSRS & Disrepair	Composite risk scoring from multiple sensors	Repairs scheduling should shift to risk-prioritised workflows; supports Decent Homes
Accessibility & Adaptability	Smart door entry, fall sensors, lighting and temperature controls	Enables tailored compliance in homes with vulnerable residents; ethics and privacy vital
Tenancy Safety (Safeguarding, Overcrowding)	Motion, door, noise, occupancy sensors	Privacy and safeguarding frameworks essential; sensors only appropriate in known risk cases

E. Regulatory & Operational Frameworks

Compliance Area	Devices / Sensors	Operational Needs / Gaps
RSH Consumer Standards	All above sensors feeding into a central dashboard	Data must be structured to align with regulatory themes: Safety, Quality, Transparency
Tenant Satisfaction (TSMs)	App-based surveys, environmental comfort data	TSM dashboards should link objective IoT data with subjective survey input
Decent Homes Standard	Aggregated data: repairs, energy, damp, health risks	Must track condition over time and across tenures; builds case for capital spend
Transparency / Duty of Candour	Auto-generated audit logs from sensors and actions	Audit trail needs to be resident-readable and tamper-proof; vital for trust
Data Ethics & Cybersecurity	Secure device onboarding, encryption, consent logs	Standards and training must underpin secure, ethical data use across all devices

2. **Integrated Data Platform** The central platform must:

- Collect, normalise, and store data from multiple IoT providers
- Run compliance logic in real time against legal and regulatory standards
- Generate dashboards and alerts accessible by asset managers, compliance teams, and residents
- Feed compliance data into core housing and asset management systems (e.g., Civica, Northgate, MRI)

3. **Operational Procedure Changes** To operate this system, landlords would need to:

- Shift from calendar-based servicing to predictive, sensor-triggered interventions
- Automate audit trail generation using event logs from devices
- Use exception-based workflows (respond to alerts, not schedules)
- Conduct remote diagnostics before dispatching physical operatives
- Flag and prioritise properties with missing data (“grey”) as part of a digital voids and asset audit process

4. **New Skills and Capabilities**

Implementing this system would require:

- **IoT integration specialists** (in-house or via suppliers)
- **Data analysts** to interpret trends and feed insight into strategic planning
- **Digital asset managers** trained to work with dashboards, rules engines, and alert systems
- **Resident engagement leads** to build trust and communicate the value of in-home sensors
- A cultural shift across housing operations to embrace automation, proactive maintenance, and data transparency

5. **Governance and Ethics Framework**

A digitised compliance model also demands:

- Transparent data governance protocols (privacy, access, retention)
- Ethical frameworks for sensor use in occupied homes
- Regulatory alignment with the Regulator of Social Housing, ICO, and Ombudsman expectations

Appendix 11 - Example Business Case Framework for shifting to “Connected Compliance”

Business Case Framework for Deploying a Connected Compliance Model

1. Purpose of the Framework

- This framework supports executive teams in evaluating the case for moving regulatory and legislative compliance into a connected home model.
- Whilst all compliance requirements are potentially able to be included in a connected compliance approach, it is recognised that landlords are likely to transition to this sequentially and incrementally.
- This framework, though, is designed to assess the business case for once the whole transition is complete and operating models have been changed
- It recognises the organisation-wide nature of the decision, including technical, operational, cultural, and reputational factors.
- It can be amended to match the individual circumstances of each landlord.

2. Logic Model: Pathway to Connected Compliance

Stage	Description
Inputs	Investment capital; supplier partnerships; sensor infrastructure; IT integration capability; data governance protocols; resident trust; internal change capacity
Activities	Deployment planning; device installation; data pipeline development; staff skills development; resident onboarding; process redesign; operating model change
Outputs	Flow of real-time condition and compliance data; fresh insights; updated operating procedures; new performance dashboards; changed policies and procedures; direct linkage to action
Outcomes	Proactive compliance assurance; improved health and safety; reduced manual inspection; reduced responsive repairs; workforce skill shift
Impacts	Demonstrable regulatory compliance; detection of potential regulatory failure; stronger resident trust; lower long-term risk exposure; enhanced organisational resilience

3. Business Case Decision Framework

This framework is structured across seven assessment domains, each with guiding questions, evidence types, and prompts for considering both action and inaction.

3.1 Strategic Alignment

- **Questions:**
 - o How does this model support our corporate objectives (e.g. Net Zero, resident satisfaction, regulatory assurance)?
 - o Are there known compliance risks we do not manage well under current systems that this solution would address?
 - o What compliance changes might be coming that we are not well placed to deal with?
- **Evidence:**
 - o Strategic plan references; audit findings; regulatory changes

3.2 Financial Case

- **Questions:**
 - o What are the projected capital and operational costs over 5–10 years?
 - o What cost savings (e.g. through prevention, efficiency, fines avoided, waste and duplicated effort prevented) might accrue?
 - o What is the cost of inaction? (e.g. reputational, time and cost of eg disrepair claims, HSE investigations)
- **Evidence:**
 - o Cost model; benchmarking; historical cost of disrepair; actuarial risk estimates

3.3 Resident Engagement and Value Exchange

- **Questions:**
 - o How will residents benefit directly or indirectly from connected compliance?
 - o What privacy, consent or data ownership issues must be addressed?
 - o What constitutes a fair exchange of value for resident-contributed data?
- **Evidence:**
 - o Consultation outcomes; resident surveys; data ethics framework

3.4 Supplier and Technology Ecosystem

- **Questions:**
 - o How do we avoid vendor lock-in
 - o What procurement strategy supports supplier diversity and interoperability?
 - o How mature is the supplier market in meeting our specific housing stock needs?
 - o Can we ensure continuity of service and device performance over time?
- **Evidence:**
 - o Market reviews; pilot programme reports; standards alignment checklists

3.5 IT Infrastructure and Information Security

- **Questions:**
 - o Can our existing infrastructure handle the volume and velocity of sensor data?
 - o Are our data security, privacy, and integration capabilities sufficient?
 - o How will we manage APIs, system updates, and cyber risk?
- **Evidence:**
 - o IT gap analysis; InfoSec audits; architecture review; data protection assessments

3.6 Workforce Skills and Operating Model

- **Questions:**
 - o What new skills (e.g. data interpretation, remote diagnostics, resident digital support) will be required?
 - o What are the implications for frontline staff, customer service, and asset management?
 - o What roles, teams, or workflows need to be redesigned in a new operating model to realise benefits?
- **Evidence:**
 - o Skills matrix; role mapping; staff readiness assessments; union feedback

3.7 Risk, Assurance, and Organisational Readiness

- **Questions:**
 - o What risks arise from deployment (e.g. tech failure, data breach, backlash)?
 - o Are we culturally and structurally ready to act on real-time compliance data?
 - o How will success be monitored and course corrections made?
- **Evidence:**
 - o Risk register; governance review; assurance plan; pilot evaluations

4. Comparative Cost Lens: Doing Something vs. Doing Nothing

This section encourages organisations to explicitly map:

- Costs of Action: Financial outlay, transition disruption, learning curve, reputational risk if rollout goes poorly
- Costs of Inaction: Missed savings, increased non-compliance risk, disrepair claims, inability to demonstrate ESG performance, organisational drift

It can be represented in a table:

Cost Type	Doing Something	Doing Nothing
Capital cost	Retrofit, infrastructure, devices	Future unplanned repair escalation
Operational cost	System management, training	Rising inspection, repair, and legal costs
Reputational impact	Perception of surveillance or tech failure risk	Continued perception of neglect or disrepair
Compliance risk	Transition errors	Inability to meet regulatory requirements
Resident relationship	Needs careful management of consent and value	No improved trust or early intervention capability

5. Summary: Using the Framework

- The framework is not a scoring system but a **thinking system**. It helps surface all the consequences of a whole-of-compliance digital model.
- Organisations should aim to build an **evidence-rich narrative** across these domains.
- Adaptation is encouraged: add local metrics, resident priorities, or strategic factors as needed.

Appendix 12 - Options Paper: Technical Stack Models for IoT in Social Housing

Option 0: Integration-First Architecture (Possible Sector Consensus)

Modelled on: Lessons from Bromford, IoT vendors like IoTSG, and ongoing sector interviews

Core Idea: Focuses on interoperability through open APIs, minimal-effort integration, and insight delivery. Emphasises procurement standards over hard architectural constraints.

Strengths:

- Aligns with real-world housing needs and sector capacity

- Flexible and vendor-neutral
- Shifts emphasis to insight delivery and workflow integration

Risks:

- Requires cultural and organisational change to realise value
- Success depends on landlord capacity to embed insights into services

Suitable for: Providers seeking scalable and modular IoT deployment with freedom to choose devices and platforms.

Option 1: Open Modular Architecture (Utility-Inspired)

Modelled on: Energy and water utilities' grid and meter systems

Core Idea: Breaks down the tech stack into independently substitutable layers: devices, comms, cloud, and analytics. Each layer adheres to standard interfaces and can evolve separately.

Strengths:

- High flexibility and long-term future-proofing
- Promotes healthy supplier competition
- Enables partial rollouts or mixed estate strategies

Risks:

- Complexity in managing interfaces
- Requires sector-wide agreement on standards

Suitable for: Digitally mature landlords or strategic alliances aiming for long-term agility.

Option 2: End-to-End Managed Service Stack (Healthcare Model)

Modelled on: Remote monitoring services in health and care

Core Idea: A single vendor provides and maintains the full stack, from sensors to insights, with minimal involvement from the landlord.

Strengths:

- Low operational burden
- Rapid deployment for compliance-focused use cases
- Single accountability point

Risks:

- Significant vendor lock-in
- Limited adaptability to bespoke or evolving needs

Suitable for: Small to mid-size landlords or those prioritising speed and simplicity over customisability.

Option 3: Platform-as-a-Service (Smart City/Digital Twin Approach)

Modelled on: Smart city platforms and shared digital infrastructure

Core Idea: A central cloud-based platform ingests data from multiple sources and delivers insights and APIs to participating landlords.

Strengths:

- Economies of scale through shared infrastructure
- Encourages regional and sectoral collaboration
- Enables system-wide benchmarking and innovation

Risks:

- High setup and coordination complexity
- Requires strong governance and data-sharing agreements

Suitable for: Consortiums of landlords, city regions, or groups pursuing collective intelligence.

Option 4: IoT Edge + Federated Cloud (Manufacturing Model)

Modelled on: Industrial IoT in manufacturing and logistics

Core Idea: Edge devices perform initial processing and send only critical data to cloud services. Processing is distributed, reducing load on central systems.

Strengths:

- Lower bandwidth and storage costs
- Better performance in poor connectivity environments
- Enhances privacy by keeping more data local

Risks:

- Greater device complexity and cost
- Harder to maintain and standardise across stock

Suitable for: High-density urban housing with patchy connectivity, or providers seeking privacy-first architectures.

Option 5: Standards-Led Procurement Framework (Transport Model)

Modelled on: Intelligent Transport Systems (ITS) and regulated interoperability frameworks

Core Idea: The sector agrees a set of minimum performance, data, and integration standards. Suppliers must conform, but can design their own stacks.

Strengths:

- Encourages innovation while ensuring interoperability
- Avoids vendor lock-in
- Easy to enforce through procurement

Risks:

- Weak uptake if not backed by regulators or funders
- Requires certification and ongoing governance structure

Suitable for: Sector-wide bodies (e.g., NHF, DLUHC) looking to enable diverse innovation under a common umbrella.