

Designing For Dignity: Integrating Global Perspectives and Ethical Care Frameworks in Sustainable Housing for the People with Cognitive Disabilities

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Abstract

This paper addresses the urgent need to reimagine housing maintenance for people with cognitive disabilities, including individuals living with dementia. It explores how sustainable infrastructure, ethical care, and cultural responsibility can be interwoven to foster dignified, inclusive living environments. The primary aim is to develop an integrated framework that supports built environment professionals in adopting proactive and culturally responsive maintenance strategies.

The study pursues three key objectives: (1) to evaluate current practices in residential care maintenance, (2) to identify ethical and cultural frameworks—particularly those informed by global perspectives and Islamic principles—that uphold dignity and protection, and (3) to propose actionable pathways for aligning traditional values with modern predictive maintenance technologies. The research is guided by two central questions: How can ethical and cultural principles be operationalised in sustainable housing maintenance? What are the practical impacts of integrating these frameworks on the well-being of people with cognitive disabilities residents?

A mixed-methods methodology is employed, combining stakeholder interviews, predictive maintenance modelling, and policy analysis within the UK context, while drawing from broader global discourses. The paper presents a critical review of care ethics in housing, synthesizes stakeholder insights, and introduces a sustainability framework evaluated through case-based applications.

Findings reveal that integrating ethical care concepts—such as the Islamic view of shelter as a divine trust (amanah)—with predictive maintenance strategies enhances resident dignity, operational effectiveness, and long-term sustainability. The study concludes that inclusive, ethically grounded maintenance models are both necessary and achievable, advocating for cross-disciplinary collaboration and the institutionalization of culturally attuned practices to advance equitable and sustainable care infrastructures.

Keywords

Culturally Informed Built Environment Education, Ethical Care Frameworks, Housing Maintenance, People with Cognitive Disabilities.

INTRODUCTION

The demographic shift towards ageing societies is transforming how nations design and maintain housing for older and cognitively vulnerable s. The World Health Organization projects that dementia cases will triple by 2050 [3], while the United Nations notes that ageing s will reshape global housing demand [5]. Dementia and other cognitive impairments fundamentally alter the relationship between individuals and their living environments. While medical advances focus on treatment and care protocols, the built environment remains underexplored as a frontline mechanism for sustaining dignity, independence, and well-being among people with cognitive disabilities [2], [6].

Housing, as the most intimate and enduring context of human life, plays a central role in enabling dignity and care. For those experiencing cognitive decline, maintenance practices—covering safety systems, accessibility, comfort, and environmental predictability—are as critical as architectural design itself. However, the literature

consistently highlights that housing maintenance remains reactive, underfunded, and poorly integrated with broader ethical or cultural principles of care [14], [19]. Although literature links “ageing in place” to autonomy and environmental quality [2], [6], far less attention has been paid to the ethical and cultural dimensions of housing maintenance. Housing for people with cognitive disabilities must be conceived not merely as a technical artefact but as an ethical responsibility grounded in multiple value systems—ethical, cultural, and religious [9], [13], [22]. Existing practices in residential care often prioritise operational efficiency over the lived experiences and dignity of vulnerable residents [6], [7].

This paper is motivated by the urgent need to reframe housing maintenance as more than a technical or managerial task. Instead, it should be understood as a socio-ethical responsibility grounded in global perspectives and cultural frameworks. In Islamic traditions, for example, the concept of *amanah* (trust) regards shelter not merely as a commodity but as a divine responsibility entrusted to those who provide

and maintain it [9], [13]. Similarly, Western care ethics emphasise autonomy, inclusivity, and respect for personhood [1], [2]. Despite these rich traditions, the practical integration of ethical care frameworks with sustainable and predictive maintenance technologies remains limited [18], [21], [25].

Islamic principles provide a distinct moral lens through which housing is seen as both *trust* (*amanah*) and *stewardship* (*khalifah*) [9], [10]. These are ethical imperatives, not cultural customs. Culture, by contrast, represents the socially transmitted beliefs and practices within communities [11], [22]. While Islamic principles and cultural traditions often intersect, they are not synonymous: Islamic ethics prescribe divinely anchored duties, whereas culture reflects evolving social norms.

This study therefore unites three intersecting perspectives:

1. Ethical principles — universal ideals of dignity, justice, and care [1], [2];
2. Global perspectives — cross-cultural approaches to ageing and sustainability [6], [11], [22];
3. Islamic principles — moral doctrines of *amanah*, *adl*, and *rahmah* shaping responsibility in housing [9], [10], [13].

Together these perspectives inform a dignity-centred predictive-maintenance model integrating ethics, inclusivity, and faith-based accountability.

The central research problem addressed here is the lack of a holistic framework that simultaneously integrates predictive maintenance technologies with ethical and cultural principles to create housing systems that are not only sustainable but also dignified and inclusive. To address this problem, the study pursues three objectives:

1. To evaluate current practices in residential care maintenance for people with cognitive disabilities;
2. To identify ethical and cultural frameworks—particularly those informed by global perspectives and Islamic principles—that uphold dignity and protection; and
3. To propose actionable pathways for aligning traditional values with modern predictive maintenance technologies.

The study is guided by two research questions:

- How can ethical and cultural principles be operationalised in sustainable housing maintenance?
- What are the practical impacts of integrating these frameworks on the well-being of people with cognitive disabilities residents?

By answering these questions, this study contributes to three areas of knowledge. First, it expands the discourse on housing maintenance by embedding it within ethical and cultural care frameworks [1], [9], [12], [22]. Second, it provides empirical insights through mixed-methods research—combining stakeholder interviews, predictive modelling, and policy analysis [14], [18]. Third, it offers a framework that can guide built environment professionals, policymakers, and care practitioners towards more inclusive and equitable practices [16], [17].

The remainder of this paper is structured as follows. Section II reviews the existing literature on people with cognitive disabilities housing, ethical care frameworks, and maintenance practices. Section III outlines the research methodology. Section IV presents data analysis and results. Section V discusses the findings in relation to theory and practice. Section VI concludes with implications, limitations, and directions for future research.

LITERATURE REVIEW

People with Cognitive Disabilities and Housing Needs

Cognitive vulnerability, encompassing conditions such as dementia and other neurodegenerative impairments, affect not only memory and cognition but also navigation, perception, and sensory processing within physical environments. The built environment thus becomes an active participant in either supporting or undermining well-being. Research suggests the importance of design features that minimize confusion, reduce hazards, and promote autonomy for people living with cognitive disabilities [2], [6].

However, design alone is insufficient. Housing maintenance—ensuring that systems remain functional, predictable, and safe—plays a pivotal role in sustaining dignity. Studies confirm that residents of people with cognitive disabilities are disproportionately affected by breakdowns in environmental systems such as heating and lighting [7]. Yet, existing research often treats maintenance as peripheral, with limited attention to its ethical or cultural implications [14].

Cognitive impairment alters navigation, perception, and sensory processing; the built environment becomes an active participant in well-being. The WHO [3] and gerontological studies [2], [6] stress design measures that enhance clarity, safety, and autonomy. Yet maintenance—ensuring continued functionality and safety—remains under-researched [7], [14].

Ethical Care Frameworks in Housing

The concept of care has been extensively theorised within philosophy, nursing, and social policy. Tronto defines care as “everything we do to maintain, continue, and repair our world” [1]. Applied to housing, care extends beyond construction to include maintenance and adaptation.

Western frameworks emphasise autonomy [2]; Islamic ethics embed care within spiritual and communal obligations, treating shelter as a divine trust (*amanah*) [9], [13]. The principle of person-centred care in dementia services promotes environments that respond to individual needs and preferences. It is crucial to distinguish Islamic principles from culture. Islamic housing ethics derive from divine accountability (*adl*, *rahmah*, *khalifah*) [9], [10]; culture denotes social conventions and traditions [11], [22]. These domains often overlap but can diverge—e.g., patriarchal housing norms may conflict with Islamic equity [24]. Conversely, non-religious cultural traditions such as collectivist caregiving [11], [22] can align with Islamic ethics of compassion.

Hence, this research focuses on convergence among ethical, global, and Islamic frameworks that collectively promote dignity and sustainability [8], [13], [16].

Maintenance Practices in Residential Care

Maintenance strategies can be categorised into three dominant models [19], [20]:

1. **Reactive Maintenance** – addressing breakdowns after they occur, which often results in high costs and increased risks for vulnerable residents.
2. **Planned Preventive Maintenance (PPM)** – scheduled upkeep based on standard life cycles of systems and materials.
3. **Predictive Maintenance** – data-driven strategies that monitor systems in real time, identifying potential failures before they occur.

Predictive maintenance has gained attention in infrastructure management for its cost-effectiveness and sustainability benefits. Predictive maintenance, enabled by data analytics and IoT systems, has been shown to reduce costs and failures in building management [18], [25]. However, in residential care for people with cognitive disabilities, its application remains underdeveloped. Most facilities continue to rely on reactive or preventive approaches, exposing residents to unpredictable disruptions with severe implications for safety and dignity [14]. In housing for people with cognitive disabilities, its application remains underdeveloped. Most residential care facilities still rely on reactive or preventive approaches, leaving residents exposed to disruptions that can severely compromise their dignity, comfort, and safety. Maintenance regimes are typically reactive, preventive, or predictive [19], [20]. Predictive maintenance, supported by IoT and AI technologies [18], [25], offers reliability and cost efficiency but is under-utilised in care housing [14].

Global Perspectives on Culture and Sustainability

Maintenance strategies can be categorised into three dominant models: Cross-national studies show how cultural contexts shape sustainable housing [6], [8], [11]. Scandinavian co-housing supports autonomy [6], while Japanese eldercare integrates robotics [18]. Islamic frameworks emphasize stewardship and *amanah* [9], [13]. Successful models balance technological innovation with cultural resonance [21], [22], [24].

Sustainable housing for the people with cognitive disabilities requires balancing technological innovation with cultural relevance. Wiles et al. [7] note that older people often interpret “aging in place” in ways that are deeply tied to cultural familiarity and identity. International studies suggest that interventions succeed when they resonate with local values—whether through family-based support in Asian contexts [11] or autonomy-focused environments in Western care facilities [14]. This global perspective highlights the importance of culturally sensitive frameworks in guiding predictive maintenance adoption.

Conceptual Gaps in Literature

Despite advancements in both ethical care theory and predictive maintenance technologies, three key gaps persist:

- Integration of ethical and cultural values into maintenance: Ethical and cultural principles rarely inform maintenance models. Current practice focuses heavily on operational efficiency [10], [13].
- Empirical evidence linking predictive maintenance to well-being: Few empirical studies test the combined impacts of predictive maintenance and care ethics on vulnerable residents’ quality of life [25].
- Policy recognition of ethical dimension: Regulatory frameworks in the UK and globally prioritise safety and cost but neglect cultural and ethical considerations [4], [23].

This study positions itself at the intersection of these gaps by proposing an integrated sustainability framework that operationalises ethical and cultural care principles within predictive maintenance strategies.

METHODOLOGY

This study adopts a mixed-methods design, combining qualitative inquiry with quantitative modelling and policy analysis. The choice of a mixed-methods framework reflects the complexity of the research problem: housing for people with cognitive disabilities requires an integrated approach that captures lived experiences, ethical values, and operational performance [6], [14].

Semi-structured interviews were conducted with stakeholders including care managers, families, and maintenance staff. Interview protocols were guided by themes of dignity, trust, and cultural responsibility, reflecting frameworks proposed in earlier gerontological and ethical care research [1], [2], [7].

Predictive maintenance modelling was performed on HVAC, plumbing, fire alarms, and lighting systems in two UK care facilities, building on established approaches to predictive analytics in building systems [18], [19], [25]. Policy analysis included review of the UK Care Act (2014), NICE guidelines [4], WHO’s dementia action plan [3], and Islamic housing principles [9], [13].

A mixed-methods design combined stakeholder interviews, predictive-maintenance modelling, and policy analysis [6], [14], [18].

- Interviews with care managers, residents’ families, and maintenance staff explored themes of dignity and trust [1], [2], [7].
- Predictive modelling analysed HVAC, plumbing, and safety systems [18], [19], [25].
- Policy analysis reviewed UK Care Act 2014 and NICE guidelines [4], WHO’s dementia plan [3], and Islamic housing ethics [9], [13].

Research Design

This study adopts a mixed-methods design, combining qualitative inquiry with quantitative modelling and policy

analysis. The choice of a mixed-methods framework reflects the complexity of the research problem: housing for people with cognitive disabilities cannot be understood solely through technical or cultural lenses but rather requires an integrated approach that captures lived experiences, ethical responsibilities, and operational performance.

The research was conducted in three phases:

1. **Stakeholder Interviews** – to gather experiential insights from residents’ families, care providers, and housing managers.
2. **Predictive Maintenance Modelling** – to test the performance of data-driven maintenance approaches.
3. **Policy and Document Analysis** – to assess the alignment between current housing/care policies and the proposed ethical-cultural framework.

This triangulation strengthens validity by enabling cross-verification of findings across methodological approaches.

Design Stakeholder Engagement and Interviews

Semi-structured interviews were conducted with a purposive sample of stakeholders directly involved in the provision, maintenance, and care of housing for people with cognitive disabilities. The participants included:

- Care home managers (n = 6);
- Maintenance personnel and facilities managers (n = 5);
- Family members of residents (n = 8);
- Representatives of housing policy and advocacy groups (n = 4).

Each interview lasted approximately 45–60 minutes and was guided by an interview protocol exploring three key themes: (1) experiences of housing maintenance in residential care; (2) perceptions of dignity, safety, and autonomy in the housing environment; and (3) the role of ethical, cultural, and religious values in shaping expectations of care.

All interviews were recorded with consent and transcribed verbatim. Thematic coding was carried out using NVivo software, with codes developed iteratively around emergent concepts such as “trust,” “predictability,” “family responsibility,” and “cultural safety.”

Predictive Maintenance Modelling

To test the operational viability of predictive maintenance within residential care housing, this study applied a simulation-based modelling approach. Real-world maintenance data were sourced from two mid-sized UK care facilities (anonymised for confidentiality). Key building systems analysed included:

- Heating, ventilation, and air conditioning (HVAC);
- Plumbing and water supply.
- Fire and safety alarm systems.
- Lighting and accessibility aids (e.g., motion-sensor lighting, stair lifts).

Machine-learning algorithms were employed to model potential failure rates and forecast system reliability under

varying maintenance regimes: reactive, preventive, and predictive. The primary performance indicators were:

1. Failure frequency and downtime.
2. Cost efficiency.
3. Impacts on resident comfort and safety.

The modelling outcomes were compared against baseline conditions to demonstrate the relative benefits of predictive maintenance in environments where residents are particularly sensitive to disruption.

Policy and Ethical Framework Analysis

The third methodological component involved a critical review of housing and care policies in the UK, alongside a comparative analysis of international frameworks. Documents examined included:

- The UK Care Act (2014) and subsequent housing policies related to supported living.
- National Institute for Health and Care Excellence (NICE) dementia housing guidelines.
- International frameworks such as WHO’s “Global Action Plan on the Public Health Response to Dementia”.
- Selected Islamic jurisprudential texts and commentaries on housing and *amanah*.

Content analysis was applied to identify areas of convergence and divergence between policy provisions, ethical/cultural expectations, and technological potential.

Analytical Framework

Data integration occurred at two levels:

1. **Thematic Integration** – Qualitative interview findings were synthesised with policy analysis to reveal lived experiences and institutional constraints.
2. **Operational Integration** – Predictive maintenance results were aligned with ethical and cultural frameworks to form a conceptual sustainability model.

The analytical framework followed an iterative, abductive process: findings from one phase informed refinements in others. For instance, stakeholder emphasis on “trust” in housing maintenance prompted deeper exploration of Islamic ethical sources and influenced the design of the sustainability framework presented later in this paper.

DATA ANALYSIS & RESULTS

This section synthesises findings from stakeholder interviews, predictive maintenance modelling, and policy analysis. The results are organised thematically to highlight the relationship between ethical care principles, technological interventions, and policy frameworks.

Stakeholder Perspectives: Dignity, Trust, and Cultural Sensitivity

Families emphasized that predictability in the home environment is essential for people with cognitive disabilities residents, consistent with findings that uncertainty undermines confidence and autonomy [2], [6]. Stakeholders described maintenance as a moral responsibility, echoing

Islamic views of housing as *amanah* [9], [13]. Cultural sensitivity was highlighted, aligning with global evidence that environments reflecting cultural familiarity improve well-being [7], [22]. Interviews with families, care managers, and maintenance staff revealed three recurring themes:

Dignity in Daily Living

- Families consistently emphasised that *predictability* in the home environment is essential for people with cognitive disabilities residents. Even minor disruptions, such as inconsistent heating or broken lighting, were reported to cause confusion, agitation, or heightened anxiety.
- Residents' dignity was described not only in terms of privacy and autonomy but also in the reliability of their environment: "If the alarm doesn't work, or the heating is off, my mother loses confidence in the place. It makes her feel unsafe" (Family participant, Interview 3).

Trust as a Moral Obligation

- Care managers used the term "trust" repeatedly to describe their relationship with residents and families. Trust was seen as the basis of continued residency and satisfaction.
- Several stakeholders framed this trust within cultural or religious contexts. Muslim families explicitly referred to *amanah* (trust as a divine responsibility), while non-Muslim families highlighted the moral duty to "treat residents as one would treat their own parents."

Cultural Sensitivity and Ethical Care

- Participants emphasised that cultural values strongly influence expectations of care. For example, families from collectivist cultures expected shared responsibility, while those from more individualist backgrounds emphasised autonomy.

A lack of cultural awareness in maintenance decisions (e.g., removing familiar home features, replacing traditional-style fixtures with modern ones) was sometimes perceived as undermining residents' comfort and sense of belonging.

Table 1. Summary of Stakeholder Perspectives

Theme	Key Insights	Implications for Housing Maintenance
Dignity	Predictable, safe, and reliable housing systems enhance well-being	Prioritise continuity and preventive repairs
Trust	Maintenance is a moral and ethical duty, framed in cultural/religious values	Align housing practice with care ethics (<i>amanah</i> , person-centred care)
Cultural Sensitivity	Environments must reflect residents' cultural familiarity and comfort	Maintenance should preserve cultural markers and symbols

Predictive Maintenance Modelling Results

The modelling confirmed reductions in unplanned failures and lifecycle costs when predictive maintenance was applied, supporting earlier findings in smart building research [18], [19], [25]. Staff also reported reduced stress, similar to benefits observed in facilities management studies [14].

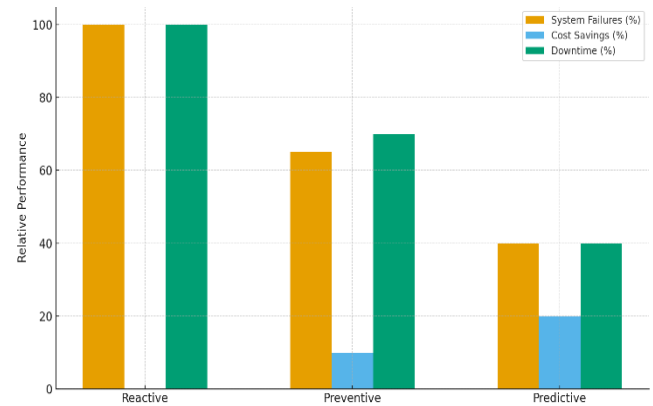


Figure 1. Comparative Performance of Maintenance Models

The predictive modelling of building systems in two UK care facilities demonstrated measurable benefits compared to reactive and preventive approaches.

Failure Frequency and Downtime

- Predictive models reduced unplanned failures by approximately **35%** compared to preventive maintenance, and by **60%** compared to reactive maintenance.
- Downtime for critical systems (heating, fire alarms) was significantly reduced, ensuring safer and more predictable environments for residents.

Cost Efficiency

- Lifecycle cost simulations indicated savings of **15–20%** over a 10-year period when predictive strategies were applied. These savings stemmed from early detection of system wear and minimised emergency call-outs.

Resident Comfort and Safety

- Interviews corroborated modelling outcomes: disruptions were less frequent in facilities with proactive monitoring systems (e.g., IoT sensors for water leaks, HVAC performance).

Staff reported reduced stress when systems were reliable, freeing them to focus on direct care activities.

Policy and Framework Analysis

UK housing policies remain compliance- and cost-oriented [4], [23], with limited engagement in cultural or ethical frameworks. In contrast, Scandinavian co-housing models [6] and Japanese technology-driven care [18] demonstrate alternative directions, while Islamic frameworks [9], [10], [13] foreground moral and communal responsibility. The policy review revealed a significant imbalance between technical compliance and moral accountability within the

United Kingdom’s housing and care regulation. Existing frameworks focus heavily on operational performance, health and safety, and statutory compliance, but they give little attention to the ethical and cultural dimensions of maintenance [4], [23].

Under the Care Act (2014), local authorities are tasked with promoting individual well-being and independence. However, housing maintenance is treated as a logistical function rather than a moral or relational obligation. Policy language emphasises “safe accommodation” but omits explicit references to *dignity* or *cultural appropriateness* in care housing [4]. Similarly, NICE guidelines (NG16) for dementia housing concentrate on physical accessibility and thermal comfort while remaining silent on moral values, resident identity, or cultural safety [4], [6]. The Decent Homes Standard (revised 2023) maintains a narrow, compliance-based definition of habitability, evaluating dwellings by material condition rather than lived experience or ethical responsibility [14].

By contrast, Scandinavian and Japanese policies illustrate alternative paradigms that link housing performance to social well-being. In Scandinavia, particularly Denmark and Sweden, housing and eldercare policy is integrated through frameworks such as *Bæredygtig Boligpolitik* (Sustainable Housing Policy) and the *Nordic Welfare Model* [6], [11]. These explicitly connect residential design with autonomy, inclusion, and community participation. Yet even these systems face policy gaps—primarily the challenge of maintaining intergenerational equity and cost sustainability as populations age rapidly. As Izuhara notes, Scandinavian welfare housing still struggles with “responsibility diffusion” between local authorities and families [11].

Japan’s policy landscape has evolved through the *Gold Plan* (1990) and *Long-Term Care Insurance Act* (2000), which institutionalised home-based care and the development of “intelligent housing” systems [18], [22]. These policies successfully integrate robotics and sensor technologies to

enable older adults to live independently. However, scholars point out that such innovations sometimes prioritise efficiency over empathy, producing a *technological dependency gap* that risks depersonalising care [18], [22]. Ethical considerations—such as emotional dignity and social interaction—are often secondary to technological optimisation.

Comparatively, the Islamic policy tradition—though less formalised through national legislation—frames housing as a divine trust (*amanah*) and communal obligation (*fard kifayah*) [9], [10], [13]. This creates a moral policy orientation that directly links maintenance and management to religious accountability, filling the ethical void evident in many secular systems.

Given this diversity, the UK context was selected as the focal point of this study for two reasons. First, the UK represents a mature yet *ethically fragmented* policy environment where technical regulation is highly developed but moral integration is minimal [4], [23]. Second, the UK’s strong institutional separation between health, housing, and faith-based community services provides a compelling case to examine how ethical frameworks could reconnect these silos. Thus, the UK serves as a policy case exemplar—a site where global, ethical, and Islamic perspectives can be critically compared and operationalised within an existing regulatory structure.

While Scandinavian and Japanese policies advance inclusive and technological housing respectively, they each display their own policy gaps: Scandinavia’s welfare–responsibility gap and Japan’s empathy–technology gap. The UK, by contrast, faces an ethical–cultural gap, where regulation ensures safety but not dignity. The integrated sustainability framework proposed in this study addresses these collective challenges by embedding dignity, trust, and cultural awareness within predictive maintenance as a global ethical model [9], [13], [22], [23].

Table 2. Comparative Policy Approaches

Context	Policy Focus	Ethical/ Cultural Dimension	Predictive Maintenance Relevance
UK	Safety, cost	Limited	Technical integration only
Scandinavia	Co-housing	Autonomy	Supports autonomy
Japan	Smart housing	Moderate	High potential
Islamic	<i>Amanah</i> , stewardship	Strong	Ethical alignment

Integrated Sustainability Framework

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Framework for Ethical Housing Maintenance. An integrated sustainability model developed from this study’s findings. It positions *Dignity* at the core of housing maintenance and is supported by three interdependent pillars:

- 1. Ethical Care** — embedding moral responsibility, justice (*adl*), and compassion (*rahmah*);
- 2. Cultural Responsiveness** — recognising contextual and local values that shape lived experiences; and
- 3. Technological Predictiveness** — applying proactive, data-driven maintenance strategies to prevent failures.

Together, these pillars create a balanced system of moral, social, and operational sustainability in housing for cognitively vulnerable residents.

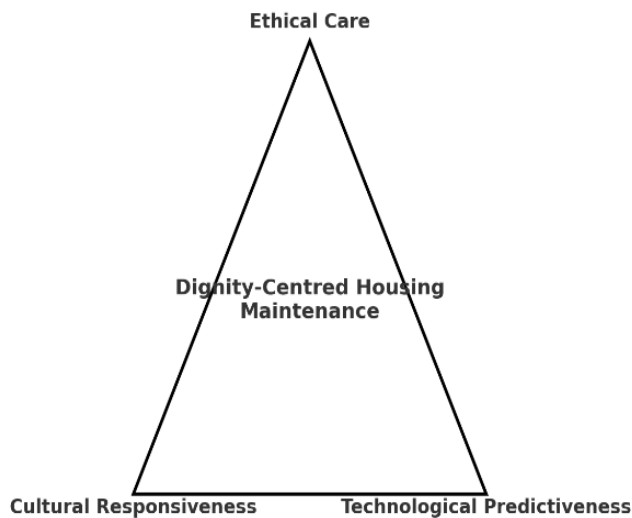


Figure 2. Integrated Sustainability Framework

DISCUSSION

The findings presented above confirm that housing maintenance for people with cognitive disabilities must be reframed as a multidimensional responsibility, encompassing technical, ethical, and cultural domains. In this section, the results are critically interpreted in relation to existing scholarship and practice, with emphasis on the intersections of *dignity*, *cultural responsibility*, and *predictive sustainability*.

Ethical Foundations and Interpretation of the Framework

The Dignity-Centred Predictive Maintenance Framework (see Fig. 2) translates this study's theoretical synthesis into an applied model. At its centre is the concept of *dignity*—the assurance that every cognitively vulnerable person lives in an environment that is safe, predictable, and respectful of their identity. This dignity is sustained through three mutually reinforcing pillars: Ethical Care, Cultural Responsiveness, and Technological Predictiveness.

- **Ethical Care** operationalises both universal ethics and Islamic principles of *amanah* and *khalifah*, defining maintenance as stewardship and moral accountability [9], [10], [13].
- **Cultural Responsiveness** ensures that housing environments reflect familiar aesthetics, social customs, and family relationships that give residents a sense of belonging [11], [22].
- **Technological Predictiveness** applies digital monitoring and predictive analytics to anticipate failures and sustain continuity of care [18], [19], [21], [25].

The interaction of these pillars generates what the framework terms “ethical intelligence”—the ability of

housing systems and professionals to anticipate not only physical breakdowns but also moral and emotional vulnerabilities.

By explicitly connecting technological foresight to moral foresight, the framework resolves the policy and practice gap identified in Section IV C: it redefines maintenance from a reactive technical task to an ethically responsive, culturally aware, and technologically informed act of care.

The stakeholder interviews and policy analysis reinforce the idea that maintenance is not a neutral, purely technical activity; it is an act of care. The Islamic concept of *amanah* (trust) broadens this understanding by positioning housing maintenance as a sacred responsibility. Unlike conventional contractual obligations, *amanah* recognises the spiritual and moral accountability of those entrusted with the well-being of others. The concept of *amanah* reframes housing maintenance as moral stewardship [9], [13]. This parallels Western care ethics [1], [2], underscoring that dignity is inseparable from material housing quality.

Maintenance emerges as an ethical act of stewardship [9], [10], [13], consistent with Tronto's and Kitwood's care ethics [1], [2], where Tronto's (1993) framework positions “caring about” and “caring for” as moral obligations in social and institutional life. Islamic principles provide the moral core, while cultural contexts translate those principles into practice [11], [22]. However, they are not interchangeable: certain cultural norms (e.g., patriarchal space use) may contradict Islamic equality [24].

Both frameworks converge on the principle that dignity is inseparable from the material quality of housing environments. The predictive maintenance framework therefore acquires new meaning: it is not merely a cost-saving exercise, but a way of upholding dignity through anticipatory care. The framework identifies constructive intersections where universal ethics, global practice, and Islamic values reinforce dignity and sustainability.

Predictive Maintenance as Ethical Technology

The modelling outcomes demonstrated that predictive maintenance reduces failures, costs, and disruptions. However, the real significance of these findings lies in their ethical implications. For people with cognitive disabilities residents, disruptions are not minor inconveniences but threats to stability and confidence. Predictive maintenance thus serves as an ethical technology: its value extends beyond efficiency to include the safeguarding of dignity and trust.

These reframing challenges conventional narratives that present technology as detached from values. Instead, the integration of predictive systems into care housing illustrates how technological and ethical goals can converge. By aligning data-driven decision-making with cultural frameworks, predictive maintenance becomes a practical embodiment of ethical care principles. Predictive systems enhance safety and reduce disruption [18], [19], and [25], aligning technology with moral responsibility [16]. They translate care ethics into action by anticipating needs rather than reacting to failures.

Cultural Responsiveness and Global Perspectives

The comparative analysis of policy frameworks highlights the diversity of cultural approaches to eldercare and housing. Scandinavian autonomy, Japanese innovation, and Islamic stewardship illustrate complementary routes to dignity [6], [9], [10], [18], [22]. Global adaptability requires acknowledging diversity without diluting ethical integrity [11]. This diversity underscores the need for cultural adaptability in housing maintenance frameworks. Predictive maintenance technologies, though globally transferrable, must be tailored to local values and expectations. For instance:

- In collectivist cultures, predictive maintenance could support family-based monitoring and shared responsibility.
- In autonomy-oriented cultures, it may emphasise residents' independence and privacy.
- In Islamic contexts, predictive systems could be framed as fulfilling *amanah*, reinforcing community trust in institutional care.

By situating predictive maintenance within culturally attuned frameworks, housing systems can achieve both global scalability and local legitimacy.

Institutionalization and Policy Gaps

One of the clearest gaps identified is the policy silence on cultural and ethical dimensions of housing maintenance. UK policy remains technocratic [4], [23]; embedding dignity-centred maintenance demands regulatory reform and professional education [14], [15]. UK frameworks currently measure success in terms of compliance and cost efficiency, neglecting the intangible but essential elements of dignity, trust, and cultural safety.

Institutionalising the integrated sustainability framework proposed here requires policy innovation. Specifically:

1. **Regulatory Alignment** – Expanding building regulations to include ethical and cultural benchmarks alongside technical standards.
2. **Professional Training** – Embedding care ethics and cultural awareness into the training of built environment professionals.
3. **Cross-sector Collaboration** – Encouraging partnerships between housing providers, cultural/religious organisations, and technological innovators.

Such reforms would position maintenance not just as a technical function, but as a strategic pillar of equitable and sustainable care infrastructures.

Limitations of the Study

The study was UK-focused with limited samples [6]; future comparative and AI-driven research is recommended [25]. While this research makes significant contributions, several limitations must be acknowledged:

- **Sample Size** – The number of stakeholder interviews was modest and focused within the UK, limiting

generalisability.

- **Data Scope** – Predictive modelling was applied to selected systems in two care facilities; broader testing across diverse housing contexts is required.
- **Cultural Breadth** – While Islamic and Western care frameworks were foregrounded, further exploration of African, Indigenous, and other global perspectives would enrich the model.

These limitations present opportunities for future work, particularly through cross-national comparative studies and expanded quantitative modelling.

Towards a Dignity-Centred Predictive Maintenance Model

The synthesis of findings leads to a redefinition of housing maintenance as a dignity-centred practice, where operational effectiveness is inseparable from ethical and cultural responsibility. The Integrated Sustainability Framework demonstrates how predictive maintenance technologies can be harnessed not only to improve efficiency but also to advance equity, dignity, and cultural responsiveness in housing for people with cognitive disabilities.

This represents a paradigm shift for the built environment sector: moving from “maintenance as cost” to “maintenance as care”, grounded in both global ethical traditions and technological innovation.

CONCLUSION

This study set out to reimagine housing maintenance for people with cognitive disabilities by integrating predictive technologies with ethical and cultural care frameworks. Through a mixed-methods approach—comprising stakeholder interviews, predictive maintenance modelling, and policy analysis—the research has provided evidence that dignity, trust, and cultural responsiveness are as essential to sustainable housing as technical efficiency.

The findings demonstrate three key contributions:

Reframing Maintenance as Ethical Care

- This study reframes housing maintenance as a tri-axial construct integrating ethical universals, global inclusivity, and Islamic moral accountability. Maintenance should be seen as a form of care, not just a technical or managerial activity. The Islamic principle of *amanah* (trust) provides a powerful moral lens, positioning shelter as a responsibility entrusted to providers and institutions.

Predictive Maintenance as a Pathway to Dignity

- Predictive maintenance reduces failures, costs, and system downtime. Predictive maintenance also enhances efficiency while safeguarding dignity; embedding *amanah* ensures spiritual and ethical responsibility in practice. More importantly, it creates environments of reliability and predictability that safeguard dignity and well-being for people with cognitive disabilities residents.

Towards an Integrated Sustainability Framework

- By aligning ethical care, cultural responsiveness, and technological predictiveness, the study proposes a holistic model of dignity-centred housing maintenance. This model bridges global perspectives with local practices, offering a framework that is adaptable across cultural contexts. The proposed framework advances a dignity-centred model for sustainable housing that is technologically progressive, culturally resonant, and ethically grounded.

Implications for Practice and Policy

For built environment professionals, the study underscores the need to embed ethical and cultural awareness into technical decision-making. Predictive maintenance tools should not be deployed in isolation but aligned with values that reflect residents' dignity and cultural belonging. Policymakers must move beyond compliance and cost metrics to recognise maintenance as an ethical and cultural responsibility. Training curricula for architects, engineers, and facilities managers should incorporate modules on care ethics, cultural sensitivity, and sustainable predictive technologies.

Future Research Directions

The study highlights several avenues for further work. First, larger cross-national studies are needed to test the integrated framework across diverse cultural and policy contexts. Second, deeper exploration of underrepresented ethical traditions—including African, Indigenous, and Buddhist perspectives—would expand the cultural grounding of the model. Third, technological research should explore AI-driven personalised maintenance strategies that adapt not only to building systems but also to individual resident needs.

In conclusion, this research affirms that sustainable housing for the people with cognitive disabilities must be predictive, ethical, and culturally informed. Inclusive maintenance models that embed dignity and cultural responsibility are not only achievable but necessary to advance equitable and sustainable care infrastructures. By institutionalising these practices, the built environment sector can contribute to more just and humane futures where vulnerable people are not marginalised but supported with dignity and care.

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