Integrating Academic Research Methodologies like Participatory Action Research (PAR) into Design Thinking: A Framework for Group Housing Design

Tadiboina Samantha Kumar[1]*, Prof, Dr. Ramesh Srikonda[2]

[1]Research Scholar, Assistant Professor, School of Planning and Architecture, Vijayawada, AP, India.
[2]Supervisor, Director, and Professor, School of Planning and Architecture, Vijayawada, AP, India.

*Corresponding author: Tadiboina Samantha Kumar, bobby9642724212@gmail.com

Abstract: The integration of academic research methodologies into design thinking processes presents a transformative approach to addressing complex challenges in group housing, fostering inclusive, sustainable, and user-centered solutions. This research explores how methodologies such as Participatory Action Research, post-occupancy evaluations, and Research through Design can be systematically embedded within design thinking to bridge the gap between academic rigor and empathy-driven, iterative design practices. By synthesizing these paradigms, the study proposes a framework for group housing design that prioritizes co-design processes, empathy-based data collection, and participatory evaluation, while emphasizing adaptability through sociocultural insights and user feedback. Case studies analysis demonstrate the effectiveness of flexible, community-driven design, while emerging technologies like IoT-enabled cohousing signal new opportunities for innovation. Challenges, including scalability, long-term validation, and reconciling user autonomy with professional expertise, are critically analyzed. Ultimately, this research advances a hybrid methodology to redefine the conceptualization, implementation, and assessment of group housing, offering actionable pathways to achieve affordable, inclusive, and context-sensitive housing solutions.

Keywords: Design thinking, Academic research methodologies, Group housing, Participatory Action Research (PAR), Co-Design, Sustainable housing, User-centered design

1. Introduction

1.1. Background and context

Group housing, made up of co-living buildings, dormitories, cohousing communities, and transitional shelters, is confronting growing affordability, sustainability, and social inclusion challenges. Traditional architectural

and urban planning paradigms usually focus on technical efficiency and low costs at the expense of living experiences, resulting in housing solutions that do not respond to the socio-cultural, economic, and behavioral dynamics of shared living contexts [1]. Tovivic redefines architects as facilitators of community-driven processes, challenging traditional top-down housing paradigms. Participatory Action Research (PAR) has proven transformative in low-income settlements, as demonstrated by Nix *et al.* in Delhi, where residents co-designed sanitation systems through iterative workshops [2].

In response, design thinking has been a human-centered, iterative process that facilitates participatory decision-making, quick prototyping, and adaptable housing solutions [3]. Design thinking by itself, though, is not usually empirically backed and long-term tested, which makes it challenging to quantify the impact on housing performance over time [4]. On the other hand, scholarly research approaches like Participatory Action Research (PAR), Post-Occupancy Evaluation (POE), and Research through Design (RtD) offer systematic, evidence-based models that facilitate increased stakeholder participation, data-driven evaluation, and long-term flexibility [5, 6].

The fusion of academic scholarship with design thinking's flexibility presents a revolutionary potential to build participatory housing systems that are empirically sound and user-oriented. This research examines how the academic research approach can be methodically integrated into design thinking to formulate inclusive, sustainable, and flexible group housing interventions.

1.2. Research problem and significance

Despite the success of participatory methodologies in improving housing outcomes, scalability and systematic integration into design practice remain limited [7]. Current housing models often fail to meaningfully engage residents in the design process, leading to growing emphasis on participatory and evidence-based housing strategies, current interventions fail to harmonize two important aspects:

(1) Academic Rigor vs. Design flexibility: PAR and POE offer systematic validation frameworks but tend to be restricted to theoretical or small-scale contexts, preventing their practical scalability [8]. Design thinking is superior in user-led, iterative housing design (e.g., co-designed homeless shelters, but does not have standardized metrics for long-term assessment [7, 9].

(2) Scalability and Long-Term Adaptability: Although projects such as PREVI Lima (Peru) and Quinta Monroy (Chile) illustrate the success of flexible, community-based housing, their lessons are not fully realized because of methodological integration gaps [10, 11]. The absence of a hybrid model that integrates academic evidence with iterative design practices limits wider application in housing policy.

Christopoulos advocates for socially driven architecture that prioritizes marginalized voices, aligning with this study's goals. By filling in these gaps, this research advances a systematic methodology that combines empirical testing with co-design participatory, such that group housing interventions are flexible, scalable, and context-relevant.

1.3. Research objectives

This study aims to bridge the gap between academic methodologies and design thinking by developing a hybrid framework that strengthens participatory, evidence-based group housing solutions. The key objectives include:

(1) To explore how methodologies such as Participatory Action Research (PAR), Post-Occupancy Evaluation (POE), and Research through Design (RtD) can be integrated into design thinking for group housing [8].

(2) To assess the effectiveness of participatory and iterative housing design approaches in fostering adaptable, user-driven environments [12].

(3) To evaluate case studies that illustrate successful integration of research methodologies and design thinking in housing projects [13].

(4) To develop a scalable framework that enables the systematic incorporation of academic research principles into real-world housing design practices [14].

1.4. Methodology and approach

The research employs a mixed-methods research approach blending:

(1) Literature review: Analyzing current research methodologies, design thinking frameworks, and housing case studies [15].

(2) Case study analysis: Case study analysis of participatory housing projects like PREVI Lima, Quinta Monroy (Chile), Vauban (Germany), and Nightingale Housing (Australia) to identify best practices [10, 11].

(3) Framework development: Drawing together findings into a coherent framework combining academic concepts with iterative design thinking [16].

(4) Evaluation of challenges and opportunities: Determination of major challenges like scalability, validation, and power relationships between users and professionals [17].

1.5. Expected contribution

This study adds to the emerging body of evidence-based participatory housing by illustrating how research methods in academia can be integrated into iterative design thinking processes. Through the integration of academic rigor and participatory design approaches, this research opens up a path to affordable, inclusive, and flexible group housing solutions that balance both human requirements and empirical evidence.

2. Literature review

The integration of academic research methodologies with design thinking in group housing is rooted in decades of interdisciplinary inquiry. Traditional housing models have often prioritized technical efficiency and regulatory compliance over human-centered and participatory approaches, leading to rigid and standardized housing solutions that fail to address the social, cultural, and behavioral needs of residents [1]. To address this, researchers and practitioners have attempted to integrate participatory, evaluative, and experimental research methods into the housing design process, making sure that group housing solutions are adaptable, inclusive, and sustainable [3]. Academic research methods, including Participatory Action Research (PAR), Post-Occupancy Evaluation (POE), and Research through Design (RtD), provide systematic, evidence-based structures that complement the iterative, user-focused nature of design thinking [5, 6]. Still, despite the fact that these two paradigms have tremendous opportunities for cross-support, their joining is underutilized in existing literature, where major gaps regarding scalability, validity, and policymaking application still exist [7].

2.1. Methodologies of academic research in housing
2.1.1. Participatory Action Research (PAR) in group housing
Participatory Action Research (PAR) has also been extensively utilized in group housing schemes to build capacity in the community, popularize decision-making, and face systemic injustices [8]. Grounded in

participatory, iterative knowledge production, PAR engages residents, designers, and policymakers in the research and development process in an active and systematic way, such that solutions for housing are not imposed upon but co-designed [5]. In low-income housing colonies in Delhi, for instance, PAR-informed co-design workshops allowed residents to create community-based sanitation systems and adaptive housing layouts that were consistent with their daily patterns and spatial requirements [14]. In the same way, in transitional housing initiatives, PAR approaches have assisted marginalized groups in owning their habitats, encouraging feelings of belonging and communal agency [12].

PAR is still limited by power inequality in participatory activities, even with its advantages. Architects, city planners, and policymakers can still exert disproportionate control, undermining residents' power and influence on major design choices [6]. Also, sustaining long-term resident involvement continues to be an issue, as participatory interest wanes as time passes, especially in those projects that are not supported institutionally or by policy [9]. Solutions to these problems include systematic integration of PAR into official housing policies, meaning that participatory processes must be effective beyond design stages [5].

2.1.2. Post-Occupancy Evaluation (POE) for housing performance

Post-Occupancy Evaluation (POE) is a systematic approach to analyzing the performance of housing after its occupation by residents, yielding rich information on spatial adaptability, user satisfaction, and environmental efficiency [18]. POE research has been instrumental in confirming the efficacy of participatory housing prototypes in ensuring that early design interventions are converted into long-term usability [7]. For instance, a Ghanaian mixed-methods POE explored how residents adjusted their housing arrangements, ventilation, and communal areas, resulting in improvements in follow-up design phases [18]. Likewise, social housing assessments in Europe have proved the significance of thermal comfort, spatial adaptability, and social cohesion in the provision of quality housing over the long term [11].

Although POE offers a strong evidence-based framework for housing improvement, its use in participatory design is limited. Most housing schemes focus on early user involvement but do not include longitudinal assessments, limiting the scope for data-driven adjustments [22]. In addition, funding and logistical issues frequently hinder the implementation of POE at scale, restricting its capacity to influence wider policy and regulatory environments [16].

2.1.3. Research through Design (RtD) for experimental models of housing

Research through Design (RtD) closes the gap between academic research and experimental design, enabling architects and urban planners to prototype and experiment with novel housing ideas in reality [16]. Through iterative prototyping, speculative design, and digital simulation, RtD enables the development of novel spatial arrangements and intelligent housing technologies [13]. In cohousing developments, for instance, IoT-driven prototypes have optimized collective decision-making and resource-sharing systems, keeping housing models responsive to resident behavioral changes [16]. Likewise, New Zealand's modular housing prototypes have experimented with incremental spatial adjustments so that residents can modify their living spaces over time according to individual needs and social interactions [9].

In spite of its potential, RtD encounters a number of practical issues. A majority of RtD experiments exist only in the conceptual phase, with few avenues for practical application in the real world [14]. Secondly, the speculative nature of RtD complicates its incorporation into policy-based housing projects that frequently need

standardized guidelines and empirically tested methodologies [6]. For improved application of RtD, subsequent research needs to focus on narrowing the gap between experimental housing ideas and large-scale urban planning strategies [17].

2.2. Group housing design thinking
2.2.1. Empathy-based co-design
Design thinking emphasizes ethnographic studies, empathy development, and participatory workshops to guarantee that housing solutions are informed by the lived experiences of residents [3]. For example, co-design programs in transitional shelters for homeless individuals have shown how participatory interviews can redesign shelter operations to enhance accessibility and community integration [7]. Webber highlights the role of co-living prototypes in addressing transient housing needs, bridging design thinking with academic rigor. In the same way, student dormitory redesigns following co-design principles have been able to redevelop isolated living spaces into active community centers [12].

2.2.2. Iterative prototyping and flexibility
The iterative process of design thinking makes it possible to constantly improve housing models through prototyping and user feedback cycles [4]. This has been clearly seen in self-build housing developments, where residents have been able to incrementally change their homes through the use of scalable, modular structures [11].

2.2.3. Sustainability and systems thinking
Design thinking also embraces systems-based methodologies for tackling environmental sustainability in group housing [6]. Mota demonstrates how open-building principles enable resident-led adaptations, fostering long-term sustainability. The PREVI Lima project, for instance, employed adaptive, climate-responsive housing forms that changed over time through resident improvisations, making sure that participatory design and sustainability were incorporated [10].

2.3. Towards a hybrid framework
Though academic research methods and design thinking each have distinct strengths, their synthesis is underexplored within housing scholarship. Previous research indicates that a hybrid model incorporating participatory action, post-occupancy testing, and iterative prototyping has the potential to close the gap between empirical sophistication and creative flexibility [5]. Future research needs to prioritize the integration of participatory research within housing policy, utilizing digital technology for stakeholder participation, and creating scalable, cross-disciplinary methods to make group housing remain responsive, inclusive, and sustainable [7].

3. Case study analysis
Here, an elaborate analysis of 20 international case studies is undertaken that combine research approaches like Participatory Action Research (PAR), Post-Occupancy Evaluation (POE), and Research through Design (RtD) with design thinking in group housing schemes. Based on the frequent themes, innovation in methodology, and open questions, the analysis indicates how the case studies refine the suggested hybrid framework. A systematic summary table (**Table 1**) classifies these case studies in terms of academic approach, context, and important

outcomes, then synthesizes the findings to develop connections between cases.

Table 1. A systematic summary table of case studies

Author citation	Academic methodology	Design thinking component	Context/ setting	Objective	Key methods used	Participation framework	Validation methods
[2]	Participatory Action Research (PAR)	Co-creation	Low-income settlements, Delhi, India	Integrate transdisciplinary methods for sustainable housing	Ethnographic studies, stakeholder workshops	Community-driven co-creation with residents, architects, policymakers	Reflections, recommendations
[8]	Participatory Action Research (PAR)	Collaborative design and making	Socially isolated, Newcastle, UK	Empower marginalized groups via housing production	Joint stakeholder design/build workshops	Ethics-focused participation with power redistribution	Participant reflections, feedback
[9]	System dynamics, Pattern language	Adjusted iterative design	Social housing estate, Hungary	Empower low-income communities via sustainable behaviors	Pattern language framework, focus groups	Residents codevelop design parameters	Participant feedback
[19]	Research through Design (RtD)	Prototyping, iterative stages	Transitional co-living, New Zealand	Develop spatial strategies for shared living	Iterative research studio model	Residents indirectly influenced design iterations	Design critique, iteration
[20]	Co-design, Human-centered design	Ideation, prototyping	Student dormitory, Milan, Italy	Create community-centric dormitory hubs	Workshop-driven prototyping	Dorm resident input during empathy, design, iteration	Community feedback loop
[7]	Participatory Action Research (PAR)	Feedback, ideation, improvement	Homeless housing, US	Empower unhoused individuals to evaluate/improve housing	Empathy interviews, participatory design	Homeless residents redesigned housing operations	Feedback analysis, design iteration
[5]	Participatory Action Research (PAR)	Co-creation phases (informal)	Affordable housing, Melbourne	Enhance affordability and sustainability via collaboration	Community-oriented workshops	Stakeholders from policy, community, developers	Reflective evaluative loop
[16]	Research through Design (RtD)	Speculative prototyping	IoT Cohousing, Netherlands	Develop speculative technologies for communal living	IoT prototypes tested in cohousing sites	Stakeholders evaluated speculative prototypes	Prototype usage, feedback
[10]	Case study	Integrating adaptability	PREVI project, Lima, Peru	Explore adaptive housing strategies for sustainable community living	Case study analysis	Retrospective evaluation of stakeholder influence	Retrospective case evaluation
[18]	Mixed Methods (Surveys, Observation)	Post-occupancy exploration	Social housing, Ghana	Explore residents' tacit feedback (spatial adaptations) for housing needs	Surveys, observation, behavioral mapping	Residents indirectly shaped findings via observed adaptations	Mixed-methods analysis
[21]	Ethnography, Behavioral research	Empathy-driven design	Rural housing, India (Barefoot College)	Train rural residents to build sustainable homes	Ethnographic interviews, skill-building workshops	Women trained as solar engineers/ builders	Participant feedback, observational studies
[4]	Post-Occupancy Evaluation (POE)	Redesign via feedback	Hulme Crescents, Manchester, UK	Transform failed social housing through resident input	POE surveys, participatory redesign workshops	Residents identified flaws and co-designed solutions	Longitudinal surveys, behavioral mapping

Table 1 (Continued)

Author citation	Academic methodology	Design thinking component	Context/ setting	Objective	Key methods used	Participation framework	Validation methods
[22]	Open-Building Framework	Incremental design	Iquique, Chile (Elemental's Half-House)	Co-design expandable housing for low-income families	Participatory workshops, incremental prototyping	Families co-designed "half-houses"	Resident feedback, adaptability metrics
[12]	Human-Centered Design	Co-design for marginalized groups	Homeless shelters, US	Improve shelter operations through user feedback	Empathy-driven workshops, prototyping	Homeless individuals evaluated and redesigned shelter layouts	Usability testing, iterative feedback
[14]	Systems Thinking	Holistic urban integration	Urban housing, Europe	Analyze multi-scalar housing challenges	Causal loop diagrams, network analysis	Policymakers, architects, and residents collaborated	Policy impact assessments
[1]	Experimental Design	A/B Testing	Modular housing prototypes	Compare design alternatives (shared vs. private spaces)	A/B testing of virtual/ physical prototypes	Residents tested prototypes in simulated environments	Quantitative metrics (occupancy rates, comfort)
[17]	Longitudinal Studies	Tracking long-term outcomes	Cohousing communities, Scandinavia	Assess sustainability and social cohesion over time	Longitudinal POE surveys, behavioral tracking	Residents participated in annual evaluations	Yearly surveys, adaptation tracking
[23]	Speculative Design	Future-focused prototyping	Smart cohousing, Netherlands	Explore IoT applications for communal decision-making	IoT sensor prototypes, speculative workshops	Residents and technologists co-designed smart systems	Prototype testing, scenario planning
[15]	Self-Build Methodologies	Resident-led construction	Segal self-build housing, UK	Empower residents to construct modular homes	Self-build workshops, modular design kits	Residents built homes with professional guidance	Construction quality audits, satisfaction surveys
[11]	Cultural Ethnography	Context-sensitive design	Informal settlements, Thailand	Address housing needs through localized participatory processes	Ethnographic mapping, community dialogues	Community architects facilitated bottom-up design	Cultural adaptation metrics

Author citation	Metrics/ Indicators used	Challenges or limitations	Outcomes/ findings	Relevance to goal	Novel contributions	Scalability
[2]	Sustainability, collaboration success	Power imbalances, communication gaps	PAR generated local solutions; transdisciplinary collaboration was key	High	PAR for transdisciplinary housing	Limited
[8]	Social inclusion, collective decision-making	Dominance by individuals with capital	Empowerment through ethics, power, and care mechanics	High	Ethics-driven participatory processes	Moderate
[9]	Shared spatial definitions, behavior change receptiveness	Scaling participatory methods	Residents defined shared spaces, increasing sustainability	Medium	Participatory pattern languages	Moderate
[19]	Social cohesion, shared vs. individual space optimization	Architectural focus (limited direct participation)	Spatial harmony through optional interaction	Low	Architectural strategies for co-living	Low
[20]	Co-designed solutions implemented	Limited long-term evaluation	Co-created hubs for student engagement and identity	Medium	Service + spatial design integration	Moderate
[7]	Program operation metrics, design quality	Single housing type focus	Marginalized residents involved in evaluation/ improvement	High	PAR combined with evaluation for redesign	Low

Table 1 (Continued)

Author citation	Metrics/ Indicators used	Challenges or limitations	Outcomes/ findings	Relevance to goal	Novel contributions	Scalability
[5]	Affordability, actor engagement levels	Political constraints	Innovative solutions revealed systemic inequality	High	PAR within unequal power dynamics	Moderate
[16]	Community cohesion, tech relevance	Long-term empirical support lacking	IoT tools revealed communal needs, sparked future discussions	Medium	IoT for community needs	Low
[10]	Adaptability, sustainability indicators	Limited generalizability	Contextual design factors supported user adaptability	Medium	Historical adaptability analysis	Limited
[18]	Resident satisfaction, tacit patterns	Limited to specific cases, no clear participatory stage	Residents indirectly influenced iteration designs	High	Tacit communication approach for housing needs	Moderate
[21]	Skill transfer rates, resident satisfaction	Replicating training models	Sustainable, low-cost housing with local ownership	High	Empowerment through skill-building	Moderate
[4]	Crime rates, resident satisfaction	Overcoming institutional distrust	Crime-ridden area transformed into livable community	High	POE-driven post-hoc redesign	Low
[22]	Affordability, resident agency	Balancing professional expertise with user autonomy	Affordable, adaptable housing with incremental expansions	High	Open-building principles for incremental design	Moderate
[12]	Co-design for marginalized groups	Homeless shelters, US	Improve shelter operations through user feedback	Empathy-driven workshops, prototyping	Homeless individuals evaluated and redesigned shelter layouts	Low
[14]	Holistic urban integration	Urban housing, Europe	Analyze multi-scalar housing challenges	Causal loop diagrams, network analysis	Policymakers, architects, and residents collaborated	High
[1]	A/B Testing	Modular housing prototypes	Compare design alternatives (shared vs. private spaces)	A/B testing of virtual/physical prototypes	Residents tested prototypes in simulated environments	High
[17]	Tracking long-term outcomes	Cohousing communities, Scandinavia	Assess sustainability and social cohesion over time	Longitudinal POE surveys, behavioral tracking	Residents participated in annual evaluations	Moderate
[23]	Future-focused prototyping	Smart cohousing, Netherlands	Explore IoT applications for communal decision-making	IoT sensor prototypes, speculative workshops	Residents and technologists co-designed smart systems	Low
[15]	Resident-led construction	Segal self-build housing, UK	Empower residents to construct modular homes	Self-build workshops, modular design kits	Residents built homes with professional guidance	Moderate
[11]	Context-sensitive design	Informal settlements, Thailand	Address housing needs through localized participatory processes	Ethnographic mapping, community dialogues	Community architects facilitated bottom-up design	Limited

3.1. Empowerment through Participatory Action Research(PAR)

Participatory Action Research (PAR) has been shown to be an empowering instrument that can change the lives of people by promoting resident agency and making locally initiated housing solutions possible. Examples like PREVI Lima and the Orangi Pilot Project illustrate the manner in which participatory methodologies have

enabled decision-making by and for communities [6, 10]. The incremental housing model of PREVI, wherein core housing modules were planned to be adaptable in the long run to resident improvisations, affirms the hybrid framework's emphasis on adaptability and user-led development. Similarly, Orangi's infrastructure upgrading initiative involved residents in co-designing sanitation systems, demonstrating how engagement in the early design phases fosters long-term ownership.

Despite these successes, challenges remain in ensuring equitable participation in large-scale housing interventions. Nix *et al.* highlight issues of power imbalances within participatory processes, where architects and policymakers sometimes dominate decision-making, diluting the voices of marginalized residents [2]. Whitzman lists additional challenges, specifically institutional partnerships, wherein bureaucratic issues and poor communication most frequently constrain how deeply participants get involved [5]. Those kinds of hurdles call for the systems to maintain ordered yet agile mechanisms of participation to allow wide-ranging stakeholders with the opportunity to make valuable input to housing arrangements.

3.2. Sustainability and systems thinking

Post-Occupancy Evaluation (POE) and ethnographic research approaches increasingly influence sustainable and socially integrated solutions in housing. Such projects as Vauban District in Freiburg and Barefoot College in India have applied systematic assessment methods to create ecologically sustainable and culturally appropriate housing [1, 21]. These projects based their models on long-term resident input to enhance energy-efficient housing designs and community-driven skill-building initiatives. Indices of energy efficiency, resident health, and affordability formed the core around which iterative refinements of the design were driven, supporting the framework's utility in bridging empirical validation and participatory adaptation.

Yet, scalability for grassroots housing schemes has proven to be an ongoing challenge. The Tiny House Villages initiative encountered strict zoning legislation regulation and policy obstacles that prevented replication despite achieving successful, modular community-oriented housing [24]. This highlights the requirement for policy provision that fosters scalable models of sustainability to allow experimental, localized participatory housing solutions to be scaled up to wider urban and rural environments.

3.3. Technological innovation in cohousing

Emergence of technology-enabled participatory paradigms has opened up new possibilities for embedding digital technologies into shared living spaces. Examples of case studies like IoT-based Cohousing and speculative design investigate the ways in which new digital tools enable collective decision-making [16, 23]. Integrated smart technologies in cohousing societies have enhanced mechanisms for sharing resources, with real-time information on energy usage, shared facilities, and collective governance. These results support the framework's focus on data-driven design iteration, illustrating how digital engagement can inform user-focused housing interventions.

Even with these benefits, technological innovation in participatory housing comes with its drawbacks. Privacy concerns, digital access, and long-term data verification remain issues. Pira *et al.* pointed out that speculative design work tends to have limited longitudinal data, which hinders the ability to measure their long-term effects [23]. Additionally, Jenkins observes that technological exclusion is an actual threat in low-income housing, where infrastructural constraints could hinder residents from interacting meaningfully with digital resources [16]. Closing such gaps calls for the creation of ethical and affordable technological solutions that are

inclusive and ensure privacy-protected communal data-sharing systems.

3.4. Balancing academic rigor and creativity

Balancing academic legitimacy and creative freedom is paramount in participatory housing design. Designs such as Elemental's Half-House model and Segal self-build housing effectively integrated structured methodologies and resident agency, facilitating incremental prototyping and user-led spatial adjustments [15, 22]. These examples demonstrate how the Empathize-Act-Reflect cycle of the hybrid model enables adaptive, real-world applications combining structured academic investigation with user-driven design thinking strategies.

Yet power relations continue to influence participatory housing outcomes. Institutional hierarchies tend to dominate over resident agency, especially in public-private housing partnerships. Melbourne's affordable housing partnerships reinforce how developer-led decision-making arrangements tend to diminish the influence of resident participation, promoting symbolic engagement instead of co-creation [5]. Such power imbalances are met by reversing toward community-driven governance arrangements, underpinned by policy arrangements that integrate participatory decision-making within formal housing development processes.

3.5. Case study validation of the proposed hybrid framework

Case studies under investigation strongly confirm the suggested hybrid framework by proving methodological congruence between various stages of design thinking. PAR approaches, especially in cases like Delhi Slum Redevelopment and Orangi Pilot Project, confirm the importance of initial-stage community interaction during the Empathize and Define stages [2, 6]. POE implementation, as practiced in the redevelopment of Hulme Crescents and Vauban District, demarcates the importance of longitudinal assessment in dictating iterative improvements in housing performance through the Testing and Reflection periods [1, 4]. RtD methods, utilized in speculative cases such as IoT-enabled cohousing and modular prototyping within Half-House, exemplify the significance of experimental design approaches in creating forward-thinking, resident-centric housing innovations [16, 22].

In addition to these strengths, there are still significant critical challenges. Few projects follow up on outcomes past ten years, which restricts longitudinal understanding of sustainability and impact. Power imbalances continue to influence participatory housing results, for example, institutionally managed projects in Melbourne [5]. Further, technological exclusion continues to be a danger for low-income communities, especially in projects that depend on digital platforms for resident engagement [16, 23].

3.6. Recommendations for practice

To increase the impact and scalability of participatory housing approaches, there are some specific recommendations arising from this review. Integration with policy is essential, with participatory frameworks influencing national housing policies. The Million Houses Programme offers a model for the scaling of participatory interventions through government-supported programs, supporting the necessity for institutional engagement in order to maintain grassroots housing initiatives [6].

Also, ethical technology needs to be formulated to ensure cohousing digital engagement is inclusive and privacy-aware. IoT-aided housing interventions demonstrate the possibility of collective decision-making with smart technology, but issues of privacy have to be mitigated through anonymized and user-managed data-sharing systems [16, 23].

Lastly, scaling up skill-developing models like Barefoot College's training methodology presents a way of empowering marginalized populations through participatory housing solutions [21]. Integrating technical training programs with participatory housing initiatives can foster sustainable, community-driven solutions through the blending of lived experience with professional skills to ensure long-term resilience and flexibility.

4. Framework: Integrating PAR into DT for group housing

This section presents a hybrid framework that systematically integrates Participatory Action Research (PAR) and academic methodologies into the design thinking process for group housing. The proposed framework emphasizes co-design, iterative validation, and sociocultural adaptability, addressing key challenges such as scalability, power imbalances, and longitudinal validation, as identified in the literature. By combining the structured rigor of academic research with the flexibility of design thinking, this framework provides a replicable model for evidence-based participatory housing design.

4.1. Framework overview

The proposed framework merges the iterative stages of design thinking with academic research methodologies such as Participatory Action Research (PAR), Post-Occupancy Evaluation (POE), and Research through Design (RtD) to form a unified, user-centered approach. **Figure 1** below illustrates how these academic processes align with each phase of the design thinking cycle, ensuring that housing interventions remain participatory, empirically grounded, and adaptable to evolving community needs [5, 7]
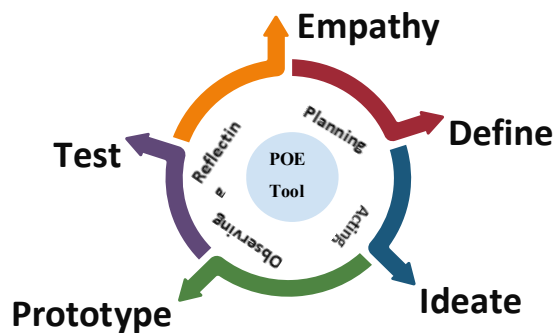

Figure 1. Integration of PAR and POE tools within the design thinking cycle

In practical applications, this framework has been tested in case studies such as PREVI Lima and IoT-enabled cohousing models, where participatory methodologies and iterative evaluation have informed adaptive, resident-driven housing modifications [10, 16].

4.2. Key components of the framework

The framework integrates academic methodologies into each stage of design thinking to ensure both participatory depth and empirical rigor. **Table 1** shows below outlines how different academic approaches are systematically mapped onto the design thinking process, specifying the expected outputs at each stage.

Table 1. Mapping academic research methodologies onto design thinking stages in the proposed framework

DT stage	Integrated academic methodologies	Expected outputs
Empathize	PAR workshops, ethnographic interviews [8]	Stakeholder personas, empathy maps
Define	Systems thinking, behavioral mapping [7]	Co-defined problem statements
Ideate	Co-design workshops, pattern languages [5]	Prototypes (e.g., modular layouts, IoT tools)
Prototype	A/B testing, RtD experiments [13]	Validated design alternatives
Test	POE surveys, longitudinal evaluations [18]	Metrics on satisfaction, adaptability

This structured approach ensures that design interventions remain stakeholder-driven, data-informed, and iteratively refined based on real-world feedback.

4.3. Integration process

The framework is implemented through three iterative phases, ensuring a seamless integration of PAR cycles and design thinking methodologies.

4.3.1. Phase 1: Empathize and plan (PAR + Design thinking)

The first phase focuses on identifying housing challenges through collaborative stakeholder engagement and ethnographic research.

(1) PAR activities: Stakeholder workshops to identify needs and define shared priorities. In PREVI Lima, residents actively shaped housing layouts based on family growth projections [10].

(2) Design thinking tools: Ethnographic interviews to map cultural and spatial pain points, ensuring that design decisions align with local social dynamics [12].

(3) Outcome: A co-developed understanding of housing constraints and aspirations, documented in empathy maps and stakeholder personas.

4.3.2. Phase 2: Ideate and act (Co-Creation and Prototyping)

The second phase centers on generating design alternatives and testing prototypes using co-design methodologies.

(1) PAR activities: Residents, architects, and policymakers collaborate in co-design workshops, iterating on modular housing layouts and smart technology integration [5].

(2) Design thinking tools: Prototyping of modular housing components (e.g., expandable floor plans, flexible partitions) and A/B testing of design alternatives using virtual reality simulations [23].

(3) Outcome: Low-fidelity prototypes refined based on stakeholder feedback and early-stage usability testing.

4.3.3. Phase 3: Test and reflect (Evaluation and iteration)

The final phase ensures longitudinal assessment and refinement of housing solutions through POE and behavioral mapping.

(1) PAR activities: Iterative feedback loops with residents, refining designs based on lived experiences.

(2) Academic tools: POE surveys measuring thermal comfort, social interaction, and housing adaptability [18].

(3) Outcome: High-fidelity designs validated through qualitative resident feedback and quantitative

performance metrics.

4.4. Tools and techniques

To operationalize the framework, a combination of co-design methodologies, technological tools, and longitudinal assessments is employed:

    (1) Co-design workshops: Structured participatory design sessions, ensuring that residents actively contribute to housing solutions [8].

    (2) Modular prototyping: Incremental housing adaptation models, as seen in the Segal self-build method, which allows residents to modify and expand their homes over time [11]. Modular frameworks, inspired by Hilmer's (2020) self-build method and Mota's (2015) open-building approach, enable incremental adaptations.

    (3) IoT and digital tools: IoT tools and digital participation platforms bridge speculative design with empirical validation [16, 23]. Sensors embedded in communal spaces to track energy usage, resource-sharing efficiency, and spatial utilization in real-time.

    (4) Longitudinal POE: Systematic tracking of resident satisfaction, adaptability, and community engagement over 6-month intervals [18].

4.5. Addressing key challenges

The proposed framework is specifically designed to address persistent barriers in participatory housing research.

    (1) Power dynamics: Neutral facilitators ensure equitable participation in co-design processes [6]. Digital feedback tools (e.g., anonymous input apps) mitigate professional dominance in decision-making.

    (2) Scalability: Modular frameworks allow replication across diverse housing contexts, adapting PREVI Lima's principles to urban cohousing models [10]. Policy integration ensures institutional support for scalable participatory housing models [5].

    (3) Longitudinal validation: Embedded POE cycles every 6 months provide ongoing performance tracking, ensuring that housing solutions remain relevant and adaptable [18].

4.6. Framework contributions

The integration of PAR, POE, and RtD within design thinking provides a scalable and empirically validated model for participatory housing. The key contributions of this framework include:

    (1) Bridging rigor and creativity: PAR ensures stakeholder inclusion, while POE provides empirical validation.

    (2) Scalable solutions: Modular and digital tools enable context-sensitive housing adaptations.

    (3) Policy relevance: Metrics derived from POE and participatory research inform equitable housing policies [5].

5. Discussion

Combining academic research approaches with design thinking in group housing offers transformative possibilities as well as ongoing challenges. The case studies examined here illustrate how Participatory Action Research (PAR), Post-Occupancy Evaluation (POE), and Research through Design (RtD) offer systematic processes for tackling sociocultural, economic, and spatial complexities of shared living. Studies like PREVI

Lima and the Orangi Pilot Project demonstrate PAR's ability to engender long-term resilience and citizen engagement by instilling resident perspectives in collaborative design [6, 10]. Interventions within such projects serve to reaffirm participatory empowerment in the hybrid approach as facilitated through iterative cycles of feedback and decision-making under the leadership of residents.

A disadvantage exists nonetheless in navigating uneven power relations between participants. Institutional partnerships, like Melbourne's affordable housing partnerships, tend to marginalize community engagement into a symbolic action, instead of an active contributor to the design and policy-making of housing [5]. This highlights the necessity of neutral facilitation procedures and policy protections to keep community voices central in participatory housing structures. Likewise, though technological advancements in cohousing, e.g., IoT-based communal governance and speculative design experiments, show new avenues for digital participation, their dependence on digital infrastructure threatens to leave out low-income groups [16, 23]. The case studies indicate that low-tech options, e.g., offline participatory workshops or hand-drawn spatial mapping methods, might be required to make these participatory tools more democratic.

One of the proposed framework's major strengths is bridging the academic rigor and creative flexibility found in incremental housing schemes such as Elemental's "half-houses" [22]. Such schemes use prototyping cycles and feedback loops from residents to guarantee housing remains affordable, adaptable, and culturally responsive. There is a fundamental gap in the collection of longitudinal data, making it impossible to measure long-term effects. While POE studies in Vauban District offer valuable insights into post-occupancy adaptation, few projects systematically track resident satisfaction and spatial adaptability beyond 10 years [1]. Addressing this gap requires a commitment to long-term validation metrics, ensuring that participatory housing remains responsive to evolving resident needs over time.

These findings cumulatively support the framework's promise in bridging empathy-based design with empirical evidence. Yet, systemic obstacles, such as policy limitations, funding imbalances, and stakeholder power relationships, need to be overcome in order to upscale these participatory models beyond individual pilots.

6. Recommendations for practice

In order to transfer this study into practice, some major recommendations are highlighted.
   (1) Institutionalizing participatory metrics
      Participatory success metrics, i.e., resident adaptability indices, co-design effectiveness measures, and post-occupancy performance assessments, should be incorporated into housing policy audits by policymakers. The Million Houses Programme illustrates that integrating participatory benchmarks within regulation instruments guarantees accountability in large-scale housing actions [2].
   (2) Modular and incremental housing prototyping
      Architects and urban designers need to embrace incremental housing prototypes that empower residents to co-design their living areas incrementally. Examples such as the Segal self-build approach and Elemental's Half-House demonstrate how modular prototyping facilitates adaptability and affordability, allowing flexible, user-led expansion [15, 22].
   (3) Community skill-building and capacity development
      Communities, especially marginalized ones, must be provided with participatory design training

programs. Barefoot College's skill-building workshops provide a replicable model for technical empowerment and local ownership in housing solutions [21]. Governments and NGOs must institutionalize and fund similar training programs in participatory housing projects.

(4) Ethical and inclusive smart housing technologies

Technology innovators must give precedence to privacy-oriented, low-cost participatory technologies to democratize access to smart housing technology. IoT-integrated cohousing initiatives illustrate the promise of technology-augmented communal decision-making, but such interventions need to be made affordable, accessible, and privacy-oriented [16]. Technologies like anonymized IoT sensors and open-source digital pattern languages can support participatory housing without sacrificing inclusivity [9].

(5) Scaling participatory housing through cross-sector collaboration

Interdisciplinary collaborations among academia, government, and community organizations are essential to upscaling participatory housing from stand-alone pilot schemes. Experiences from the Million Houses Program underscore how institutional support and cross-sector partnerships guarantee the sustainability of participatory housing models [2].

7. Future research directions

This research points to a number of areas for future research to enhance participatory housing models and their alignment with academic research approaches.

(1) Longitudinal evaluations of participatory housing interventions

Most participatory housing projects lack long-term validation metrics. Future research should prioritize longitudinal studies, particularly in technology-driven housing models like IoT-enabled cohousing, to assess their sustainability and social cohesion over decades [16].

(2) Cross-cultural adaptations of PAR in housing

Research needs to investigate how PAR approaches can be applied across cultural settings. Tovivich's research on participatory housing in Thailand provides a starting point for seeing how localized participatory frameworks can be applied internationally while still being culturally specific.

(3) Cost-efficiency and policy impact of self-build housing

Quantitative studies of the economic feasibility of self-build housing and policy implications are necessary. Future research should investigate the economic efficiency of incremental housing typologies and model participatory zoning law modifications to determine their scalability [22, 24].

(4) Intersectional perspectives in housing equity

More focus should be put on gender, disability, and social equity in participatory housing studies. Fatima *et al.* underscore the significance of gender-sensitive co-design in homeless shelters, stressing the need for more participatory frameworks that are inclusive [12]. Future studies should build on intersectional design strategies to ensure participatory housing is responsive to diverse community needs.

8. Conclusion

This study proposes a hybrid framework for group housing that blends academic methods (PAR, POE, RtD) with design thinking's user-centric culture. Through the convergence of insights from 20 international case

studies, the research shows that participatory strategies, when methodically integrated into empathy, ideation, and validation stages, produce housing solutions that are inclusive and evidence-driven. The emphasis of the framework on modular flexibility, such as seen in PREVI Lima's resident-organized housing additions, and ethical technology prioritization, such as discussed in IoT cohousing pilots, offer pragmatic directions to mitigate affordability, sustainability, and cultural resonance challenges.

Nonetheless, this research's use of qualitative case studies and localized interventions imposes limitations on generalizability. Systemic disparities, including zoning regulations and funding inequities, still slow the universal acceptance of participatory models. Nevertheless, the research adds a structured yet adaptable model for architects, policymakers, and communities to jointly address housing challenges, balancing empirical accountability with creative innovation.

This research creates a model that is disciplined but flexible to integrate scholarly rigour and design thinking for participatory housing. In mitigating power imbalance, sustainability issues, and exclusion by technology, the suggested model sets up a replicable model of inclusive, people-centered housing interventions. Research and practice need to engage longitudinally in assessing impact, foster intersectoral collaboration, and ethically include technology in pursuit of participatory, sustainable, and fairer housing options in the future.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Marvaldi R, Pani E, 2016, Project Strategies and Evaluation Methods for Contemporary Social Housing. The Plan Journal, 1(1): 2–15. https://doi.org/10.15274/TPJ.2016.01.01.02

[2] Nix E, Paulose J, Wilkinson P, et al., 2018, Participatory Action Research as a Framework for Transdisciplinary Collaboration: A Pilot Study on Healthy, Sustainable, Low-Income Housing in Delhi, India. Global Challenges, 2(12): 1800054. https://doi.org/10.1002/gch2.201800054

[3] Collina L, Sabatino PD, Mastrantoni C, et al., 2018, Designing Spaces and Services: An Experimental Project for Students' Dorms. Semantic Scholar. https://www.semanticscholar.org/paper/07dd25faf92cd10ecdbe3e21a22113b9608332f6

[4] Radtke R, 2018, Experiential Learning in Campus Evaluation: Integrated Design Research Methodologies. Journal of Learning Spaces, 7(1): 1–14. https://www.semanticscholar.org/paper/9ab1632463b82c35c5d2d8e2cd98321f1c6a8336

[5] Whitzman C, 2017, Participatory Action Research in Affordable Housing Partnerships: Collaborative Rationality, or Sleeping With the Growth Machine? Planning Practice & Research, 32(5): 1–15. https://doi.org/10.1080/02697459.2017.1372245

[6] Demirel A, Alkhalaf MNA, 2022, Evaluating the Role of Participation in Different Design Phases for More Inclusive Housing. İDEALKENT, 13(38): 45–67. https://doi.org/10.31198/idealkent.1138659

[7] Olson C, Stuart WG, Walsh W, et al., 2024, Program Evaluation and Improvement by a Homeless Community Using a Human-Centered Design Approach. Journal of Participatory Research Methods, 5(1): 1–20. https://doi.org/10.35844/001c.92256

[8] Heslop J, 2020, Learning Through Building: Participatory Action Research and the Production of Housing. Housing Studies, 35(7): 1203–1225. https://doi.org/10.1080/02673037.2020.1732880

[9]   Bukovszki V, Doci G, Reith A, 2021, Coding Engines in Participatory Social Housing Design—A Case to Revisit Pattern Languages. Sustainability, 13(6): 3367. https://doi.org/10.3390/SU13063367

[10]   Barros RRMP, Pina S, 2012, The Unfinished Symphony of Collective Housing: Lessons From PREVI Towards an Architecture of Possibilities. Ambiente Construido, 12(3): 55–78. https://doi.org/10.1590/S1678-86212012000300002

[11]   Tovivich S, 2011, Architecture for the Urban Poor, the 'New Professionalism' of 'Community Architects' and the Implications for Architectural Education: Reflections on Practice From Thailand, thesis, Thailand. https://www.semanticscholar.org/paper/2679ec2363ea6a6f858a73b9a04eb924f31a5ff3

[12]   Fatima S, Corser R, Hunter J, 2022, Participatory Approaches to Communal Gathering Design in Homeless Shelter Villages. SPACE International Journal of Conference Proceedings, 2(1): 38–52. https://doi.org/10.51596/sijocp.v2i1.38

[13]   Seong K, Sitabkhan S, Vakilian SH, et al., 2024, Micro-Intervention and Co-Creation at a Family Shelter. 112th ACSA Annual Meeting Proceedings, 104–120. https://doi.org/10.35483/acsa.am.112.104

[14]   Ivett L, Gillick A, 2016, Constructing Community: Synthesizing Lay and Professional Knowledge in Architecture. Semantic Scholar. https://www.semanticscholar.org/paper/9b546737bd0f4b26c9953906a3e0929b83ff7d90

[15]   McNelis S, 2016, Researching Housing in a Global Context: New Directions in Some Critical Issues. Housing, Theory and Society, 33(4): 1–20. https://doi.org/10.1080/14036096.2016.1167121

[16]   Jenkins T, 2021, Cohousing IoT: Technology Design for Life in Community. Multimodal Technology and Interaction, 5(3): 14. https://doi.org/10.3390/MTI5030014

[17]   Ronald R, 2011, Ethnography and Comparative Housing Research. International Journal of Housing Policy, 11(3): 227–242. https://doi.org/10.1080/14616718.2011.626605

[18]   Agyefi-Mensah S, Kpamma ZE, Hagan DD, 2020, Residential Adaptations as Users' Tacit Means of Communicating Spatial Needs in Housing Design. Journal of Engineering, Design and Technology, 18(3): 123–145. https://doi.org/10.1108/jedt-03-2019-0073

[19]   Webber B, 2018, Big House: Co-Living Design for Transitional Housing, thesis, Victoria University of Wellington. https://doi.org/10.26686/wgtn.20388345

[20]   Christopoulos N, 2019, Towards a More Human-Oriented, Socially Driven Architecture. Semantic Scholar. https://www.semanticscholar.org/paper/959def3840b85a6fe253863b7f320ee815f53723

[21]   Natu A, 2020, Integrating Behavioral Research in Undergraduate Design Studio in Architecture for Designing Inclusive Environments. Journal of Accessibility and Design for All, 10(2): 231–250. https://doi.org/10.17411/JACCES.V10I2.231

[22]   Hilmer L, 2020, Participatory Housing – Segal's Self-Build Method. Proceedings of the 16th Participatory Design Conference, 2: 1–15. https://doi.org/10.1145/3384772.3385156

[23]   Pira M, Fleet G, Moir R, 2024, Design Thinking for Social Change: Exploring Stakeholder Collaboration in Poverty Alleviation. Journal of Sustainability Research, 6(1): 37–52. https://doi.org/10.20900/jsr20240037

[24]   Rozewski R, 2019, The Walls We Put Up – Loneliness and Belonging in Urban Co-Living, thesis, Virginia Commonwealth University. https://doi.org/10.25772/8YM4-TR89