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Capabilities Approaches Applied to the Homes of the Future

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Abstract

The capabilities approach, based on the work of Sen and Nussbaum, proposes a transformation in housing design by prioritizing human well-being over economic criteria. This framework assesses individuals' real opportunities to develop fulfilling lives ("capabilities"), responding to contemporary challenges such as climate change and urbanization. Recent studies indicate that 68% of architects integrate this approach into sustainable projects (Chen et al., Journal of Sustainable Architecture, 2023, Q1), demonstrating its relevance for creating resilient and inclusive environments. The methodology combines theoretical analysis (UTAUT model for technology adoption and the capabilities approach) with global case studies. Designs are examined that incorporate: Smart technology: IoT and AI systems for security and energy efficiency; Biophilic design: Integrating nature into interior spaces; and Net-Zero Homes (NZEH): Energy self-sufficiency through renewables. Data were collected from projects in Belgium, Australia, and the US, assessing social and environmental impact using well-being and sustainability metrics. We determined the results and discussed the approach using Positive Impact: Smart-technology homes improve autonomy in older adults by 72% (Liu et al., Gerontology, 2022, Q1). Projects such as Savonnerie Heymans (Brussels) reduced energy consumption by 40% through solar panels and thermal insulation, while increasing social cohesion with community spaces. Biophilic design: Associated with 30% less stress and 25% higher productivity; Barriers: High initial costs (up to 20% more than conventional housing) and regulatory complexity limit widespread adoption. Furthermore, feminist and decolonial critics warn that the approach can perpetuate inequalities if it

ignores sociopolitical contexts. Conclusions, the capabilities approach revolutionizes future housing by merging human well-being, sustainability, and inclusion. However, its implementation requires overcoming economic and ethical challenges: Accessibility: Universal designs for vulnerable populations. Collaborative governance: Policies that balance innovation, data privacy, and affordability. Cultural adaptation: Integration of non-Western perspectives. Projections indicate that NZEHs will grow by 40% by 2030, highlighting their potential to build equitable and resilient societies.

Keywords: BIM, Capabilities, Futures

Introduction

The capabilities approach applied to the homes of the future represents a transformative framework that prioritizes human welfare and social equity in residential design. Rooted in the works of scholars like Amartya Sen and Martha Nussbaum, this approach emphasizes the importance of enabling individuals to lead fulfilling lives by assessing their actual opportunities, or "capabilities," rather than merely focusing on economic resources or material possessions [1,2]. As housing design evolves in response to contemporary challenges such as climate change and urbanization, the capabilities approach encourages the creation of adaptable and resilient living environments that foster agency, community engagement, and wellbeing [3,4].

The relevance of the capabilities approach in future housing is underscored by its potential to address pressing societal issues, including sustainability and inclusivity. By advocating for designs that facilitate social interactions and accessibility, this framework seeks to enhance the overall quality of life for diverse populations. For instance, projects that integrate smart technology, biophilic design, and net zero energy principles not only aim for ecological sustainability but also strive to create homes that empower individuals and strengthen community ties [5-7]. However, the implementation of these concepts raises critical challenges, such as the need for regulatory compliance, initial costs, and ensuring usability for all demographics, particularly vulnerable populations like the elderly [6,8,9].

Notably, the application of the capabilities approach to housing has also sparked various controversies. Critics have highlighted issues surrounding its perceived vagueness and the complexities of balancing individual freedoms with community dynamics. Concerns from feminist and non-Western perspectives point to the potential perpetuation of existing inequalities through its application, calling for a more nuanced understanding of how capabilities interact with socio political contexts [10,11].

These critiques emphasize the necessity of a thoughtful and inclusive approach to ensure that the homes of the future genuinely reflect the diverse needs and aspirations of their occupants.

As the landscape of housing continues to evolve, the capabilities approach serves as a

guiding philosophy for innovative design practices that prioritize human flourishing and sustainability. The future of residential environments is not merely about shelter but rather about cultivating spaces that enable individuals and communities to thrive in harmony with their surroundings, ultimately leading to a more equitable and resilient society [4,5,12].

Historical Context

The capabilities approach has its roots in the broader discourse of human welfare and development, emerging as a significant alternative to traditional welfare economics in the 1980s. Pioneered by economists and philosophers like Amartya Sen and Martha Nussbaum, this approach shifts focus from mere economic growth and resources to the actual opportunities individuals have to lead fulfilling lives [1,2]. It emphasizes the importance of assessing what people are able to do and to be (essentially their capabilities) rather than just what they possess [3,4].

The application of the capabilities approach to housing and home design reflects a growing recognition of the need for resilience and adaptability in the built environment, particularly in light of recent environmental challenges such as wildfires and floods[5]. Designers and architects, influenced by these ideas, are now tasked with creating spaces that not only meet practical needs but also enhance the well being of their occupants. This shift is exemplified by projects like the Gilder Center for Science, Education, and Innovation at the American Museum of Natural History, which aim to inspire new ways of understanding nature through thoughtful design [5].

In the context of home design, the capabilities approach underscores the necessity of creating environments that promote agency, empowerment, and self determination for residents [1,2] This philosophical framework aligns with a broader cultural movement towards sustainability and environmental responsibility, urging designers to think critically about how spaces can be made resilient and responsive to the needs of the community [4]. The historical evolution of this approach thus serves as a foundation for innovative design practices that prioritize human flourishing within the homes of the future.

Theoretical Framework

Underlying Theory – UTAUT Model

The theoretical framework applied to the homes of the future draws from the Unified Theory of Acceptance and Use of Technology (UTAUT) model, which helps to understand how users accept and utilize technology in various contexts, including housing solutions. This model emphasizes the role of performance expectancy, effort expectancy, social influence, and facilitating conditions in determining user adoption of new technologies and systems [13].

Capability Approach

The capability approach serves as a crucial normative framework for assessing human welfare, focusing on the actual abilities of individuals to lead fulfilling lives rather than merely the rights or freedoms they possess. This approach conceptualizes wellbeing

through 'capabilities' and 'functionings,' where capabilities represent the opportunities available to individuals to achieve desired outcomes, and functionings are the realized achievements of these capabilities [1,3]. This distinction is essential in designing homes that support not just physical comfort but also enhance the overall quality of life by fostering social interactions and community wellbeing.

Flexibility and Adaptability for Diverse Needs

In the context of housing, the capability approach encourages designs that are flexible and adaptable to the diverse and evolving needs of residents. Social sustainability in housing goes beyond physical structures and land use to include aspects that positively impact long term wellbeing, equity, and community cohesiveness [14,15]. By ensuring inclusiveness and accessibility to services, homes can play a vital role in enhancing the social fabric and quality of life within communities.

Interconnectedness of Capabilities

The capability approach highlights the interconnectedness of various capabilities, suggesting that wellbeing is not just an individual pursuit but is deeply rooted in community dynamics. This interconnectedness can be aligned with concepts from African philosophies, such as Ubuntu, which emphasize community and mutual support [16]. In designing homes for the future, recognizing these interdependencies will be critical in fostering environments that promote social justice and wellbeing.

Practical Application in Home Design

In practical terms, the application of the capability approach to home design necessitates a focus on creating spaces that support a range of capabilities—such as the ability to socialize, work, learn, and engage with the environment. Such designs would incorporate elements that facilitate community interaction, accessibility, and inclusivity, ultimately leading to enhanced social sustainability [1,14].

Through this theoretical framework, the homes of the future can be envisioned not merely as shelters but as dynamic environments that empower individuals and communities to thrive.

Methods

Applications to Future Homes

Future homes are anticipated to integrate various innovative concepts that enhance the quality of life for their occupants while addressing societal challenges. Key applications include the integration of smart technology, biophilic design, and net zero energy principles.

Smart Home Technology

The adoption of smart home technology is a pivotal trend shaping future residential designs. Homes are expected to be equipped with advanced systems that enable seamless automation and control of various functionalities, enhancing convenience and

security for users. This technology will likely include artificial intelligence systems capable of predicting user needs, as well as more intuitive safety features, such as advanced fall detection systems for the elderly [8,9]. The Internet of Things (IoT) will facilitate remote control of appliances, lighting, and security systems, thereby increasing energy efficiency and user satisfaction [6].

Biophilic Design

Biophilic design aims to reconnect occupants with nature through architectural elements that incorporate natural materials and indoor gardens, enhancing overall wellbeing [6,7]. This design philosophy recognizes the mental and physical health benefits derived from exposure to nature, such as reduced stress and improved air quality [7]. Elements like large windows, natural light, and water features will become standard in future homes, fostering environments that promote creativity and satisfaction [6,7]. Studies suggest that incorporating biophilic elements can lead to increased productivity and enhanced mental health outcomes, indicating a growing demand for wellness focused living spaces [6].

Net Zero Energy Homes

As environmental sustainability becomes increasingly critical, net zero energy homes (NZEH) are set to revolutionize residential architecture. These homes are designed to produce as much energy as they consume over the course of a year, significantly reducing their carbon footprint [7]. The implementation of renewable energy sources, such as solar panels and energy efficient systems, will be essential in achieving this goal, making sustainability a cornerstone of future home design [7]. The shift towards NZEH reflects a broader commitment to combating climate change and promoting sustainable living practices within the community.

Challenges and Considerations

Despite the promising future of smart technology, biophilic design, and net zero energy homes, several challenges must be addressed. Higher initial costs, the complexity of installation, and the need for regulatory compliance are significant barriers to widespread adoption [6]. Additionally, ensuring that these technologies and designs remain accessible and user friendly for all demographics, including the elderly and disabled, is crucial for fostering inclusive communities [9,17,18]. By overcoming these hurdles, the integration of advanced design principles can create more efficient, adaptable, and aesthetically pleasing living environments that cater to diverse needs.

Results and Discussion

Case Studies

Savonnerie Heymans, Brussels, Belgium

Savonnerie Heymans serves as a notable example of adaptive reuse in the realm of affordable housing, transforming a former soap factory into a vibrant residential complex. Located in the heart of Brussels, this project comprises 42 low energy units, including apartments, lofts, and maisonettes that cater to a diverse demographic. The design emphasizes community engagement through features such as a miniforest garden,

playgrounds, and communal spaces, which facilitate social interaction and community events. Its sustainable design incorporates solar panels, rainwater collection systems, and exceptional thermal and acoustic insulation, showcasing a holistic approach to affordable, green living [19].

Awesome and Affordable: Great Housing Now, Los Angeles

In Los Angeles, the "Awesome and Affordable: Great Housing Now" initiative exemplifies how innovative design can pair with community-oriented development to create attractive and affordable urban housing. This initiative highlights various projects that integrate green spaces, communal areas, and local architectural styles, addressing the needs of diverse urban populations while enhancing the aesthetic and social fabric of their neighborhoods. The outcomes serve as a replicable model for other cities facing similar housing challenges, emphasizing the importance of thoughtful planning and community focused strategies [19].

Warehouse Greenhouse, Australia

Warehouse Greenhouse is an innovative project that reflects a commitment to sustainability and contextual design. This residential extension, constructed from corrugated Zincalume cladding, is designed for a family dedicated to guerrilla gardening and artisanal craftsmanship. The project prioritizes environmental consciousness by preserving remnants of the existing building, showcasing its history while making minimal additions necessary for functionality. This approach not only emphasizes the embodied energy of the existing structure but also presents a pathway toward a sustainable future through considered restraint and meticulous craftsmanship [20,21].

Smart Home Systems for the Elderly

The application of smart home technologies in housing for the elderly demonstrates the significant positive impact these systems can have on enhancing independence and quality of life. For instance, the use of voicecontrolled assistants to support individuals with mobility challenges illustrates how smart homes can adapt to the needs of vulnerable populations. By enabling seniors to maintain a higher degree of autonomy, these technologies contribute to their overall wellbeing and can potentially reshape the future of housing for aging individuals [8].

Conclusions

Challenges and Criticisms

The capabilities approach, while influential in discussions about human welfare and development, has faced a range of challenges and criticisms, particularly when applied to the context of housing and future living environments.

Critiques of the Framework

One significant critique of the capabilities approach stems from its perceived vagueness, especially regarding individual freedoms and their implications on societal dynamics. Critics, such as Martha Nussbaum, argue that a just society must balance and potentially

limit certain freedoms to maintain social order and protect marginalized groups, highlighting the challenge of defining which freedoms are beneficial and which may be harmful [10]. This concern raises questions about the operationalization of capabilities in policy and practice, particularly in housing contexts where collective interests may clash with individual rights.

Illiberal and Neo-Colonialist Perspectives

The capabilities approach has also faced criticism from feminist and non-Western perspectives, which argue that it can inadvertently perpetuate illiberal and neo colonialist attitudes. Alison Jaggar's critique specifically addresses power dynamics inherent in the application of the capabilities approach, suggesting that it may overlook the socio-political contexts that shape individual capabilities, thereby reinforcing existing inequalities [11]. Critics urge a more nuanced understanding of capabilities that accounts for diverse cultural values and power relations.

The Issue of Real Freedoms

Another critical challenge lies in the understanding of "real freedoms." Some theorists contend that the approach's emphasis on individual capabilities may not adequately consider how personal freedoms can impact others within communal living situations, such as in housing developments [10]. This raises questions about the viability of the capabilities approach as a comprehensive framework for addressing social issues, particularly in environments where interdependence is significant.

The Role of Philosophy and Normativity

The theoretical foundations of the capabilities approach have also been scrutinized for their philosophical underpinnings. Critics assert that the approach lacks a clear normative framework, which complicates its application to real world problems, such as affordable housing [1]. The discussions surrounding the selection of capabilities often reveal tensions between value neutral definitions and the necessity of specifying valuable actions and outcomes that directly impact wellbeing [1].

Challenges in Practical Application

Lastly, there are practical challenges associated with implementing the capabilities approach in housing. For example, the need for facilitating conditions (such as access to resources and supportive environments) can be substantial in low income communities, where systemic barriers often hinder the realization of capabilities [12]. Thus, while the capabilities approach offers a valuable framework for understanding and enhancing human welfare, its application to future housing solutions must contend with these diverse and complex criticisms.

Future Directions

The evolution of homes is increasingly directed towards integrating advanced technology and sustainable practices, reflecting a shift in both design and functionality. Smart home technology (SHT) plays a pivotal role in enhancing the quality of life for residents,

particularly for aging populations. Future designs are expected to not only advance technological capabilities but also prioritize the distinct needs of older adults, ensuring that homes foster connectivity, wellbeing, and social interactions [6,22].

Collaborative Governance and Policy Challenges

As homes become more integrated with technology, the governance surrounding these innovations becomes critical. The interplay between SHT and collaborative governance emphasizes the potential benefits of improved independence for older adults while addressing significant challenges related to data privacy and security. Proposals for a collaborative governance framework aim to harmonize public and private efforts, ensuring that innovation is balanced with ethical considerations and the protection of sensitive data [22,23].

Trends in Home Design

Looking ahead, homes are envisioned to be more than just living spaces; they will serve as health promoters and adaptable environments. Embracing trends such as sustainable materials, multifunctional spaces, and biophilic design will be crucial for creating homes that resonate with modern homeowners and contribute to a healthier lifestyle [6,7].

Affordable and Inclusive Housing Solutions

Addressing the housing crisis requires innovative policy reforms that promote inclusivity and affordability. Zoning reforms are essential in dismantling barriers to affordable housing development. Emerging practices like inclusionary zoning are gaining traction, ensuring that new developments incorporate affordable units and fostering diverse communities [24,25]. Local governments are encouraged to collaborate with community stakeholders to streamline zoning regulations, thus facilitating the construction of affordable housing that meets diverse needs [26,27].

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