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The Influence of Social Values and Economic Context on User Adaptation to Adaptive Smart Homes in Grand Duta City Bekasi

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A B S T R A C T
The development of modern residential areas has accelerated the adoption of smart home technology as an effort to enhance energy efficiency and residential comfort. However, the level of user adaptation to such technology is not determined solely by technical aspects but is also influenced by socio-cultural factors inherent to users. This study aims to examine the effects of social values, needs, and social relationships (X1), as well as economic context and accessibility (X2), on the level of user adaptation to adaptive smart home technology (Y) in the Grand Duta City Bekasi residential area. This study employed a quantitative approach using multiple linear regression analysis involving 144 respondents residing in landed housing units. The results indicate that, partially, both social values, needs, and social relationships (X1), as well as economic context and accessibility (X2), have a significant influence on user adaptation to adaptive smart homes (Y). Simultaneously, these independent variables are also proven to explain variations in user adaptation levels. These findings suggest that the successful implementation of smart home technology strongly depends on its alignment with community social values, supported by economic capacity and ease of access to technology.

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INTRODUCTION

As one of Jakarta's primary buffer regions, Bekasi Regency has experienced rapid development in the residential and infrastructure sectors. Its geographical proximity to the capital city, as reflected in the Jabodetabek Commuter Statistics issued by Statistics Indonesia (2023), along with the availability of transportation networks such as toll roads, commuter rail lines, and public transport systems, has positioned Bekasi as a strategic residential choice for urban communities seeking relatively affordable housing. The high population growth rate, which places Bekasi Regency as the third most populous region in West Java Province, has driven the massive development of new residential areas, with landed housing emerging as the dominant residential typology.

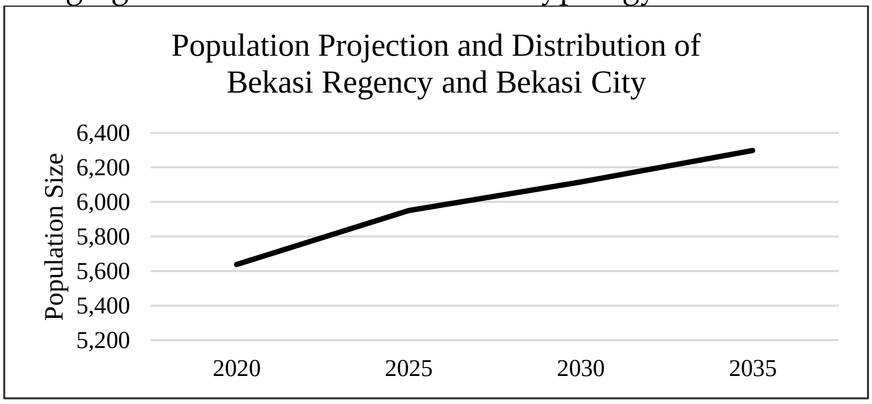

Figure 1. Population Projection and Distribution

Source: Statistics Indonesia, Population Projections of Regencies/Municipalities in West Java Province, 2020–2035 (2023), processed by the author

One residential area that reflects this phenomenon is Grand Duta City Bekasi, an integrated housing development initiated in 2021 which, according to the developer's official brochure, targets approximately 25,000 modern minimalist landed housing units equipped with communal facilities. Nevertheless, the expansion of residential areas also brings implications in terms of increased energy consumption, environmental pressure, and socio-cultural dynamics within the community.

The construction sector is known to contribute significantly to greenhouse gas emissions in Indonesia. Bahfein and Alexander (2023) report that this sector accounts for approximately 24.6% of national emissions. In addition, landed housing development and electricity consumption during the residential phase contribute substantially to emissions, particularly in urban areas such as Bekasi.

In an effort to reduce greenhouse gas emissions, local governments, through the Environmental Agency, have undertaken emission inventory and mitigation initiatives. Although the achievements of these initiatives remain relatively limited, they indicate an initial commitment that needs to be strengthened, particularly in the housing sector as one of the main contributors to emissions.

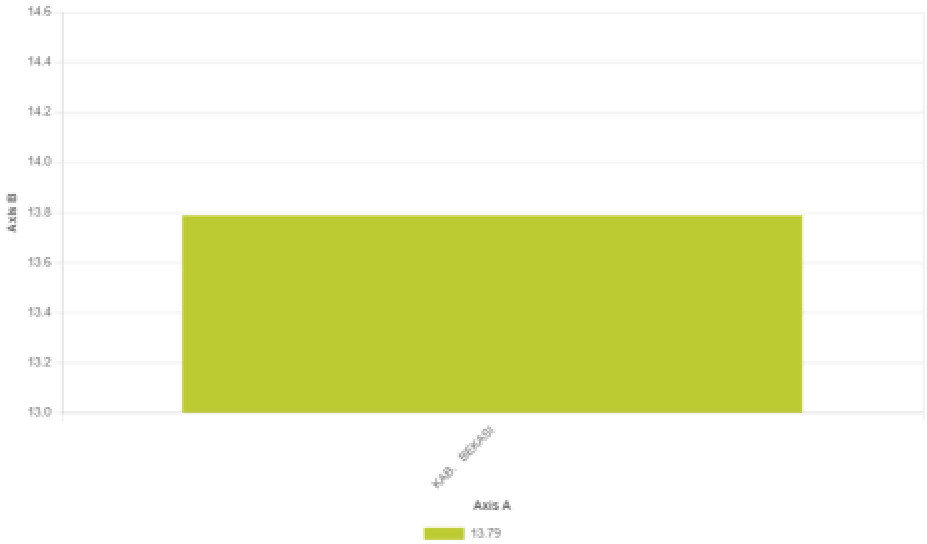

Figure 2. Inventory and Mitigation of Greenhouse Gas Emissions
Source: Environmental Agency of Bekasi Regency

In line with the concept of sustainable development, smart home technology has emerged as an innovative approach integrating digital technology, sensors, and the Internet of Things (IoT) to enhance energy efficiency, security, and residential comfort. Through application-based automation systems, residents can manage lighting, temperature, and energy consumption more efficiently. The implementation of this concept is also aligned with Indonesia's commitment under the Nationally Determined Contribution (NDC) to reduce greenhouse gas emissions by 29% by 2030 (Nationally Determined Contribution, 2016).

However, the implementation of smart home technology does not always operate optimally. Its success is highly influenced by users' social, cultural, and economic factors. Social values, family norms, income levels, and perceptions of digital security and privacy play critical roles in determining technology acceptance and adaptation.

The heterogeneous characteristics of Bekasi's population demand smart home systems that can adapt to local conditions. Variations in technological literacy, economic capacity, and digital infrastructure readiness result in uneven smart home adaptation processes. Some communities still perceive smart homes as exclusive and costly facilities rather than as sustainable housing solutions.

Most previous studies on smart homes have predominantly emphasized technical aspects such as IoT architecture, automation systems, energy optimization, and security mechanisms, while social and economic dimensions of users have received relatively less attention (Hanani & Hariyadi, 2020; Surantha et al., 2023; Dehghani et al., 2025; Lee et al., 2023).

Therefore, this study focuses on social and economic factors as key determinants of user adaptation to adaptive smart homes in the Grand Duta City Bekasi residential area. This research is expected to provide empirical contributions to the development of more contextual and sustainable smart home implementation strategies.

Research Questions

Based on the background described above, the research questions are formulated as follows:

1. Do social values, needs, and social relationships significantly influence user adaptation to adaptive smart homes?
2. Does economic context and accessibility significantly influence user adaptation to adaptive smart homes?
3. Do social and economic factors simultaneously influence user adaptation to adaptive smart homes?

Research Objectives

The objectives of this study are as follows:

1. To examine the influence of social values, needs, and social relationships on user adaptation to adaptive smart homes.
2. To analyze the influence of economic context and accessibility on user adaptation to adaptive smart homes.
3. To assess the simultaneous influence of social and economic factors on user adaptation to adaptive smart homes.

LITERATURE REVIEW

Smart Homes as Sociotechnical Systems

Contemporary literature on smart homes indicates a shift from a technology-oriented paradigm toward a more human-centered approach. Smart homes are no longer understood merely as collections of IoT-based automated devices, but rather as sociotechnical systems operating through interactions between technology, users, and their surrounding social and cultural contexts.

From the Science, Technology, and Society (STS) perspective, technology is not viewed as a neutral entity, but as a product of social processes that simultaneously reshape social practices and structures. Bibri (2015) emphasizes that technology evolves through complex relationships among social actors, economic interests, cultural values, and environmental conditions. Accordingly, the implementation of smart homes in residential environments should be understood as a bidirectional adaptation process between technology and users, rather than a linear and deterministic adoption process.

The sociotechnical approach emphasizes that successful smart home implementation depends not only on system sophistication, but also on the extent to which technology aligns with users' habits, values, and needs. In residential contexts, smart homes interact directly with domestic routines, family structures, and social norms, thus requiring contextualized design and implementation.

User Adaptation to Adaptive Smart Homes

User adaptation to adaptive smart homes refers to residents' ability and readiness to understand, accept, and integrate technology into their daily activities. This adaptation is measured not only by usage frequency, but also by comfort level, trust, and the long-term sustainability of technology utilization.

In urban residential environments, technology adaptation is dynamic and often involves interactions among family members. Smart home usage is typically collective rather than individual, where decisions and usage patterns are shaped by social relationships within the household. The adaptation process includes stages of technology introduction, negotiation of values and habits, behavioral adjustment, and the formation of new routines integrated with smart home systems.

Adaptive smart homes fundamentally require alignment between technology and users. Technologies that do not correspond to lifestyles, social values, or users' capabilities may encounter resistance, even if they are technically efficient. Therefore, user adaptation serves as a key indicator of smart home implementation success.

Social Values, Needs, and Social Relationships (X1)

Social values serve as a fundamental basis influencing how individuals and families perceive and utilize technology. In the context of smart homes, values such as efficiency, comfort, security, and independence often motivate technology adoption. However, these values vary across households, leading to adaptation and negotiation processes in actual usage.

Knoefel et al. (2024) explain that smart homes are generally designed to address users' specific needs, such as time efficiency, enhanced comfort, and support for domestic activities. The degree of alignment between technological features and residents' actual needs determines acceptance and sustained use.

Beyond values and needs, social relationships within households play a crucial role in technology adaptation. Iannone et al. (2020) argue that smart homes can reshape social interaction patterns within families and surrounding communities. Adaptation often begins with one family member acting as an early adopter, followed by other members until collective habits are formed.

Thus, greater alignment between smart home technology and social values, family needs, and social interaction patterns increases the likelihood of optimal and sustainable adaptation.

Economic Context and Accessibility (X2)

Economic context is a critical factor determining users' ability to adopt and sustain smart home technology. Initial investment costs, operational expenses, and household financial capacity are major considerations in housing technology decisions.

Herwig (2022) notes that economic pressures in urban areas encourage the development of more efficient and flexible residential technologies. However, without adequate accessibility, smart homes risk exacerbating digital inequality in residential environments. Accessibility encompasses not only affordability, but also the availability of digital infrastructure, ease of maintenance, and users' technological literacy.

Knoefel et al. (2024) highlight the risk of social exclusion if smart home technology is accessible only to certain groups. Therefore, supportive economic context and accessibility are essential prerequisites for accelerating user adaptation to adaptive smart homes, particularly in residential areas with diverse socio-economic backgrounds.

The Relationship between Social Values, Economic Context, and Smart Home Adaptation

User adaptation to smart homes results from complex interactions between social and economic factors. Technologies aligned with users' social values and needs but unsupported by sufficient economic capacity and accessibility are unlikely to be optimally adopted. Conversely, economically affordable technologies that conflict with residents' habits and social values may also be underutilized.

A holistic approach integrating social and economic dimensions is key to successful adaptive smart home implementation. In urban residential contexts, this approach allows smart home technology to function not merely as an automation tool, but as an integral part of residents' social lives.

Hypothesis Development

Based on the theoretical review and previous studies, the hypotheses of this research are formulated as follows:

1. H1: Social values, needs, and social relationships have a significant effect on the level of user adaptation to adaptive smart homes.
2. H2: Economic context and accessibility have a significant effect on the level of user adaptation to adaptive smart homes.
3. H3: Social values, needs, and social relationships, together with economic context and accessibility, simultaneously have a significant effect on the level of user adaptation to adaptive smart homes.

METHODOLOGY

Research Type and Approach

This study employs a quantitative approach with an explanatory research design. The quantitative approach is adopted because the study focuses on objectively testing relationships and effects among variables through statistical analysis. The explanatory design aims to test hypothesized relationships between independent and dependent variables based on measurable empirical data.

The independent variables consist of social values, needs, and social relationships (X1), as well as economic context and accessibility (X2), while the dependent variable is user adaptation to adaptive smart homes (Y). This approach enables the study not only to describe smart home usage phenomena, but also to systematically test hypotheses regarding factors influencing user adaptation.

Research Location and Time

The research was conducted in the Grand Duta City Bekasi residential area. This location was selected due to its characteristics as a modern urban housing development with potential smart home technology implementation in residents' daily lives. In addition, the area's diverse social and economic characteristics make it a relevant research object.

The study was carried out from September 2025 to January 2026, covering instrument preparation, data collection, data processing, analysis, and report preparation.

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Population and Sample

The population of this study comprises all residents of landed housing units in Grand Duta City Bekasi who own or use smart home facilities. Due to time and access constraints, purposive sampling was used to select respondents who met the research criteria.

The population consisted of 224 individuals. Sample size determination employed the Slovin formula with a adequate sample size for regression, resulting in a minimum sample size of 144 respondents. This number was considered sufficient for multiple linear regression analysis and met the minimum sample size requirements for quantitative research.

Purposive sampling was used, with criteria that respondents were permanent residents of the study area and had experience or understanding of smart home technology. This approach ensured the relevance of respondents to the research objectives.

Data Collection Techniques

Data were collected through structured questionnaires distributed to respondents. The questionnaires were developed based on indicators of each research variable and designed to measure perceptions and adaptation levels toward adaptive smart homes.

The research instrument employed a five-point Likert scale ranging from strongly disagree to strongly agree. This scale enabled the collection of quantitative data reflecting respondents' attitudes, perceptions, and experiences.

In addition to primary data, secondary data were obtained through documentation studies and literature reviews to strengthen the theoretical foundation and contextualize empirical findings.

Operational Definition of Variables

The first independent variable is social values, needs, and social relationships (X1), operationalized through indicators such as alignment of smart home technology with family values, the technology's ability to support daily activities, and its influence on household social interaction patterns.

The second independent variable is economic context and accessibility (X2), measured through indicators including household financial capacity, affordability of smart home devices and operational costs, ease of access to technology, and users' digital literacy levels.

The dependent variable is user adaptation to adaptive smart homes (Y), measured through indicators such as users' understanding of smart home systems, comfort in usage, frequency of use, and the integration of smart home technology into daily routines.

Data Analysis Techniques

Data analysis employed multiple linear regression to examine the effects of social values, needs, and social relationships (X1), as well as economic context and accessibility (X2), on user adaptation to adaptive smart homes (Y). This method allows for the simultaneous analysis of multiple independent variables affecting a single dependent variable.

Prior to regression analysis, validity and reliability tests were conducted to ensure that the research instruments were appropriate and produced consistent data. The validity test was applied to all measurement items, consisting of five statements for social values, needs, and social relationships (X1), five statements for economic context and accessibility (X2), and fifteen statements for user adaptation to adaptive smart homes (Y). The results indicate that all items have corrected item–total correlation values exceeding the critical value of $r_{table} = 0.163$, confirming that all measurement items are valid.

Reliability testing was conducted using Cronbach's alpha to assess internal consistency. The results show Cronbach's alpha values of 0.625 for X1, 0.683 for X2, and 0.787 for Y. Given that all values exceed the minimum acceptable threshold of 0.60, all variables are considered reliable.

Classical assumption tests were conducted to assess the suitability of the data for multiple linear regression analysis. The tests included normality, multicollinearity, and heteroscedasticity tests. The results of these tests are presented in the following tables and discussed accordingly to ensure that the regression model meets the required statistical assumptions.

a. Normality Test

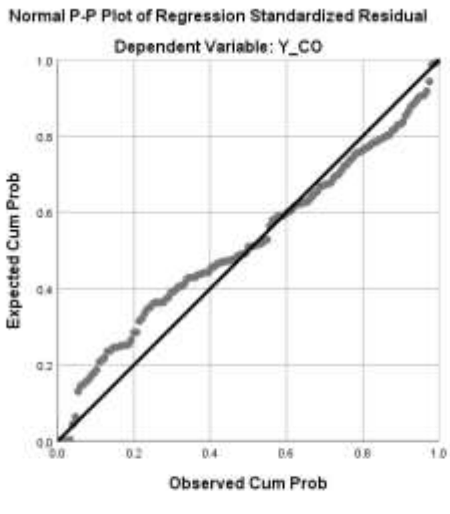

Figure 3. Normality Test, *processed by the author*

The normality of the residuals was assessed using a Normal P–P Plot of the regression standardized residuals. As shown in Figure X, the observed cumulative probabilities closely follow the diagonal reference line, indicating that the residuals are approximately normally distributed. Therefore, the normality assumption required for multiple linear regression analysis is satisfied.

b. Multicollinearity Test

Table 1. Multicollinearity Test, *processed by the author*

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	2.082	.643		3.239	.001		
	X1_CO	.919	.075	.386	12.287	.000	.995	1.005
	X2_CO	1.674	.064	.818	26.022	.000	.995	1.005

a. Dependent Variable: Y_CO

The multicollinearity test shows that all independent variables have tolerance values greater than 0.10 and variance inflation factor (VIF) values below 10, indicating the absence of multicollinearity (Table 1).

c. Heteroscedasticity Test

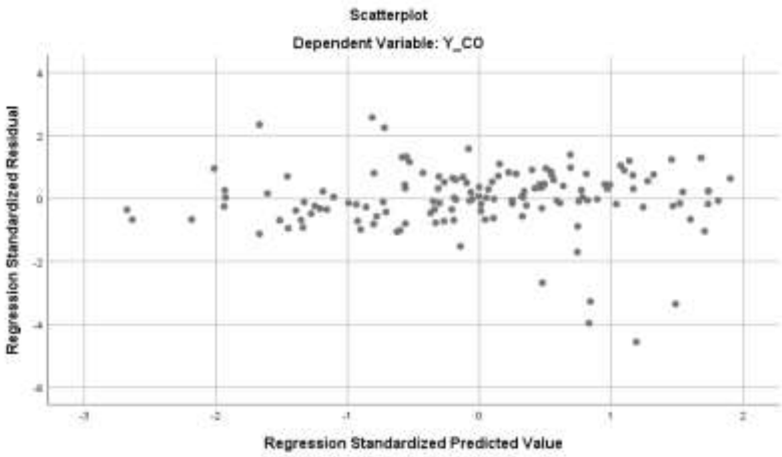

Figure 4. Heteroscedasticity Test, *processed by the author*

Heteroscedasticity was examined using a scatter plot of regression standardized residuals against standardized predicted values. As shown in Figure 4, the residuals are randomly dispersed around the zero line and do not form a specific pattern, indicating the absence of heteroscedasticity. This suggests that the assumption of homoscedasticity is met.

d. Autocorrelation Test

Table 2. Autocorrelation Test, *processed by the author*

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.929[a]	.862	.860	3.25300	1.988

a. Predictors: (Constant), X2_CO, X1_CO

b. Dependent Variable: Y_CO

Autocorrelation was tested using the Durbin–Watson statistic. The obtained Durbin–Watson value of 1.988 is close to the ideal value of 2, indicating that there is no autocorrelation in the regression residuals. Therefore, the autocorrelation assumption is satisfied.

RESEARCH RESULT

Results of Multiple Linear Regression Analysis

Multiple linear regression analysis was conducted to examine the effects of social values, needs, and social relationships (X1), as well as economic context and accessibility (X2), on the level of user adaptation to adaptive smart home technology (Y). Data processing was performed using statistical software, involving 144 respondents.

Table 3. *Multiple Linear Regression Analysis*, *processed by the author*

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.929[a]	.862	.860	3.25300

a. Predictors: (Constant), X2_CO, X1_CO

b. Dependent Variable: Y_CO

The analysis results indicate that the regression model is appropriate for further analysis. The correlation coefficient (R) value of 0.929 demonstrates a very strong overall model fit. This finding suggests that changes in social values and economic context are closely associated with the level of user adaptation to adaptive smart homes.

The coefficient of determination (R Square) value of 0.862 indicates that 86.2% of the variation in user adaptation to adaptive smart homes can be explained by social values, needs, and social relationships, as well as economic context and accessibility. The remaining 13.8% of variation is influenced by other factors not included in this research model.

The Adjusted R Square value, which is also 0.860 indicates that the regression model maintains high explanatory power even after adjustment for the number of independent variables and sample size. Therefore, the model used in this study demonstrates a high level of explained variance in explaining the phenomenon of user adaptation to adaptive smart homes.

Although the coefficient of determination is relatively high, this result does not necessarily indicate a perfect model. The high R Square value may be attributed to the fact that all analyzed variables belong to the same conceptual domain, namely users' perceptions and experiences related to adaptive smart homes. Consequently, the interpretation of these results should be conducted cautiously, taking into account the characteristics of perception-based data and potential methodological limitations.

Results of Simultaneous Test (F-Test)

The simultaneous test, or F-test, was conducted to determine the collective effect of social values, needs, and social relationships (X1), as well as economic context and accessibility (X2), on user adaptation to adaptive smart homes (Y). This test also aims to assess the overall suitability of the regression model.

Table 4. *F-Test*, *processed by the author*

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9284.948	2	4642.474	438.715	.000[b]
	Residual	1481.477	140	10.582		
	Total	10766.425	142			

a. Dependent Variable: Y_CO

b. Predictors: (Constant), X2_CO, X1_CO

Based on the ANOVA results, the calculated F-value is 438.715 with a significance level of $p < 0.001$. Since this value is lower than the predetermined significance level ($\alpha = 0.05$), it can be concluded that the regression model is statistically significant.

These results indicate that social values and economic context variables simultaneously have a significant influence on user adaptation to adaptive smart homes. Therefore, the hypothesis stating that social and economic factors jointly affect user adaptation is accepted.

This finding suggests that adaptation to smart home technology is not influenced by a single factor, but rather results from the interaction of multiple social and economic factors. This further supports the perspective that smart homes should be understood as sociotechnical systems involving dynamic relationships between technology and user context.

Results of Partial Test (t-Test)

The partial test, or t-test, was conducted to analyze the individual effects of each independent variable on the dependent variable.

Table 5. t-Test, *processed by the author*

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2.082	.643		3.239	.001
	X1_CO	.919	.075	.386	12.287	.000
	X2_CO	1.674	.064	.818	26.022	.000

a. Dependent Variable: Y_CO

The t-test results indicate that social values, needs, and social relationships (X1) have an unstandardized regression coefficient of 0.919, with a t-value of 12.287 and a significance level of $p < 0.001$. Since this value is lower than the predetermined significance level ($\alpha = 0.05$), X1 has a statistically significant effect on user adaptation to adaptive smart homes. This finding suggests that aligning technology with social values, family needs, and household social interaction patterns plays a crucial role in encouraging the acceptance and habitual use of smart home technology.

Furthermore, the economic context and accessibility variable (X2) has an unstandardized regression coefficient of 1.674, a t-value of 26.022, and a significance level of $p < 0.001$. These results indicate that X2 has a statistically significant effect on user adaptation to adaptive smart homes.

However, the t-value only reflects the significance of each variable's effect, not the relative magnitude of influence between variables. Therefore, standardized coefficients (Beta values) were used to determine the most dominant influencing variable.

The analysis results show that economic context and accessibility (X2) have a standardized Beta value of 0.818, which is higher than the Beta value of social values, needs, and social relationships (X1), which is 0.386. This indicates that, relatively, economic context and accessibility are the most dominant factors influencing user adaptation to adaptive smart homes.

The dominance of economic and accessibility factors suggests that financial capacity, affordability, and ease of access and use of technology are critical aspects in the successful adaptation of adaptive smart homes, particularly in urban residential contexts.

Discussion of the Coefficient of Determination

The high coefficient of determination indicates that the research model has a very strong capacity to explain variations in user adaptation to adaptive smart homes. This finding confirms that social and economic factors are key determinants in the process of residential technology adaptation.

Nevertheless, a small proportion of variation in user adaptation is still influenced by factors outside the research model, such as individual user characteristics, more specific levels of digital literacy, and technical support provided by smart home service providers. These factors present opportunities for future research to develop more comprehensive and inclusive models.

DISCUSSION

Overall, the results demonstrate that social values, needs, and social relationships, as well as economic context and accessibility, have significant effects on user adaptation to adaptive smart homes, both partially and simultaneously. These findings support all research hypotheses formulated in this study.

The results reinforce the view that smart home implementation cannot be separated from users' social and economic contexts. Smart home technologies designed without consideration of social values, family needs, and economic capacity are likely to face challenges in achieving optimal adoption.

The implications of this study highlight the importance for housing developers and smart home technology providers to design systems that are not only technically advanced, but also economically affordable, user-friendly, and aligned with residents' social values and needs. This approach is expected to enhance user adaptation levels and ensure the long-term sustainability of adaptive smart home use in urban residential environments.

CONCLUSIONS

Based on the analysis and discussion presented in the previous chapters, it can be concluded that user adaptation to adaptive smart home implementation is significantly influenced by social values, needs, and social relationships, as well as economic context and accessibility.

The results of the simultaneous testing indicate that both independent variables jointly have a significant effect on the level of user adaptation to adaptive smart homes. This finding confirms that the process of residential technology adaptation cannot be understood in isolation, but rather as an interaction between interrelated social and economic factors.

Partially, social values, needs, and social relationships are proven to have a significant effect on user adaptation. This suggests that the alignment of smart home technology with social values, family needs, and household interaction patterns plays a vital role in encouraging acceptance and sustained use of the technology.

In addition, economic context and accessibility are also shown to have a significant influence on user adaptation to adaptive smart homes and represent the most dominant factor. This finding indicates that economic capacity, affordability, and ease of access and use of smart home systems are primary determinants of successful user adaptation. Overall, the research model demonstrates high explanatory power in explaining variations in user adaptation to adaptive smart homes. However, the findings should be interpreted with caution due to certain limitations. This study was conducted within a single residential area, employed purposive sampling, and relied on respondents' perceptions, which may limit the generalizability of the results to other residential contexts. Future studies are therefore encouraged to involve broader study areas, apply probability sampling techniques, and incorporate more objective measures to enhance external validity.

RECOMMENDATIONS

Based on the research conclusions, the following recommendations are proposed:

1. For Housing Developers and Smart Home Technology Providers
   Housing developers and smart home technology providers are encouraged to design systems that not only emphasize technological sophistication, but also consider affordability, ease of use, and alignment with residents' social values and needs. Such an approach is expected to improve acceptance and user adaptation to adaptive smart homes.
2. For Housing Planners and Policymakers
   Policymakers in the housing sector are encouraged to support the implementation of adaptive smart homes through enabling policies, such as incentives, technical standards, and technology literacy programs for communities. These measures are important to ensure broader and more sustainable access to smart home technology.

ADVANCED RESEARCH

Future studies are recommended to incorporate additional variables not examined in this research, such as digital literacy levels, user demographic characteristics, and technical system factors. Moreover, the use of alternative methodological approaches, such as qualitative or mixed-methods research, may provide deeper insights into user adaptation processes related to smart home technology.

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