

Consumer Switching Behaviour towards Smart, Green, and Sustainable Building Materials: A UTAUT2-PPM-VBN Triad-Framework

Rajendra P.^{1,*}, Mohanasundaram T.², B. R. Vinod³, T. Gunasekar⁴

¹Department of Management Studies and Research Centre, B. M. S. College of Engineering, Bull Temple Road, Bengaluru-560019, KA, India

²Department of Management Studies, Ramaiah Institute of Technology, MSRIT Post, MSR Nagar, Bangalore-560054, India

³Department of Civil Engineering, BMS Institute of Technology and Management, India

⁴Department of Electrical and Electronics Engineering, Kongu Engineering College, Perundurai, Erode, Tamil Nadu, India

Received November 11, 2025; Revised March 23, 2026; Accepted April 15, 2026

Cite This Paper in the Following Citation Styles

(a): [1] Rajendra P., Mohanasundaram T., B. R. Vinod, T. Gunasekar, "Consumer Switching Behaviour towards Smart, Green, and Sustainable Building Materials: A UTAUT2-PPM-VBN Triad-Framework," *Civil Engineering and Architecture*, Vol. 14, No. 3, pp. 1715 - 1730, 2026. DOI: 10.13189/cea.2026.140322.

(b): Rajendra P., Mohanasundaram T., B. R. Vinod, T. Gunasekar (2026). *Consumer Switching Behaviour towards Smart, Green, and Sustainable Building Materials: A UTAUT2-PPM-VBN Triad-Framework*. *Civil Engineering and Architecture*, 14(3), 1715 - 1730. DOI: 10.13189/cea.2026.140322.

Copyright©2026 by authors, all rights reserved. Authors agree that this article remains permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

Abstract Transition to smart, green, and sustainable building materials (SGSBM) is essential for low-carbon buildings. This study develops and tests a hybrid model integrating UTAUT2, Push-Pull-Mooring (PPM), and Value-Belief-Norm (VBN) to understand and explain consumer switching behavior for SGSBM. Survey data from 193 homeowners in Bangalore, India, were analyzed with PLS-SEM (5,000 bootstraps). Goodness of fit was appropriate as per standard threshold (SRMR = 0.044; NFI = 0.937), and the explanatory power was high (R^2 of BI = ~79%; R^2 of SWB = ~79%). Performance Expectancy (PE), Effort Expectancy (EE), Hedonic Motivation (HM), Social Influence (SI), Facilitating Conditions (FC), Perceived Value (PV), and Environmental Beliefs (EB) all significantly and positively predicted Behavioral Intention (BI). BI, Perceived Behavioral Control (PBC), and PV were significant predictors of Switching Behavior (SWB) ($\beta = 0.502$, $p < 0.001$; $\beta = 0.281$, $p < 0.001$; and $\beta = 0.216$, $p < 0.001$, respectively). The direct effects of PE, EE, and HM on SWB were non-significant, and bias-corrected bootstraps confirmed significant indirect paths via BI (e.g., PE \rightarrow BI \rightarrow SWB $\beta = 0.135$, 95% CI [0.090, 0.201]), consistent with indirect-only or complementary mediation with the UTAUT2/TPB logic. The findings confirm the

essential role of intention as the focal mechanism for the transmission of cognitive, moral, and normative drivers of switching into action, while PBC was also a significant enabler of action as hypothesized, consistent with TPB/UMT tenets. The integrated tri-framework offers theoretical advances by providing a unified understanding of utilitarian, normative, and control pathways of high-involvement sustainable consumption. Communication that raises performance and value, normative approval, and the provision of enabling infrastructure can be leveraged to accelerate SGSBM adoption.

Keywords Smart, Green, and Sustainable Building Materials, Consumer Switching, Behavioral Intention, PLS-SEM, UTAUT2, PPM, VBN, Mediation, Sustainable Consumption and Pro-Environmental Behavior

1. Introduction

Sustainable consumption is now a focal point in psychological studies of pro-environmental behaviour, though switching to green alternatives in high-involvement

areas is under-studied [1]. For example, in the residential construction industry, the embodied carbon of all building materials accounts for 65–85% of all carbon emissions from "cradle to grave" throughout the entire life-cycle of the structure [2]. Traditional products like Portland cement and fired clay bricks are heavy GHG emitters that also deplete natural resources and cause pollution [3]. In contrast, Smart, Green, and Sustainable Building Materials (SGNSBM) like self-healing concrete, self-cleaning glass, bamboo, and stabilised mud interlocking blocks can provide psychological benefits such as better performance, less maintenance, cost savings, and moral congruence with one's values [4], [5]. Despite these benefits, consumers rarely switch from established routines. This status quo bias is a well-known intention-behaviour gap stemming from cognitive, normative, and inertial processes [6].

Classical approaches to understanding user behavior with regard to technology adoption, for example, the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) by [7], support that use behaviors are driven by rational/optimistic factors of use behavioral intent: performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), hedonic motivation (HM), and price value (PV). UTAUT2 has been validated in green product settings, energy-efficient appliances, and sustainable apparel [5], [8], [9]. However, the theory posits initial adoption rather than switching from a status quo and ignores the drivers and dynamics of migration, as well as the activation of moral-normative motives that have been shown to be crucial in sustainability transitions [10].

This study addresses the limitation of previous studies by expanding on the UTAUT2 to include the Push-Pull-Mooring (PPM) framework and the Values-Beliefs-Norms (VBN) theory [11], [12]. The PPM framework represents switching as a migration process: Push (pushed by conventional materials, e.g. environmental damage), Pull (pulled by SGNSBM, e.g., performance, pleasure), and Mooring (mooring factors, e.g., control, resources).

Empirical evidence includes the UTAUT2-PPM bundled model in cloud services switching [13] and green repurchase [14]. Through the VBN route, personal norms are activated by an individual's ecological worldview, generating awareness of consequences, which results in a sense of responsibility, where Environmental Beliefs (EB) is the mediating belief construct [15], [16]. UTAUT2-VBN integration has been proven in green fashion adoption [5], [9]. UTAUT2-PPM-VBN multi-framework is unique in consumer psychology as UTAUT2 provides rational-utilitarian routes (PE, PV, HM), PPM configures switching migration, and VBN provides moral-normative commitment through EB. Earlier research has not utilized this particular triad for analyzing material switching events which involve the intersection of identity, ethics, and inertia [17].

The study was conducted in Bangalore, India, a city where intense construction pollution is caused by rapid urbanization and increasing middle-class awareness and demand for green buildings and sustainable homes [18]. This research tests the predictive validity of the framework on BI and SWB using PLS-SEM on survey data from 193 homeowners who built their homes during 2022–2023. This research contributes to the body of knowledge within the field of consumer psychology by providing an additional layer of insight into the complexities of the three processes mentioned above: utilitarian, migratory and moral. The framework is relevant for nudging pro-environmental decision-making in the market for durable goods and sustainable high-involvement consumption more broadly.

Figure 1 is supplied by Good Earth Construction Company in Bangalore, Karnataka, India. Figure 1 shows the Villa houses construction using stabilized mud bricks, Solar PVs, and earthen materials.



Source: Author captured photographic image (Courtesy: Good Earth Medley Project, Bangalore, India)

Figure 1. Photo of Good Earth medley Ochre project, Bangalore, India

1.1. Sustainable Consumption and Pro-Environmental Behavior

Consumer psychology: There is an intention-behavior gap in sustainability (i.e., measured attitudes correlate with stated intentions but only weakly predict behavior; cognitive (e.g., inertia), affective (e.g., guilt), and contextual barriers exist [6], [10]. A meta-analysis found that norms, control, and attitudes explain 52% of the variance in intentions ($r = 0.42$ for behavior) as per [10]. In high-involvement domains (e.g., durables), consumers make identity-relevant decisions, which in turn strengthen the effects of self-congruence and moral identity [17], [19].

The present research contributes to consumer psychology by deciphering sustainable switching behavior as a layered psychological process, instead of a marketing-centric adoption perspective. The UTAUT2-PPM-VBN model combines the processes of intention

formation and execution, explaining how cognitive appraisals, moral beliefs, and inertia/control together influence high-involvement consumer decision-making. Unlike earlier research deriving from a single or two dimensions, this model provides a more integrated psychological explanation for barriers to translating intention into behaviour by considering utilitarian, moral, and control-related mechanisms simultaneously.

Value-based drivers prevail: biospheric values influence green intentions through concern [20]. In developing countries, social norms and eco-labelling can aid sustainable consumption, but economic factors are more influential. Recent studies mention combined hedonic-utilitarian motives. Enjoyment and value boost green involvement [5], [9]. Post-COVID behaviors: increased environmentalism, yet inertia remains [21]. Implications: need for models integrating rational, normative, and inertial factors.

1.2. Adoption of Green Building Materials

Green materials reduce lifecycle impacts through efficiency and conservation [22], [23], targeting construction's 39% emissions share [24]. SGNSBM examples include self-healing concrete [25] and bamboo [26], lowering maintenance and energy use (e.g., 40% reduction using stabilised mud interlocking (SMIB) bricks [27]).

Though technically feasible, use is slow due to switching costs, supply constraints, quality issues, and consumer inertia [28]. Consumers have been found to pay a premium of 5-20% for green buildings when certified (perceived as healthy - better indoor air quality, economic returns - energy savings, and environmental values) [29]. In India, cultural values and awareness campaigns are driving the use of SMIB to decrease pollution and labor dependency [30]. However, low perceived behavioral control and hedonic appeal may act as barriers to switching [31]. This underlines a research gap, as most focus on initial adoption, not shifting from traditional routines.

1.3. Theoretical Foundations

As stated by Venkatesh et al. [7], who developed UTAUT2, behavioral intentions (BI) to use a new technology are dependent upon performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), hedonic motivation (HM), and price value (PV). UTAUT2 has been validated for explaining green technology adoption, such as solar PV, but is focused on utilitarian motivations to adopt and lacks constructs related to switching and moral activation [32].

PPM models switching as migration [11]:

- **Push:** Dissatisfaction with status quo (e.g., environmental harm)

- **Pull:** Attractions of alternative (e.g., performance, cost savings)
- **Mooring:** Inertial forces (e.g., control, resources)

PPM complements UTAUT2 in green repurchase and service switching [13], [14].

Stern et al. [12] created VBN links biospheric values to environmental beliefs (EB), personal norms, and behavior. It predicts green choices through moral obligation [15], [16], enhancing UTAUT2 in electric vehicles [33].

Research gap: Pairwise integrations of UTAUT2 with PPM and VBN are emerging in sustainable consumption: UTAUT2-PPM explains green repurchase, while UTAUT2-VBN captures normative drivers in green app adoption [14] [34]. Triadic models remain scarce in consumer psychology, with minimal applications in sustainable adoption, integrating UTAUT2, PPM-like switching costs, and VBN norms for green marketing effects. This convergence highlights a need for holistic frameworks addressing rational (UTAUT2 utility), migratory (PPM inertia), and moral (VBN self-congruence) pathways, particularly in identity-laden decisions like green material switching [19].

1.4. Hypothesis Development

The UTAUT2-PPM-VBN link of constructs is as follows:

- Push (PPM): EB (VBN belief)
- Pull (PPM): PE, EE, SI, HM, PV (UTAUT2)
- Mooring (PPM): FC, PBC (UTAUT2)
- Normative Pathway (VBN): EB influences BI (personal norm) that in turn influences SWB

The model also contains direct antecedent-SWB paths to represent non-intentional influences in high-involvement switching (e.g., control facilitates the action). The following direct hypotheses, based on previous evidence, are posited, and then the mediation hypotheses, where the effects are channeled through BI, are presented [35].

While behavioral intention is predicted to mediate most relationships in theory, various direct paths to Switching Behavior were included for empirical testing, where it was anticipated that some constructs could act as residual or enabling factors in high involvement switching contexts. This approach permits examination of both full and partial mediation, as opposed to a priori intent-only assumptions.

1.5. Direct Effect Hypotheses

H1: Performance expectancy (PE) positively affects behavioral intention (BI). UTAUT2 green technology adoption studies have found that PE is the strongest determinant of BI, explaining 20–30% of the variance in sustainable intentions [32].

H2: Effort expectancy (EE) positively affects BI. EE

mitigates perceived barriers, positively impacting BI in high-involvement green choices. The effects are moderated by user familiarity [7], [36].

H3: Social influence (SI) positively affects BI. SI bolsters BI through normative conformity. Value-driven green purchases are where SI impacts BI by heightening the commitment to purchase for peer approval [30].

H4: Facilitating conditions (FC) positively affect BI. FC offers resources that positively influence BI, aiding in overcoming adoption gaps in sustainable behaviours [37].

H5: Environmental beliefs (EB) positively influence BI. EB activates moral norms, positively impacting BI in pro-environmental decisions, according to VBN theory [16].

H6: Price value (PV) positively influences BI. PV significantly enhances BI in UTAUT2 models for green adoption, where consumers assess cost-benefit tradeoffs [7].

H7: Perceived behavioral control (PBC) positively influences BI. PBC positively affects BI in TPB extensions for sustainable switching by overcoming perceived barriers [38].

H8: Hedonic motivation (HM) positively influences BI.

HM strengthens BI through affective pleasure, increasing engagement in GT adoption [8].

H9: Behavioral intention (BI) positively influences switching behaviour (SWB). BI is a strong predictor of SWB in UTAUT2 models for sustainable products, explaining 50% of the behaviour variance [6].

H10: Effort expectancy (EE) positively influences SWB. EE has a direct positive effect on SWB in green adoption, reducing the switching barriers beyond intention [8].

H11: Social influence (SI) positively influences SWB. SI has a direct normative influence on SWB, bypassing intention in value-congruent behaviours [5], [9].

H12: Facilitating conditions (FC) positively influence SWB. FC has a direct enabling effect on SWB through resource support, complementing intention in high-involvement contexts [39].

H13: Environmental beliefs (EB) positively influence SWB. EB has a direct effect on SWB via moral activation, independent of intention [16].

H14: Price value (PV) positively influences SWB. PV

has a direct effect on SWB in sustainable repurchase, as the cost-value tradeoffs override intention [14].

H15: Perceived behavioural control (PBC) positively influences SWB. PBC has a positive effect on SWB, mitigating inertia in switching models [38].

H16: Hedonic motivation (HM) positively influences SWB. HM has a direct positive effect on SWB through affective enjoyment, enhancing commitment beyond intention [8].

H17: Behavioural intention (BI) positively influences SWB. BI's direct effect is quite strong, with meta-analyses reporting explanatory power of $r = 0.52$ or 52% [6].

1.6. Mediation Hypotheses

Behavioural intention (BI) serves as the normative mediator, channelling antecedent effects to SWB, consistent with VBN's norm activation and UTAUT2's intention core [33], [35]. The existing literature offers minimal, if any, relevant support for these mediation paths. Therefore, they will be examined using a partial least squares-based structural equation model.

H18: BI mediates the relationship between PE and SWB.

H19: BI mediates the relationship between EE and SWB.

H20: BI mediates the relationship between SI and SWB.

H21: BI mediates the relationship between FC and SWB.

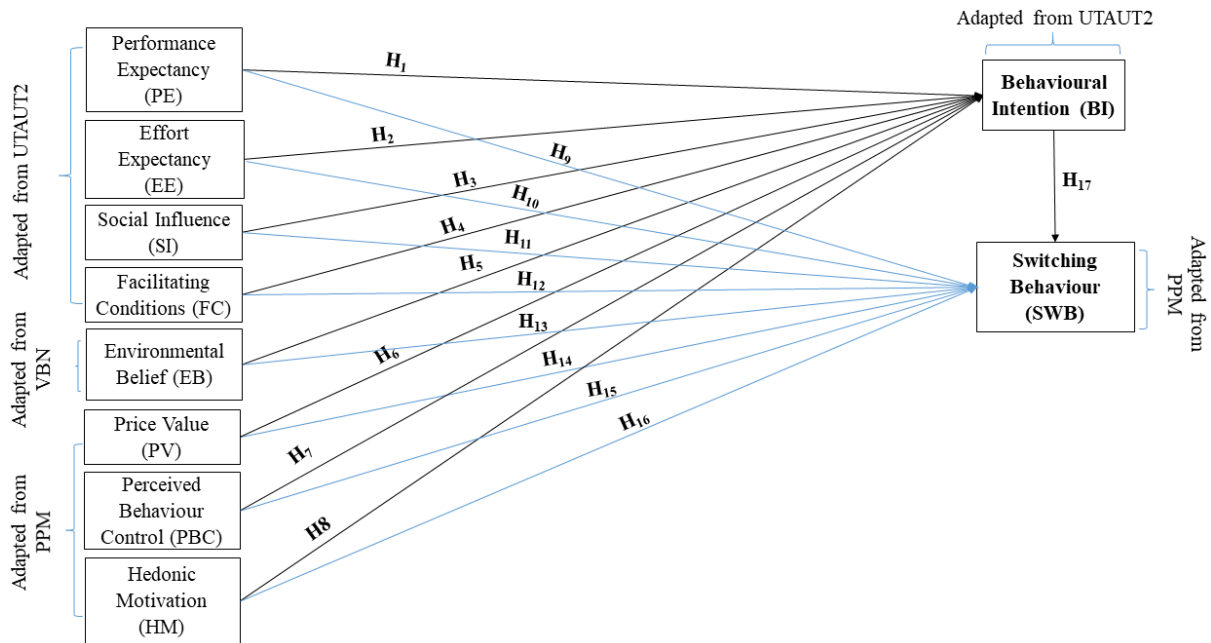
H22: BI mediates the relationship between EB and SWB.

H23: BI mediates the relationship between PV and SWB.

H24: BI mediates the relationship between PBC and SWB.

H25: BI mediates the relationship between HM and SWB.

These hypotheses advance consumer psychology by testing BI's mediating role in a triadic framework (UTAUT2-PPM-VBN), addressing the intention and switching behaviour as shown in Figure 2 (conceptual model/framework).



Source: Conceptual model of SGNSBM adoption. Adapted from various literature and modified by the author contextually

Figure 2. Triadic conceptual model/framework of SGNSBM adoption (UTAUT2-PPM-VBN)

2. Materials and Methods

2.1. Framework, Research Design and Methodology

An integrated UTAUT2–PPM–VBN model is used in this study to describe a multi-layered transition process, which cannot be perfectly presented with a pairwise model integration only. The model shows how the utilitarian and moral–normative beliefs (VBN) jointly affect behavioural intention (UTAUT2), while switching enablers or inertia (PPM) influence whether this intention is realized into actual behaviour. But in making this distinction explicit, the framework provides a new theoretical explanation for why high pro-environmental intentions may not necessarily lead to switching in practised behaviour in high involvement sustainable consumption.

In the present model, UTAUT2 depicts users' cognitive appraisal of smart, green, and sustainable building materials (e.g. perceived performance, effort, and value) that guide behavioural intention. VBN represents a sense of moral obligation such that green beliefs inspire consumers to behave according to the values favoring the environment. PPM reflects both inertia and control variables by revealing whether consumers could transform intention into switching behaviour.

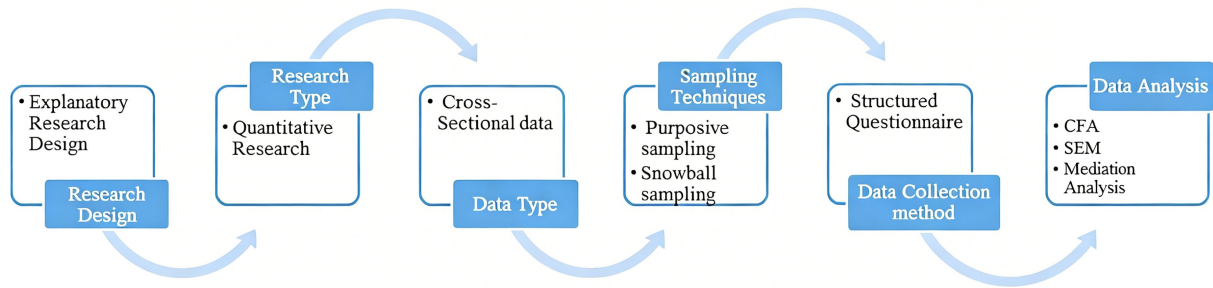
This study uses an explanatory, quantitative research method to determine which psychological drivers influence consumers' switching behavior to SGNSBM.

The cross-sectional design was used to test the integrated framework of UTAUT2-PPM-VBN. A suitable research design has been selected in order to test a theory within the area of consumer psychology, because it allows one to investigate the structural relationship between latent constructs and deal with the normality issues which are common when collecting behavioural data from surveys [40]. The partial least squares structural equation modeling (PLS-SEM) is a suitable methodological approach for testing and validating predictive models as well as complex relationships in the context of exploratory studies such as this one [41].

Figure 3 clearly depicts the complete research process used in this study.

2.2. Population and Sampling

Homeowners in Bangalore, India who either built or renovated a house during 2023 and 2024 were selected as the target population. This population was selected as it represents recent home construction in the context of increasing urbanization and environmental awareness in India [18]. Furthermore, Bangalore was selected for its contextual relevance as an emerging market city characterized by high construction-related pollution and growing environmental consciousness in its middle class [21].



Source: Authors own

Figure 3. Process of research method framework designed for this study

A hybrid approach to non-probability sampling was used, combining purposive sampling to identify and recruit initial participants that met certain selection criteria (e.g., recent homeowners that have had substantial experience making decisions) and snowball sampling to allow for snowball expansion through referrals [42], [43]. This sampling method is perfect for getting to hard-to-reach subpopulations in the field of consumer psychology where probability sampling isn't possible because the group is too small [44]. Questionnaires were distributed through online platforms & offline modes (e.g., Google Forms for online mode) and in-person networks (e.g., real estate associations). Out of 235 responses, 193 were valid after checking for completeness (more than 80% of items), univariate outliers (Mahalanobis distance < χ^2 critical value at $p < 0.001^{***}$), and multivariate normality (kurtosis < 7; skewness < 2) [40]. This sample size surpasses the 10-times-rule for PLS-SEM (10×19 paths = 190) and the power analysis criteria (G*Power: 80% power, $\alpha = 0.05$, $f^2 = 0.15$) [45].

2.3. Measures and Instrument Development

A validated multi-item scale was utilized to measure the constructs to create a multi-item Likert scale (1- Strongly Disagree / 5- Strongly Agree). Scales were adapted to fit the SGNSBM context (e.g., 'to construct the home' for most items).

Performance Expectancy (PE): The four items were adapted from [7]. For instance: "Using SGNSBM will help me improve the performance of my home."

Effort Expectancy (EE): 4 items adapted from [7]. Example item: "Learning to use SGNSBM would be easy for me."

Social Influence (SI): 3 items adapted from [7]. Example item: "People important to me think I should use SGNSBM."

Facilitating Conditions (FC): Three items were adapted from [7]. For example: "I have the resources to use SGNSBM."

Hedonic Motivation (HM): 4 items adapted from [7]. Example item: "Using SGNSBM would be enjoyable."

Price Value (PV): 3 items adapted from [7]. Example

item: "SGNSBM are worth the cost."

Perceived Behavioral Control (PBC): 3 items adapted from [7]. Example item: "I have control over using SGNSBM."

Environmental Beliefs (EB): 3 items adapted from [7]. Example item: "Using SGNSBM protects the environment."

Behavioral Intention (BI): 3 items adapted from [7]. Example item: "I intend to switch to SGNSBM."

Switching Behavior (SWB): 3 items adapted from [14]. Example item: "I have switched to SGNSBM in my project."

The instrument was pilot-tested with 30 Bangalore homeowners (Cronbach's $\alpha > 0.80$ for all scales; no items deleted).

2.4. Data Collection Procedure

Data was collected between January and June 2023 through online (self-administered) (via targeted emails and social media of Google Forms) and offline (real estate events) modes to maximise reach. A screening question was included for respondents to confirm their eligibility. Digital informed consent was acquired, emphasising anonymity, voluntary participation, and the sole utilisation of data for research objectives. After reminders, the response rate was 65%. Data were kept safe on encrypted servers, and IP anonymisation was used to prevent duplicates from happening.

2.5. Data Analysis

PLS-SEM was performed in SmartPLS 3.0 as it is appropriate for the predictive and complex models in consumer psychology [40]. The analysis was completed in three stages:

Descriptive analysis: Using descriptive statistics, the respondents' demographic features are calculated together.

Measurement model: Confirmatory Factor Analysis assessed the reflective indicators for reliability (CR > 0.70; Cronbach's $\alpha > 0.70$; $\rho_A > 0.70$), convergent validity (AVE > 0.50; Loadings > 0.70), discriminative validity (HTMT < 0.85) and collinearity (VIF < 5) [46]. Common

Method Bias (CMB) was assessed via the full collinearity VIF approach (all VIF values < 3.3) which supports that there is no substantial risk of CMB affecting the validity of the research results [47].

Structural Model: Evaluated path coefficients, significance (bootstrapping, 5,000 subsamples, two-tailed, $p < 0.05$), effect sizes ($f^2 > 0.02$ small, > 0.15 medium), predictive relevance ($Q^2 > 0$), and model fit (SRMR < 0.08, NFI > 0.90; [40]). Specific indirect effects with bias-corrected confidence intervals (95%, 5,000 bootstraps) were used to test mediation based on parameters of [40].

2.6. Ethical considerations

In the course of this research, informed consent was secured from every participant/respondent, and it was promised that the respondents themselves would remain anonymous and confidential due to privacy concerns. Moreover, the research was conducted ethically, adhering to the standard norms guiding human subject's research in social sciences.

3. Results

Partial least squares structural equation modelling (PLS-SEM) was employed for the data analysis by applying SmartPLS 3.0, and criteria from [40] were followed for reflective measurement models and structural relationships. The significance of the path was tested by bootstrapping (5,000 subsamples; two-tailed, $p < 0.05$). The findings provide support for the proposed combined UTAUT2-PPM-VBN triad theoretical model, accounting for 76.9% of the variance in endogenous constructs BI and SWB. Descriptive statistics, measurement model assessment, structural model testing, mediation analysis, and predictive relevance are shown in the subsequent sections for transparency and reproducibility.

There were 193 respondents in the sample, and there was a noticeable gender distribution. 38.86% ($n=75$) of the respondents were women, while 61.14% ($n=118$) of the respondents were men. There was variation in the age distribution of the respondents, indicating a broad variety of age groups. Up to 35 years old made up a significant share of the respondents (43%; $n=83$). The biggest age group in the sample was 36–45 years old, making up 46.1% ($n=89$). Furthermore, 6.2% ($n=12$) of the sample were 46–55 years, 4.1% ($n=8$) were 56–65 years, and 0.5% ($n=1$) were above 65 years. The respondents had diverse educational backgrounds. 58.9% of the sample ($n = 113$) had a postgraduate degree, making them the majority. Undergraduates came next, with 24.9% ($n=48$). Secondary education (1%, $n = 2$), pre-university education (2.1%, $n = 4$), diploma holders (2.1%, $n = 4$), professional degrees (10.9%, $n = 21$), and Ph.D. holders (0.5%, $n = 1$) were

among the other educational levels. This suggests that most of the sample respondents are well educated, with a large proportion of respondents holding a graduate degree. The sample's occupational status showed good cross-sector distribution. With 37.8% ($n=73$) of the total representation, the private sector was the highest, followed by the public/government sector with 35.2% ($n=68$) and the professionals with 26.9% ($n= 52$). In order to capture a wide variety of viewpoints, it is essential that a fair representation of various occupational backgrounds be included in this distribution. According to the statistics on marital status, 58.55% ($n=113$) of the respondents were married, whilst 41.45% ($n=80$) were single. The respondents' socioeconomic and family circumstances are shown by this distribution. The respondents had a wide range of monthly household income. 32.6% ($n=63$) of the respondents reported a monthly income ranging from Rs 3,00,001 to Rs 4,00,000. After that, 22.8% ($n=44$) reported earning less than Rs 1,00,000, 15% ($n=29$) reported earning between Rs 2,00,001 and Rs 3,00,000, 11.9% ($n=23$) earned between Rs 1,00,001 and Rs 2,00,000, and 17.6% ($n=34$) reported earning more than Rs 4,00,000. The respondent's diverse economic backgrounds are shown in the wide range of income levels in Table 1.

The mean value of the PE, EE, EB, FC, HM, SI, PV, and PBC constructs was between 3.057 and 4.492. Standard deviation shows moderate variability. Kurtosis values, which measure the shape of a distribution in terms of peak and flat, range from -0.661 to 4.357. Since the ideal Kurtosis value is 3, this range includes both platykurtic and leptokurtic distributions. Skewness values range from -2.132 to 0.014, indicating primarily left-skewed distributions. SmartPLS software was used for a structural equation model as it can handle complex models with many constructs and indicators, and it also works well with non-normal data [40].

3.1. Measurement Model (Construct Reliability and Validity)

The reflective model of measurement was found to be psychometrically sound. The internal consistency was proved: Cronbach's $\alpha = 0.861$ – 0.934 , composite reliability (CR) = 0.915–0.958 and ρ_A (rhoA) = 0.862–0.935 (all values > 0.70), refer to Table 2 [40]. Convergent validity was demonstrated: AVE = 0.748–0.883 (>0.50), outer loadings = 0.851–0.947, as per Table 3 [40].

Figure 4 is a pictorial representation of the measurement model assessment before proceeding with full-scale structural model evaluation and assessment.

Discriminant validity was established using Hetero-trait mono-trait ratios (HTMT) ratios < 0.85 (max 0.800 for BI-SWB), as shown in Table 3 [48]. Collinearity was not detected: VIF = 2.022–4.406 (all values < 5) as per [40].

Table 1. Demographic characteristics of respondents participating in this survey study

Gender		
Parameter	Frequency	Percentage
Male	118	61.14
Female	75	38.86
Total	193	100
Age		
Parameter	Frequency	Percentage
Up to 35 years	83	43
36 - 45	89	46.1
46 - 55	12	6.2
56 - 65	8	4.1
above 65 years	1	0.5
Total	193	100
Education		
Parameter	Frequency	Percentage
Secondary School Education	2	1
Pre-university education	4	2.1
Diploma	4	2.1
Under Graduate	48	24.9
Post Graduate	113	58.9
Professional degree	21	10.9
Ph.D.	1	0.5
Total	193	100%
Occupation		
Parameter	Frequency	Percentage
Private Sector	73	37.8
Public/Government Sector	68	35.2
Professional	52	26.9
Total	193	100
Marital Status		
Parameter	Frequency	Percentage
Single	80	41.45
Married	113	58.55
Total	193	100
Your Family Income (Monthly)		
Parameter	Frequency	Percentage
Below Rs 1,00,000	44	22.8
1,00,001 - 2,00,000	23	11.9
2,00,001 - 3,00,000	29	15.0
3,00,001 - 4,00,000	63	32.6
Above 4,00,000	34	17.6
Total	193	100

Source: Authors own

Table 2. Construct Reliability and Validity

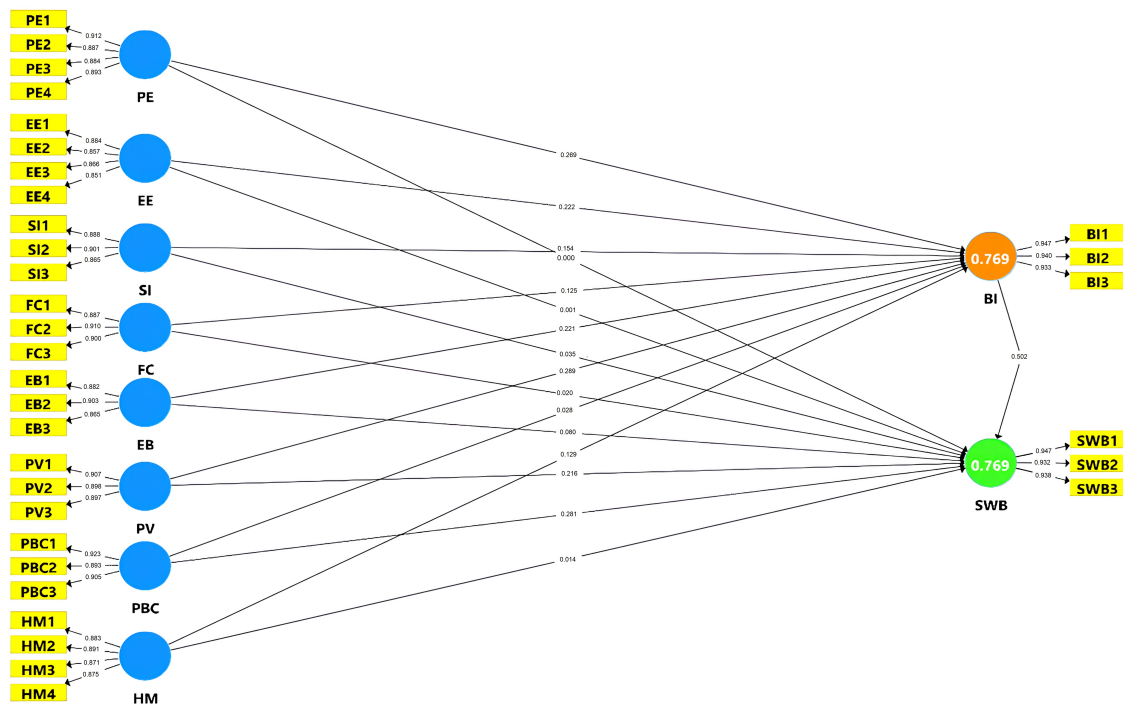
Construct	Cronbach's α	ρ_A	CR	AVE
BI	0.934	0.935	0.958	0.883
EB	0.861	0.863	0.915	0.783
EE	0.888	0.891	0.922	0.748
FC	0.882	0.895	0.927	0.809
HM	0.903	0.908	0.932	0.774
PBC	0.894	0.904	0.934	0.825
PE	0.916	0.917	0.941	0.799
PV	0.883	0.886	0.927	0.81
SI	0.862	0.862	0.916	0.784
SWB	0.933	0.933	0.957	0.882

Source: Authors own

Table 3. HTMT Ratios (Discriminant Validity)

Construct	BI	EB	EE	FC	HM	PBC	PE	PV	SI	SWB
BI	-	-	-	-	-	-	-	-	-	-
EB	0.663	-	-	-	-	-	-	-	-	-
EE	0.601	0.307	-	-	-	-	-	-	-	-
FC	0.535	0.506	0.332	-	-	-	-	-	-	-
HM	0.476	0.358	0.259	0.287	-	-	-	-	-	-
PBC	0.401	0.277	0.288	0.203	0.199	-	-	-	-	-
PE	0.618	0.372	0.385	0.228	0.197	0.189	-	-	-	-
PV	0.629	0.33	0.251	0.262	0.322	0.408	0.235	-	-	-
SI	0.514	0.303	0.259	0.287	0.158	0.242	0.279	0.312	-	-
SWB	0.800	0.589	0.476	0.447	0.387	0.626	0.463	0.705	0.459	-

Source: Authors own



Source: Authors Own

Figure 4. Measurement Model Assessment

Model fit was found good along with SRMR = 0.044 (<0.08), NFI = 0.937 (>0.90), d_ULS = 1.074, d_G = 0.729, chi-square = 849.660, and rms_Theta = 0.117 (<0.12) in Table 4 [40]. All recommended fit indices are met or exceeded. The SRMR value (0.044) indicates a good fit, NFI (0.937) suggests an adequate fit relative to a baseline model, and rms_Theta (0.117) supports a reflective model of acceptable quality. The small values for d_ULS and d_G support the model fit, as they reflect the lack of discrepancy between the empirical and model-implied covariance matrices.

3.2. Structural Model Assessment

The structural findings (bootstrapping with 5,000 samples) provide empirical support for the hypothesised

relationships within the integrated UTAUT2-PPM-VBN framework. In line with Hair et al. [40], the significant and positive standardised coefficients demonstrate that BI is the key mechanism through which the antecedent perceptions lead to SWB, based on Table 5. The R² values (0.846 for BI and 0.838 for SWB) are higher than the minimum of 0.67 “substantial” threshold as per [50] recently updated by [40], indicating that the model predicts a high variance in sustainable behaviour, as observed in Figure 5. Because of the cross-sectional nature, causation of the structural relationships should not be strictly inferred from this theoretical model, but rather robustness regarding explanatory power (R² < 0.80) and bootstrapping results suggest that reasonable predictions within the proposed SEM model are possible.

Table 4. Model Fit Indices of the Measurement and Structural Model

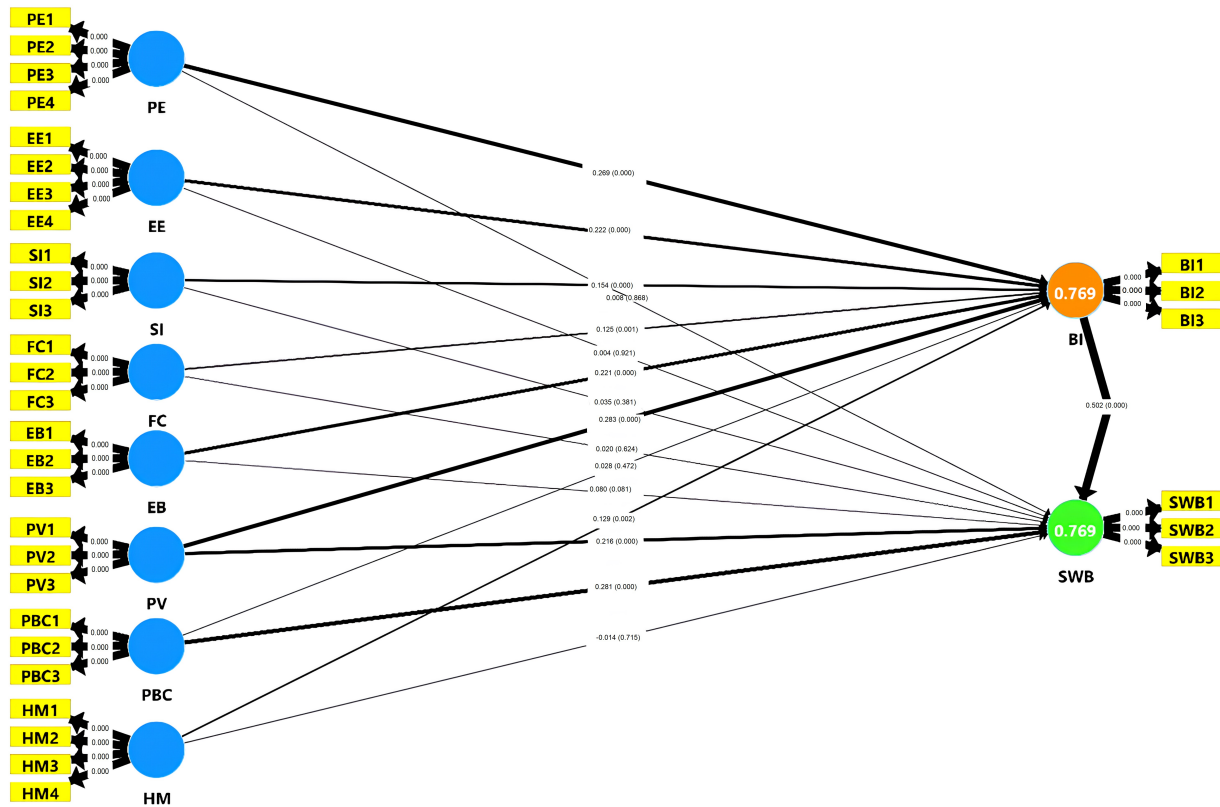
Fit Index	Description	Threshold Criteria	Saturated Model	Estimated Model	Reference
SRMR	Standardized Root Mean Square Residual	< 0.08 (Good Fit)	0.044	0.044	[40], [41]
d_ULS	Squared Euclidean Distance (Unweighted Least Squares)	Lower values = better fit	1.074	1.074	[41]
d_G	Geodesic Distance	Lower values = better fit	0.729	0.729	[41]
χ^2 (Chi-Square)	Model Chi-Square	—	849.66	849.66	[40]
NFI	Normed Fit Index	> 0.90 (Acceptable), > 0.95 (Excellent)	0.937	0.937	[40], [49]
rms_Theta	Root Mean Square Residual Theta (Reflective Model Quality)	< 0.12 (Good), < 0.07 (Excellent)	—	0.117	[40], [41]

Source: Authors own

Table 5. Direct structural relationships (bootstrapping = 5,000 resamples)

Hypothesis & Paths	β (Coefficient)	t-value	p-value	Decision
H1: PE → BI	0.269	8.349	0.000	Supported
H2: EE → BI	0.222	5.433	0.000	Supported
H3: SI → BI	0.154	3.671	0.000	Supported
H4: FC → BI	0.125	3.226	0.001	Supported
H5: EB → BI	0.221	5.396	0.000	Supported
H6: PV → BI	0.283	7.273	0.000	Supported
H7: PBC → BI	0.028	0.720	0.472	Not supported
H8: HM → BI	0.129	3.084	0.002	Supported
H9: BI → SWB	0.502	6.509	0.000	Supported
H10: EE → SWB	0.004	0.100	0.921	Not supported
H11: SI → SWB	0.035	0.875	0.381	Not supported
H12: FC → SWB	0.020	0.490	0.624	Not supported
H13: EB → SWB	0.080	1.743	0.081	Marginal
H14: PV → SWB	0.216	4.787	0.000	Supported
H15: PBC → SWB	0.281	6.879	0.000	Supported
H16: HM → SWB	-0.014	0.365	0.715	Not supported
H17: PE → SWB	0.008	0.166	0.868	Not supported

Source: Authors own



Source: Authors own

Figure 5. Structural Model Assessment

More specifically, PV ($\beta = 0.283$, $p < 0.001$), PE ($\beta = 0.269$, $p < 0.001$), and EE ($\beta = 0.222$, $p < 0.001$) exerted the strongest influences on BI followed by EB ($\beta = 0.221$, $p < 0.001$). This implies that at the pre-intention phase, their perceptions are shaped more by cognitive and utilitarian antecedents than social or facilitating ones. Simultaneously, environmental beliefs (beta = 0.221, $p < 0.001$) were a strong ethical/moral motivator supporting Stern's Value-Belief-Norm theory that states that people also use value-based obligations as a factor in making utility-driven choices when it comes to sustainable behaviors [12]. Finally, the large effect size of BI → SWB (beta = 0.502, $p < 0.001$) confirms that intention is the closest behavioral motivator [51]. High R^2 values highlight the predictive strength of the model for sustainable switching.

In the behavioural stage, Behavioural Intention ($\beta = 0.502$, $p < 0.001$), Perceived Behavioural Control ($\beta = 0.281$, $p < 0.001$), and Price Value ($\beta = 0.216$, $p < 0.001$) had a significant impact on switching behaviour. This suggests that in order for intention to be translated into action, individuals must have both the intention and the belief that they can actually adopt an alternative product/service, as stated by the Theory of Planned Behaviour [51]. The non-significant direct effects of Performance Expectancy, Effort Expectancy, and Hedonic Motivation on SWB show that performance expectancy,

effort expectancy, and hedonic motivation do not have a direct effect on SWB but only through intention; thus, there is only indirect mediation.

3.3. Mediation Path Assessment

Performance Expectancy (H18), Effort Expectancy (H19), Social Influence (H20), Hedonic Motivation (H22) and Environmental Beliefs (H24) have an indirect effect on Switching Behaviour via Behavioural Intention. Therefore, this study shows a direct-only mediation of the mediation model as shown in Table 6. This finding is consistent with the assumptions of UTAUT2 and TPB, which state that these factors influence intention but do not directly cause behaviour [7], [51].

Facilitating Conditions (H21) and Perceived Value (H23) displayed complementary mediation, showing both direct and indirect influence on behaviour - consistent with utilitarian resource and benefit frameworks [40].

Perceived Behavioural Control (H25) showed no mediation, acting instead as a direct behavioural enabler, typical of volitional constructs under high-involvement decisions. In conclusion, the pattern of indirect-only and complementary mediation confirms a theoretically coherent intention-driven mechanism, consistent with evidence in sustainable consumer behaviour meta-analyses [6], [10], [17].

Table 6. Mediation effects through Behavioral Intention

Mediated Path	β	t-value	P - value	95 % Confidence Interval [Lower Limit, Upper Limit]	Mediation Type	Decision
H18: PE → BI → SWB	0.135	4.887	0.000	[0.090, 0.201]	Indirect-only	Supported
H19: EE → BI → SWB	0.111	4.086	0.000	[0.066, 0.176]	Indirect-only	Supported
H20: SI → BI → SWB	0.077	3.201	0.001	[0.036, 0.133]	Indirect-only	Supported
H21: FC → BI → SWB	0.063	2.709	0.007	[0.026, 0.119]	Complementary	Supported
H22: HM → BI → SWB	0.065	2.839	0.005	[0.024, 0.117]	Indirect-only	Supported
H23: PV → BI → SWB	0.142	4.892	0.000	[0.092, 0.207]	Complementary	Supported
H24: EB → BI → SWB	0.111	4.566	0.000	[0.068, 0.164]	Indirect-only	Supported
H25: PBC → BI → SWB	0.014	0.730	0.465	[-0.025, 0.052]	No mediation	Not supported

Source: Authors own

Theoretically, this cross-framework validation showed that the performance-effort rationality in UTAUT2, together with the moral awareness in VBN and push-pull incentives in PPM, adequately explained consumer switching to smart, green, and sustainable materials. Methodologically, the high SRMR (0.044) and good NFI (0.937) values indicated the global adequacy of the model [41]. Practically, the results highlight that the offering (pull) benefits, facilitating conditions, and the eco-moral consciousness are conjoint forces for actualizing pro-environmental behavioural intentions.

4. Discussion and Conclusion

This research validated an integrated UTAUT2-PPM-VBN model of consumer switching behaviour in smart, green, and sustainable building materials. The model showed high explanatory power ($R^2 = 0.769$ or 76.9% for Behavioural Intention; $R^2 = 0.769$ or 77% for Switching Behaviour) and a good model fit, demonstrating the solidity of the proposed approach.

Cognitive and utilitarian drivers: There were significant correlations between all factors, including Performance Expectancy, Effort Expectancy, Perceived Value and Hedonic Motivation with Behavioural Intention (which confirms UTAUT2 proposition that both not only rational utility but also experiential utility determine an individual's acceptance of technology usage) [7]. This result corroborates previous sustainable-consumption studies, which have found that consumers evaluate green products based on both functional performance and experiential reward [5], [9].

Moral and normative drivers: EBs had a positive effect on intention. This finding could suggest the significance of moral obligation and environmental identity on intention to be sustainable [12]. This study contributes to the extension of the VBN theory. The study validated the complementary relationship between moral cognition and utilitarian incentives in the process of sustainability transition, in line with the meta-analytic

conclusions by [10].

Volitional control: In addition to the direct influence of Perceived Behavioural Control on Switching Behaviour, no mediating effect was found for intention. This is in line with [51] hypothesis that the volitional potential can become a critical factor at the action stage. The finding is supported by research findings that show that financial control and situational control moderate sustainable choice in a high-involvement domain, such as housing [6].

Mediation structure: Indirect-only mediation emerged as the most common pattern for all cognitive and affective variables, which further consolidates the unique role of intention as the pivotal psychological mechanism that links beliefs to behaviour as repeatedly evidenced in the sustainability field [52], [53]. It also offers a sound basis of conceptual consistency with the intention-behaviour framework and supports the argument that sustainable switching behaviour is more often intentional than spontaneous.

4.1. Conclusions

The empirical testing of the general model demonstrated the significance of intent as the primary cause of a consumer's decision to transition toward smart, green, and sustainable building supplies. Validated by the cognitive beliefs, moral concern, and perceived control, this mechanism delivers critical actionable information towards sustainability transitions. The hypothesised model proved that most of the studied antecedents affect the studied constructs indirectly through the behavioural intention, therefore empirically supporting the motivational predominance of the consumers' decisions and actions.

By empirically combining and reconciling the UTAUT2, PPM, and VBN models, the research builds and validates a generic structural model of rational utility, moral concern, and perceived control. The empirical evidence on this novel integrative theoretical framework positively contributes to the consumer-behaviour theory by clarifying both the indirect-only and complementary patterns of

mediation. These patterns disentangle the enabling conditions under which cognitive beliefs, moral awareness, and perceived control affect the behaviour of consumers with smart, green, and sustainable building materials. In its totality, this model extends the boundary of theoretical contribution in consumer psychology (beyond green marketing) with an explanation on how all three cognitive, moral, and control-based factors work together to predict intention and behavior when deciding a high-involvement purchase.

The key policy recommendation from this study is that mandatory use of green building materials in buildings (residential and commercial), including authorization processes, should be mandated to promote sustainable building material use. Additionally, economic incentives (e.g., tax credits and subsidies) in collaboration with certification programs (resulting from green building ratings), such as Indian Green Building Council (IGBC), Leadership in Energy and Environmental Design (LEED) and Building Research Establishment Environmental Assessment Methodology (BREEM), are crucial measures which enhance perceived values as well as behavioural control that could support a smooth consumer switch toward smart, green, and sustainable building materials with little no resistance.

5. Limitations and Future Scope

An inherent limitation is the cross-sectional nature, which prevents causal inferences. Currently, a very low/negligible amount of longitudinal data is available for the analyzed variables in the context of this study. As the field moves forward, statistically sufficient levels of longitudinal data could be acquired so that future studies can use this approach to make further analyses. Further, studies in the future may examine the generalizability of the model in different countries, and it would be beneficial to explore moderation effects, including income levels, prior green experience, environmental identity, emotions, and identity. More practically, the mediating variables this research study identified could potentially help to inform policy makers and marketing efforts that serve to translate motivations and beliefs into salient, sustainable behaviors.

Lastly, self-reported survey data were used in this study, which may generate common method bias as well as social desirability bias for these pro-environmental characteristics of the constructs. Procedural remedies (e.g., anonymity, confidentiality assurances) and statistical tests (full collinearity VIF assessment were used to address this issue, but future studies may include multi-source data, behavioural tracking, or objective adoption measures for further validation.

Declaration of Originality

The authors report that, in the course of the final revision

process, they have utilized Grammarly as their exclusive grammar and proofreading resource for the purpose of checking grammatical errors, misspellings and punctuation errors. In no case have the authors used Grammarly to assist in the generation of writing, to provide paraphrases, or to contribute to the development of any intellectual content contained within the manuscript. Therefore, all ideas, analyses, and conclusions presented in this document are entirely the product of the authors, upon which the authors accept full responsibility. The manuscript was checked for plagiarism and AI-generated content before submitting it using Turnitin, which ensured that the manuscript was authentic.

Acknowledgements

We appreciate all of the expert feedback we have received on how to properly and constructively enhance our manuscript.

Author Contribution Statement

Each of the authors has reviewed, accepted, and finalized the manuscript that is the focus of this research. In addition to reviewing, accepting and finalizing the manuscript, each of the authors has also contributed to the research paper in the following manner.

Conceptualisation: Rajendra Puttamanjaiah.

Methodology: Rajendra Puttamanjaiah

Formal Analysis: Rajendra Puttamanjaiah, Mohanasundaram Thangamuthu and Vinod B R

Investigation: Rajendra Puttamanjaiah, Mohanasundaram Thangamuthu and Vinod B R

Writing - Original Draft Preparation: Rajendra Puttamanjaiah, Mohanasundaram Thangamuthu and Vinod B R

Writing - Review and Editing: Rajendra Puttamanjaiah, Mohanasundaram Thangamuthu, Vinod B R and T.Gunasekar

Visualisation: Rajendra Puttamanjaiah and T.Gunasekar

Supervision: Mohanasundaram Thangamuthu, Vinod B R and T.Gunasekar

Funding Declaration

No funding to declare.

Conflict of Interest

The authors have no conflict of interest to report.

REFERENCES

- [1] White K., Habib R., Hardisty D. J., “How to SHIFT consumer behaviors to be more sustainable: A literature review and guiding framework,” *Journal of Marketing*, vol. 83, no. 3, pp. 22–49, 2019. DOI: 10.1177/0022242919825649.
- [2] Magwood C., Huynh T., Olgyay V., “Hidden climate impact of residential construction,” Rocky Mountain Institute (RMI), 2023. URL: <https://rmi.org/insight/hidden-climate-impact-of-residential-construction/>
- [3] Habert G., Miller S. A., John V. M., Provis J. L., Favier A., Horvath A., Scrivener K. L., “Environmental impacts and decarbonization strategies in the cement and concrete industries,” *Nature Reviews Earth & Environment*, vol. 1, no. 11, pp. 559–573, 2020. DOI: 10.1038/s43017-020-0093-3.
- [4] Han B., Zhang L., Ou J., *Smart and Multifunctional Concrete Toward Sustainable Infrastructures*, Springer, 2017, pp. 1-400.
- [5] Kumar S., Yadav R., “The impact of shopping motivation on sustainable consumption: A study in the context of green apparel,” *Journal of Cleaner Production*, vol. 295, pp. 1-14, 2021. DOI: 10.1016/j.jclepro.2021.126239.
- [6] Klöckner C. A., “A comprehensive model of environmental behaviour,” *Global Environmental Change*, vol. 23, no. 5, pp. 1028–1038, 2013.
- [7] Venkatesh V., Thong J. Y. L., Xu X., “Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology,” *MIS Quarterly*, vol. 36, no. 1, pp. 157–178, 2012. DOI: 10.2307/41410412.
- [8] Jeon H. M., Sung H. J., Kim H. Y., “Customers’ acceptance intention of self-service technology of restaurant industry: Expanding UTAUT with perceived risk and innovativeness,” *Service Business*, vol. 14, no. 4, pp. 533–551, 2020. DOI: 10.1007/s11628-020-00425-6.
- [9] Sreen N., Yadav R., Kumar S., Gleim M., “The impact of the institutional environment on green consumption in India,” *Journal of Consumer Marketing*, vol. 38, no. 1, pp. 47–57, 2021. DOI: 10.1108/JCM-12-2019-3536.
- [10] Bamberg S., Möser G., “Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour,” *Journal of Environmental Psychology*, vol. 27, no. 1, pp. 14–25, 2007. DOI: 10.1016/j.jenvp.2006.12.002.
- [11] Bansal H. S., Taylor S. F., James Y. S., “‘Migrating’ to new service providers: Toward a unifying framework of consumers’ switching behaviors,” *Journal of the Academy of Marketing Science*, vol. 33, no. 1, pp. 96–115, 2005. DOI: 10.1177/0092070304267928.
- [12] Stern P. C., Dietz T., Abel T., Guagnano G. A., Kalof L., “A Value-Belief-Norm Theory of Support for Social Movements: The case of environmentalism,” *Human Ecology Review*, vol. 6, no. 2, pp. 81–97, 1999. URL: <https://www.jstor.org/stable/24707060>
- [13] Xu F., Tian M., Xu G., Ayala B. R., Shen W., “Understanding Chinese users’ switching behaviour of cloud storage services,” *Electronic Library*, vol. 35, no. 2, pp. 214–232, 2017. DOI: 10.1108/EL-04-2016-0080.
- [14] Perez-Castillo D., Vera-Martinez J., “Green behaviour and switching intention towards remanufactured products in sustainable consumers as potential earlier adopters,” *Asia Pacific Journal of Marketing and Logistics*, vol. 33, no. 8, pp. 1776–1797, 2021. DOI: 10.1108/APJML-10-2019-0611.
- [15] Han H., “Travelers’ pro-environmental behavior in a green lodging context: Converging value-belief-norm theory and the theory of planned behavior,” *Tourism Management*, vol. 47, pp. 164–177, 2015. DOI: 10.1016/j.tourman.2014.09.014.
- [16] Mustafa S., Hao T., Jamil K., Qiao Y., Nawaz M., “Role of eco-friendly products in the revival of developing countries’ economies and achieving a sustainable green economy,” *Frontiers in Environmental Science*, vol. 10, article 955245, 2022. DOI: 10.3389/fenvs.2022.955245.
- [17] Gifford R., Nilsson A., “Personal and social factors that influence pro-environmental concern and behaviour: A review,” *International Journal of Psychology*, vol. 49, no. 3, pp. 141–157, 2014. DOI: 10.1002/ijop.12034.
- [18] Ganguly S., “Making sustainability palatable? Changing practices of middle-class food consumption in Bangalore,” *International Development Policy / Revue internationale de politique de développement*, vol. 8, no. 2, 2017. DOI: 10.4000/poldev.2478.
- [19] Aquino K., Reed A. II, “The self-importance of moral identity,” *Journal of Personality and Social Psychology*, vol. 83, no. 6, pp. 1423–1440, 2002. DOI: 10.1037/0022-3514.83.6.1423.
- [20] Joshi Y., Rahman Z., “Factors affecting green purchase behaviour and future research directions,” *International Strategic Management Review*, vol. 3, no. 1–2, pp. 128–143, 2015. DOI: 10.1016/j.ism.2015.04.001.
- [21] Testa F., Iovino R., Iraldo F., “The circular economy and consumer behaviour: The mediating role of information seeking in buying circular packaging,” *Business Strategy and the Environment*, vol. 29, no. 8, pp. 3435–3448, 2020. DOI: 10.1002/bse.2587.
- [22] Olanrewaju A. L., “An artificial neural network analysis of rework in sustainable buildings,” *IOP Conference Series: Earth and Environmental Science*, vol. 1101, no. 2, p. 022003, 2022. DOI: 10.1088/1755-1315/1101/2/022003.
- [23] Spiegel R., Meadows D., *Green Building Materials: A Guide to Product Selection and Specification*, 3rd ed., John Wiley & Sons, 2010.
- [24] United Nations Environment Programme (UNEP) and Global Alliance for Buildings and Construction (GlobalABC), “2022 Global Status Report for Buildings and Construction: Towards a Zero-Emission, Efficient and Resilient Buildings and Construction Sector.” UN Environment Programme. <https://www.unep.org/resources/publication/2022-global-status-report-buildings-and-construction> (accessed Nov. 21, 2025).
- [25] Tebo B. M., Bargar J. R., Clement B. G., Dick G. J., Murray K. J., Parker D., Verity R., Webb S. M., “Geomicrobiology of manganese(II) oxidation,” *Trends in Microbiology*, vol. 13, no. 9, pp. 421–428, 2005. DOI: 10.1016/j.tim.2005.07.009.

- [26] Rathour R., Kumar H., Prasad K., Anerao P., Kumar M., Kapley A., Pandey A., Awasthi M. K., Singh L., "Multifunctional applications of bamboo crop beyond environmental management: An Indian prospective," *Bioengineered*, vol. 13, no. 4, pp. 8893–8914, 2022. DOI: 10.1080/21655979.2022.2056689.
- [27] Webb D. J. T., "Stabilised soil and the built environment," *Renewable Energy*, vol. 5, no. 5–8, pp. 1066–1070, 1994. DOI: 10.1016/0960-1481(94)90134-1.
- [28] Beermann K., Austin M. C., "An inspection of the life cycle of sustainable construction projects: Towards a biomimicry-based road map integrating circular economy," *Biomimetics*, vol. 6, no. 4, p. 67, 2021. DOI: 10.3390/biomimetics6040067.
- [29] Darko A., Chan A. P. C., Huo X., Owusu-Manu D. G., "A scientometric analysis and visualization of global green building research," *Building and Environment*, vol. 149, pp. 501–511, 2019. DOI: 10.1016/j.buildenv.2018.12.059.
- [30] Pramudita M., Sunarso J., Hartanto D., Satyarno I., "A study on polymeric fibre reinforced stabilized mud blocks," *IOP Conference Series: Materials Science and Engineering*, vol. 1026, p. 012010, 2021. DOI: 10.1088/1757-899X/1026/1/012010.
- [31] Darko A., Chan A. P. C., "Review of barriers to green building adoption," *Sustainable Development*, vol. 25, no. 3, pp. 167–179, 2017. DOI: 10.1002/sd.1651.
- [32] Bekti D. B. M., Nugroho M., Hidayanto A. N., Shihab M. R., "Determining factors affecting rooftop solar PV intention: A PLS-SEM approach," *Sustainability*, vol. 14, no. 1, p. 280, 2022. DOI: 10.3390/su14010280.
- [33] Wang S., Fan J., Zhao D., Yang S., Fu Y., "Predicting consumers' intention to adopt hybrid electric vehicles: Using structural equation modelling," *Transportation*, vol. 43, no. 1, pp. 123–143, 2016. DOI: 10.1007/s11116-014-9567-9.
- [34] Pegan G., Marzi G., Ranfagni S., "Extending UTAUT2 with values: A cross-country study on young consumers' intention to adopt fashion subscriptions," *Business Strategy and the Environment*, vol. 34, no. 7, pp. 8334–8357, 2025. DOI: 10.1002/bse.7005.
- [35] Baron R. M., Kenny D. A., "The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations," *Journal of Personality and Social Psychology*, vol. 51, no. 6, pp. 1173–1182, 1986. DOI: 10.1037/0022-3514.51.6.1173.
- [36] Yadav R., Pathak G. S., "Young consumers' intention towards buying green products in a developing nation: Extending the theory of planned behavior," *Journal of Cleaner Production*, vol. 135, pp. 732–739, 2016. DOI: 10.1016/j.jclepro.2016.06.120.
- [37] Ajao Q., Sadeeq L., Sodiq O. O., "The impact of facilitating conditions on electric vehicle adoption intentions in sub-Saharan Africa: An integrated UTAUT model," *Journal of Renewable and Sustainable Energy*, vol. 16, no. 6, p. 065904, 2024. DOI: 10.1063/5.0230725.
- [38] Li X., Zhang X., Liu C., Shi L., Yang H., "Mechanism of attitude, subjective norms, and perceived behavioral control influencing green development behavior of construction enterprises," *Humanities and Social Sciences Communications*, vol. 10, p. 219, 2023. DOI: 10.1057/s41599-023-01724-9.
- [39] Al-Okaily M., Alkhwaldi A. F., Abdulmuhsin A. A., Alqudah H., Al-Okaily A., "Cloud-based accounting information systems usage and its impact on Jordanian SMEs' performance: The post-COVID-19 perspective," *Journal of Financial Reporting and Accounting*, vol. 21, no. 1, pp. 126–155, 2023. DOI: 10.1108/JFRA-12-2021-0476.
- [40] Hair J. F., Hult G. T. M., Ringle C. M., Sarstedt M., *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, 3rd ed., Sage, 2022.
- [41] Henseler J., Hubona G., Ray P. A., "Using PLS path modeling in new technology research," *Industrial Management & Data Systems*, vol. 116, no. 1, pp. 2–20, 2016. DOI: 10.1108/IMDS-09-2015-0382.
- [42] Heckathorn D. D., "Snowball versus respondent-driven sampling," *Sociological Methodology*, vol. 41, no. 1, pp. 355–366, 2011. DOI: 10.1111/j.1467-9531.2011.01244.x.
- [43] Sadler G. R., Lee H. C., Lim R. S.-H., Fullerton J., "Recruitment of hard-to-reach population subgroups via adaptations of the snowball sampling strategy," *Nursing & Health Sciences*, vol. 12, no. 3, pp. 369–374, 2010. DOI: 10.1111/j.1442-2018.2010.00541.x.
- [44] Riley R. D., Ensor J., Snell K. I. E., et al., "Minimum sample size for developing multivariable prediction models with continuous outcomes," *Statistics in Medicine*, vol. 40, no. 19, pp. 4230–4251, 2021. DOI: 10.1002/sim.9025.
- [45] Wolf E. J., Harrington K. M., Clark S. L., Miller M. W., "Sample size requirements for structural equation models: An evaluation of power, bias, and solution propriety," *Educational and Psychological Measurement*, vol. 76, no. 6, pp. 913–934, 2013. DOI: 10.1177/0013164413495237.
- [46] Henseler J., Ringle C. M., Sarstedt M., "A new criterion for assessing discriminant validity in variance-based structural equation modeling," *Journal of the Academy of Marketing Science*, vol. 43, no. 1, pp. 115–135, 2015. DOI: 10.1007/s11747-014-0403-8.
- [47] Kock N., "Common method bias in PLS-SEM: A full collinearity assessment approach," *International Journal of e-Collaboration*, vol. 11, no. 4, pp. 1–10, 2015. DOI: 10.4018/ijec.2015100101.
- [48] Voorhees C. M., Brady M. K., Calantone R. J., Ramirez E., "Discriminant validity testing in marketing: An analysis, causes for concern, and proposed remedies," *Journal of the Academy of Marketing Science*, vol. 44, no. 1, pp. 119–134, 2016. DOI: 10.1007/s11747-015-0455-4.
- [49] Bentler P. M., Bonett D. G., "Significance tests and goodness of fit in the analysis of covariance structures," *Psychological Bulletin*, vol. 88, no. 3, pp. 588–606, 1980. DOI: 10.1037/0033-2909.88.3.588.
- [50] Chin W. W., "The partial least squares approach for structural equation modeling," in *Modern Methods for Business Research*, G. A. Marcoulides, Ed., Lawrence Erlbaum Associates, 1998, pp. 295–336.
- [51] Ajzen I., "The theory of planned behavior," *Organizational Behavior and Human Decision Processes*, vol. 50, no. 2, pp. 179–211, 1991. DOI: 10.1016/0749-5978(91)90020-T.
- [52] Nitzl C., Roldan J. L., Cepeda G., "Mediation analysis in

partial least squares path modeling: Helping researchers discuss more sophisticated models,” *Industrial Management & Data Systems*, vol. 116, no. 9, pp. 1849–1864, 2016. DOI: 10.1108/IMDS-07-2015-0302.

[53] Zhao X., Lynch J. G., Chen Q., “Reconsidering Baron and Kenny: Myths and truths about mediation analysis,” *Journal of Consumer Research*, vol. 37, no. 2, pp. 197–206, 2010. DOI: 10.1086/651257.