SMART AND SUSTAINABLE FURNITURE: CONSUMER PERCEPTIONS OF SMART TECHNOLOGIES AND CIRCULAR MATERIALS IN DOMESTIC ENVIRONMENTS

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Abstract

The furniture sector is increasingly integrating smart technologies and sustainability principles, driven by the diffusion of smart home solutions and circular economy practices. While existing literature has largely examined smart homes and sustainable furniture as separate domains, empirical evidence on how consumers jointly perceive smart functionalities and sustainable material attributes in furniture purchasing decisions remains limited. This paper addresses this gap by analysing how domestic routines, sustainability orientations, and perceptions of smart and eco-material attributes influence consumer behaviour. An online survey based on the Computer Assisted Web Interviewing (CAWI) method was conducted with 217 Italian consumers over a nine-month period. Data were analysed using descriptive statistics, visual analytics, and an exploratory cluster *analysis. The findings show that consumers primarily interpret both sustainability and smartness through a functional and user-centred perspective, associating them with tangible benefits such as durability, safety, repairability, comfort, and energy efficiency. Conversely, more abstract environmental attributes and advanced smart technologies display lower levels of awareness and perceived relevance. The cluster analysis identifies two distinct consumer profiles: Functional–Practical Home Users, oriented toward long-term value and performance, and Aesthetics- and Style-Oriented Users, mainly driven by design and visual harmony. By jointly addressing smart technologies, sustainable materials, and domestic practices, the study contributes to research on sustainable consumption and smart home adoption, offering insights for furniture manufacturers, designers, and policymakers involved in the development of smart and sustainable living environments.*

Keywords: Smart furniture; Sustainable consumption; Circular materials; Smart home technologies; Consumer behaviour; Furniture design.

1. Introduction

The furniture sector is gradually incorporating digital technologies and environmental aspects into product development, production, packaging and marketing, alongside more traditional concerns like price and functionality. Smart-home devices and ambient intelligence solutions are increasingly embedded in domestic environments, while circular-economy principles are encouraging the use of certified and recycled materials, low-emission finishes, and resource-efficient packaging (Marcon *et al.*, 2022; Di Biase *et al.*, 2022; Michos, Dalagdi & Vrakas, 2023; Alamry, 2024; Su *et al.*, 2024)

Studies concerning smart homes and smart furniture documented a wide range of applications, from security, energy and lighting management to comfort, health monitoring and assistive technologies

(Di Biase *et al.*, 2022; Michos, Dalagdi & Vrakas, 2023; Su *et al.*, 2024; Yu *et al.*, 2024; Magara & Zhou, 2024). In parallel, research on sustainable and circular furniture have analyzed the role of certified and locally sourced wood, recycled and recyclable materials, eco-friendly finishes and smart packaging in reducing environmental impacts and supporting new business models (Marcon *et al.*, 2022; Alamry, 2024; Akinyemi, Adewole, & Tejumaiye, 2024; Pandita & Choudhary, 2024; Rashdan & Ashour, 2025). However, these two fields are normally considered separately, and empirical evidence on how users simultaneously relate to smart-home functions and to sustainable material and packaging attributes in their furniture choices is still limited.

Therefore, the objective of the paper is to fill this gap by analyzing how home routines, attitudes toward sustainability, perception of smart-home and eco-material attributes influence consumers behavior and purchase decisions. Specifically, rather than treating smartness and sustainability as independent value dimensions, this study adopts a user-centered perspective in which both are interpreted through everyday domestic practices and perceived functional value.

To achieve this objective, an online survey with 217 respondents was conducted over a nine-month period to investigate the motivations for furniture purchases, awareness and perceived importance of circular materials and packaging, and interest in smart-home and ambient technologies integrated into furniture. The survey was conducted within the framework of two projects sponsored by the Marche region (Italy), namely

DEMANU.GOAL and INTELI, and in collaboration with Cosmob S.p.A., a Technological and Research Centre for manufacturing and Wood-Furniture sector.

The study explicitly addresses consumer heterogeneity by adopting an exploratory cluster analysis, aimed at identifying distinct user profiles based on domestic practices, purchasing criteria, and attitudes toward smart and sustainable furniture solutions. This segmentation perspective is particularly relevant in the furniture sector, where products are embedded in everyday practices and where functional, aesthetic, and sustainability-related expectations may coexist in different ways across users.

Overall, the findings document how consumers prioritize durability, safety and user-centered benefits over more abstract environmental attributes and reveal different patterns of interest in smart-home technologies integrated into furniture.

By combining evidence on domestic practices, sustainability orientations and perceptions of smart and circular attributes, the paper contributes to research on economic behavior, sustainable consumption and smart-home adoption, and offers implications for firms and policymakers engaged in the design and promotion of smart, sustainable furniture solutions.

The paper is structured as follows: after this introduction section, a literature review is presented; then section 3 explains the methodology of the research and section 4describes the main results. Section 5 discusses them, while subsequently drawing the main conclusions, limitations and future research directions of this research.

2. Literature Review

This literature review is designed to frame the study within two research streams that are increasingly relevant for the furniture sector, yet still insufficiently integrated from a consumer perspective: (i) Smart home and ambient technologies, and (ii) sustainable materials and packaging. While both streams have developed rapidly over the past decade, they have largely evolved in parallel, focusing respectively on technological innovation and environmental performance, with limited attention to how these dimensions are jointly perceived and interpreted by end users in everyday domestic contexts. The review therefore pursues a dual objective. First, it systematises the main technological and material dimensions through which smartness and sustainability are currently incorporated into furniture and domestic environments. Second, and more importantly, it provides the theoretical foundation for developing a user-centred and segmentation-oriented approach aimed at understanding how different consumer profiles evaluate smart and sustainable furniture attributes in relation to their daily living routines.

2.1 Smart Home and ambient technologies

Current literature, both academic and technical, on smart homes and ambient technologies considers furniture as a part of an interconnected system that concerns human comfort, security, and energy management. The main categories withing this system, where furniture plays an active part, are: (i) Home Security, (ii) Smart Rooms, (iii) Smart Lighting and Energy Saving, (iv) Comfort and Care Technologies, (v) Voice Control & Acoustic Systems, (vi) Device Power & Charging Systems, and (vii) Health Monitoring and Telemedicine.

Literature on household security and protection systems highlights micro-cameras, movement detectors using behavior prediction codes, touch-ID entry methods, along with digital alert mechanisms (Gaikwad, Gabhane and Golait, 2015; Mahmud, Ahmed and Alhaj, 2019; Bansal, 2020; Huang, 2021; Bakhit *et al.*, 2022; Magara & Zhou, 2024).

Literature concerning smart rooms focuses on furniture that includes a network of sensors and RFID technology, that can be used as indoor climate tracking tools, gas leak and Co2 alerts, and as automated electricity managers (Endra *et al.*, 2019; Salah *et al.*, 2020; Rifai *et al.*, 2023; Su *et al.*, 2024).

Concerning lighting and energy saving, current literature focuses on intelligent energy management systems (IEMS), IoT smart lightning, sensor activated lighting and voice activated lighting (Khoa, Nhu, Son, *et al.*, 2020; Artiyasa, Kusumah, Suryana, *et al.*, 2020; Krasniqi & Vershevci, 2020; Alsalemi *et al.*, 2020; Ali *et al.*, 2021, Bouakkaz *et al.*, 2021; Ahmad *et al.*, 2022; Michos, Dalagdi & Vrakas, 2023).

Regarding comfort and care technologies, literature highlights IoT-integrated care ecosystems for the elderly, spatial accessibility optimization, therapeutic domotics and ergonomic comfort optimization (Frischer *et al.*, 2020; Simonet & Noyce, 2021; Luo, 2022; Wang *et al.*, 2022; Yu *et al.*, 2024).

Concerning voice control & acoustic systems, literature focuses on voice-controlled smart systems and smart panels for indoor acoustic regulation (Sharif & Tenbergen, 2020; Hugo *et al.*, 2021, Tao *et al.*, 2021).

Regarding device power and charging systems, current literature highlights USB ports in cabinets, desks, and various furniture, wireless charging surfaces in tables and cabinets, integrated electrical outlets in furniture, outdoor furniture and lights with integrated solar panels for solar charging (Azevedo & Santos, 2021; Xiong *et al.*, 2023; Yao, 2023).

Finally, concerning health monitoring and telemedicine, literature focuses on wearable sensors connected to sensors and hardware integrated into furniture to assist medical patients, smart medical furniture design, unobtrusive smart home health monitoring, markerless radio frequency sensing, behavioral safety analytics and intelligent systems for health monitoring (Philip *et al.*, 2021; Wang *et al.*, 2021; Li *et al.*, 2021; Cellucci, 2022; di Biase *et al.*, 2022).

Table 1 synthesizes the above categories and dimensions emerged from the literature.

Overall, the literature on smart home and ambient technologies highlights a wide range of technical solutions and application domains, but tends to adopt a system-oriented or technology-driven perspective. Consumer perception, everyday practices, and differences in how users interpret and value smart functionalities embedded in furniture remain largely underexplored. In particular, few studies explicitly address how different user profiles relate to smart technologies in domestic environments.

2.2 Sustainable materials and packaging

Recent studies on sustainable furniture highlight materials and packaging as central elements supporting circular practices throughout a product's lifespan. Ten main aspects stand out specifically: (i) Certified Wood, (ii) Locally Sourced Wood, (iii) Recycled Wood, (iv) Other Recyclable Materials, (v) Vegetable Oil/Wax-based Finishes, (vi) Low-polluting/Low-toxic Materials, (vii) Natural/Bio-based Materials, (viii) Nanomaterials, (ix) Environment-functional Materials, and (x) Smart and Eco-friendly Packaging.

Table 1 − Smart home and ambient technologies integrated into furniture: categories, technological dimensions and literature sources.

Categories	Dimensions	References
Home security	Micro-cameras; movement detectors with behavior-prediction algorithms; touch-ID entry; digital alert and notification systems	Gaikwad, Gabhane & Golait, 2015; Mahmud, Ahmed & Alhaj, 2019; Bansal, 2020; Huang, 2021; Bakhit *et al.*, 2022; Magara & Zhou, 2024
Smart rooms	Furniture with integrated sensor networks; RFID-enabled furniture; indoor climate tracking; gas leak and CO_2 alert functions; automated electricity management	Endra *et al.*, 2019; Salah *et al.*, 2020; Rifai *et al.*, 2023; Su *et al.*, 2024
Smart lighting and energy saving	Intelligent Energy Management Systems (IEMS); IoT smart lighting; sensor-activated lighting; voice-activated lighting	Khoa, Nhu, Son *et al.*, 2020; Artiyasa, Kusumah, Suryana *et al.*, 2020; Krasniqi & Vershevci, 2020; Alsalemi *et al.*, 2020; Ali *et al.*, 2021; Bouakkaz *et al.*, 2021; Ahmad *et al.*, 2022; Michos, Dalagdi & Vrakas, 2023
Comfort and care technologies	IoT-integrated care ecosystems for elderly users; spatial accessibility optimization; therapeutic domotics; ergonomic comfort optimization	Frischer *et al.*, 2020; Simonet & Noyce, 2021; Luo, 2022; Wang *et al.*, 2022; Yu *et al.*, 2024
Voice control & acoustic systems	Voice-controlled smart systems; smart acoustic panels and solutions for indoor sound regulation	Sharif & Tenbergen, 2020; Hugo *et al.*, 2021; Tao *et al.*, 2021
Device power & charging systems	USB ports integrated in cabinets, desks and furniture; wireless charging surfaces in tables and cabinets; integrated power outlets; solar-powered outdoor furniture and lighting	Azevedo & Santos, 2021; Xiong *et al.*, 2023; Yao, 2023
Health monitoring & telemedicine	Wearable sensors connected to furniture-embedded hardware; smart medical furniture design; unobtrusive smart-home health monitoring; markerless RF sensing; behavioral safety analytics and intelligent health-monitoring systems	Philip *et al.*, 2021; Wang *et al.*, 2021; Li *et al.*, 2021; Cellucci, 2022; Di Biase *et al.*, 2022

Source: Author's elaboration.

Literature about certified and locally sourced wood focuses on timber from forests managed responsibly - using regional supplies tracked by labels like FSC or PEFC, which help confirm legal sourcing while cutting transport needs (Marcon *et al.*, 2022; Alamry, 2024).

Research into recycled wood and other recycled materials stresses combining waste from homes and factories into new products, and designing items so they can be taken apart later, helping recycle materials within furniture life cycles (Marcon *et al.*, 2022; Suandi *et al.*, 2022)

Concerning surface finishes, treatments and emissions, current literature highlights that eco-friendly treatments using plant-based oils or waxes together with the adoption of low-polluting and low-toxic materials are crucial for better indoor air and occupant well-being (Marcon *et al.*, 2022; Alamry, 2024; Akinyemi, Adewole, & Tejumaiye, 2024; Pandita & Choudhary, 2024; Rashdan & Ashour, 2025).

Literature concerning natural and biobased materials emphasizes integrating renawable and bio-sourced materials into panels, resins and composites, suggesting possible cuts in stored carbon while matching public interest in environmentally oriented furnishings (Marcon *et al.*, 2022; Alamry, 2024)

Recent studies on nanomaterials highlight the benefits on using them in everyday furniture products, considering for examples components that have environmental or health-related functions, such as self-cleaning, antibacterial or air-purifying properties (Akinyemi, Adewole, & Tejumaiye, 2024; Pandita & Choudhary, 2024; Rashdan & Ashour, 2025). However, alongside these benefits, extant research also stresses the importance of evaluating possible dangers from ultra-small particles - particularly how they might affect indoor air or reach people through contact - pointing toward stronger safety rules and oversight measures within furniture manufacturing.

Finally, concerning smart and eco-friendly packaging within the furniture sector, prior studies highlight a move toward lightweight, reusable, or modular designs - frequently built for multiple uses or simple disposal - to cut down on waste, lessen shipping effects, and promote circular economic practices (Xiong *et al.*, 2020; Marcon *et al.*, 2022; Alamry, 2024). Table 2 briefly depicts the main categories and aspects detailed.

Table 2 − Sustainable materials, functional finishes and smart packaging for circular furniture: categories, dimensions and literature sources.

Categories	Dimensions	Sources
Certified wood	Use of wood from sustainably managed forests; certified supply chains (FSC, PEFC, Ecolabel, etc.)	Marcon *et al.*, 2022; Alamry, 2024
Locally sourced wood	Origin of materials; reduction of transport impacts; regional timber sourcing	Marcon *et al.*, 2022; Alamry, 2024;
Recycled wood	Use of recycled materials; integration of post-consumer and post-industrial wood flows	Marcon *et al.*, 2022; Alamry, 2024;
Recyclable materials	Product/material recyclability at end-of-life; design for closed-loop material recovery	Marcon *et al.*, 2022; Suandi *et al.*, 2022;
Vegetable oil/wax-based finishes	Low-impact surface treatments; natural oil and wax finishing systems	Marcon *et al.*, 2022; Alamry, 2024
Low-polluting/low-toxic materials	Reduced VOC and hazardous emissions; indoor air quality and health-oriented material choices	Akinyemi, Adewole, & Tejumaiye, 2024; Pandita & Choudhary, 2024; Rashdan & Ashour, 2025
Natural/bio-based materials	Use of bio-based, renewable and natural resources in panels, resins and composites	Marcon *et al.*, 2022; Alamry, 2024
Nanomaterials	Nano-enabled coatings and components; nano-scale additives for performance and functionalization	Akinyemi, Adewole, & Tejumaiye, 2024; Pandita & Choudhary, 2024; Rashdan & Ashour, 2025
Environment-functional materials	Materials with added environmental or health functions (e.g. self-cleaning, antibacterial, air-purifying)	Akinyemi, Adewole, & Tejumaiye, 2024; Pandita & Choudhary, 2024; Rashdan & Ashour, 2025
Smart & eco-friendly packaging	Reduced, lightweight, recyclable and detachable packaging; multifunctional, easy-to-dispose solutions	Xiong *et al.*, 2020; Marcon *et al.*, 2022; Alamry, 2024

Source: Author's elaboration.

While existing studies provide detailed insights into sustainable materials, finishes, and packaging solutions, they mainly focus on technical, environmental, or design-related aspects. Less attention has been paid to how consumers perceive these attributes, which sustainability dimensions are actually considered relevant in purchasing decisions, and how such perceptions vary across different types of users. As a result, sustainability is often implicitly treated as a homogeneous value, rather than as a set of attributes interpreted differently depending on domestic practices and lifestyles.

3. Methods

This methodological approach was designed to capture both aggregate trends and underlying heterogeneity in consumer behaviour related to smart and sustainable furniture. In line with the exploratory and user-centred objectives of the study, the analysis combines descriptive statistics, visual analytics, and an exploratory clustering technique to identify distinct consumer profiles based on domestic practices, purchasing motivations, and sustainability orientations.

3.1 Data Collection

Data for this study were collected through an online questionnaire administered using the Computer Assisted Web Interviewing (CAWI) method. The survey was conducted over a nine-month period, from November 2024 to August 2025, and yielded a total of 217 valid responses. The adoption of the CAWI approach was motivated by its well-known advantages, including low administration costs, rapid data collection, anonymous participation, automated data entry, and the ability to reach geographically dispersed respondents (Kraut *et al.*, 2004; Thompson *et al.*, 2003). In CAWI surveys, respondents complete the questionnaire autonomously and without the direct involvement of researchers, which facilitates participation and reduces interviewer bias (Sowa *et al.*, 2015).

The questionnaire was developed within the framework of the Marche Region research projects DEMANU.GOAL and INTELI in collaboration with Cosmob S.p.A., a Technological and Research Centre for manufacturing and Wood-Furniture sector, situated in the Marche Region (province of Pesaro and Urbino), and its content was designed in collaboration with domain experts and representatives of the companies involved in the projects. Before its dissemination, the instrument underwent a pilot test with a small group of professionals (five to six company representatives) to assess wording clarity, internal coherence, and approximate completion time. Minor revisions were made on the basis of the feedback received during the pilot phase.

The final version of the questionnaire was disseminated through online channels, including social media platforms (e.g., Facebook, Instagram, LinkedIn), messaging applications, and institutional communication tools. As participation was voluntary and based on self-selection, the study relied on a non-probability sampling strategy, specifically a combination of convenience sampling and snowball recruitment. Although this approach is common in CAWI-based consumer studies, it does not allow for full statistical generalizability of results due to the impossibility of estimating population representativeness (Kraut *et al.*, 2004; Sowa *et al.*, 2015). Nevertheless, this strategy was considered appropriate for exploratory research seeking to capture emerging attitudes, behaviours, and expectations related to sustainability, circularity, and future living environments.

The questionnaire consisted of five sections. The first section explored respondents' daily habits, time spent at home, and use of domestic spaces. The second focused on attitudes toward sustainability and the consumption of environmentally friendly furniture products. The third section investigated knowledge, perceived importance, and willingness to adopt circular and eco-materials. The fourth addressed comfort, well-being, and expectations regarding future living environments and smart-home technologies. Finally, the fifth section collected standard sociodemographic information, including gender, age , education, income, and household characteristics.

3.2 Data analysis

As a first step of the analysis, a comprehensive set of descriptive statistical procedures was performed to explore the main patterns emerging from the survey data and to provide an empirical basis for the subsequent clustering phase.

Descriptive analyses included frequency distributions, means, and standard deviations across all key variables, covering respondents' time use at home, domestic routines, purchasing motivations, sustainability-related attitudes, and awareness of eco-materials and smart-home technologies.

To enhance the interpretability of multidimensional constructs, several visual analytics techniques were employed. First, two heatmaps visualizations were generated to simultaneously examine respondents' awareness and perceived importance of (a) sustainable furniture materials and (b) home-automation technologies. These visualisations allowed for the identification of patterns of familiarity and value attribution across different technological and material attributes. In addition, a radar (spider) plot was produced to summarize respondents' behavioural and attitudinal dimensions related to daily home practices, providing an integrated overview of how users engage with domestic spaces.

Subsequently, a cluster analysis was conducted to identify internally homogeneous and externally heterogeneous groups of respondents based on their behavioral patterns, purchasing preferences, sustainability attitudes, and domestic practices. The analytical procedure followed established methodological guidelines for consumer segmentation (Hair *et al.*, 2010; Kaufman & Rousseeuw, 2005).

First, a set of variables was selected to represent the multidimensional construct of home-related behavior and attitudes. The selected variables reflect three complementary dimensions identified in the literature as central to furniture-related consumption: domestic practices and time use, purchasing criteria and value orientations, and sustainability- and technology-related attitudes. These included: (a) *time spent at home* during working days and weekends; (b) *time spent in each domestic environment*; (c) *frequency of activities performed at home*; (d) *importance assigned to purchasing factors*; (e) *importance assigned to sustainability-related factors*; (f) *willingness to pay a premium price*; (g) *well-being inside the home*; (h) *use of different home environments for daily activities*; and (i) *use of information sources*. Ordinal scales were treated as interval-level measures (Malhotra *et al.*, 2017), and categorical variables were transformed into binary indicators.

Prior to clustering, data were standardized using z-scores to ensure comparability across variables measured on different scales (Everitt *et al.*, 2011). A K-means clustering algorithm (MacQueen, 1967) was then applied to the standardized dataset. To determine the optimal number of clusters, both the Elbow Method (Thorndike, 1953) and the Silhouette

Coefficient (Rousseeuw, 1987) were evaluated for solutions ranging from $k = 2$ to $k = 8$. The $k = 2$ solution demonstrated the best balance between within-cluster cohesion and between-cluster separation, with the highest silhouette value and a clear plateau in the inertia curve and was therefore selected for interpretation. Beyond statistical adequacy, the two-cluster solution also proved theoretically meaningful, as it reflects a clear distinction between consumers primarily oriented toward functional performance and long-term value, and those mainly driven by aesthetic and stylistic considerations in the domestic environment.

The resulting two clusters were then profiled using descriptive statistics and cross-tabulations with sociodemographic variables (generation, gender, educational level, employment status, income, home tenure, and home size). The interpretation of each cluster followed a triangulation of quantitative differences in the cluster centers and theoretical expectations regarding home practices, consumer values, and sustainability attitudes (Steg & Vlek, 2009).

The final clusters represent two distinct user profiles that differ in time-use patterns, engagement with the home, sensitivity to sustainability issues, and purchasing motivations.

4. Results

4.1 Profile and consumer home behaviour

The sample consists of 217 respondents and presents a relatively balanced distribution across generational cohorts, although with a predominance of Generation X (37.3%) and Generation Y (34.6%), followed by Generation Z (19.4%) and a smaller proportion of Baby Boomers (8.8%). This composition reflects a population largely situated in adult and young-adult life stages, which aligns with typical target groups for furniture consumption and home-related decision-making.

In terms of gender, the sample is predominantly female (65.9%), with men representing 31.8% of respondents. Nearly half of respondents hold a high school diploma (49.3%), while 40% have a university degree (bachelor, master, or PhD), indicating substantial exposure to formal education.

Employment status is dominated by employees (67.3%), followed by students (12.4%) and self-employed workers (10.1%). The presence of retired individuals and unemployed respondents is minimal, in line with the young average age. Monthly income levels are largely concentrated in the €1,000–2,000 range (49.8%), followed by the €2,000–3,000 range (18%). Lower-income groups (< €1,000) represent around 20%, while higher-income brackets (> €3,000) remain limited. With regard to housing, the vast majority of respondents live in an owned home (82.5%), and about half reside in houses larger than 100 sqm (48.8%), while 39.6% live in medium-sized houses (60–100 sqm). A large portion of the sample (76.5%) reports owning a second home; additionally, 50.2% have lived in their home for more than 10 years, suggesting generally stable residential situations.

Household composition shows that most respondents live in families of two to three members, while only 4.6% live alone. About half of the sample reports the presence of children in the household (50.7%), whereas the presence of elderly individuals is less common (8.3%) (see Table 3).

Table 3 − Sample profile

		N.	%
Age	Gen. Z (1997-2012)	42	19,4
	Gen. Y (1981-1996)	75	34,6
	Gen. X (1965-1980)	81	37,3
	Baby boomers (1946-1964)	19	8,8
Gender	Female	143	65,9
	Male	69	31,8
	Prefer not to specify	5	2,3
Education	Elementary School Diploma	2	0,9
	Middle School Diploma	7	3,2
	High School Diploma	107	49,3
	Bachelor degree	43	19,8
	Master degree	44	20,3
	PhD	14	6,5
Occupation	Employee	146	67,3
	Student	27	12,4
	Self-employed worker	22	10,1
	Enterpreneur	10	4,6
	Unemployed	1	0,5
	Housewife	9	4,1
	Retired	2	0,9
Monthly Income	< 500€	25	11,5
	500-1.000€	19	8,8
	1.000-2.000€	108	49,8
	2.000-3.000€	39	18,0
	3.000-5.000€	12	5,5
	> 5.000€	5	2,3
Type of home	Owned home	179	82,5
	Rented home	29	13,4
	Other	9	4,1
House dimension	> 100 sqm	106	48,8
	60 - 100 sqm	86	39,6
	40 - 60 sqm	19	8,8
	< 40 sqm	6	2,8
Second home owner	Yes	166	76,5
	No	51	23,5
Time living in that home	Less than 1 year	15	6,9
	1-5 years	50	23,0
	6-10 years	43	19,8
	More than 10 years	109	50,2
Family members	I live alone	10	4,6
	1	37	17,1
	2	57	26,3
	3	69	31,8
	4	28	12,9
	5	9	4,1
	More than 5	7	3,2
Children at home	Yes	110	50,7
	No	97	44,7
	Prefer not to say	10	4,6
Elderly people at home	Yes	18	8,3
	No	189	87,1
	Prefer not to say	10	4,6

During a typical working day, respondents report spending a substantial amount of time at home. Only a small minority (5.7%) stays at home for less than two hours, whereas the large majority declares spending between 4 and 6 hours (41.6%) or between 2 and 4 hours (29.6%) at home during weekdays. A further 17.7% remains at home for 6 to 8 hours, and 9.1% spend more than 8 hours at home. These findings suggest that, even on working days, individuals maintain a consistent level of domestic presence, which may reflect the persistence of hybrid work arrangements, increased time allocated to household routines, or lifestyle shifts observed in recent years.

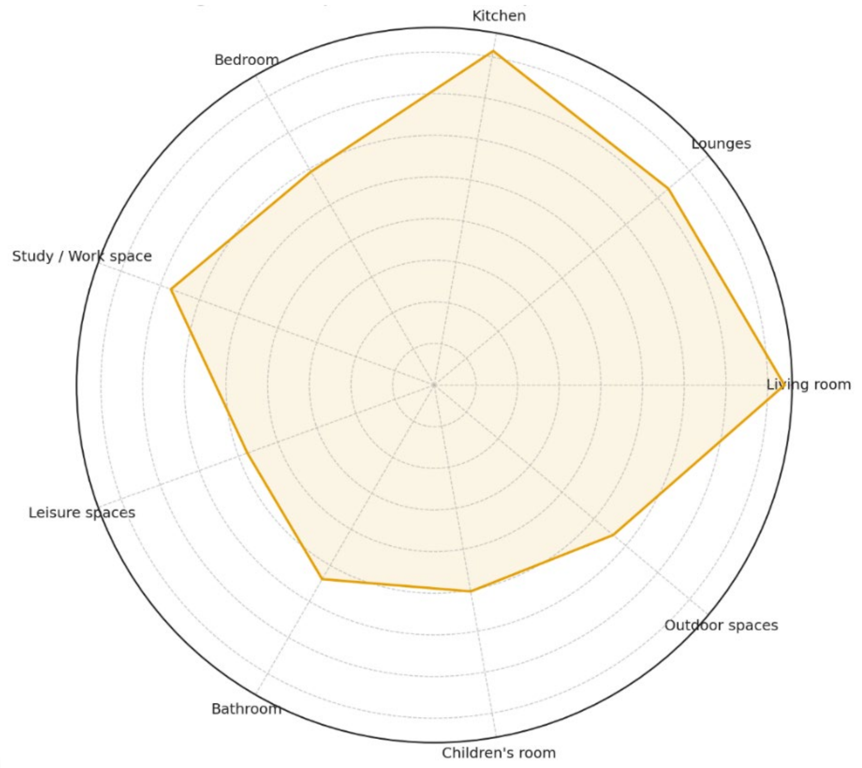
The amount of time spent at home increases considerably during weekends and holidays. Nearly half of respondents (47.8%) report spending more than 8 hours at home, while an additional 32.5% stay at home for 6 to 8 hours. Only a small fraction remains at home for shorter periods (1-4 hours), representing less than 4% of the overall sample.

The comparison between weekdays and weekends reveals substantial positive variations in the upper categories: the share of individuals spending more than 8 hours at home rises by +38.7 percentage points, while the proportion staying 6-8 hours increases by +14.8 points. Conversely, all lower time intervals decrease markedly.

Overall, weekends are characterised by significantly more prolonged domestic presence, indicating that the home remains a central place for leisure, rest, and family activities.

Figure 1 presents a radar plot illustrating the average amount of time respondents spend in different areas of their home. The distribution shows clear functional priorities. The living room and kitchen emerge as the most frequently used spaces, receiving the highest average scores, which confirms their central role in daily domestic life as multifunctional zones for cooking, eating, socialising, and relaxation.

Figure 1 − Average time spent in home spaces



The study/work space also shows relatively high usage levels, reflecting the widespread adoption of remote work or hybrid work practices. Bedrooms occupy a moderate position, suggesting that, beyond resting hours, they serve limited daytime functions.

Usage levels decline for more peripheral or activity-specific environments. Outdoor spaces, bathrooms, children's rooms, and leisure areas (such as hobby rooms, home gyms, or garages) record lower average scores, indicating that they are accessed more occasionally or for shorter, purpose-oriented intervals.

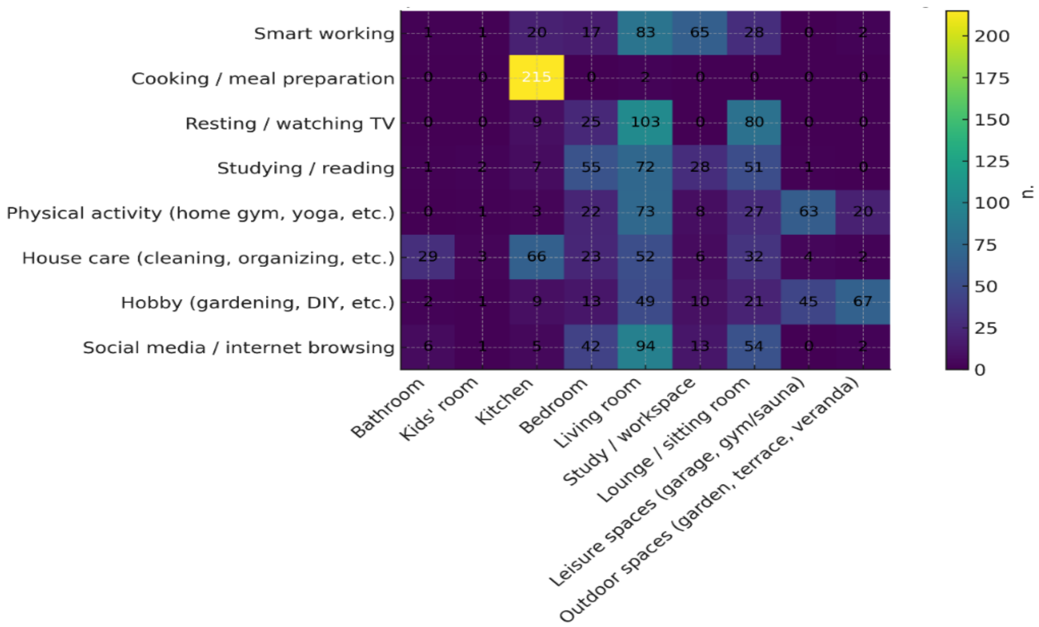
Overall, the radar profile highlights a domestic ecosystem organised around a few core spaces, particularly the living room, kitchen, and work/study area, while specialised spaces play a more marginal, complementary role in everyday life.

Figure 2 illustrates the correspondence between household activities and the domestic spaces in which they are predominantly performed. The heatmap reveals clear usage patterns that reflect the functional organisation of contemporary homes: as expected, cooking and meal preparation is overwhelmingly concentrated in the kitchen, which records the highest single frequency in the matrix. Activities related to resting and watching TV occur mainly in the living room, confirming its centrality as the primary leisure space. The living room also hosts a substantial portion of social media and internet browsing, suggesting its role as a multipurpose technological hub.

Activities requiring concentration, such as studying and reading, are distributed between the study/workspace and the bedroom, although the former shows higher frequencies, indicating that dedicated workspaces are effectively used when available. Smart working follows a similar pattern, occurring primarily in the study/workspace but also spreading across the living room and kitchen, reflecting flexible or hybrid working arrangements.

House care tasks are mainly associated with the kitchen and living areas, where cleaning and organising activities typically take place. Physical activity and hobbies show more fragmented spatial distributions, with notable usage of leisure spaces (garage, gym room, or similar), outdoor areas, and occasionally the living room, depending on the nature of the activity.

Figure 2 − Activities and prevalent home environments



Overall, these results indicate that furniture purchasing decisions are primarily driven by a combination of aesthetic appeal and pragmatic considerations, while sustainability is mainly valued when it translates into tangible benefits such as durability, safety, and ease of use. More abstract environmental attributes appear to play a secondary role.

4.2 Consumer home buying behaviour

To better understand how consumers search for information when purchasing furniture and home accessories, the study analysed the relevance attributed to a variety of information sources. Table 2 summarises the mean importance scores assigned to each source, providing insights into the channels that most strongly influence consumers' decision-making processes.

The results indicate that digital and company-managed channels play a central role in informing consumers' purchasing decisions. Company websites receive the highest importance score (M = 3.37), suggesting that respondents rely heavily on official online content when evaluating furniture options. This is followed by blogs and social networks (M = 2.86) and online shopping portals such as Amazon and eBay (M = 2.92), confirming the relevance of digital ecosystems in shaping perceptions of product features, prices, and user experiences.

Among offline sources, store staff emerge as the most influential (M = 2.96), highlighting the continued importance of in-store interactions, especially for product categories such as furniture, where tactile inspection and personalised advice still matter. Recommendations from friends and relatives (M = 2.58) also play a moderate role, reflecting the social and experiential nature of home-related purchases. Conversely, traditional mass media appear considerably less relevant. Both television advertising (M = 1.88) and radio advertising (M = 1.43) receive low scores, indicating a limited impact on consumers' decision-making processes. Similarly, although interior design magazines score slightly higher (M = 2.43), their influence remains modest compared to digital sources. Finally, architects and interior design consultants (M = 2.12) exhibit a relatively low level of influence, suggesting that professional advice is accessed selectively, possibly due to cost considerations or the informal nature of many furniture purchases (see Table 4).

Table 4 − Information sources when buying furnitures

	Mean	Std
Television advertising	1,88	1,005
Radio advertising	1,43	0,737
Interior design magazines	2,43	1,177
Architects and interior design consultants	2,12	1,265
Store staff	2,96	1,261
Recommendations from friends/relatives	2,58	1,136
Blogs/social networks	2,86	1,251
Company websites	3,37	1,218
Information and online shopping portals (eBay, Amazon, etc.)	2,92	1,213

Considering the importance of different factors in influencing consumers' furniture purchase decisions (Table 5), the results show that aesthetic and economic considerations dominate consumers' decision-making process. *Design and aesthetics* (M = 4.25) and *price* (M = 4.19) are the most influential factors, indicating that visual appeal and affordability remain the primary drivers when choosing furniture. This suggests that consumers value products that express personal style while meeting budget constraints.

Conversely, several factors display notably low importance. *Alignment with fashion trends* (M = 2.51) is among the least relevant, implying that consumers are not strongly influenced by fast-changing design trends. Similarly, the *use of easy-to-dispose packaging* (M = 2.67) and *brand reputation* (M = 2.99) play a relatively minor role, indicating limited attention to packaging sustainability and reduced loyalty to specific brands.

Among moderately influential factors, *space-saving solutions* (M = 3.66) and *product adaptability* (M = 3.69) score relatively high, highlighting a preference for functional flexibility, especially in homes with limited space. Likewise, *technological comfort features* (M = 3.12) show emerging but still moderate relevance.

Overall, the data portray consumers as pragmatic and design-oriented, with limited sensitivity to branding, packaging sustainability, or fashion-driven attributes.

Table 5 − Importance of factors influencing consumers' furniture purchase decisions

	Mean	Std
Origin of Materials	3,30	1,163
Design/Aesthetics	4,25	0,862
Price	4,19	0,876
Brand	2,99	1,173
Space saving if intended for small homes	3,66	1,237
Alignment with fashion trends	2,51	1,202
Technological features for product comfort (e.g., interactivity with other products in the room and with the consumer, automation, etc.)	3,12	1,162
Use of easy-to-dispose packaging	2,67	1,273
Product traceability to facilitate service interventions	3,45	1,205
Product adaptability to the environment	3,69	1,151
Product certification and compliance with industry regulations	3,46	1,270

By focusing on sustainability-related factors influencing the consumer behaviour, the results reveal a strong emphasis on product quality and long-term value. *Product durability* (M = 4.39) and *product safety* (M = 4.24) emerge as the most important sustainability-related factors, suggesting that consumers associate sustainability with reliability, longevity, and health protection. *Repairability* (M = 4.14) and *ease of assembly/disassembly* (M = 3.93) also score high, reflecting an appreciation for furniture that can be maintained, repaired, or reconfigured over time.

At the other end of the spectrum, more conceptual or upstream sustainability aspects, such as *biodegradability* (M = 3.21), *use of sustainably sourced wood* (M = 3.32), and *reduction of packaging* (M = 3.28), show lower levels of importance. These scores indicate that consumers may value environmental performance primarily when it translates into tangible, user-centered benefits, rather than abstract ecological attributes.

Moderate scores for recyclability, country-of-origin information, and environmental certifications suggest that, while consumers acknowledge these aspects, they are not decisive drivers in purchase decisions (see Table 6).

Table 6 − Importance of sustainability-related factors in consumers' furniture purchase decisions

	Mean	Std
Use of wood from sustainably managed forests	3,32	1,238
Use of recycled materials	3,35	1,165
Reduction of packaging	3,28	1,158
Product biodegradability	3,21	1,186
Product safety	4,24	0,967
Product durability over time	4,39	0,971
Product recyclability at end-of-life	3,48	1,202
Product repairability	4,14	1,013
Ease of assembly and disassembly	3,93	0,962
Product reusability	3,80	1,055
Environmental certifications (e.g., FSC, PEFC, Ecolabel, etc.)	3,38	1,272
Information on product composition	3,58	1,203
Information on the product's country of origin	3,49	1,163
Option for product take-back at end-of-life for disposal	3,47	1,277

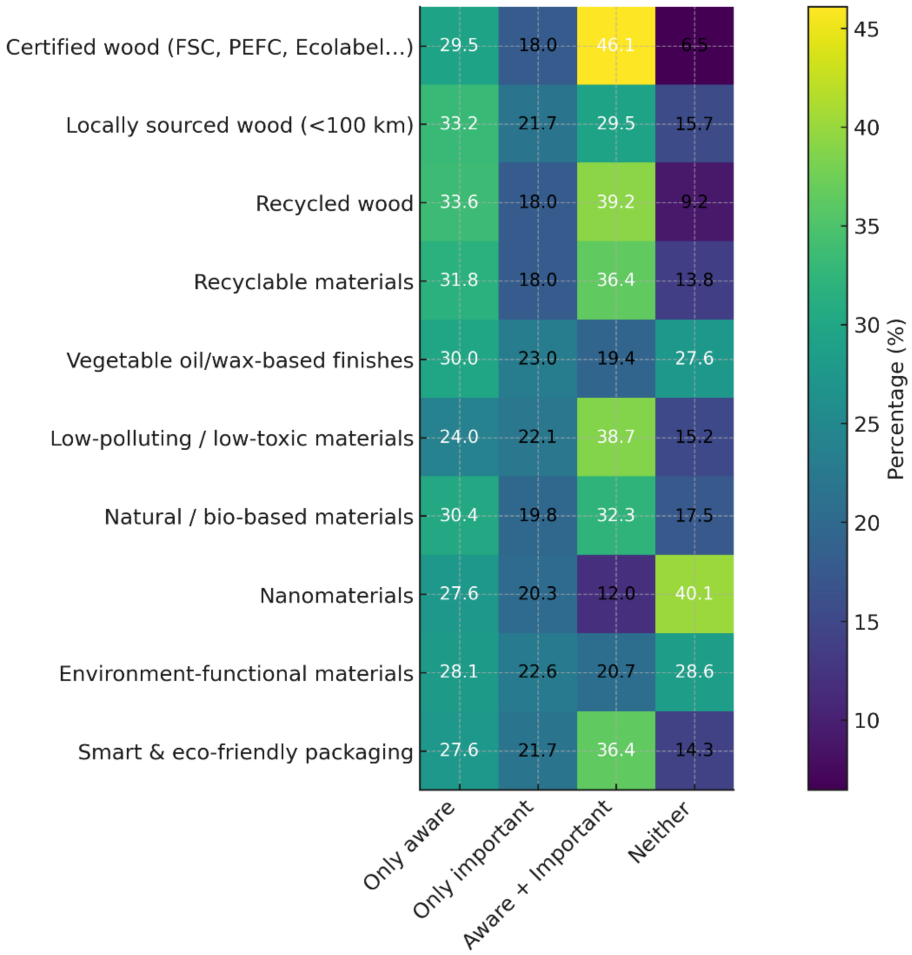
4.3 Consumer Awareness and Importance of Eco-Materials and Home Automation Technologies

This section examines consumers' awareness and perceived importance of sustainable furniture materials and home automation technologies that can be integrated into domestic environments. The analysis identifies which solutions are better known, which are considered important, and where knowledge gaps or weak perceived relevance may hinder market adoption.

The heatmap of Figure 3 reveals strong awareness and importance attached to conventional and widely publicised sustainable materials, such as *certified wood (FSC, PEFC)* and *recycled wood*. Certified wood stands out with the highest share of respondents who consider it both known and important (46.1%), indicating high trust in recognised environmental labels. Similarly, *low-polluting/low-toxic materials* and *recyclable materials* show substantial "aware + important" values, reflecting a consumer focus on health, indoor well-being, and environmental safety.

Conversely, the results highlight pronounced knowledge gaps for more advanced or emerging materials. *Nanomaterials* display the strongest lack of familiarity, with 40.1% of respondents declaring "neither aware nor important," suggesting that these technologies remain largely outside mainstream consumer understanding. *Environment-functional materials* and *vegetable oil/wax-based finishes* also show relatively high proportions of respondents in the "neither" or "only aware" categories, pointing to limited recognition or perceived relevance.

Figure 3 − Heatmap of respondents' awareness and importance of sustainable and eco-friendly furniture materials



The second heatmap (Figure 4) shows a similarly uneven landscape regarding home automation technologies. Lighting and energy-saving systems emerge as the most established category, with nearly half of respondents (48.4%) viewing them as both known and important. This suggests widespread familiarity with energy-efficient solutions and aligns with broader market trends promoting smart lighting and consumption monitoring.

Voice control and acoustic systems also register relatively high combined awareness and importance (42.4%), indicating that mainstream smart-home technologies, often embedded in consumer electronics, are increasingly integrated into furniture-related expectations. *Device charging and power systems* also show moderate recognition, likely reflecting practical everyday needs.

In contrast, more specialised and advanced technologies present noticeable awareness gaps. *Home security automation* and *smart room automation* show high shares of respondents in the "not aware" or "only importance" categories, suggesting limited technical understanding despite recognising their potential usefulness. *Health monitoring and telemedicine* technologies display a balanced distribution but still lack strong "knowledge + importance" responses, indicating that these innovations are not yet perceived as central within the home environment.

Overall, awareness is higher for consumer-electronics-driven smart technologies and for energy-saving systems, while more integrated and infrastructural home automation solutions remain less familiar. These results suggest that the adoption of advanced domotic technologies is still at an early stage, constrained by limited knowledge rather than perceived irrelevance.

Figure 4 – Heatmap of respondents' awareness and importance of smart-home technologies that can be integrated into furniture and domestic environments

4.4 Exploratory Analysis of Behavioral and Attitudinal Dimensions for Clustering

To deepen the understanding of how consumers differ in their home-related behaviours, purchasing preferences, sustainability orientations, and daily domestic practices, an exploratory clustering analysis was conducted. The procedure identified two distinct consumer clusters, each characterised by unique behavioural patterns, attitudinal profiles, and lifestyle attributes. The two profiles should not be interpreted as mutually exclusive or normative categories, but as analytically distinct orientations that highlight different ways in which consumers relate to furniture, technology, and sustainability in everyday life. Tables 7-13 and 14 summarize the differences between these clusters across behavioural dimensions (Table 7-13) and sociodemographic characteristics (Table 14).

Cluster 1, named "*Functional-Practical Home Users*" (65.9%) shows a pronounced focus on functionality, practicality, and long-term product value. Their purchasing decisions are strongly guided by factors such as durability (M = 4.74), safety (M = 4.65), repairability

(M = 4.57), adaptability (M = 4.14), and space-saving solutions (M = 3.99), all elements that directly reinforce a utilitarian, purpose-driven approach to the home.

Sustainability features that enhance performance or longevity, such as recycled materials, certified wood, low-toxicity materials, and traceability, also receive consistently higher scores in this cluster. This confirms that their interest in sustainability is functional rather than ideological: they value sustainable choices when these improve product reliability and household efficiency.

From an information-seeking perspective, Functional-Practical Users rely heavily on company websites (M = 3.68), blogs/social networks (M = 3.19), store staff (M = 3.41), and online shopping portals (M = 3.11). This indicates a preference for detailed, structured, and product-focused information when making purchasing decisions.

Their domestic routines also reflect this profile: they dedicate more time to cooking (M = 3.93), house care (M = 3.83), and functional home activities, reinforcing an organized, efficiency-oriented lifestyle.

Cluster 2, named "*Aesthetics- and Style-Oriented Users*" (34.1%), displays a decisively visual, aesthetic, and style-driven approach to home consumption. Consistent with the chosen label, this group attributes highest relevance to design and aesthetics (M = 3.85) and to the overall visual harmony of the home (M = 3.86).

Compared to Cluster 1, these consumers assign substantially lower importance to durability, repairability, or material sourcing. For example, durability drops from 4.74 to 3.80, repairability from 4.57 to 3.42 and certified materials from 3.93 to 2.46 These results highlight their reduced concern for functional or long-term product attributes, and instead a focus on products that contribute to immediate visual enhancement or stylistic cohesion.

Their information-seeking behaviours further confirm this orientation: they score lower than Cluster 1 on rational information sources such as company websites (2.78) and online portals (2.55), suggesting that their decisions are less research-intensive and more guided by visual cues, personal taste, or intuitive styling preferences.

Domestically, Aesthetics- and Style-Oriented Users spend less time in functional home tasks such as cooking (3.07 vs. 3.93) or house care (2.83 vs. 3.83), reinforcing a lifestyle where the home is experienced more as a place of comfort, identity expression, and leisure than as a space of structured daily routines.

Table 7 − Comparison of behavioral patterns across the two consumer clusters

		Functional-Practical Home Users (n. 143; 65,9%)		Aesthetics- and Style-Oriented Users (n. 74; 34,1%)	
		N.	%	N.	%
Hs at home (working days)	Less than 2 h	5	3,5	7	9,5
	2-4 h	34	23,8	28	37,8
	4-6 h	64	44,8	23	31,1
	6-8 h	27	18,9	10	13,5
	More than 8 h	13	9,1	6	8,1
Hs at home (week end)	Less than 2 h	0	0,0	2	2,7
	2-4 h	4	2,8	1	1,4
	4-6 h	25	17,5	17	23,0
	6-8 h	42	29,4	26	35,1
	More than 8 h	72	50,3	28	37,8

Table 8 − Comparison of information sources across the two consumer clusters

Info sources	Mean	St. Dev.	Mean	St. Dev.
Television advertising	2,08	1,190	1,43	0,800
Radio advertising	1,56	0,807	1,18	0,475
Interior design magazines	2,86	1,010	1,61	1,020
Architects and interior design consultants	2,55	1,232	1,30	0,937
Store staff	3,41	1,007	2,10	1,247
Recommendations from friends/relatives	2,94	0,966	1,88	1,034
Blogs/social networks	3,19	1,109	2,23	1,213
Company websites	3,68	1,058	2,78	1,348
Information and online shopping portals (eBay, Amazon, etc.)	3,11	1,142	2,55	1,333

Table 9 − Comparison of purchasing factors across the two consumer clusters

Behavioral buying factors	Mean	St. Dev.	Mean	St. Dev.
Origin of Materials	3,75	0,964	2,56	1,0840
Design/Aesthetics	4,49	0,644	3,85	1,0260
Price	4,37	0,665	3,90	1,0909
Brand	3,24	1,106	2,56	1,1619
Space saving if intended for small homes	3,99	1,082	3,12	1,2979
Alignment with fashion trends	2,69	1,238	2,21	1,0807
Technological features for product comfort (e.g., interactivity with other products in the room and with the consumer, automation, etc.)	3,37	1,087	2,72	1,1751
Use of easy-to-dispose packaging	3,18	1,156	1,81	0,9632
Product traceability to facilitate service interventions	3,94	1,024	2,62	1,0194
Product adaptability to the environment	4,14	0,818	2,94	1,2384
Product certification and compliance with industry regulations	3,96	1,007	2,59	1,2144

Table 10 − Comparison of behavioral patterns, information sources, purchasing factors, material-related buying preferences across the two consumer clusters

Material buying factors	Mean	St. Dev.	Mean	St. Dev.
Use of wood from sustainably managed forests	3,84	0,990	2,44	1,1180
Use of recycled materials	3,88	0,881	2,46	1,0374
Reduction of packaging	3,85	0,833	2,33	1,0000
Product biodegradability	3,80	0,893	2,21	0,9181
Product safety	4,65	0,578	3,57	1,1061
Product durability over time	4,74	0,571	3,80	1,1981
Product recyclability at end-of-life	4,06	0,850	2,52	1,0853
Product repairability	4,57	0,641	3,42	1,1165
Ease of assembly and disassembly	4,29	0,749	3,33	0,9874
Product reusability	4,21	0,829	3,11	1,0368
Environmental certifications (e.g., FSC, PEFC, Ecolabel, etc.)	3,93	0,990	2,46	1,1516
Information on product composition	4,14	0,818	2,64	1,1652
Information on the product's country of origin	3,96	0,847	2,69	1,1900
Option for product take-back at end-of-life for disposal	4,01	0,977	2,56	1,2042

Table 11 − Comparison of well-being perceptions across the two consumer clusters

Health behavior	Mean	St. Dev.	Mean	St. Dev.
Physical comfort (e.g., comfortable chairs, bed sofas)	4,79	0,406	4,07	1,0097
Psychological well-being (e.g., a feeling of tranquility and relaxation)	4,75	0,467	3,81	1,0967
Spatial functionality (e.g., ease of organizing and using spaces)	4,85	0,363	4,09	0,9513
Aesthetics and visual harmony (e.g., the overal appearance of the home that contributes to visu pleasure)	4,43	0,674	3,86	0,9715
Flexibility (e.g., multifunctional furniture that can adapt to different needs or times of the day	4,25	0,850	3,44	1,1180

Table 12 − Comparison of home-use habits across the two consumer clusters

Living spaces at home	Mean	St. Dev.	Mean	St. Dev.
Living room	2,57	1,789	2,25	1,7644
Lounges	2,02	1,703	1,81	1,5318
Kitchen	2,51	1,550	1,77	1,2120
Bedroom	1,31	1,587	1,44	1,6677
Study and workspaces	1,77	1,669	1,57	1,6859
Leisure spaces	0,79	0,757	0,85	0,7273
Bathroom	1,01	0,914	1,07	0,8130
Children's bedroom	0,95	0,836	0,85	1,0412
Outdoor spaces	1,23	1,249	1,07	1,0178

Table 13 − Comparison of home activities across the two consumer clusters

Home activities	Mean	St. Dev.	Mean	St. Dev.
Work (smart working)	2,04	1,279	1,80	1,1771
I cook or prepare meals	3,93	1,034	3,07	1,2225
I rest or watch TV	3,32	0,948	3,22	1,1402
I study or read	2,93	1,072	2,58	1,2234
I do physical activity (home gym, yoga, etc.)	1,93	1,069	1,59	0,8333
I take care of the house (cleaning, organizing, etc	3,83	1,044	2,83	1,0930
I pursue my favorite hobby (gardening, DIY, etc.	2,24	1,071	1,77	0,8982
I follow social media and surf the internet	3,04	1,036	2,67	1,1068

Table 8 further strengthens the distinction between the two profiles by showing how demographic patterns align with their behavioural orientations. Cluster 1 is predominantly female (72.7%), with a higher presence of Gen X and Gen Y, and a meaningful proportion of respondents with advanced education levels (Master's and PhD). This sociodemographic structure aligns naturally with a greater involvement in functional household tasks and with a more pragmatic evaluation of furniture attributes. These respondents tend to live in larger, owned homes and have greater residential stability (51% living in the same home for more than 10 years). Such stability typically correlates with a stronger focus on product longevity, repairability, and functional optimization, all dominant traits of this cluster.

Cluster 2 includes a higher proportion of younger respondents, especially Gen Z (24.3%), and a greater presence of male participants (43.2%). Their educational background is more concentrated around high school and bachelor-level studies, with fewer individuals holding advanced degrees.

They also show slightly higher representation among students and individuals with more recent housing mobility. These characteristics align well with a lifestyle in which aesthetic expression, visual preferences, and trend sensitivity play a stronger role, while long-term durability or material sustainability are not primary drivers.

Their demographic profile therefore reinforces the naming choice: this cluster reflects consumers who are more attuned to style, immediate visual appeal, and home atmospherics, and less focused on technical details or performance-based attributes.

Table 14 − Profile of the two consumer clusters

		Functional-Practical Home Users (n. 143; 65,9%)		Aesthetics- and Style-Oriented Users (n. 74; 34,1%)	
		N.	%	N.	%
Age	Baby Boomers (1946-1964)	14	9,8	4	5,4
	Gen X (1965-1980)	56	39,2	25	33,8
	Gen Y (1981-1996)	48	33,6	27	36,5
	Gen Z (1997-2012)	25	17,5	18	24,3
Gender	Male	37	25,9	32	43,2
	Female	104	72,7	39	52,7
	Prefer not to specify	2	1,4	3	4,1
Education	Elementary School Diploma	2	1,4	0	0,0
	Middle School Diploma	4	2,8	3	4,1
	High School Diploma	67	46,9	40	54,1
	Bachelor degree	26	18,2	17	23,0
	Master degree	35	24,5	9	12,2
	PhD	9	6,3	5	6,8
Occupation	Employee	98	68,5	48	64,9
	Student	15	10,5	12	16,2
	Self-employed worker	14	9,8	8	10,8
	Entrepreneur	6	4,2	4	5,4
	Unemployed	0	0,0	1	1,4
	Housewife	9	6,3	0	0,0
	Retired	1	0,7	1	1,4
Monthly Income	< 500€	17	11,9	8	10,8
	500-1.000€	13	9,1	6	8,1
	1.000-2.000€	71	49,7	37	50,0
	2.000-3.000€	25	17,5	14	18,9
	3.000-5.000€	7	4,9	5	6,8
	> 5.000€	3	2,1	2	2,7
	Not specified	7	4,9	2	2,7
Type of home	Owned home	119	83,2	60	81,1
	Rented home	16	11,2	13	17,6
	Other	0	0,0	0	0,0
House dimension	> 100 sqm	71	49,7	35	47,3
	60 - 100 sqm	58	40,6	28	37,8
	40 - 60 sqm	11	7,7	8	10,8
	< 40 sqm	3	2,1	3	4,1
Second home owner	Yes	29	20,3	18	24,3
	No	111	77,6	55	74,3
	Not specified	3	2,1	1	1,4
Time living in that home	Less than 1 year	8	5,6	7	9,5
	1-5 years	31	21,7	19	25,7
	6-10 years	31	21,7	12	16,2
	More than 10 years	73	51,0	36	48,6

5. Discussion and conclusions

5.1 Discussion of results

The findings of this study both confirm and further nuance existing literature on smart homes, furniture design, and sustainable consumption, showing that consumers tend to interpret technological innovation and sustainability primarily through a functional and user-centered lens rather than an ideological or symbolic one. In line with previous studies on green consumer behavior (Marcon *et al.*, 2022; Steg & Vlek, 2009), sustainability is mainly associated with tangible attributes such as durability, safety, repairability, and material healthiness, while more abstract or upstream characteristics, such as biodegradability, packaging reduction, or certified origin of resources, play a less decisive role in purchase decisions. Similarly, with regard to smart technologies, consumer interest is concentrated on solutions that are already embedded in everyday domestic practices, such as smart lighting, energy-saving systems, and integrated charging solutions, in line with the literature describing the incremental adoption of IoT technologies in home environments (Michos, Dalagdi & Vrakas, 2023; Su *et al.*, 2024). By contrast, more advanced or less visible technologies, such as health monitoring systems or sensor-based smart room automation, still exhibit significant knowledge gaps. This suggests that their limited diffusion is driven more by informational and cognitive barriers than by a lack of perceived usefulness, as previously suggested by Di Biase *et al.* (2022) and Philip *et al.* (2021).

The cluster analysis further strengthens this interpretation by identifying two consumer profiles that are consistent with prior research on domestic consumer segmentation. On the one hand, Functional–Practical Home Users are oriented toward performance, residential stability, and long-term value, prioritizing attributes that enhance efficiency, reliability, and adaptability over time. On the other hand, Aesthetics- and Style-Oriented Users perceive the home primarily as a space for identity expression and immediate comfort, assigning greater importance to visual harmony and design while attributing less relevance to durability, material sourcing, or repairability. This polarization suggests that the integration of smart technologies and sustainable materials in the furniture sector cannot rely on a one-size-fits-all approach. Instead, it requires differentiated design and communication strategies capable of translating innovation and sustainability into concrete, understandable benefits that align with users' daily practices and lifestyles. In this respect, the main contribution of the study lies in demonstrating that smartness and circularity, often treated as separate domains in the literature, are perceived by consumers as complementary only when they directly enhance usability, domestic well-being, and overall quality of everyday life.

5.2 Theoretical and Managerial implications

From a theoretical perspective, this study contributes to the literature on sustainable consumption and smart home adoption by bridging two research streams that are still largely treated separately: smart and ambient technologies on the one hand, and sustainable and circular furniture attributes on the other. Moreover, it advances a practice-oriented perspective by emphasising how these features are interpreted, prioritised, and integrated into everyday domestic routines. The findings suggest that consumers do not conceptualize smartness and sustainability as independent value dimensions, but rather evaluate them through their capacity to deliver concrete, user-centered benefits related to comfort, safety, health, and long-term usability. This supports and extends behavioral models of pro-environmental consumption (Steg & Vlek, 2009; Marcon *et al.*, 2022) by showing that sustainability-oriented choices in the furniture sector are primarily mediated by functional performance and experiential value, rather than by abstract environmental ideals. Moreover, the identification of two distinct consumer profiles highlights the importance of incorporating domestic practices, time-use patterns, and lifestyle orientations into theoretical frameworks that aim to explain the adoption of smart and sustainable home solutions.

Overall, the study suggests that theoretical frameworks addressing smart and sustainable living environments would benefit from integrating user heterogeneity, domestic practices, and experiential value as core analytical dimensions, rather than treating technology and sustainability as predominantly technical or normative constructs.

From a managerial standpoint, the results offer several actionable insights for furniture manufacturers, designers, and technology providers. First, product development strategies should prioritize the integration of smart and sustainable features that are immediately perceivable and easily interpretable by users, such as durability-enhancing materials, low-toxicity finishes, repairable components, and intuitive smart functions related to energy management and everyday comfort. Second, communication strategies should emphasize concrete benefits, such as improved well-being, reduced maintenance costs, and adaptability over time, rather than relying exclusively on technical specifications or environmental claims. The clear segmentation between Functional–Practical and Aesthetics- and Style-Oriented users suggests that differentiated value propositions are needed: performance-oriented narratives for consumers seeking reliability and efficiency, and design-driven narratives for those motivated by visual harmony and identity expression. In this context, company websites, digital platforms, and in-store staff emerge as critical touchpoints for conveying credible and comprehensible information about smart and circular attributes.

Finally, the study also carries relevant implications for policymakers and institutions involved in promoting sustainable and digital transitions within the built environment. The observed knowledge gaps regarding advanced smart technologies and innovative materials indicate a need for clearer standards, labeling schemes, and public information initiatives that translate technical complexity into accessible consumer knowledge. Policies supporting circular furniture design, such as incentives for repairability, modularity, and take-back systems, could reinforce consumer tendencies already oriented toward durability and long-term value.

5.3 Limitations and future research directions

Despite its contributions, this study is subject to several limitations that should be acknowledged when interpreting the results and that also open promising avenues for future research. First, the empirical analysis is based on a relatively limited sample of consumers and relies on a non-probability sampling strategy. As a consequence, the findings cannot be considered statistically representative of the entire Italian population. Although this approach is appropriate for exploratory research aimed at capturing emerging attitudes and behaviors, future studies should aim to involve larger and more diverse samples to enhance the generalizability of the results and to test the robustness of the identified consumer profiles.

A second limitation concerns the exclusively quantitative nature of the research design. While the survey allowed for the systematic comparison of attitudes, behaviors, and preferences across a relatively broad set of variables, it does not fully capture the deeper motivations, meanings, and interpretations that consumers attach to smart technologies and sustainable furniture attributes. Future research could therefore benefit from integrating qualitative methods, such as in-depth interviews or consumer-focused focus groups, to explore how individuals make sense of concepts such as smartness, circularity, comfort, and well-being in their everyday domestic practices. Qualitative insights would be particularly valuable for unpacking the cognitive and emotional processes underlying the knowledge gaps identified in relation to advanced smart technologies and innovative materials.

A further limitation relates to the cross-sectional nature of the data, which captures consumer perceptions and behaviors at a single point in time. Given the rapid evolution of both smart home technologies and sustainability-related norms, longitudinal studies could provide deeper insights into how awareness, acceptance, and adoption patterns change over time, especially as new technologies become more affordable, standardized, and embedded in everyday life.

Building on these limitations, several directions for future research emerge. In the Italian context, future studies could expand the sample size and refine segmentation analyses to better capture regional differences, housing characteristics, and socio-cultural factors influencing furniture consumption. Moreover, considering the strong export orientation of the Italian furniture industry, comparative cross-country studies represent a particularly relevant avenue for further investigation. Analyzing consumer perceptions of smart and sustainable furniture in key European and extra-European markets would allow researchers to identify convergences and divergences in demand patterns, cultural expectations, and adoption barriers. Such insights would not only enrich the academic understanding of smart and sustainable consumption but also provide valuable guidance for firms seeking to align product development and market strategies with international consumer expectations.

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