

DOI: 10.5281/zenodo.12511042

A CAUSAL MODEL OF PRODUCT DESIGN, TECHNICAL PERFORMANCE AND BRAND AWARENESS AS PREDICTORS OF CONSUMER PURCHASE INTENTIONS FOR SMART HOUSEHOLD ELECTRICAL APPLIANCES

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Received: 01/12/2025

Accepted: 02/01/2026

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ABSTRACT

To explore the key driving factors influencing consumers' purchase of smart home appliances, this paper constructs a causal model of consumer purchase intention, with product design, technical performance, and brand awareness as the core antecedent variables. By reviewing relevant literature and defining the dimensions of the variables, this paper collects samples through a questionnaire survey, selecting over five hundred consumers from mainstream online shopping platforms in China, such as JD.com, Tmall, Tiktok, and Pinduoduo. The reliability, validity, and mediating effect of the questionnaire are verified using Cronbach's alpha coefficient. The results confirm that consumers' focus on smart home appliances primarily lies in technical performance, operational convenience, brand, appearance, and other aspects. This study also provides a basis for home appliance enterprises in product research and development, technological improvement, and brand management, offering theoretical references for the healthy development of the home appliance industry.

KEYWORDS: Product Design, Technical Performance, Brand Awareness, Consumer Purchase Intentions, Smart Household Electrical Appliances

1. INTRODUCTION

Artificial intelligence, IoT technology, and the smart home ecosystem are profoundly influencing the development of the smart home appliance industry with a trend of deep integration. Especially with the improvement of AI chip integration and the decrease in sensor costs, smart home appliances have gradually transformed from traditional basic function processing tools to home intelligent agents with perception, learning, decision-making, and execution capabilities. In the context of consumer upgrading and digital economy, consumers' requirements for smart home appliances are intelligence, scalarization, aesthetics, and brand trust. Excellent household appliance enterprises in the Chinese Mainland market, such as Gree, Midea and Xiaomi, are rapidly promoting the intelligent upgrading of household appliances. Smart audio and video, smart air conditioning, smart washing machines and other products are actively purchased by consumers. According to professional institutions' predictions, the global growth scale of smart home appliances will maintain double-digit growth in the next five years. The growth rate in the Asia Pacific region is more pronounced (Chakraborty S.2013). The booming smart home appliance market is the starting point of this study. Studying consumers' willingness to purchase smart home appliances has important theoretical and practical significance for product development, marketing, and brand management of home appliance enterprises.

Consumers' willingness to purchase smart home appliances has unique complexity. Consumers choose to purchase smart home appliances, and their needs are different from those of purchasing traditional home appliances. Consumers not only want ordinary functions, but also tend to prefer interactive design, intelligent interconnection, and trust in home appliance brands. According to data from professional market research institutions, consumer satisfaction with smart home appliances mainly involves easy operation, excellent performance, product aesthetics, and brand awareness. This provides a basis for this study and constructs a model of consumer purchase intention. This study systematically examines technical performance, product design, brand awareness, perceived usefulness, and perceived ease of use as the main variables, attempting to establish a causal relationship between the interaction of several factors and consumer purchase intention. This integration is an important breakthrough in the study of smart home appliances. The research on consumer purchase intention cannot be separated from the technology acceptance model and the upgraded

version UTAT2, which provide the basis for this study. TAM emphasizes the important mediating role of "perceived usefulness" and "perceived ease of use" (Legris, P., 2003).

Product design innovation is an important factor that affects consumers' willingness to purchase, and it is also a barometer for home appliance companies to increase their profits. A good product that is loved by the public will inevitably experience hot sales. The design of household appliances involves core design elements such as appearance, material, color, and interface. Research data shows that the human-computer interaction characteristics of product design have a significant effect on attracting consumers to purchase. These characteristics also make consumers feel that they are getting better value for money. In addition, in the functional design of household appliances, both complex and single functions can affect consumers' willingness to purchase (Hu Tongruilin., 2024).

Brand awareness profoundly affects consumers' willingness to purchase. In a fully open market, numerous home appliance brands present consumers with difficulties in making choices. At this point, the brand highlights its important guiding role. As an intangible asset of quality assurance, brand enables consumers to resolve their concerns during purchase and avoid purchasing risks. Consumers are price sensitive and have high requirements for functionality, and their perception of the brand is seen as a guarantee. The literature on brand research shows that consumers' perception of a brand gradually establishes brand trust and loyalty through modern media promotion. This means that brand awareness has a significant impact on consumer purchase intention and can also lead to repeat purchases. Repeated purchases by consumers can have a positive impact on the technical performance and product design (Kim, J.,2018).

Existing research has confirmed that technological performance, product design, and brand awareness all have a positive impact on consumer purchase intention, but the intrinsic relationship between the three has not been systematically clarified. The existing research results have three important shortcomings: firstly, there is a lack of models that integrate the synergistic effects of technology, products, and brands, making it difficult to reveal the interaction effects and mediating pathways between the three variables; secondly, there is insufficient research on the causal direction between the three variables. It has not been empirically proven whether brand awareness directly affects purchase intention or whether it is moderated by factors such as technical performance. Thirdly, most of the existing research results are targeted at a specific country or

region as the research sample. However, there are significant differences in consumer willingness among different countries and regions, so the universality of the model still needs to be tested.

This study aims to construct a causal model with technical performance, product design, and brand awareness as the core independent variables, perceived usefulness and perceived ease of use as moderating variables, and consumer purchase intention as the dependent variable. This study mainly focuses on three main issues. Firstly, the impact of technological performance, product design, and brand awareness on consumers' purchase of smart home appliances; Second, what is the moderating effect of perceived usefulness and perceived ease of use on purchase intention? Thirdly, how do the three core independent variables interact with each other, and what is the moderating effect of the mediator? Fourthly, whether the constructed model has measurement invariance for different consumer groups.

This study proposes research hypotheses and constructs a theoretical model from a literature review. The research adopts the purposive sampling method to collect more than 500 consumers from the main online shopping platforms in China (Jingdong, Suning, Tmall, Tiktok, Pinduoduo) for questionnaire survey. Using structural modeling techniques to measure and test models, conducting causal path analysis, verifying hypotheses, exploring moderating mediating effects, and ultimately contributing theoretical and practical operations to the home appliance industry based on research results.

2. LITERATURE REVIEW

2.1 Technical Performance

The technical performance of smart home appliances involves multiple aspects, with hardware as the foundation and software algorithms as the core to provide consumers with an intelligent experience. According to the current development trend, technical performance includes basic performance. For example, collaborative work that relies on efficient compressors, variable frequency motors, and intelligent algorithms. The quality of core components such as motors, chips, and sensors also affects consumers' love for home appliances. The intelligence of household appliances mainly relies on sensor arrays and interactive technology. Sensors collect environmental and status data, simulating human intelligence for work. Interaction technology mainly refers to the human-computer interaction and communication between users and household appliances, and different household appliances have different human-computer interaction modes.

2.1.1 Artificial Intelligence

Artificial intelligence and the Internet of Things have a comprehensive impact on the home appliance industry. Especially with the improvement of AI chip integration and the decrease in sensor costs, the perception and learning capabilities of smart home appliances have been enhanced. Home appliances achieve intelligent operation by analyzing sensor data and user behavior patterns. The main tasks involve user activities, resource consumption, abnormal operation, scenarios, comfort, and health. Algorithms involve classical methods, ensemble methods, deep learning methods, and lightweight models optimized for edge devices. An analysis was conducted on different algorithms in terms of accuracy, requirements, adaptability, and real-time integration.

Large models represented by DeepSeek are driving fundamental changes in smart home appliances (Shin, J., 2025). Transforming from emphasizing functionality to life scenarios to intelligent learning, and elevating to a whole house home system. Intelligent perception is the use of AI to capture human activities, perform detection, and integrate data such as temperature, humidity, wind, air, sound, and light in the bathroom to create a comfortable bathing environment through multi-dimensional intelligent perception (Zhang Limin, 2026). "Adaptive" is different from AI, as it involves analyzing sensor data to understand consumer preferences. In the intelligent regulation of wind speed in range hoods, long short-term memory algorithms are used to achieve dynamic control through real-time monitoring and analysis of cooking process parameters, effectively reducing PM2.5 concentrations in the discharged oil fumes (Xian Zhixiong, 2026). 77 Voice interaction is a common human-computer interaction. The interaction of ordinary household appliances is limited to "on" and "off" modes, lacking intelligent perception of users' lifestyle habits. In the future, smart home appliances will be able to perceive human gestures, expressions, emotions, and language through human feedback. Artificial intelligence embodies that products are self-heating products of life, with flawless human-machine interaction and machines capable of intelligently understanding consumer needs.

2.1.2 Internet of Things

With the development of cloud computing, big data, and artificial intelligence, the interconnection cost of smart home appliances has significantly decreased. Specifically manifested in technologies such as ZigBee, Z-Wave, Wi Fi, and Bluetooth. Wi Fi is characterized by its high bandwidth and wide

compatibility; Zigbee and Z-Wave are low-power, compatible, and suitable for devices such as sensors; Bluetooth demonstrates its convenience through its point-to-point connection. There is also Matter's protocol, which unifies devices from different vendors based on existing technologies such as Wi-Fi and Thread, solving interoperability challenges. At the technical level, the unified interconnection standard has established a three-in-one framework of "soft bus+hard, bus+intelligence": the open-source Harmony OS carries the soft bus, the Star Flash wireless communication protocol supports the hard bus, and the end cloud collaborative AI constitutes intelligence. This autonomous and controllable standard system is expected to form a global parallel dual standard situation with Matter standards.

Since 5G technology supports the whole house intelligence of the household and therefore facilitates connection of all household appliances as well as data transmission, it is natural and logical to use blockchain technology to guarantee data security, and to employ improved algorithms for local processing of sensitive data.

The Internet of Things technology in smart home appliances is evolving from "connectivity" to "intelligence" and from "single product" to "ecology". Cross-scenario collaboration is gradually being implemented. However, challenges such as device management, multi-user, privacy and security, and standardization still need to be overcome. The future focus will be on intelligent frontiers such as cloud edge, open ecology, and scenarios, in order to promote the transition of smart home appliance IoT technology from "interconnectivity" to "active intelligence". (Habib, M. R., et al. 2024).

2.1.3 Sensors and Cloud Computing

Because sensors and cloud computing together support the perception and computing functions of smart home appliances, it is very natural and apt to describe sensors as the "nerve endings" of smart home appliances, which gather information and monitor user behavior, while cloud computing is the 'central brain' that offers data storage, processing, and analysis capabilities.

Since sensors and cloud computing together support the perception and computing functions of smart home appliances, it is very natural and apt to say that sensors are the "nerve endings" of smart home appliances, used for gathering information and monitoring user behavior, while cloud computing is the 'central brain' providing data storage, processing, and analysis. (Chayalakshmi, C. L., et al. 2024) The sensor functions of smart home appliances are

divided into visual sensing, position sensing, physical sensing, etc. The choice of sensor depends on the specific application requirements: optical sensors are widely used due to their cost advantages. However, smart home appliances face many challenges. For example, furniture placement, space, and materials can all affect signal propagation, so sensors must have adaptive capabilities and high-precision algorithm support. Non-contact sensors have good applications in analyzing user activities, physiological perception, and other aspects. Traditional sensor systems have complex debugging and poor environmental adaptability. To address these issues, the Network and Cloud Computing team at Tianjin University has achieved a key solution. Their high-precision perception of WiFi signals does not require users to wear devices, and can accurately determine users' location, posture, and behavior solely based on WiFi signals. The team will also turn robotic vacuum cleaners into "collectors" of environmental data. In the daily cleaning process, the system constructs synchronized home maps and WiFi maps to accurately identify the location of household appliances and furniture, which is the direction for wireless sensing technology to enter the public home (Gampa, S. H., et al. 2023).

Research shows that in elderly fall testing; cloud computing uses optical sensors to collect user data and achieves real-time judgment and warning of falls in the elderly through cloud algorithms. In the management of household appliance power consumption, AI-driven sensors and cloud computing synchronously implement monitoring, automation, and voice control, which have played a good role in reducing household appliance energy consumption (Li, et al. 2024).

2.2 Product Design

Artificial intelligence is deeply integrated into the design of home appliances. Among them, digital design, AI design, personalized customization, green design, embodied intelligence, and interactive design have become mainstream. The consumption concepts of green, intelligent, and healthy have a profound impact on product design, and user-centered design has become mainstream. By transforming abstract user needs into concrete product designs and combining engineering and design theories, a modeling design system covering form, elements, and style has been constructed, achieving a perfect integration of product form, color, and human-computer interaction interface (Zhang S, 2023).

Inclusive design is becoming an important direction in the design of smart home appliances. The research by Yao Jian et al. systematically elucidates

the four dimensions of inclusive design: firstly, functional inclusiveness, practicality, and ease of operation. The second is that when applying home appliances, specific functions can be recognized and the entire smart home system can be interconnected; the third is to focus on the adaptability of physiological functions, the caring nature of emotions, the ease of use of cognitive memory, and the auxiliary nature of behavioral activities. The core of the four points is safety, ease of use, accessibility, and emotional companionship.

AIoT technology presents new features of systematization, integration, and complexity in the experience of smart home appliances. Human computer interaction is also the mainstream of smart home appliance design. In interaction design, it is important to focus on the interaction between users and products, as well as the emotional experience, in order to achieve the design goals of being “user-friendly and easy to use.”

2.2.1 Appearance Design

Exterior design is a comprehensive design that revolves around appearance, materials, color, and interface, elevating household appliances from “industrial products” to “works of art”. The current mainstream design is simplicity, allowing appliances to harmoniously match with furniture and walls. In terms of color, light blue, white, light gray, etc. become the main colors, and the materials are extended to ceramics, glass, metal, etc. In terms of craftsmanship, light and shadow, color change, and CMF are reconstructing the appearance of household appliances. In order to stand out among similar products, the appearance design will form replicable family design symbols such as shape, color, proportion, etc., deepening consumers’ impression of the product. The integration of elements such as new Chinese style and Eastern aesthetics into exterior design achieves the fusion of tradition and modernity, reflecting the power of Chinese design (Zhang Linghao, 2021).

Green design should also be considered in the appearance design of smart home appliances, making material selection, manufacturing, and recycling a complete cycle. Personalized design is also an important aspect that can satisfy niche aesthetics. The appearance design should focus on multimodal seamless interaction, voice, touch, and sensing technologies, reflecting that “the best design is to make users feel the design”. Since the appearance design of smart home appliances is essentially an interdisciplinary field involving design aesthetics, functional technology, user experience, and environmental space, the future design follows a

clear and reasonable direction: user centricity, interdisciplinary integration, harmony of technology and aesthetics, standardization combined with personalization, and moving products from life tools toward life artworks.

2.2.2 Functional Design

Functional technology can reasonably be described in terms of types, interfaces, features, power consumption, and sustainability, while functional design itself is based on sensor data and an understanding of user behavior to arrive at proper actions. The AI perception scene chip achieves excellent visual accuracy, thus enabling reliable detection of subtle changes in human posture and activity, which in turn allows air conditioners to regulate environmental temperature and humidity in real time intelligently, refrigerators to recognize different foods, and washing machines to assess the cleanliness of clothes for optimal washing (Kim, S., et al. 2019).

The principle of adaptive decision-making is clearly stated: the system optimizes its operation continuously on the basis of context awareness (Rey-Jouanchicot, J., 2025), which is nicely illustrated by an air conditioning product exhibited at the AWE 2026 exhibition, which uses millimeter wave radar to sensitively detect human position and posture and therefore provides air conditioning supply truly suited to user comfort. Similarly, Haier L4 smart home appliances are equipped with AI Eye 2.0 technology that automatically handles household chores throughout the house, taking single product intelligence up to whole house intelligence (Samancioglu, N., et al. 2024).

Cross device collaboration technology is reshaping the functional boundaries of smart home appliances. Cross device collaboration technology achieves a complete closed loop of “perception, cognition, decision-making, execution, and natural interaction”, and can also analyze user behavior predict implicit needs, and realize the transformation from “people looking for services” to “services looking for people”. Xiaomi’s Miloco whole house intelligent system is a deep integration of AI and the real world, becoming an important component of the whole house brain.

2.2.3 Interface Design

Interface design has developed from early physical buttons and touch screens to present-day multimodal, seamless interaction, and it is well established that 70% of returns in the market are caused by interface confusion and complicated operation. Therefore, the quality of interface design has become an important criterion affecting

consumer purchases. Good interface design makes the ease of use of home appliances immediately evident to users.

The current interface design mainly upgrades from “function panel” to “intelligent experience”. The specific manifestation is the minimalist zero UI and invisible interaction, implementing the design aesthetic of “less is more”. Hidden touch, sleep screen, mini screen, and status light effects replace large-sized screens to reduce visual interference. The multimodal fusion interactive interface is a comprehensive system that focuses on voice, supplemented by touch, and supplemented by sensing. Voice control operation, precise touch adjustment, infrared sensing control, suitable for scenarios such as kitchens and bathrooms. AI adaptive interface is based on user habits and environment to adjust interface layout, information priority operation, etc. in real time. In terms of age friendly design, it focuses on the characteristics of elderly users, with large fonts, high contrast, lifelike icons, touch buttons of 5mm or more and simplified processes. Comprehensively reduce the disoperation of the elderly. Digital twin maps household appliances into a three-dimensional spatial model, allowing users to directly control the devices in a virtual scene and achieve spatial operations. When the state is abnormal, it uses light and shadow prompts to break through the limitations of two-dimensional and improve the intuitive operation (Hwang, S., & Hoey, J. 2022). In the future, the interface of smart home appliances will develop towards active intelligence, seamless interaction, and universal accessibility for all ages, privacy native, and whole house collaboration. The specific manifestation is active perception interface, AI prediction of demand, and zero operation; Secondly, light, sound, and vibration convey emotions and enhance the sense of temperature; The third is privacy native design, with visualized permissions and embedded interfaces that minimize data; Fourthly, cross device unified language, whole house interface collaboration, and elimination of operational fragmentation; The fifth is a flexible and deformable interface that adapts to curved surfaces, folding, and spatial integration (Molex. 2023).

2.3. Brand Awareness

Market research data shows that 60% of consumers prioritize well-known brands when purchasing products, considering them as guarantees of quality, after-sales service, and data security. Midea’s annual R D investment exceeds 20 billion yuan, while Haier’s Smart Home Brain and Huawei’s HarmonyOS are companies building technological barriers. Patents,

algorithms, and the speed of new product development are all factors that companies use to shape brand awareness, enhance brand reputation, and increase user repurchase rates. Brand management has evolved from marketing to strategy.

Since brand awareness is closely related to marketing, management, design, and data science, therefore in the future we should focus on user needs and increase brand awareness by means of technological innovation, emotional connection, and product value.

2.3.1 Brand Image

The brand image of smart home appliances is composed of two major factors. The brand name, logo design, product appearance, and interactive interface of household appliances constitute the visual image of the brand. Digitization, intelligence, greenness, and high-end constitute the connotation image of the brand. These two factors directly affect consumer purchase intention, brand loyalty, and brand premium. The powerful functional technology image enables consumers to form trust in the brand. Appearance design, interactive interface, materials, colors, craftsmanship, and serialization are the core of image design. Bauhaus style, Eastern aesthetics, and other elements enhance the brand’s image.

Service image and ecological image are organic extensions of a brand. The quality of after-sales service affects consumers’ user experience and brand reputation. Social responsibility places high demands on brands, such as green, low-carbon, environmentally friendly, sustainable development, aging friendly, privacy and security protection, etc., which have an important impact on the long-term development of brands.

For brand building, many smart home appliance companies have clear long-term plans. Continuously investing heavily in research and development, focusing on technological innovation, strengthening professional characteristics, shaping the characteristics of high-tech enterprises, and forming a good brand image through CIS design system and family and series products. Enterprises focus on deploying both online and offline channels to provide consumers with a good experience on both online shopping platforms and physical stores, and to convey the culture and value of the brand in marketing. Renowned home appliance companies carefully layout in both local and overseas markets, deeply cultivate the market, and export the power of their brands.

Brand image building is a systematic project. A leader in functional technology, a work of art in life aesthetics, and a manifesto for a brand-new life.

Excellent brands can harmoniously integrate these three aspects to form a brand image system. On the technical level, brand credibility is achieved; on the aesthetic level, brand attractiveness is shaped; and on the conceptual level, the emotional value and lifestyle of the brand are provided. Together, the three build the unique charm of the brand (Kim, J., & Park, J.2018).

2.3.2 Brand Trust

Brand trust becomes an intangible asset for the success or failure of a company. Compared to traditional home appliances, the brand trust of smart home appliances has undergone fundamental changes. From the perspective of brand management, brand trust has evolved from single quality reliability to a complex of technology, ethics, and assurance, involving data security, privacy protection, system stability, and more.

Brand trust is a psychological need of consumers. Consumers have a relatively simple risk perception of traditional household appliances, such as whether the refrigerator can stably cool, whether the washing machine can clean clothes, and so on. Smart home appliances will increase risks, such as whether cameras will be hacked, whether voice assistants will leak content, and whether user behavior patterns will be illegally exploited. This is a transition from "physical risk" to "digital risk", which elevates consumers' trust in brands to new heights.

Brand trust consists of two core elements: brand reliability and brand goodwill. In smart home appliances, brand reliability is reflected in functional stability, data security, accurate algorithms, and ecological compatibility. Brand goodwill is to make consumers believe that companies and third parties will not use technological advantages to infringe on their rights.

The path characteristics of brand trust are: "primary trust experience trust deep trust". Primary trust involves brand reputation, third-party endorsement, market recommendations, etc., and is the trust formed by consumers during their initial purchase. Experience trust is feedback after product use. The intelligence of home appliances, human-computer interaction, and timely resolution of faults are all affecting this experience trust. Deep trust refers to the persistent trust that consumers still have in a home appliance brand when it is in crisis, which also greatly tests the crisis public relations ability of home appliance companies (Kim, J., & Park, J.2018).

2.3.3 Brand Loyalty

Brand loyalty cannot properly be analyzed by looking only at consumers' repeat purchases, so it is

necessary to consider also usage situations, lifestyle habits, and emotional values.

From the perspective of consumer behavior, behavioral loyalty is manifested as the continuous purchase and use of the brand after consumers recognize it, whether it is the diversified development of the product or the upgrade of the product, they will follow it. Attitude loyalty is manifested as consumers having a deep emotional attachment to the brand, including brand values and brand identity.

The path of loyalty to smart home appliance brands is manifested as "locking in functions, solidifying habits, and attaching emotions". The locking function is recognized by consumers for the excellent performance of the product. Fixed habits refer to the habitual patterns formed by consumers towards using a specific brand through habitual use. Attachment emotions resonate with consumers' values and brand values. This path evolution reflects the butterfly transformation of loyalty of smart home appliance brands from rationality to sensibility.

From the perspective of consumer perceived risk, some consumers' brand loyalty is not genuine loyalty. For example, when consumers consider abandoning brand A and switching to brand B, they not only have to relearn the operating methods, but also face the risk of product incompatibility, and there may be historical data that cannot be migrated across platforms. This conversion cost forces consumers to stop and creates a 'cage effect'. This is a big challenge for brand management.

Consumers of the same brand will establish communities. On the brand community communication platform, users share knowledge, experience, and seek mutual assistance. In the group, users not only gain product experience knowledge, but also establish identity recognition. Senior users will actively participate in community content contributions, help new users solve problems, and become brand defenders. This way, brand awareness will expand from point to surface, playing a positive role in brand communication.

2.5 Based on Theory

The Technology Acceptance Model (TAM) was proposed by Fred D. Davis (Fred D., 1989) which simplifies behavior into two aspects: Perceived Useful (PU) and Perceived Easy to Use (PEOU). These two factors together affect users' attitudes towards technology, which in turn influence their behavior, ultimately determining their purchase and use (Davis, F. D. 1989).

The S-O-R model was proposed by Mehrabian and Russell, and its full name is "Stimulus Organism

Response”, developed from the behaviorist S-R (Stimulus Response) model. This theory emphasizes that external stimuli need to be mediated through individual physiology and psychology in order to be transformed into concrete behaviors. Originally used to analyze the impact of shopping environment on consumer behavior, it was later expanded to online shopping, mainly focusing on external factors such as product quality, marketing, and brand image (Mehrabian, A., & Russell, J. A. 1974).

The theory of perceived value (PVT) was proposed by Zeithaml (Zeithaml,1988), which holds that consumers’ purchase intention does not come from the objective attributes of the product, but rather from the “gains and losses” of using the product. In the study of consumer purchase intention, perceived value is a key mediating variable that connects product functionality with purchase intention. In this study, technical performance, product design, and brand awareness were used as external stimuli (S) to first stimulate consumers’ perceived value evaluation of the product (O), thereby affecting their purchase intention (R).

The brand resonance theory was proposed by Keller (Keller,2001). This theory constructs a pyramid shape centered on consumers, from bottom to top: brand identification, brand image, brand response, and brand resonance. Among them, brand resonance is located at the top of the pyramid. The viewpoint of brand resonance theory is that the

ultimate source of brand value is not just popularity, but the deep interactive relationship established between consumers and the brand. When consumers resonate with a brand, they not only make repeat purchases but also recommend it to others (Keller, K. L. 2003).

2.6 Research Model

This study takes SOR theory as the overall framework, with technical performance, product design, and brand awareness as external stimuli (S), perceived usefulness and perceived ease of use as internal states (O), and purchase intention as behavior (R). The Technology Acceptance Theory (TAM) contributes two core variables, perceived usefulness and perceived ease of use, to explain consumers’ judgments on the functionality of smart home appliances. The theory of perceived value (PVT) contributes concepts such as functional value and emotional value, reflecting the diverse values of consumers. The brand resonance theory deepens the connotation of brand awareness, expanding it from the cognitive level to the emotional and relational level. This theoretical integration not only maintains the simplicity of the theory, but also incorporates the advantages of various theories, providing a multidimensional analysis of consumers’ purchasing intentions (Venkatesh, V., & Davis, F. D. 2000).

2.7. Research Framework

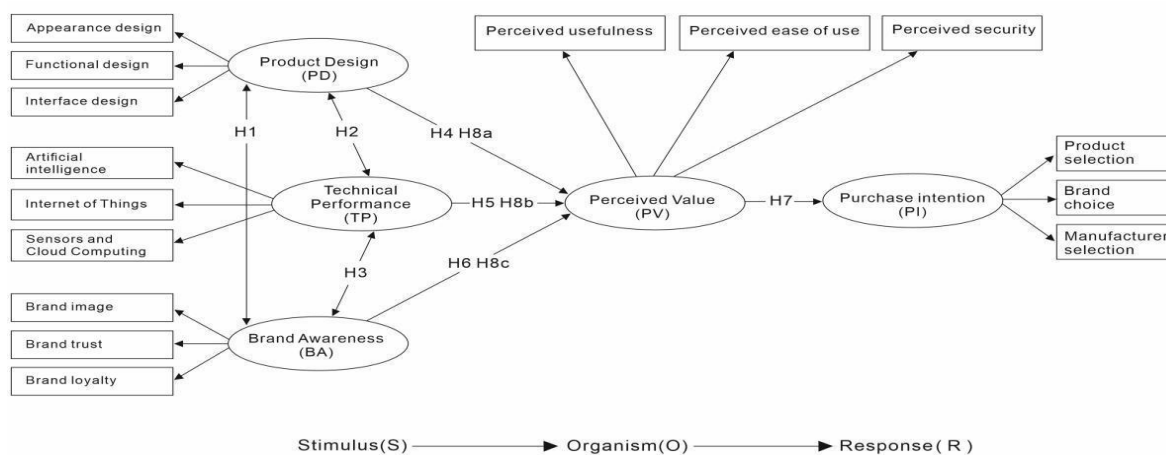


Figure 1: Research Framework

3. METHODOLOGY

The research design and instrument in this study employed a quantitative approach, utilizing questionnaires to gather information. The research survey is focused on 449 million consumers in China, with an error margin of 5% and a reliability of 95%. According to Taro Yamane’s formula, it is calculated that at least 400 consumer respondents should be

selected for the study, but in practice, the questionnaire is distributed through the Internet, and the actual number of collected questionnaires may be lower than the number distributed. Therefore, to guarantee the validity of the results of the study, the number of respondents was increased by 40% (Vanichbuncha,2006), and the final sample size was $400 + (400 \times 0.4) = 560$. Then, the sampling method, adhering to the five platforms with the largest

number of online shopping platforms in China which including JD, Suning, Tmall, Tiktok and Pinduoduo (China National Bureau of Statistics,2022).The data collection was carried out by the distribution questionnaires, with a total of 560 respondents. This indicates that 500respondents, or 89.28percent of the total, returned the questionnaire. Cronbach’s Alpha is an α coefficient between 0.8 and 0.9, indicating excellent scale reliability; if the coefficient is between 0.7 and 0.8, it means that the scale’s reliability is acceptable; if the coefficient is below 0.6, it indicates that the scale’s internal reliability is destitute and lacks reference value. In this study, the minimum acceptable value of the coefficient Cronbach’s alpha was at least 0.7. In addition, the convergent validity of the survey questionnaire in this study that the AVE values corresponding to all factors are greater than 0.5 and the CR values are all higher than 0.7, indicating that the data analyzed in this study has good convergence validity. The analysis data were used with social science statistical techniques, such as frequency, descriptive statistical analysis, percentage, the correlation between variables and structural equation model analysis techniques.

4. RESULTS AND DISCUSSION

According to demographic frequency analysis, the research results show that among 500 survey respondents, 260 were male, accounting for 52% of the total sample size,and 240 were female, accounting for 48% of the total sample size, with a relatively

balanced gender distribution. The number of people in the 18-25 age group is 110, accounting for 22% of the total sample size. There are a total of 145 people in the age group of 26-35, accounting for 29% of the sample size. The number of people in the 36-45 age group is 137, accounting for 27.4% of the sample size. The number of people in the age group of 46 and above is 108, accounting for 21.6% of the sample size. The age distribution is relatively balanced. The number of people with high school/vocational school education or below is 138, accounting for 27.6% of the total sample size; The number of people with a university degree is 140, accounting for 28% of the total sample size; The number of people with a bachelor’s degree is 116, accounting for 23.2% of the total sample size; number of people with a master’s degree or above is 106, accounting for 21.2% of the total sample size. The distribution of educational backgrounds is relatively balanced.85 people have an average monthly expenditure of less than or equal to 3000 yuan, accounting for 17% of the total sample size; The number of people with an average monthly expenditure between 3001 and 5000 yuan is 117, accounting for 23.4% of the total sample size; The number of people with an average monthly expenditure between 5001 and 7000 yuan is 145, accounting for 29% of the total sample size; The number of people with an average monthly expenditure greater than or equal to 7001 yuan is 153, accounting for 30.6% of the total sample size. The detailed information is shown in Table 1 below

Table 1: Results of demographic frequency analysis (n=500)

	Characteristic	Number	Percentage (%)
Gender	Male	260	52
	Female	240	48
Age	18-25 years old	110	22
	26-35 years old	145	29
	36-45 years old	137	27.4
	≥ 46 years old	108	21.6
education	High school/vocational school and below	138	27.6
	College diploma	140	28
	undergraduate college	116	23.2
	Master's degree or above	106	21.2
Monthly average expenses	≤ 3000 yuan/month	85	17
	3001-5000 yuan/month	117	23.4
	5001-7000 yuan/month	145	29
	≥ 7001/month	153	30.6

Using a research framework combined with statistical software, the article carries out a systematic and well-organized analysis of the relationship between technological performance, product design, brand awareness, and consumer willingness to purchase smart home appliances, and thus naturally and convincingly arrives at the conclusion: digitization, intelligence, aesthetics, and user -

friendly interfaces all enhance brand awareness and therefore increase the likelihood of consumers purchasing smart home appliances. It also appropriately notes the favorable consumer reaction to the use of environmentally friendly materials. Hence, the model presented in the article is a valuable contribution to the Chinese smart home appliance consumption literature. As shown in Figure 2.

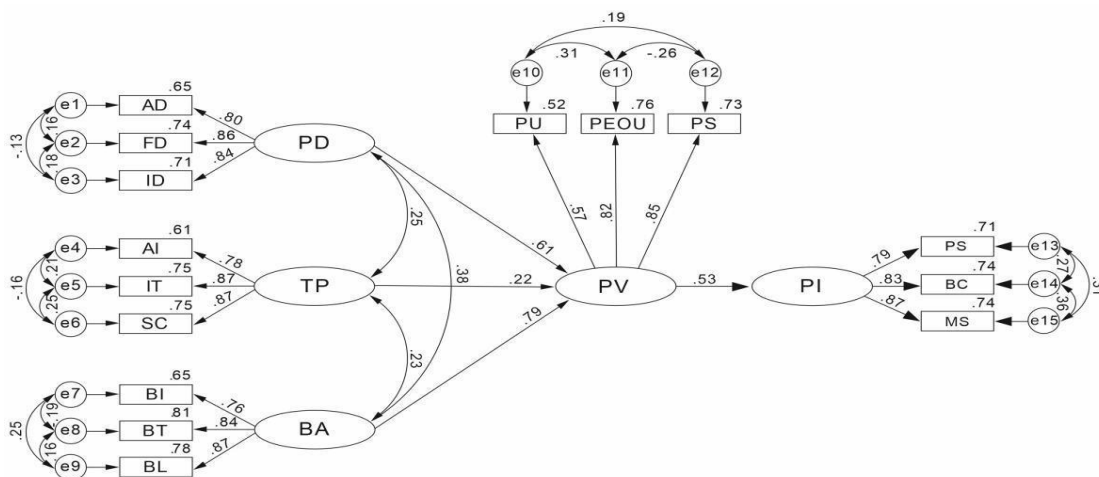


Figure 1: Structural Equation Model Fitting Diagram. Source: Authors

By analysis in the structural equation model, the result of the indicator value of the structural equation model was a fitting index of the variables in this study to be consistent with the empirical data, considering

that χ^2/df is 1.85, less than 3; RMSEA is 0.066, less than 0.10; IFI is 0.949; GFI is 0.938; CFI is 0.922; and TLI is 0.931, all greater than 0.9. Table 2 displays the results.

Table 2: Summary of Goodness-of-fit indices for SEM

Indicators criterion	χ^2/df	GFI	IFI	CFI	TLI	RMSEA
		< 3	≥0.90	≥0.90	22	≥0.90
SEM:Results	1.85	0.938	0.949	0.931	0.931	0.066

Summary: all values met the criteria for acceptable model fit by analysis of the measured variables, the

correlation between variables showed significant positive correlation. The details are presented in Table 3.

Table 3: Correlation Coefficient Table

	Product design	Technical Performance	Brand awareness	Perceived Value	Purchase intention
Product design	1				
Technical Performance	0.841**	1			
Brand awareness	0.588**	0.632**	1		
Perceived Value	0.201**	0.202**	0.302**	1	
Purchase intention	0.135**	0.145**	0.161**	0.170**	1

Note: * At the 0.01 level (two-tailed), the correlation is statistically significant.

From table 3, it can be seen that there is a correlation ($r=0.841, p<0.01$; $r=0.588, p<0.01$; $r=0.201, p<0.01$; $r=0.135, p<0.01$). There is a correlation between perceived usefulness, perceived ease of use, purchase and use, and brand awareness ($r=0.632, p<0.01$; $r=0.202, p<0.01$; $r=0.145, p<0.01$). There is a correlation ($r=0.302, p<0.01$; $r=0.161, p<0.01$). There is a correlation between purchase and perceived ease of use ($r=0.170, p<0.01$).

5. CONCLUSIONS

5.1 Research Findings

The research results indicate that technical performance, product design, and brand awareness all have a significant impact on consumer purchase intention (She, L., 2025). Among them, technical performance, as the basic function of household appliances, has the strongest impact and reflects

consumers' actual needs for functionality. Secondly, the impact of product design indicates that in situations where functionality is similar, design aesthetics, user experience, and other factors become key factors in competing with similar products. The impact of brand awareness is relatively small, but it still holds an important position in the minds of consumers, who believe that the brand is a guarantee of quality (Davis, F. D. 1989).

Research has confirmed that perceived usefulness and perceived ease of use play a significant mediating role between technological performance, product design, brand awareness, and purchase intention. Consumers perceive that household appliances can efficiently complete tasks, thereby making useful judgments that indirectly affect their willingness to purchase; In product design, consumers' judgment of convenient operation during the use of household

appliances indirectly affects their willingness to purchase; Brand awareness indirectly affects purchase intention through the combined effect of perceived usefulness and perceived ease of use (Venkatesh, V., & Davis, F. D. 2000).

5.2 Theoretical Contributions

The theoretical contributions of this study are mainly reflected in the following aspects. The first level is to integrate SOR theory, technology acceptance theory, and product design theory, branding theory, and perceived value theory in an interdisciplinary manner to analyze the factors that affect consumer purchase intention in a diverse manner. On the second level, this study uses structural equation modeling to conduct causal path testing, and systematically analyzes the moderating mediating effects between the three variables of technical performance, product design, and brand awareness to better analyze the reasons for the formation of purchase intention. In terms of mixed research, the technology acceptance model and design, branding, marketing, and other fields jointly influence consumer purchase intention. This provides feasibility for exploring interdisciplinary comprehensive research. On the third level, China is the world's largest market for smart home appliances, and consumers have a great willingness to purchase smart home appliances. The Chinese market is highly open, with a high degree of marketization and numerous home appliance brands. Therefore, this study has important reference significance for the consumption of smart home appliances in the Chinese market (Zhang, K., & Cheng, X. 2025).

5.3 Practical Significance

The research results have important practical guidance significance for product research and development, brand management, and marketing of smart home appliance enterprises. The research results confirm that enterprises should take technical performance as the fundamental starting point. No matter how exquisite the product design is or how well-known the brand is, the primary focus that consumers ultimately pay attention to is whether the product can efficiently complete tasks. Moreover,

enterprises should attach great importance to product design. The quality of product design affects consumers' perception, and "user experience creation" should be elevated to a strategic level. Enterprises should implement differentiated layout in brand planning and position themselves differently based on their target customers. For the mass market, brands should strengthen their power through technology, expert certification, and other means (Keller, K. L.2001).

5.4 Limitations

Despite some achievements in this study, there are still limitations. This article adopts a cross-sectional research design and collects data at a single time point, which makes it difficult to reveal the dynamic relationships between variables. It is best to adopt a longitudinal design to track the entire process of consumers from product recognition to purchase, test the dynamic changes of variables, and observe the evolution of mediating effects. The data for this study is sourced from Chinese consumers, and the generalizability of the research conclusions needs to be verified. The consumption behavior of smart home appliances may be influenced by various factors such as cultural beliefs, values, economic level, and infrastructure. Future research can be conducted across countries and cultures. In addition, this article only studies three independent variables and does not extend to other possible important variables such as price, environmental protection, privacy, etc. This study used a questionnaire survey method, and there is no data on consumers' purchasing process in real situations. Future research can use experimental methods, eye tracking, electroencephalography, and other methods to explore the challenges of consumer purchase intention in depth.

ACKNOWLEDGMENTS

This academic article is part of the graduate student in the Doctor of Philosophy program in management at Chakrabongse Bhuvanarth International College of Interdisciplinary Studies, Rajamangala University of Technology, Tawan-OK, and Thailand. The researcher thanks all referenced professionals for their contributions to this research.

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