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Identifying the Key Drivers and Barriers of Smart Home Adoption: A Thematic Analysis from the Business Perspective

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Abstract: Smart homes embrace advanced technologies and the connectedness of devices that aim to increase consumers' life quality. They are based on data integration over shared platforms collected via sensors and wireless networks. However, although consumers' current and potential adoption of smart homes have received some research interest, there is a low number of studies considering the foreseeable future of smart homes from the business perspective. To fulfill this gap in the literature, this study presents the results of an exploratory research attempting to reveal the foresight of the business side regarding the penetration of smart home technologies (SHTs) into consumers' lives. Based on the opinions of industry experts collected through 13 semistructured in-depth interviews, numerous drivers of and barriers to SHT adoption are uncovered and displayed in their intertwined relationship in a thematic map. In creating this map, the qualitative data gathered through the interviews are integrated with widely used theories/models of technology adoption in the literature to develop a full-fledged set of determinants. As a result, drivers of SHT adoption (five sub-themes) and barriers that hinder smart home penetration (eight subthemes) were determined. Drivers consist of relative advantage, enjoyment, image enhancement, modern and multifunctional design, and consumers' technology innovativeness. In contrast, the main barriers are high cost, complexity, lack of compatibility, lack of trialability, lack of observability, lack of a trusted brand in the market, lack of facilitating conditions and support services, and consumers' technology anxiety. This rich set of SHT adoption determinants can be used in future studies to examine their relative impact on consumers' adoption of SHT.

Keywords: smart homes; in-depth interview; qualitative research; IoT; internet of things; thematic map

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1. Introduction

Recent developments in sensors, networking technologies, broadband internet, cloud services, and artificial intelligence have led to significant growth in the Internet of Things (IoT). IoT connects objects with other objects and people, which enables the application of innovative services to different scenarios, such as wearables, smart homes, autonomous cars, and smart cities. In this way, IoT leads a paradigm shift in how we communicate, work, and even live by blending virtual and physical worlds through data sharing. The emergence of various IoT-based devices has driven recent developments in SHTs. SHTs have been transformed from wired, expensive, and niche gadgetry to widely reachable connected smart appliances that turn consumers' home routines into more comfortable experiences. Smart home technologies [1] are often used synonymously with "home automation" [2,3], "home network" [4], "household technology" [5], "smart domestic products" [6], or "home intelligence" [7,8]. Various definitions have been used to conceptualize and define smart homes. Based on the analysis of previous smart home literature, all aspects of smart home definitions are combined in the following description. The smart home is the collection of domestic appliances, smart devices, and sensors that are integrated into an intelligent

home network that offers control, monitoring, support, and responsive services and embraces a range of financial, social, sustainability, security, and health-related benefits to their users [9,10]. SHTs have changed our traditional homes into more intelligent and interconnected smart homes and have enabled connected living.

Among services of IoT, smart homes hold significant importance for innovation diffusion/technology adoption research considering the time people spend at their homes. Homes are a safe harbor where people live, work, study, relax, self-care, and entertain. With the rise of IoT devices, the smart home market grows and offers myriad ways of different individualized services to support consumers' life, such as home automation, energy-aware homes, and health monitoring. Smart homes are considered one of the critical enablers of the paradigm shift towards smart living. The projected global market revenue has reached nearly USD 105 billion by 2021, hitting 263 million homes with an average 12.3% penetration rate [11]. By 2021, 32.7% of all households in North America and 15% in Europe are expected to adopt SHT [11].

In the literature, some studies discuss smart homes as one of the core elements of sustainability efforts due to their energy-efficiency-related benefits [12]. This research stream incrementally expands from smart homes to smart grids, smart cities, and a smart planet [1]. Considering that 68% of the world's population is projected to live in cities by 2050 [13], smart homes are crucial for a more sustainable future. Another major research area of smart homes is assisted living [14–16]. Smart home technologies are discussed as the main enabler of personalized care and independent living for the elderly, disabled, or chronically ill people. On the other side, home automation provides comfort, enhanced security and safety, and enriched entertainment to its users [17] and supports their modern lifestyles. Friedewald et al. [18] even put forward that context-aware, ambiently intelligent smart homes would transform how people socialize by providing new communication methods at home.

Considering the lifestyle-changing effects of this wide range of smart home usage areas, both marketing scholars and practitioners concentrate on examining SHT adoption determinants. Understanding determinants will lead to designing an appropriate strategy for introducing different SHTs to consumers. This research aims to reveal the determinants of SHTs for enabling practitioners to gain a competitive advantage in the smart home market and to open fruitful research avenues to scholars in the multifaceted smart home adoption area. Pioneering in smart home adoption research, this research considers the foreseeable future of smart homes from the perspective of industry experts. It integrates those perspectives with the established innovation diffusion theory and the different technology adoption models from the previous literature. Moreover, smart home adoption can be explained as a continuum ranging from adopting a single device/service for a specific use case to full home automation for complex use cases utilizing artificial intelligence. This indicates the need to study smart home adoption from a broad perspective. It is acknowledged in this research, and a comprehensive set of determinants is revealed that covers the adoption of both basic and advanced smart home setups for different use cases.

For developing the visual thematic map of a full-fledged set of SHT adoption determinants, qualitative data gathered through in-depth expert interviews are integrated with the diffusion of innovation theory and some factors from different technology adoption models from the literature. With the precedent factors from the previous studies, an interview guide is built, and 13 industry experts are interviewed accordingly. The thematic analysis of in-depth interviews reveals a large set of SHT adoption determinants. Then, those determinants are categorized as drivers and barriers to SHT adoption and displayed in an interconnected thematic map. This map provides insights into determinants that may facilitate or impede SHT penetration. Our study differentiates from previous smart home adoption studies firstly by utilizing the qualitative approach to uncover the foreseeable future of smart home adoption from the perspective of industry experts, secondly by visualizing SHT adoption determinants in a thematic map as drivers and barriers, and thirdly by being conducted in a developing country, where SHT penetration is still in early stages.

This country may have different cultural and macroeconomical dynamics than the mature markets, where most of the smart home adoption studies were executed in the existing literature.

This paper begins with a brief literature review on widely used theories/models of technology adoption to bring insights into our understanding of the determinants of smart home diffusion. The methodology is then outlined by how the industry experts are selected and approached, and how semistructured in-depth interviews are conducted. Subsequently, findings are explained as numerous drivers and barriers to SHT adoption, and their intertwined relationship is displayed in a thematic map derived from this research. Finally, the research outcomes are discussed, and implications and future research directions are presented.

2. Theoretical Background

For revealing a broad list of SHT adoption determinants, mainstream theories/models on technology adoption and innovation diffusion are reviewed. The proposal of mixed constructs borrowed from different theories is an accepted approach in innovation diffusion studies [19,20], following the assumption of Benbasat and Barki [21] that comprehensive models are more likely to explain the users' acceptance behavior fully. This section briefly explains these widely used frameworks/theories for smart home adoption.

Research on smart home adoption and diffusion has received increasing attention since the 2000s [22]. Most studies take the technology acceptance model (TAM), the unified theory of acceptance and use of technology (UTAUT), UTAUT2, or diffusion of innovation (DOI) theory as a theoretical base and extend it with relevant constructs of other theories such as perceived risk theory (PRT) to explain consumers' SHT adoption [23–27].

TAM, which is proposed by Davis [28], is one of the most frequently used models in explaining and predicting technology acceptance and usage. TAM assumes that two beliefs, namely perceived usefulness and perceived ease of use, govern the attitude towards using, which on the other hand, is closely related to the intention to use technology. Perceived usefulness focuses on one's subjective possibility of enhancing performance when adopting technology. In contrast, perceived ease-of-use belief refers to the user's expectation that using the technology is free of physical and mental effort (Davis, 1989). TAM has been widely applied to diverse technologies and users, as well as in different contexts of IoT technologies such as smart homes [29–32] and wearables [33].

Despite TAM's high predictive power, this model is designed for business contexts in the early 1990s. Thus, more advanced models are formed over time. A leading example is Venkatesh's UTAUT, developed to explain employees' technology acceptance in an organizational context [34]. This model builds on four dimensions: performance expectancy, effort expectancy, facilitating conditions, and social influence. Performance expectancy is defined as enhancing performance when using a specific technology [34]. Effort expectancy is explained similarly to perceived ease of use belief in TAM as the degree of ease associated with technology usage [34]. Social influence is the degree of the individual's perception that their significant others want him to use a specific technology [34]. Facilitating conditions are described as the belief in the availability of organizational and technical infrastructure for supporting technology usage [34]. Extended UTAUT models are proposed to explain the adoption of different smart home technologies [24,35].

UTAUT is adjusted by Venkatesh et al. [36] as UTAUT2 for capturing dimensions that measure the level of consumers' technology acceptance in voluntary situations. This model adds three more dimensions, namely hedonic motivation, price value, and habit, on top of the four dimensions of UTAUT. Hedonic motivation is considered an intrinsic value that is derived fun from consumers' technology usage [36]. Price value is the consumers' belief that the benefits of technology overweight its monetary cost [36]. Habit has the definition of previously learned automated technology usage [36]. Several researchers stress the importance of UTAUT2 dimensions in IoT adoption [25,37,38].

The DOI theory by Rogers [39] proposes innovation diffusion as a process by which an innovation is communicated through specific channels over time among the members of a social system. Diffusion is determined by the rate of adoption, which is influenced by various attributes of the innovation, namely relative advantage, complexity, compatibility, trialability, and observability [39]. Relative advantage is equivalent to TAM's perceived usefulness and UTAUT's performance expectancy beliefs [34].

In the same view, complexity is the conceptual opposite of ease-of-use belief in TAM and performance expectancy dimension in UTAUT. Compatibility is, however, the perception of innovation's consistency with one's values, lifestyle, and past experiences [39]. Trialability is "the degree to which an innovation may get experienced on a limited basis." In contrast, observability is explained as "the degree to which the results of an innovation are visible to others" [39] (p. 16). Franceschinis et al. [40] study the adoption of renewable heating systems based on a model stemming from DOI theory. Some researchers prefer to integrate DOI theory with other theories/models such as TAM to study the adoption drivers of different IoT contexts, namely smart homes [27,41] and wearables [42].

Moore and Benbasat [43] are the pioneers who adapted the characteristics of innovations of DOI theory to the technology context. Thereby, they refined a set of constructs to study individual technology acceptance by adding two factors, namely image and voluntariness, to DOI innovation factors. Image is defined as the perceived enhancement of one's image or status in one's social system [43]. Voluntariness is explained as the perceived free will in innovation's usage [43]. Other technology adoption researchers also show the influence of image and voluntariness on the diffusion process [44,45].

PRT is defined as the perceptions of uncertainty regarding the occurrence of adverse consequences and was first introduced by Bauer [46] to the marketing world to explain consumers' behavior. Many studies adopt the perceived risk concept in analyzing the adoption of different technologies and show that it is negatively related to the usage intention [27,29,47–50].

The analysis of frequently used diffusion/adoption theories/models for smart home penetration provides the base information for building the interview guide of this study. Based on this interview guide, the in-depth expert interviews are executed and after that thematically analyzed to reveal determinants of SHT adoption. Thus, the results of this study are both stemmed from previous literature and conclude the very contextual factors related to smart home technology adoption itself.

3. Methodology

A qualitative research approach is recommended to be utilized in home settings [5], as smart homes are a new and complex phenomenon for consumers [51], and their penetration is currently low [52]. Therefore, a qualitative approach is chosen to reveal the determinants of SHT adoption by understanding key drivers and barriers to their market growth. This study presents the results of an exploratory research attempting to disclose the foresight of the business side regarding the penetration of SHTs into consumers' lives.

Although positivism is the dominant research paradigm in household technology adoption and diffusion [22], some essential qualitative studies on the adoption and resistance of smart homes are listed in Table 1, utilizing either content or thematic analysis as the analysis method.

Table 1. Exemplary qualitative studies on smart home acceptance utilizing thematic analysis.

Application	Data Collection	Analysis Method
Drivers and barriers of smart homes for sustainable energy consumption [53]	Focus Group (n = 29) Germany	Content Analysis
Social barriers to the adoption of smart homes [9]	Semistructured expert interviews (n = 8) Public Deliberate Workshops (n~60) United Kingdom	Thematic Analysis
Technoeconomic challenges of smart home adoption [4]	Public Deliberate WorkshopsUnited Kingdom (n~60), Germany (n~60), Italy (n~60)	Thematic Analysis
Smart home users, usage areas, and challenges [54]	Systematic literature review (n = 150)	Thematic Coding
Smart home characteristics, services, benefits, and risks [10]	Systematic literature review (n = 143)	Thematic Coding
Smart home technology concepts, benefits, risks, and policies [1]	Literature review (n~70) Semi-structured expert interviews (n = 31) Site visits (n = 37) United Kingdom	Thematic Coding

Other than these in Table 1, other qualitative study types are applied in the smart home context, such as case study [55–57] and ethnography [58,59].

A semistructured interview data-gathering approach is particularly relevant for innovations or experimental technologies in qualitative research [9], where interviewees are provided the freedom to elaborate on the interview guide. Seeking expert opinions for revealing consumer adoption insights is preferred in smart home research [1,9,60] as their adoption is still in the early stages. Moreover, experts are a rich information source since they manage marketing activities, including segmentation and targeting of potential consumers. Consequently, semistructured in-depth expert interviews were conducted with smart home industry professionals. The interview questions were determined based on the widely used theories/models in previous smart home adoption literature. The step-by-step methodological approach of the study is depicted in Figure 1 below:

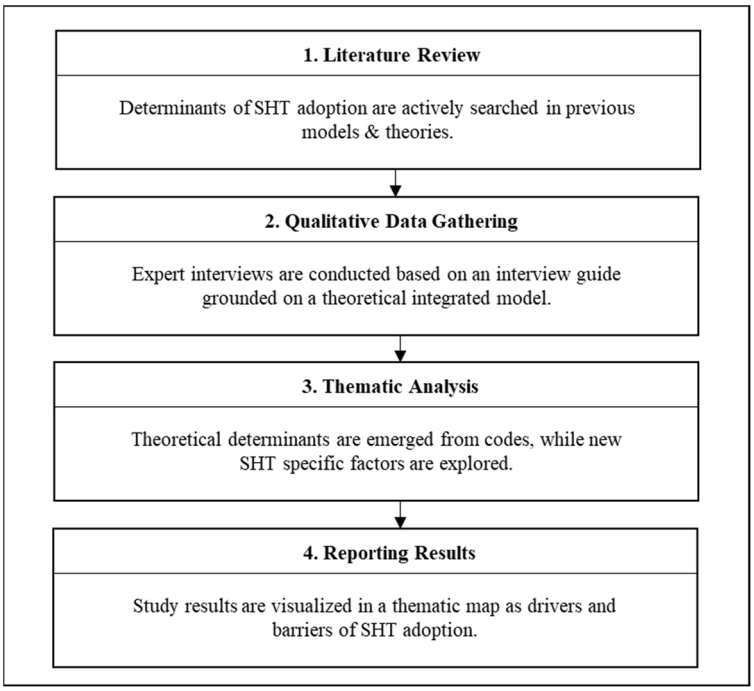

Figure 1. The methodological approach of the study.

The interviewee sample was meticulously chosen to represent all subcategories of SHTs. The qualitative data gathered from these interviews were explored with the thematic analysis method, which is one of the foundational methods for qualitative research [61]. By applying the thematic analysis method, researchers can derive rich and detailed results representing various aspects of the research topic by identifying, analyzing, and reporting patterns within the original data set [61]. This method was utilized in technology adoption research for different contexts such as wearables [62], mobile applications [63], or smart homes [4,24,64]. As a result of the thematic analysis, a thematic map was constructed, which is a visualization tool for the representation of relationships between the codes [61] and the hierarchy among the emerged themes and subthemes. By merging established constructs from literature with our thematic analysis results [62,63], this map was enriched with exploratory qualitative findings and still grounded on the theory.

3.1. Selection of Interviewee Sample

Thirteen experts working in the private sector on different smart home domains were interviewed in this study. The experts' sector, their position in the company, and years of experience are provided in Table 2. All interviews were conducted face-to-face in a developing country from May 2018 to July 2018. Our sampling strategy was purposive and intended to involve experts from different sectors with smart home products/services portfolios. Initially, experts known in the domain were contacted via LinkedIn Inbox. Further stakeholders were then identified through a snowball sampling procedure. Out of identified 20 experts, 13 agreed to participate in the study, representing a range of sectors, including telecommunications, energy, home appliances, and home automation. On the other hand, security services, building products, technology, and healthcare companies could not be covered in this research as they did not respond to our invitation. The sample size was guided by the achievement of thematic saturation [65] in which no new themes were identified in ongoing data collection. By this method, it was decided that sufficient participants and data were included in the study.

Table 2. Characteristics of experts.

Pseudonyms of Experts	Sector	Position of Expert	Experience in SHTs
Expert 1	Home Appliances	IS and Innovation	+10 years
Expert 2	Home Appliances	Strategic Marketing	+25 years
Expert 3	Home Appliances	Business Development	+25 years
Expert 4	Home Appliances	IS and Innovation	+20 years
Expert 5	Home Appliances	Strategic Marketing	+15 years
Expert 6	Home Appliances	Business Development	+5 years
Expert 7	Home Appliances	Digital Marketing	+10 years
Expert 8	Home Appliances	Strategic Marketing	+15 years
Expert 9	Home Automation	Country Head	+30 years
Expert 10	Smart Lighting	Strategic Marketing	+10 years
Expert 11	Smart Lighting	Digital Marketing	+5 years
Expert 12	Telecommunications	Strategic Marketing	+10 years
Expert 13	Energy	Business Development	+20 years

3.2. Interview Procedure

As applied in some previous smart home research [23,27,41,66], an integrative model was proposed, where constructs from several established models on technology adoption, namely DOI theory, UTAUT 2, and PRT, were merged. The interview guide in Table 3 is based on this multidimensional research model and provides the framework for our semistructured interviews.

Table 3. Interview guide of the study.

Interview Questions
How do you define the concept of the smart home?
How do you group SHTs according to their usage?
What is the demand for SHTs in this market? What can be done to grow this market?
What are the most critical features and benefits of SHTs from the perspective of your customers?
What are the points where the consumer's home experience and SHT overlap?
How and where can your consumers experience SHTs?
Where can your consumers get information on SHTs? Who are the leading opinion leaders? Or who can be? Why?
Do your consumers find SHTs easy to use?
Do your consumers enjoy using SHTs?
What can you say about the price value perception of SHTs?
How does the social environment of consumers react to SHTs?
Is there any confidentiality agreement between you and your consumers about private data usage? How do you manage this process?
How do you ensure the security of SHTs?

It is essential to obtain their existing understanding of the smart home before addressing specific questions related to the theoretical model. Therefore, interviews started with questions regarding experts' views on the definition and categories of the smart home.

After that, specific questions related to the innovation's five attributes based on Rogers' DOI theory [39] were directed. Those constructs are relative advantage, complexity, compatibility, trialability, and observability. Many marketing and information systems studies have empirically proven their significance [23,27] in the adoption. Moreover, the image construct was included in the research model, considering that it was proposed by Moore and Benbasat [43] along with the other DOI factors for the technology adoption context. Social outcomes gain importance in home settings, where people welcome their guests. Furthermore, hedonic motivation and price value constructs were included in the interview guide from UTAUT2, as they are important antecedents of technology adoption in a voluntary consumer context [36]. Finally, privacy and security concerns were added from PRT to represent uncertainties that may arise from adopting SHTs [47].

By incorporating specific theoretical constructs of established technology adoption models, an integrative interview guide was developed to qualitatively explore the drivers and barriers of smart home adoption and reveal the imminent future of smart homes. It is responsive to the specific characteristics of SHTs and represents multifaceted usage areas, which improves the relevance and robustness of this research.

Before the interview, informed consent was explained and obtained with signatures to make sure that participants were ensured protection of their privacy. Each interview lasted between 60 to 90 min for completion, and participants were asked questions in the interview guide and provided a chance to elaborate on questions. The researcher who conducted in-depth interviews (the first author) was trained in interviewing techniques to obtain the most detailed and rich data from interviewees. All interviews were audio-recorded so that

transcriptions and statements could be checked for accuracy. After collecting the interview data, each interview was transcribed verbatim in Microsoft Word documents.

4. Results

In this section, the analysis of interview data is explained in detail, and the study results are provided in a thematic map.

4.1. Data Analysis

The transcribed interview data were studied using the thematic-analysis method outlined by Braun and Clarke [61] to capture experts' views on determinants of SHT adoption. Thematic analysis is a widely used qualitative approach that involves six phases of analysis, which are:

- familiarization with the data;
- generation of initial codes;
- search for themes;
- review of themes;
- definition and naming of themes;
- production of the report.

The confirmatory coding framework [67] was utilized in this research, which was synthesized using the DOI, UTAUT2, and PRT. Therefore, previous findings in the literature on SHT adoption can be blended with our exploratory qualitative study. Interview data were also evaluated with an exploratory view to identifying new, SHT-specific factors and relevant dimensions from previous technology acceptance research.

Returning to the data-analysis steps proposed by Braun and Clarke [61], the transcribed interview data were first repeatedly read for data familiarization. In the second step, initial codes were identified by searching the recurring patterns in the raw data. Thirty different codes were identified from the data set. The next step involved grouping codes under common subthemes based on coherent patterns. A constant review of literature accompanied the process of matching codes with subthemes and then subthemes with themes. In the fourth step, subthemes were reduced to the most prevalent determinants in the technology adoption literature. Step five involved naming the themes, where similar names were chosen, evolving from the previous studies. The last step concerned reporting and visualizing the emergent themes using the thematic map. It was a recursive process completed by moving back and forth as needed throughout the phases, as advised by Braun and Clarke [61]. The overview of themes and code frequencies are provided in Table A1 of Appendix A.

An iterative analysis between the transcripts and literature enabled the identification of determinants of SHT adoption as perceived by the industry experts. This qualitative study revealed the inhibitor research stream's importance and adoption motivators. Therefore, determinants of SHT adoption were categorized in a thematic map in Figure 2, composed of two themes, "drivers" and "barriers", and 13 subthemes related to them. The resulting drivers and barriers to SHT adoption were explained by quoting interviewees. To protect our industry experts' identities, pseudonyms in the form of "E" indicating experts and corresponding numbers were used rather than their real names.

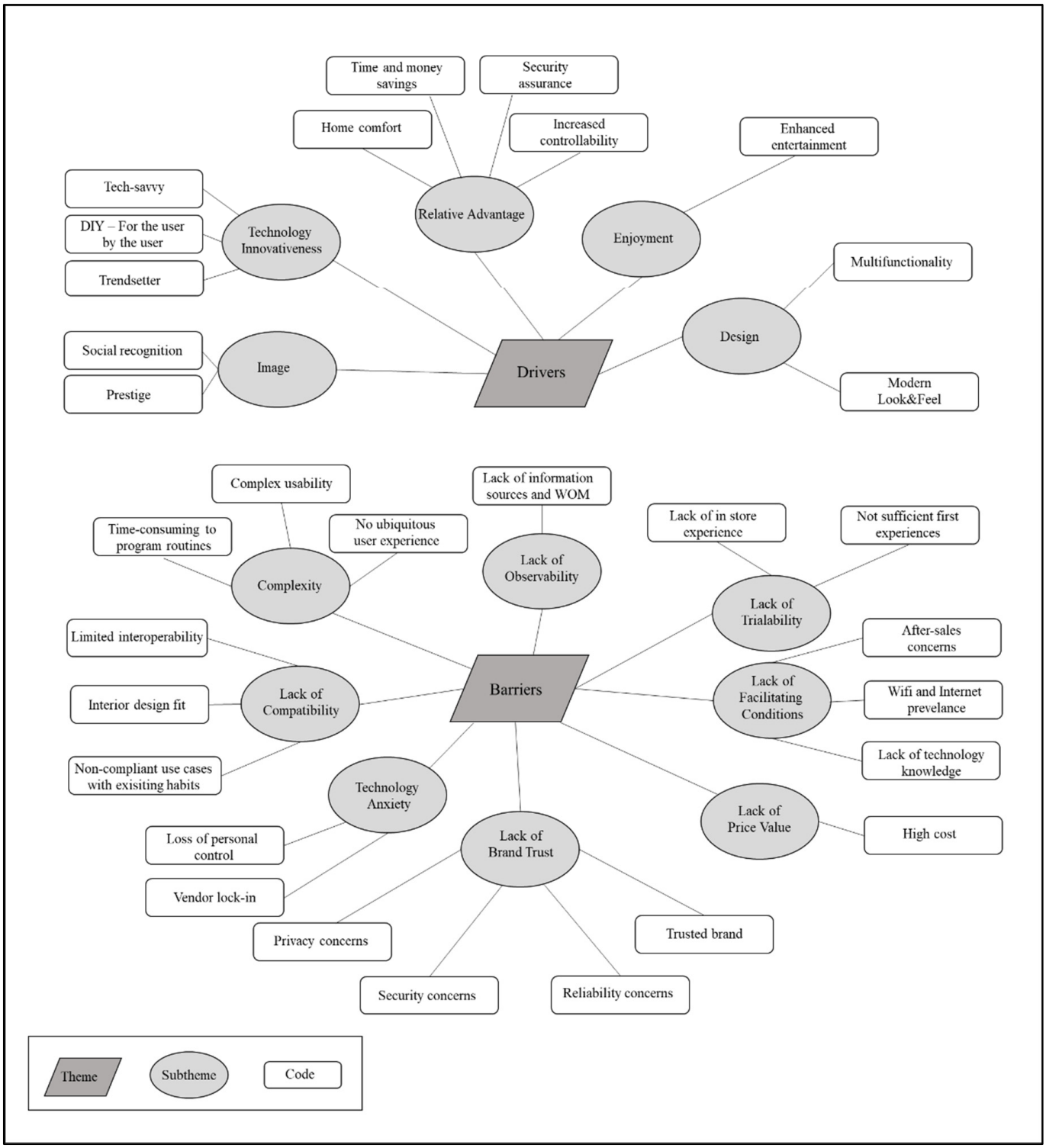

Figure 2. The thematic map of smart home technology adoption.

4.2. Drivers of Smart Home Adoption

Drivers incorporated what industry experts perceive consumers to benefit from in the uptake of SHTs. They constitute subthemes of relative advantage, enjoyment and image gains, modern and multifunctional design, and consumers' technology innovativeness.

Relative advantage is defined as the perceived functional benefits of SHTs relative to their traditional alternatives. Increased home comfort and control, security assurance,

and potential time and money savings are frequently mentioned advantages of SHT usage. Security is the first and most prevalent use case, as people are more concerned about securing their household against break-ins. This situation is more country-specific, as no previous studies in other countries did emphasize this benefit so dominantly. As E12 says, "*The need for security perceived by people in developing countries is much higher than in mature countries.*" Following security, increasing home comfort, and saving time/money are common advantages of smart homes. E3 states, "*People living with urban lifestyle perceive time as a scarce resource, so they seek to have more peace of mind and comfort at their houses.*" Despite experts recognizing the environmental benefits of SHT usage, they argue that they are not the primary reason for their adoption. Most of the time, the monetary gains resulting from energy efficiency motivate consumers more than a decrease in their carbon footprint. Experts propose increased control as the current value proposition of SHTs, as the context-aware smart homes are not in their existing solution portfolio. Only one expert touches upon the gains from other enhanced experiences from context-aware smart home usage. As per E1, "*Your washing machine can order the appropriate detergent directly from your preferred e-commerce company based on the washing programs you used and your washing frequency.*"

Perceived enjoyment is another crucial enabler of adoption in the context of smart homes. Experts indicate that consumers want joy and excitement from their SHT usage, and many consumers are already engaged in hedonic experiences with SHTs. The statement of E10 points out that "*Smart lighting products serve to satisfy our consumers' enjoyment need by enhancing the computer game or movie watching experiences with scene adaptive ambiance lights. They can even amuse their babies with this colorful atmosphere. There is a strong relationship with psychological moods and lights.*" Supporting this, E4 mentions the ecosystem collaboration among SHT and online streaming service providers for enhancing home entertainment experiences.

Image is perceived as one of the critical enablers of SHT acceptance. Consumers derive how modern they are from the smart devices they use in home settings, and therefore perceive them as a means of social recognition and prestige. They want to show their smart home off to their guests and neighbors and are proud of having pretentious technologies at home. E9 comments on this social benefit "*Even construction companies build their marketing communication strategy on this motive.*"

From the design perspective, experts advised that consumers want to express themselves that they are modern through the uptake of SHTs. Therefore, they value the contemporary look and feel of SHTs. Moreover, they tend to buy the newest version of the multifunctional appliances. The bundle of different functionalities in one device is perceived as a benefit by SHT consumers, even if they are not using all of them [E2].

Technology innovativeness is a subtheme of SHT adoption drivers that constitutes the combination of tech-savviness, enjoying the do-it-yourself (DIY) concept, and being a trendsetter. E3 states, "*For DIYers, the limit is the sky for SHT benefits and usage areas.*" Tech-savviness is explained as motivation to own the newest technology products immediately after their launch, even if it requires the complex installation and usage processes and the product may have some flaws. Experts are prioritizing digital-native millennials for mass-market diffusion of SHTs in the coming years. They have been interacting with technology from childhood, but they are not yet old enough to make household technology adoption decisions by themselves. Experts find digital native millennials as "*naturally tech-savvy*" [E12]. The last code under this trait is a trendsetter, characterized as a follower of attractive contemporary lifestyles [E11].

4.3. Barriers of Smart Home Adoption

Barriers account for perceived insecurities and risks inhabiting consumers' adoption behavior. They are presented by means of the following subthemes: high cost, complexity, lack of technical and lifestyle compatibility, lack of trialability, lack of observability, issues around facilitating conditions and support services, and the lack of a trusted brand in the market, and technology anxiety.

High cost is defined as the lack of taken value from the monetary sacrifice (e.g., initial price, subscription cost) for buying and using SHTs. It is the most prevalent inhibitor of their adoption. Without any exception, all experts stated the unequal monetary trade-off of SHT usage. E13 states, "*Even a simple, smart home configuration costs more than US $1000. How can a consumer who earns a minimum wage of approximately US $300 effort it? SHTs are only for the high-income consumers.*" When the reasons are asked, some experts explain this barrier because of the country's economic conditions and consumers' short-term living perspective. E8 argues the situation with these words: "*In a country, where people conceive 12 months as long term, it is highly uncommon to spend money on a future value such as energy or monetary savings.*" Consequently, some experts offer a subscription-based model to remedy this problem, where consumers do not need to invest in SHT in the first place. This model enables SHTs to be financially viable for all types of users [E6 and E12].

The complexity subtheme covers the lack of ubiquitous user experience, usability problems, and time-consuming programming requirements. Complexity is one of the main inhibitors of SHT adoption [1,9]. E1 states, "*We need to reach a state where the machine is constantly learning from the data produced inside and outside the home. Only this highly personalized and ubiquitous environment will be attractive to mainstream consumers.*" SHTs are not providing an intuitive user experience yet. Consumers need to handle the programming of complex routines for personalized usage. Usability problems arise from downloading multiple software applications to monitor and control different SHTs in the home. Each software has an additional user interface and customer journey, which also increases the complexity. Not having the local language option in these applications and technical jargon used for the operators are also added as adoption inhibitors. Experts emphasize that expanding smart speakers as a control unit or hub for all SHTs at home will ease their personalization, and therefore, their usage [E3 and E12].

The lack of compatibility subtheme is expressed with a technical, decorative, and habitual misfit with the current lifestyles of the customers. More than half of the experts declare the technical misfit among different SHTs. From the connection perspective, interoperability of SHTs should be achieved by adopting universal standards as a communication protocol [E9]. Experts emphasize the importance of building ecosystems by cooperating with a wide range of providers and service operators to close the gap between the customer needs, wants, and preferences and the smart home service offerings. Current SHTs are far from learning consumers' routines and adapting their services in case of any change. E7 states, "*Even if people buy SHTs, they stop using the smart features because the current use-cases do not trigger behavior change and consequently do not create new habits at household.*" Moreover, one expert expresses the complaints of luxury segment consumers about the interior design incompatibility of SHTs [E1].

The insufficient number of in-store experience centers and unavailability of trial periods impede consumers' adoption of SHTs by the lack of trialability perceptions. Furthermore, E3 asserts, "*First experiences of early adopters with SHTs are insufficient. As service providers, it should be our priority to improve further product generations through continuous product development. Otherwise, we could not cross the chasm to the mass market.*" E12 expresses the same problem for voice assistants: "*The previous experience with innovation has a significant effect on its adoption. We are facing this barrier with voice assistants. After a couple of failed trials, people develop a negative attitude towards them.*" Regardless of the usage area, experts stress the importance of trialability and the need for more occurrences to enable the self-trial of SHTs [E6].

Lack of observability is voiced as an inhibitor many times. The penetration rate of smart homes in the studied country is 9.4% in 2021 [11], which indicates that the SHT diffusion is still in its early stages. Therefore, people have limited occasions to observe the usage and benefits of SHTs. Experts voice this phenomenon as "*limited Word of Mouth (WOM)*" [E9, E12, E13]. Moreover, industry experts indicate online and offline information sources as limited and scarce. Social media influencers are considered significant sources of observability, and E12 proposes: "*We can even use big data to identify the online channels and*

influencers for the promotion of smart homes in the future." Moreover, E9 suggests organizing a smart home scenario contest on social media channels so that people can share their stories with SHTs and increase SHT awareness.

The facilitating conditions subtheme covers the concerns around three codes, lack of prevalence of wireless networks and a broadband internet connection, problems with aftersales support services, and lack of knowledge, including awareness of the SHTs, where to buy, and how to install/set up products. Despite the growth of wireless technologies enabling easy and scalable smart home installations, the lack of widespread and affordable broadband internet for existing housing stock is still a barrier to reaching the mass market. The concerns about aftersales services are portrayed as having a significant impact on SHT acceptance. E6 states, "*Even internet modems are installed to consumers' houses by service providers. Providing installation service is a must for SHTs.*" Therefore, experts voice a need for SHT information flow (e.g., product/service specifications, installation guides) through their supply chain (providers to wholesalers and technical services, and then to consumers) and to expand their wholesaler network. E11 adds that consumers have limited knowledge of installing smart lighting products. Consumers believe that calling an electrician is necessary, even if the installation of smart bulbs is the same as a standard bulb. In the same orientation, E7 indicates that most households do not even know the Wi-Fi password they use at home.

Concerns regarding trust in brands are among the most critical barriers. This subtheme includes concerns about the security of SHTs, low reliability of the devices in case of power outages, and distrust of the provider to prevent inhabitants' privacy. Experts repeatedly state that consumers are not concerned about neither the security and reliability of the product nor the confidentiality of their data, as long as they trust the brand of the SHT provider. E3 concludes: "*Only after an established brand with an existing household portfolio makes a significant investment in the smart home market then this market will grow in the studied country.*" Regarding security, dual responsibility between providers and users is often expressed. Therefore, it is essential to guide consumers to develop knowledge and skills to secure their SHT usage. E7 argues, "*An average consumer can only perceive what they see as a threat, not an abstract concept like cyber security. Therefore, they are extremely uncomfortable only with smart cameras considering the visual surveillance risk, but not afraid of cyber criminals.*" Some experts argue that security concerns are the easiest to address among barriers. For example, E9: "*Smart home networks are protected with 128-bit encryption. Breaking a traditional front door is easier than hacking such encryption key.*" Coming to reliability, it is indicated that SHTs must be reliable in the delegation of agency of critical tasks such as assisted living or safety [E8]. Moreover, it is mentioned that there should be a recovery solution to coordinate a smart living environment in case of power outages [E9].

Technology anxiety is specified as the feeling of being out of control when using SHTs and the fear of being too dependent on technology vendors for expanding the smart home environment with different scenarios. It is named a hindrance to smart home adoption. Consumers are reported to be worried about SHTs doing something by themselves, causing them to lose control of their homes [E9].

5. Conclusions and Implications

This study examines the impeding and encouraging factors of SHT adoption. By lending insights from previous technology adoption literature, an interview guide is built on an integrated theoretical framework, whose constructs are based on DOI theory and some elements of UTAUT2 and PRT. Results of thematic analysis of qualitative data gathered from 13 in-depth industry expert interviews indicate that 13 constructs are affecting the adoption of SHTs. Those constructs are visualized as drivers and barriers to SHT adoption in a thematic map.

Parallel to the literature, relative advantage, image, enjoyment, design, and technology innovativeness are identified as facilitators. In contrast, high cost, lack of compatibility, lack of trialability, lack of observability, lack of a trusted brand, lack of facilitating conditions

and support services, complexity, and technology anxiety are the obstacles to SHT adoption. This full-fledged set of determinants enables academics to raise future research avenues in smart home adoption research. An integrative set of determinants is critical in understanding the adoption of technologies such as smart homes, which affect consumer's life pervasively and immediately after their adoption. Ultimately, SHT adoption would lead to a lifestyle change for consumers; it is not only a technology upgrade. Technology adoption in the home setting is complex by nature, with different actors relating to different scenarios based on multiple technology components. Therefore, it is more important to reveal all possible determinants of smart home adoption to gain insights from all perspectives.

Adding upon the prior research on smart home adoption, this study also categorizes the SHT adoption determinants as motivators and inhibitors. Previous studies are more focused on the drivers of the SHT adoption [23,30,41], whereas the studies on barriers and risks are limited to understanding SHT resistance [9,68,69]. This study reveals a comprehensive smart home adoption determinant set as a result of a qualitative research, supported by the well-known diffusion of innovation theory. Despite some previous studies on the benefits and risks of smart home adoption [1,17], this research methodologically differentiates from them in thematically analyzing industry experts' opinions, which are collected through in-depth interviews. Industry experts are rich information sources for adoption/market penetration studies because they can observe the consumers in the field where consumers openly tell their expectations or hesitations. Further, they manage marketing activities of smart homes such as segmentation and targeting of potential customers and definition of related content for each selected communication channel.

In the conclusion of this study, SHTs help consumers to achieve both instrumental outcomes (e.g., time and money savings, enhanced security) as well as hedonic (e.g., enhanced entertainment) and social (e.g., prestige) outcomes. Those are the main drivers of SHT adoption. Ensuring easy-to-use, technically, and habitually compatible SHTs, which trusted brands provide at an affordable price, can help consumers mitigate related perceived uncertainties and build customer confidence in their adoption. Trying them in experience centers and reaching online and offline information sources will increase awareness of their benefits, so that the barriers to SHT adoption will be mitigated.

5.1. Theoretical Implications

This resulting thematic map provides researchers with a visualized structure for drivers and barriers to SHT adoption. The developed subthemes could support theory-building efforts to uncover consumers' attitudes and adoption behaviors towards SHTs by assessing their perceptions of these determinants. This study proposes an integrated and unique smart home adoption model that can explain the complex motives behind SHT acceptance by providing a comprehensive set of determinants.

Results of our qualitative study support all innovation attributes derived from DOI (relative advantage, compatibility, complexity, trialability, observability, and image) and confirm some adoption determinants stem from the UTAUT2 technology adoption model (enjoyment, price value, and facilitating conditions) and add contextual "design" and "brand trust" constructs to the determinants of smart home adoption. Another important finding of our study is the identification of some technology-related traits which act as enablers or inhibitors of SHT adoption. "Technology innovativeness" and "technology anxiety" are the leading two consumer characteristics, which are distinguished from other personality traits and demographics considering their effect on SHT adoption. Previous research also confirms the impact of technology-related negative feelings on adoption/attitude/behavior in smart homes [70]. Moreover, innovativeness has been identified as a direct motivator of SHT intention to use [35,41] in previous studies.

Moreover, the thematic analysis is executed with a versatile view, considering standard technology adoption theories/models and exploring new determinants with a thematic analysis of industry expert views. The following constructs are identified from mainly used technology adoption theories/models: relative advantage, compatibility, complexity,

trialability, observability, image, enjoyment, and price value. On the other hand, the following are identified through the exploratory coding strategy: technology innovativeness, technology anxiety, brand trust, design, and facilitating conditions. Both approaches allow this study to reveal context-specific factors along with the validated theoretical constructs.

Finally, the interviewed experts reflected the professionals' view on smart home determinants in a developing country, where the penetration rate of smart homes is 9.4% in 2021 [11], which indicates that the SHT diffusion is still in its early stage. Experts highlighted the following points specific to this market: An established brand is an important driver of SHT adoption because a brand could mitigate the consumer's device reliability concerns and is perceived as the assurance of the consumer privacy. However, previous studies discussed the reliability, the privacy, and the security aspects of SHTs individually [1,4,9] and suggest them as barriers of SHT adoption. The pricing of SHTs is proposed to attract special attention, as the economic prosperity of majority of consumers could not easily afford adopting SHTs in the subjected country. In contrast to the previous findings of Sovacool and Del Rio (2020) in European countries, experts did not recognize the environmental benefits of SHTs as a major driver of their adoption. They brought forward the home security enhancement use cases, which could be critical in some countries, where the burglary rate is high. Lastly, facilitating conditions such as broadband internet prevalence and general technology literacy of consumers are another interesting determinant, where the situation may differ country by country.

5.2. Practical Implications

From a business standpoint, the derived thematic map of SHT determinants can serve as a market entry guide for smart home providers by highlighting potential barriers and drivers of SHT adoption, as well as helping smart home providers to modify their products/services to meet consumers' expectations at their best. It enables marketers to understand their consumers and design their communication and service strategies accordingly. Companies easily target innovative consumers from the technology perspective, who are the trendsetters and do not get upset quickly with building their use cases in their homes. In contrast, people with technology anxiety would be late adopters. They want to ensure that they would still be able to control their homes by themselves after smart home installations. Perceived functional, social, or hedonic benefits are the main drivers of SHT adoption. Marketers should emphasize the key role of SHTs in facilitating daily life and task completion, along with the enjoyment and prestige arising from solely using or owning them. Subsequently, starter kits can provide easy-to-install and affordable smart home experiences for consumers to overcome complexity and lack of compatibility barriers and enable users to benefit from SHTs in the form of predesigned use cases. Having the opportunity to receive an installation service as a part of aftersales services would help shrink the service gap for facilitators of SHT adoption. In the meantime, providing specialized consultancy services for building unique and hypercustomized smart home scenarios would satisfy the expectations of prestige and comfort-focused consumers. Additionally, our research shows that consumers trust SHT brands for the security and reliability of the product/services, but more interestingly, for their privacy protection. This fact indicates that providers need to gain the consumers' trust by addressing those privacy, security, and reliability concerns through applying transparent information policy and security-by-design principles.

From the public policy standpoint, the results of this study present fruitful insights to policymakers to understand the risk-and-benefit perceptions of consumers arising from SHT adoption and to act upon them to promote a smart city strategy. Smart homes are the primary enablers of energy efficiency, sustainable development, and improved life quality in urban areas. Our thematic map provides rich insights for governmental institutions and municipalities seeking to transform current building stock into a more environmentally friendly and economically sustainable version and improve the quality of urban life. Utilizing our thematic map, they can identify critical motivators and hindrances of smart home adoption and adjust their communication strategy accordingly. Considering

the perception that the initial investment cost of SHTs is high for an average citizen, our findings encourage the provision of financial incentives for smart home adopters who use this technology with the purpose of building energy-aware houses. In contrast to the previous literature findings, consumers in the studied developing country do not put enough value on the environmental benefits of smart home adoption. Policymakers can tackle this point by releasing public awareness campaigns on the importance of energy efficiency and sustainability. Another important finding is that smart home security, privacy, and reliability concerns are hindering their adoption. Regulator institutions can act on this point as an accelerator for reconciling interoperability and security standards for smart objects. In contrast, policymakers can put a framework for consumers' privacy protection such as General Data Protection Regulation.

6. Limitations and Future Research

There are two main limitations to this study. First, the study was conducted using a limited number of experts from specific sectors, even if the number of interviewees was satisfactory, according to Guest et al. [65] for thematic saturation. Interviewing with the specific sector experts restricts the explanatory power of the category-related findings on drivers and barriers to SHT adoption. Security, technology, and health sectors were not covered in the sample. Future research may refine our results by recruiting informants with a broader range of sector distribution. Since our study was conducted in one country, a second limitation might be geographical. This study was carried out in an emerging economy, where the penetration of SHTs is still limited. Therefore, industry experts from more developed countries where smart home penetration is higher might indicate other aspects of drivers and barriers. Future research is encouraged to be executed in different settings to check whether similar results may be found.

The topic also opens new avenues for future research. Interesting research questions have emerged during our analysis of interviews. The detailed description of the drivers and barriers can be used as a starting point for a comprehensive smart home adoption model that investigates factors that foster and hinder the adoption of SHTs, leading to consumer behavioral change in marketing research. A quantitative study may be used to validate this integrated model. It would also provide an opportunity to determine which constructs are significant, whatever technology-related trait of consumers is concerned, by using multi-group models on samples of consumers of different characteristics and lifestyles. Furthermore, similar in-depth interviews can be conducted with smart home adopters in the countries where smart home technology penetration is higher than in the studied country and where consumers are more knowledgeable in different individual SHTs and interconnected smart home scenarios.

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Appendix A

Table A1. Overview of themes and code frequencies.

Theme	Subtheme	Code	Frequency
Drivers	Relative Advantage	Security assurance	13
		Home comfort	13
		Increased controllability	9
		Time and money savings	8
	Enjoyment	Enhanced entertainment	4
	Image	Prestige	8
		Social recognition	3
	Design	Multifunctionality	6
		Modern look and feel	3
	Technology Innovativeness	Tech-Savvy	9
		Trendsetter	5
		DIY—For the user by the user	4
Barriers	High Cost	Expensive	13
	Complexity	No ubiquitous user experience	10
		Time-consuming to program routines	8
		Complex usability	7
	Lack of Compatibility	Limited Interoperability	8
		Noncompliant use cases with existing habits	6
		Interior design fit	3
	Lack of Trialability	Lack of in-store experience	5
		Not sufficient first experiences	4
	Lack of Observability	Lack of information sources and WOM	11
	Lack of Facilitating Conditions	Aftersales concerns	9
		Lack of technology knowledge	6
		Wi-Fi and Internet prevalence	3
	Lack of Brand Trust	Trusted brand	10
		Security concerns	7
		Reliability concerns	6
		Privacy concerns	3
	Technology Anxiety	Vendor lock-in	5
		Loss of personal control	3

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