CONSUMERS' ATTITUDES TOWARD AND INTENTIONS TO ADOPT SMART HOME TECHNOLOGIES

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CONSUMERS' ATTITUDES TOWARD AND INTENTIONS TO ADOPT SMART HOME TECHNOLOGIES

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DECLARATION OF ORIGINALITY

I, Birgül Başarır Özel, certify that

- I am the sole author of this thesis and that I have fully acknowledged and documented in my thesis all sources of ideas and words, including digital resources, which have been produced or published by another person or institution;
- this thesis contains no material that has been submitted or accepted for a degree or diploma in any other educational institution;
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ABSTRACT

Consumers' Attitudes Toward and Intentions to Adopt Smart Home Technologies

Smart homes embrace different smart home technologies (SHT) to offer various services to fulfill their users’ needs and wants. They are one of the key enablers of smart living. Conversely, SHT penetration is still growing slowly compared to its potential benefits. Thus, this dissertation proposes a diffusion of innovation (DOI) based integrated research model for understanding consumers’ attitudes toward and intentions to adopt smart home technologies, through subjective perceptions of the innovation characteristics. For this purpose, the existing literature on technology adoption and smart homes is examined and innovation characteristics are complemented with the contextual factors extracted from 13 expert interviews. The final research model is tested with the data collected from 995 individuals via a face-to-face survey. During the analysis, consumers are clustered into meaningful segments regarding their technology-related traits stemming from the technology readiness index (TRI) 2.0, and smart home adoption determinants are explored for these consumer segments to reveal segment-based distinctions. Additionally, differences in SHT adoption are investigated based on lifestyle attributes-based consumer segments, demographics, socioeconomics, prior experience, and housing structure. This research contributes to understanding the adoption of innovations in the consumer behavior context.

ÖZET

Tüketicilerin Akıllı Ev Teknolojilerine Yönelik Tutumları ve Benimseme Niyetleri

Akıllı evler, kullanıcılarının ihtiyaçlarını ve isteklerini yerine getiren çeşitli hizmetler sunmak adına farklı akıllı ev teknolojilerinden (SHT) yararlanır. Bu teknolojiler akıllı yaşamın kilit unsurlarındandır. Diğer taraftan, akıllı ev pazarı potansiyel faydalarına kıyasla halen yavaş büyümektedir. Bu nedenle, bu çalışma, tüketicilerin akıllı ev teknolojilerine yönelik tutumlarını ve benimseme niyetlerini anlamak adına, inovasyon yayılımı teorisine (DOI) dayanan ve tüketicilerin akıllı ev inovasyonu özelliklerine ilişkin öznel algıları inceleyen bir araştırma modeli önermektedir. Bu amaçla, teknolojinin benimsenmesi ve akıllı evler ile ilgili mevcut literatür incelenmiş ve 13 uzman görüşmesinden çıkarılan bağlamsal faktörlerin de katkısıyla akıllı ev inovasyonu özellikleri tamamlanmıştır. Nihai araştırma modeli, yüz yüze anket yoluyla 995 kişiden toplanan veriyle test edilmiştir. Analiz sırasında tüketiciler, teknolojiye hazır olma endeksi (TRI) 2.0'da yer alan, teknoloji ile ilgili kişilik özelliklerine göre anlamlı segmentlere ayrılmıştır. Bu segmentler arasındaki farklılıkları ortaya çıkarmak adına akıllı ev benimseme belirleyicileri segmentler bazında da incelenmiştir. Ek olarak, akıllı ev teknolojilerinin benimsenmesindeki farklılıklar, yaşam tarzı özelliklerine istinaden bulunan tüketici segmentleri, demografik ve sosyoekonomik özellikler, önceki deneyimler ve konut yapısına dayalı olarak araştırılmıştır. Bu çalışma, tüketici davranışı bağlamında inovasyonun benimsenmesinin anlaşılmasına katkıda bulunmaktadır.

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ABBREVIATIONS

AI	Artificial Intelligence
ANOVA	Analysis of Variance
CA	Cronbach’s Alpha
CI	Condition Index
DOI	Diffusion of Innovation
DIY	Do It Yourself
EFA	Exploratory Factor Analysis
KMO	Kaiser-Meyer-Olkin
IoT	Internet of Things
IS	Information Systems
MATH	Model of Adoption of Technology in Households
PhD	Doctor of Philosophy
PRT	Perceived Risk Theory
Q-Q	Quantile-Quantile
SHT	Smart Home Technologies
SES	Socioeconomic Status
TAM	Technology Acceptance Model
TL	Turkish Lira
TRA	Theory of Reasoned Action
TRI	Technology Readiness Index
TRI 2.0	Technology Readiness Index 2.0
TUAD	Turkish Researchers’ Association
TPB	Theory of Planned Behavior

USD	United States Dollar
UTAUT	Unified Theory of Acceptance and Use of Technology
UTAUT2	Unified Theory of Acceptance and Use of Technology2
VIF	Variance Inflation Factor
ZPRED	Standardized Predicted
ZRESID	Standardized Residuals

CHAPTER 1

INTRODUCTION

The research topic is introduced, and the objectives of the thesis are explained in this chapter. Initially, a summary of smart homes is given, then the aim of this dissertation is presented.

1.1 Overview of smart homes

The growth of IoT has been propelled by advancements in sensors, networking technologies, broadband internet, cloud services, and artificial intelligence (AI). Through IoT, objects and people can be connected, allowing for the application of innovative services in various scenarios, such as wearables, autonomous cars, smart homes, and smart cities. This blending of virtual and physical worlds through data sharing leads to a paradigm shift in how people communicate, work, and live. The recent development of various IoT-based devices has also contributed to advancements in SHTs. Smart home technologies (Sovacool & Del Rio, 2020) are frequently used interchangeably with “home automation” (Takayama et al., 2012), “home network” (Balta-Ozkan et al., 2014), “household technology” (Brown, 2008), “smart domestic products” (Woodall et al., 2018), or “intelligent home” (Reinisch et al., 2011). Smart homes have been conceptualized using various definitions. By examining smart home literature and integrating various aspects of smart home definitions, it can be concluded that a smart home is a system of interconnected intelligent devices and sensors that provide users with control, monitoring, support, and responsive services to meet their needs (Balta-Ozkan et al., 2013; Marikyan et al., 2019). Smart homes reinforce various home activities such as living, working, learning, and leisure by providing their users with sustainability, security, economic, health-related, emotional, and social benefits. SHTs have transformed conventional homes into intelligent and interconnected smart homes. They have facilitated smart living, aiming at improving life through efficiency, productivity, controllability, economic benefits, sustainability, and integration (European Commission, 2014).

Smart homes are an essential area of research for innovation diffusion and technology adoption, among the many services provided by IoT. As IoT devices become more widespread, the smart home market expands, offering consumers various personalized services such as energy-aware homes, health monitoring, and home automation to support their daily lives. In the literature, smart homes are viewed as a core element of sustainability efforts due to their potential to promote energy efficiency (e.g., Pinochet et al., 2019). This research area has grown beyond smart homes, extending to smart grids, smart cities, and even a smarter planet (Sovacool & Del Rio, 2020). Given that 68% of the world's population is projected to live in cities by 2050 (United Nations, 2018), smart homes are crucial to creating a more sustainable future. Assisted living is another major research area for smart homes (Demiris & Hensel, 2008; Chan et al., 2009; Doukas et al., 2011; Bennett, 2017). Smart home technologies enable personalized care and independent living for the elderly, disabled, and chronically ill, making them a critical enabler of assisted living. In addition, as Li et al. (2021) point out, home automation offers its users increased comfort, improved security and safety, and more enjoyable entertainment options, all of which align with modern lifestyles. According to Friedewald et al. (2005), context-aware and ambiently intelligent smart homes could revolutionize socialization by introducing novel communication methods within the home.

The multitude and diversity of smart home products and services in the market showcase the multi-faceted nature of smart homes and, thus, the complexity of the research problem. Park et al. (2003) devised 22 smart home appliances ranging from smart walls to smart pillows in their experimental smart home project. Since this experimentation, the number of SHTs has grown. It is posited by Sovacool & Del Rio (2020) that there are 267 prominent SHT options commercially available in the European market under 13 categories, which are lighting, entertainment, safety and security, baby and pet monitors, appliances, home robots, gardening, energy and utilities, health and wellness, clothes and accessories, vehicles and drones, integrated solutions, and others. Opportunities in the smart home market are thriving (McKinsey&Company, 2016).

Despite the wide usage area and vast market potential of smart home technologies, their diffusion is not pervasive as expected, and consequently their potential is mainly intact. The projected global market revenue is expected to turn up nearly $187 billion by 2025, reaching 494 million homes with an average 22% penetration rate (Statista, 2021). By 2025, 47.8% of all households in the USA and 29.4% in Europe is projected to implement SHTs (Statista, 2021). However, only 9.4% of households in Turkey adopted smart homes in 2021, with the expectation to grow to 18% by 2025, which raises research attention for this early adopter country. Some scholars claim that smart home development is technology-centered rather than user-experience-focused, which has caused their slow diffusion (e.g., Wilson et al., 2015; Hoffman & Novak, 2016). Similarly, Bjelica (2018) evaluated smart homes as the most complicated type of consumer IoT technology, both from installation and usage perspectives. Brush et al. (2011) mentioned four barriers that hinder the wider implementation of smart homes: the high cost of ownership, inflexibility, poor controllability, and security concerns. Lee (2020) suggested that privacy concerns and vulnerabilities are the main reasons for home IoT resistance. These counterarguments indicate the need for studying determinants of SHT adoption to contribute theoretically to technology adoption and innovation diffusion literature and to unleash smart homes' market potential from a practical angle.

Due to the significant impact that a wide range of smart home applications can have on people's lifestyles, marketing scholars and practitioners have focused on examining consumers' attitudes toward and intentions to adopt SHTs. The examination of SHT adoption determinants is essential to facilitate the successful adoption and rapid diffusion of these technologies. By identifying key factors that influence consumer adoption of SHTs, the industry can design effective marketing strategies for introducing these technologies to the market. In turn, this provides scholars with numerous research opportunities in the multi-faceted area of smart home adoption.

1.2 Purpose of the dissertation

This research develops an integrated model to examine the factors that drive the adoption of smart home technologies. By meticulously reviewing the technology adoption and innovation diffusion literature, innovation characteristics are distilled from a theory base and combined with contextual elements extracted from industry expert interviews. This comprehensive research model is explicitly tailored to study consumers' attitudes toward and intention to adopt smart home technologies. The main theoretical underpinning of this research model is DOI. The initial set of innovation characteristics is proposed as relative advantage, complexity, compatibility, trialability, observability, image, price value, enjoyment, design, privacy, security, and brand trust, which have an impact on the attitude toward and the intention to adopt SHTs. Thereafter, this initial set is further analyzed with exploratory factor analysis (EFA) to reveal the final set of innovation characteristics.

The purpose of this research is to uncover the antecedents of the adoption of smart home technologies, allowing professionals to achieve a competitive edge in the smart home market. Moreover, consumers' reactions to the adoption of SHTs vary according to their demographic characteristics (e.g., Shin et al., 2018; Kennedy & Holcombe-James, 2022) and are also affected by their technology-related traits (e.g., Agarwal & Prasad, 1998; Venkatesh & Bala, 2008; Ahn et al., 2016; Kowalczuk, 2018; Nikou, 2019) or lifestyle attributes (e.g., Rogers, 2003; Gao et al., 2015; Schill et al., 2019). Leading the way in research on smart home adoption, this research also attempts to find distinct consumer segments according to their technology-related traits and then examine variation among these segments regarding the innovation characteristics that predict their attitude toward and intention to adopt SHTs. This dissertation also incorporates the role of three different lifestyle attributes (environmental responsibility, health orientation, and home-as-extended-self) on SHT adoption decisions and studies the role of individual difference variables such as demographics, socioeconomics, prior experience, and housing structure.

This dissertation sets itself apart from previous research on smart home adoption, firstly by proposing a comprehensive research model of SHT adoption by integrating innovation characteristics from previous technology adoption theories and blending them with more smart home-related contextual factors revealed in the qualitative study, and secondly by incorporating different technology-based consumer segments into the analysis and lastly by searching the role of varying lifestyle attributes and individual characteristics on smart home innovation adoption. Therefore, this dissertation aims to address the following research questions:

- Which innovation characteristics are significant determinants of consumers' attitudes toward and intentions to adopt SHTs?
- What are the distinct segments of consumers about their perceptions of TRI 2.0 dimensions?
- How do determinants of consumers' attitudes toward and intentions to adopt SHTs change among consumer segments based on their technology-related traits?
- Do consumers' attitudes toward and intention to adopt SHTs differ depending on their lifestyle attributes, demographics, socioeconomics, prior experience, and housing structure?

To answer these questions, the structure of this dissertation is outlined as follows: Following this introduction chapter, which presents the research purpose and questions, Chapter 2 discusses the theoretical background as the state of smart home literature, frequently used theories/models of technology adoption, the diffusion of innovation theory, and the technology readiness index. Chapter 3 details the research methodology and procedures employed and explains the reasoning behind their usage. Chapter 4 presents the qualitative aspect of this dissertation, incorporating the data gathered from expert interviews. Chapter 5 gives details of the quantitative part by explaining theoretical background, research model, derived hypotheses, measurement instrument, and sampling strategy. Chapter 6 addresses research questions of this dissertation and provides the empirical analysis of results. Chapter 7 contains a discussion of the results and conclusions. Chapter 8 explains theoretical and practical implications followed by future research ideas and study limitations.

CHAPTER 2

THEORETICAL BACKGROUND

In this chapter, the previous literature was summarized with the aim to grasp deep knowledge on the research objective, which was to understand SHT adoption determinants by taking the problem holistically from both innovation characteristics and individual differences views. Therefore, firstly, smart homes were discussed within the context of IoT services. Subsequently, the technology adoption/innovation diffusion literature was explored. To this extent, a literature review covering a general understanding and various smart environment implementations around the theory of reasoned action (TRA), the theory of planned behavior (TPB), the technology acceptance model (TAM), the unified theory of acceptance and use of technology (UTAUT), UTAUT2, the model of adoption of technology in households (MATH), and the perceived risk theory (PRT) was provided. Finally, DOI theory was described as the basis of innovation characteristics, and TRI and TRI 2.0 were elaborated to provide a theoretical background for the technology-related traits of consumers.

2.1 The definition and evolution of smart home technologies

The term IoT was first introduced in 1999 to describe the network of objects coupled with sensors to deliver data to the Internet (Ashton, 2009). Ashton (2009) emphasizes how data collection directly from objects without human intervention could change the world, as the Internet did. IoT standards typically encompass various wireless networks and sensors. Those two technologies are the primary enablers of IoT. A decade later, the IoT has evolved into a network of assets that are interconnected via any sensor, which enables them to be identified, and managed remotely (Ng & Wakenshaw, 2017). These earlier definitions of the IoT are mainly focused on the technical aspects. On the other hand, the IoT paradigm offers a smart environment to create a better and safer society from a sociological perspective.

The significant growth in smart objects has been driven by recent advancements in sensors, networking technologies, broadband internet, cloud services, and AI technologies. These developments have taken the lead to the progress of self-governing systems, such as smart homes, smart cities, and autonomous cars. This merge of the Internet and the tangible objects via the IoT is described as the third wave of the Internet by evolving many physical assets into digital services (Porter & Heppelmann, 2014; Brody & Pureswaran, 2015; Ng & Wakenshaw, 2017; Risteska et al., 2017). Therefore, several countries have recognized the importance of IoT for their future economic growth and sustainability (Santucci, 2010). Brody and Pureswaran (2015) expected to have more than 100 billion things connected with each other by 2050, as illustrated in Figure 1.

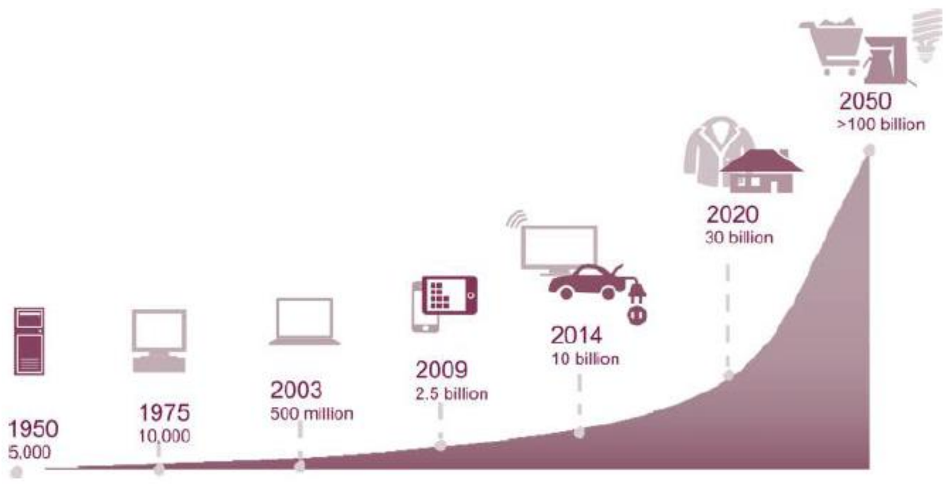

Figure 1. Connectivity transformation
Source: [Brody & Pureswaran, 2015]

The rise of various IoT-based tools has enabled the creation of smart objects enriched with AI, which could obtain information from the adjacent environment and respond consequently (Marikyan et al., 2019). Smart objects have capabilities that can be categorized into four areas: monitoring, control, optimization, and autonomy. These capabilities build upon each other, so for example, a product must have monitoring capability to have control capability (Porter & Heppelmann, 2014).

Smart homes are important implementation areas of the IoT (McKinsey Global Institute, 2015; Choi et al., 2021). Smart home technologies have transformed conventional homes into intelligent and interconnected living spaces. Researchers in the field of smart homes are showing increasing interest (Li et al., 2022). Smart home technologies (Sovacool & Del Rio, 2020) are frequently used interchangeably with "home automation" (Takayama et al., 2012), "home network" (Balta-Ozkan et al., 2014), "household technology" (Brown, 2008), "smart domestic products" (Woodall et al., 2018), "digital home technologies" (Venkatesh, 2008), "connected home" (McKinsey&Company, 2016) or "intelligent home" (Reinisch et al., 2011). Smart homes have been conceptualized using various definitions. Analyzing smart home literature and combining all facets of smart homes definitions, the smart home represents an ecosystem of domestic smart objects which are integrated into a smart structure for providing management, monitoring, and responsive services through the connections within the home and to the Internet (Aldrich, 2013; Balta-Ozkan et al., 2013; Marikyan et al., 2019). This integration results in a selection of benefits, including sustainability, security, economic, health-related, emotional, and social to satisfy users' needs and desires (Marikyan et al., 2019).

This definition can be broken into four parts. Smart domestic objects and intelligent networks present the technical aspects, whereas services and benefits complement business aspects. Smart domestic objects could be domestic appliances, sensors, devices, and hubs. Home appliances refer to white goods such as smart ovens, refrigerators, and washing machines. In contrast, sensors are utilized to distinguish environmental factors such as humidity, light, and temperature or to gather data concerning the conditions of objects. Devices can be electronic (such as televisions or computers) or electric (such as light bulbs or kettles). Finally, a home hub can be either a device (such as smartphones or laptops) with data storage capacity, local processing capability, and the ability to communicate with devices outside the home network or a dedicated hardware device (such as a wall mounted remote control) that manages other devices (Balta-Ozkan et al., 2014; Risteska et al., 2017; Wilson et al., 2017). These different smart home technologies are networked, most of the time wirelessly, using standardized communication protocols. In the second part, the intelligent network system is the core of smart homes. It represents AI-empowered configurations of domestic smart objects that produce customized services to satisfy residents' needs (Chan et al., 2009).

In the third part, a wide range of services are emerging for home-context. These services are provided by third parties ranging from technology to utility companies, from white goods producers to consumer electronics vendors. Balta-Ozkan et al. (2014) conducted an analysis of smart home services and case studies found in the literature, grouping them into three categories: safety, lifestyle support, and energy management, as depicted in Figure 2.

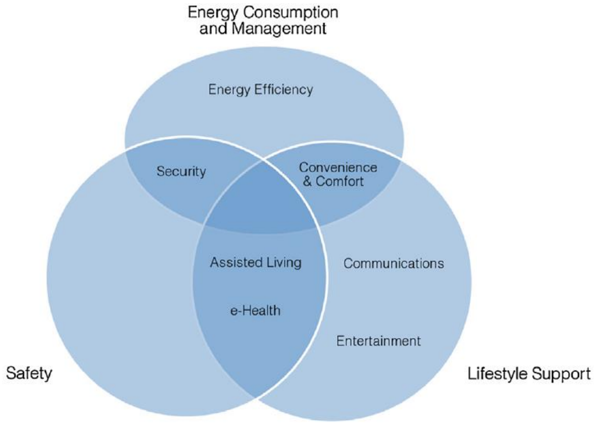

Figure 2. Types of smart home services
Source: [Balta-Ozkan et al., 2014]

In 2019, Marikyan et al. (2019) grouped smart home services into five categories: monitoring, comfort, support, health therapy, and consultancy. By then, in 2020, Sovacool and Del Rio posited that 267 smart home technology alternatives are commercially available in the European market under 13 categories, which are lighting, entertainment, safety and security, baby and pet monitors, appliances, home robots, gardening, energy and utilities, health and wellness, clothes and accessories, vehicles and drones, integrated solutions, and others. In conclusion, smart home users face the integration of various technologies and services across a broad range of usage contexts.

In the fourth and final part of the definition, smart homes offer a range of benefits that cater to consumers' needs, requirements, and preferences, including energy management, improved safety and security, enhanced entertainment services, and extended personal independence through assisted living. Several studies have examined the perceived and potential advantages of smart home technologies, both in the short and long term (e.g., Wilson et al., 2017; Marikyan et al., 2019; Sovacool & Del Rio, 2020). Wilson et al. (2017) identified the potential benefits of SHTs in the UK as energy efficiency, less effort at home, time and money savings, improved security, comfort, peace of mind, improved quality of life, enhanced leisure, increase in property value, and caregiving. Marikyan et al. (2019) categorized the functional advantages of SHTs into four dimensions: environmental, financial, health-related, and psychological well-being. Moreover, Sovacool and Del Rio (2020) found 13 distinct forms of benefits of SHTs to households, businesses, or society. These are ranked by frequency: (1) energy efficiency, (2) comfort, (3) financial benefits, (4) system benefits for grids, (5) environmental benefits, (6) design and fashion, (7) health benefits, (8) social benefits, (9) educational benefits, (10) entertainment, (11) safety and security, (12) other enhanced experiences (such as shopping), and (13) free services or promotional gifts. SHTs enable users to attain both cognitive outcomes, such as saving energy, money, or time, enhancing security or health, and affective goals, such as entertainment and increased enjoyment (Wilson et al., 2017). It can be concluded that SHTs have many different benefits. However, they are potentially competing sometimes.

Even if the term "smart home" reminds people most of the time of the futuristic scenarios shown in the animated sitcom "The Jetsons", the first smart home was introduced a long time ago. Coming back to the history of smart homes, a smart home example in the "Network Exhibition" at the Berlin Technical Museum dated back to 1912. This was a call button used in mansions, hotels, and government offices, to inform the service team about room calls. This smart home scenario provided advanced communication to its users. In the same exhibition, the silent film "The Electric House", created by Buster Keaton in 1922, shows its audience the comfort that home automation will offer and turns its course into comedy when the whole house gets out of control. It is as if the concerns of today's smart home users were reflected on the screen with a humorous point of view at that time. These two smart home scenarios were prototyped to facilitate people's home life and increase communication with the existing technologies of that day. The widespread availability of high-speed internet during the latter part of the 1990s facilitated the growth of home networks. However, during the 1990s, the expansion was not so widespread, other than a few famous examples such as Microsoft founder Bill Gates' mansion in Seattle, which caused a sensation in the USA in 1995, was in all the news at that time and became a symbol of magnificence and personalized comfort (McGrath, 2016). With the rise of mobile phones and wireless technologies in the late 2000s, smart homes became more common, not just among the wealthy but also among middle-income families. In the mid2010s, it has been leaning toward context-aware smart homes, as shown in Table 1. Context-aware homes are intelligent through AI technology, which enables automation to understand and respond to people's needs. Smart homes flourish by integrating IoT and AI (Venkatesh, 2008; Yang et al., 2018).

Table 1. Evolution of Smart Homes

Period	Stage	Technical Background	Key Purpose
1990-2000	Automation	Broadband Internet	Household Automation
2001-2010	Network	Smartphone and Mobile Applications	Remote Monitoring & Control
2011-2020	Smartness	IoT & AI	Context Awareness

Source: [Yang et al., 2018]

Smart home technologies could gradually be integrated into homes, so there is a spectrum beyond traditional homes and fully automated homes. Based on homes' smartness level, Sovacool and Del Rio (2020) suggested a seven-level rating schema presented in Figure 3. At level zero, none of the smart home technologies are available, whereas, at level six, a smart society is proposed where the smartness level goes beyond a single house.

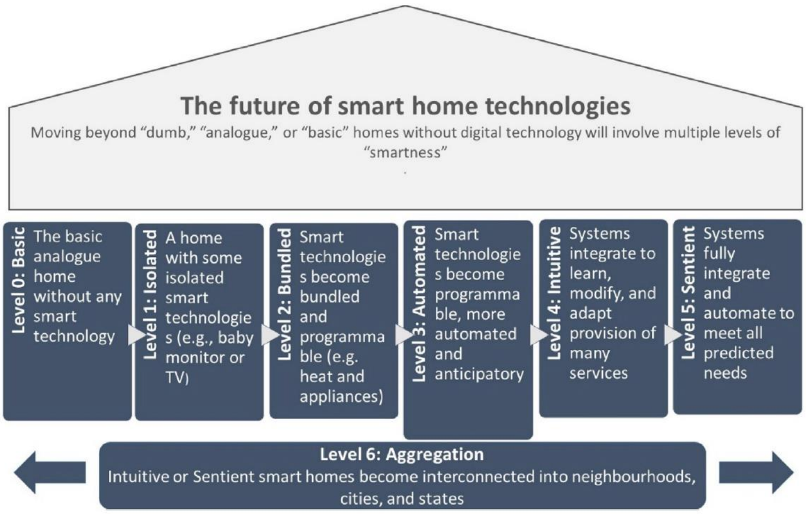

Figure 3. Levels of smartness in smart homes
Source: [Sovacool & Del Rio, 2020]

Detailed descriptions of all levels are provided below:

Level 0: This level is attributed to a traditional analog home that has locally controlled, manually operated devices, typically activated by flipping a switch or pressing a button, without the use of SHTs (Balta-Ozkan et al., 2013).

Level 1: This level indicates a partially smart home that has a limited number of isolated smart devices, such as a TV or baby monitor that provide simple feedback to their users. Their users interact with them in a traditional, non-automated manner.

Level 2: At this level smart home devices began to get integrated to each other to offer improved household services such as climate control (using a smart thermostat) and entertainment (through a smart TV).

Level 3: At a mid-level of automation, smart home devices can synchronize and anticipate specific requirements, such as switching on lights or devices just before residents return home. These homes can be programmed to cater to individual choices among multiple tools, including varying temperatures in separate rooms.

Level 4: An interconnected smart home system can start to pick up and adjust services based on context, such as automatically stopping lawn watering if rain is predicted in an hour. With sensors and monitors that monitor the home's conditions, technology can learn and respond through feedback loops, making it increasingly autonomous and capable of adapting to what it thinks you desire.

Level 5: At its highest level, the smart home system becomes nearly seamless, with monitoring, feedback, and learning merging across multiple integrated systems, such as heating, lighting, gardening, and entertainment. The house can provide ambient experiences, merging physical reality with virtual worlds.

Level 6: Smartness extends beyond individual homes to encompass entire communities. Smart homes are considered key components in efforts towards creating smart grids and smart cities (Pinochet et al., 2019).

The number of IoT devices continues to proliferate (Statista, 2021; GSMA Intelligence, 2022), in parallel the smart home market is growing, with projections estimating that the global smart home market revenue will reach around $187 billion by 2025, reaching 494 million homes with an average penetration rate of 22% (Statista, 2021). Smart home technologies are launched to the market by multinational giants to start-ups. Sovacool and Del Rio (2020) found that smart home technologies are provided in the European market by 113 different companies with 267 different options. SHTs can be purchased from a variety of direct suppliers, home improvement stores, department stores, and electronics and appliance retailers.

With the services offered by these smart home technology providers, McKinsey Global Institute (2015) estimated the economic impact of home IoT applications to range from $200 billion to $350 billion annually by 2025.

Despite the availability of smart home technologies for some time, their adoption has not been widespread; the USA is leading the market with 47.8%, followed by Europe’s nearly 30% penetration rate in 2021 (Statista, 2020b). The penetration rate of smart homes in Turkey is expected to be doubled in three years, growing from 9.4% in 2021 to 18% in 2025 (Statista, 2021). Thus, their potential is largely intact, indicating the need for studying antecedents of smart home acceptance. According to Marikyan et al. (2019), there is limited empirical evidence on the factors affecting acceptance and adoption of SHTs. So, barriers and drivers of smart homes are found as follows in the current literature:

Barriers to smart home adoption are varied but mainly include questions of reliability, security, privacy, interoperability, usability, and cost (Balta-Ozkan et al., 2014). Brush et al. (2011) mentioned four barriers that hinder the broader acceptance of smart homes: the high cost of ownership, inflexibility, poor controllability, and security concerns. One of the impediments to smart home adoption is the people’s unwillingness to hand over the agency of their homes to technology-guided third parties (Gram-Hanssen & Darby, 2012). Disharmony with current lifestyles is another barrier to smart home adoption (Marikyan et al., 2019). People tend to cling to established habits and are often resistant to changing their lifestyle to incorporate SHTs (Balta-Ozkan et al., 2013). Lee (2020) suggested that privacy concerns and vulnerabilities are the main reasons for home IoT resistance. Sovacool and Del Rio (2020) identified 17 risks as barriers to SHT adoption. These are ranked by frequency as: (1) privacy and security concerns, (2) technical reliability, (3) ease of use, (4) perceived elitism, (5) difficulty in monetizing benefits, (6) interoperability, (7) energy consumption, (8) perceived loss of personal control, (9) sustainability, (10) lack of home ownership, (11) cultural differences, (12) poor connectivity and supply chain issues, (13) corporate longevity and accountability, (14) high cost, (15) fear of new technology, (16) social isolation, and (17) health concerns.

Smart home technologies represent relatively new innovations, and many potential users are not fully informed about their capabilities and advantages. This absence of knowledge is a barrier to their wider acceptance and their wider penetration into the main markets. When consumers acquire more information about SHT, their positive perceptions of potential benefits will strengthen. Therefore, the successful adoption of smart home technologies depends on potential users perceiving clear benefits and being willing to accept the associated risks. Wilson et al. (2017) found that ensuring SHTs are manageable, reliable, user-friendly, and marketed by credible companies can help build customer confidence. Moreover, early adopters are crucial to creating a virtuous cycle supporting market demand.

2.2 Theories and models of technology adoption

The study of technology adoption focuses on exploring the motivations and processes behind individuals accepting and incorporating new information technologies into their lives (Venkatesh et al., 2003). The study of technology adoption is a rich and abundant area of research within the field of Information Systems (IS). Numerous theories are developed to understand why and how individuals adopt new information technologies, each with its own set of acceptance factors (e.g., Rogers, 2003; Davis, 1989; Brown & Venkatesh, 2001; Venkatesh et al., 2003; Venkatesh et al., 2012). Adopting a general theory for new technology innovation enhances the scientific accuracy and broad applicability of the theory, while context-specific theories provide a more practical approach for practitioners to follow (Brown et al., 2015). Therefore, IS academicians prefer to establish context-specific technology adoption models in their research. They often take a widely used technology adoption theory or model and tailor it to the specific context of smart homes (e.g., Shin et al., 2018; Kowalczuk, 2018; Shuhaiber & Mashal, 2019). The purpose of this research is to follow this tradition and propose an adoption model that is specifically applicable to the acceptance of smart home technologies to gain a deeper understanding of SHT adoption.

The following subsections provide in-depth information about TRA, TPB, TAM, UTAUT, UTAUT2, MATH, and PRT, to give a comprehensive understanding of the most used technology adoption models in IoT, smart objects, and smart home domains.

2.2.1 Theory of reasoned action (TRA)

The TRA is a social psychological model that explains the relationships between individuals' beliefs, attitudes, and behaviors. (Fishbein & Ajzen, 1975). According to the theory, an individual's behavior is defined by their intention, which is in turn affected by their attitude towards the behavior and their subjective norms (perceived social expectation to behave in a particular way). The TRA proposes that attitudes and subjective norms are formed based on opinions about the outcomes of performing a behavior. Factors underlying TRA and their relationship are shown in Figure 4:

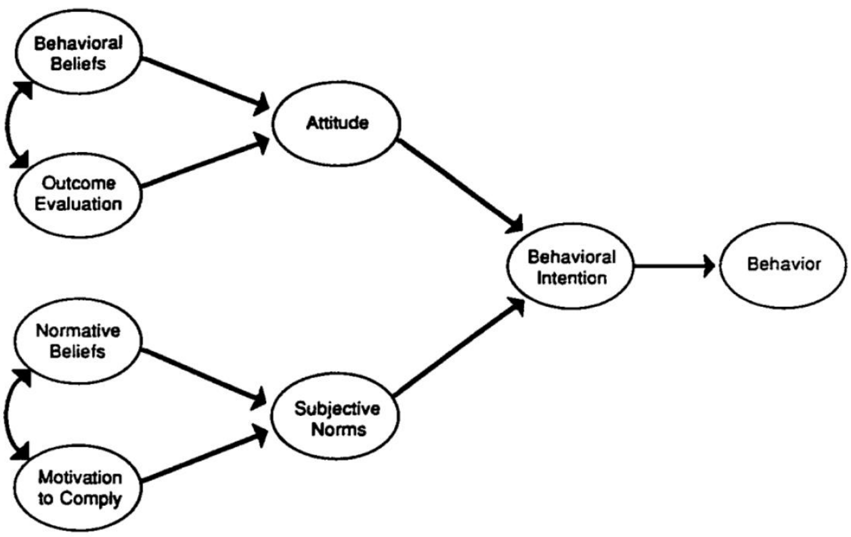

Figure 4. Theory of reasoned action
Source: [Fishbein & Ajzen, 1975]

TRA is implemented to help understand intentions to engage in adoption behaviors in various IoT technology contexts, such as smart homes (Klobas et al., 2019) and smart cities (Pinochet et al., 2019).

Attitude and intention from TRA were incorporated into the integrated research model as two main target variables. Behavioral beliefs were adopted from DOI innovation characteristics (i.e., relative advantage, complexity, compatibility, trialability, and observability). However, subjective norms were not incorporated in the research model, considering that SHTs are not yet widely adopted. The influence of subjective norms may increase when the idea becomes a part of daily life. Supporting this, Ahn et al. (2016) observed no link between social pressure and adopting sustainable household technology. Their findings were confirmed in the study by Baudier et al. (2018), who discovered no significant impact of social influence on the usage intention of smart homes.

2.2.2 Theory of planned behavior (TPB)

The TPB (Ajzen, 1991) is an extension of the TRA developed by Fishbein and Ajzen (1975) by including the idea of behavioral control. It states that a person's actual behavior when performing a particular action is determined by their behavioral intention and is influenced by three key beliefs: attitude, subjective norm, and perceived behavioral control (Ajzen, 1991). Behavioral intention corresponds to a person's level of commitment to show a specific behavior. Attitude refers to a person's positive or negative evaluation of a specific behavior. Subjective norm indicates to the perceived social or organizational pressure to engage in, or avoid, a specific behavior. Perceived behavioral control reflects the perception of a person on the simplicity or the complexity of performing a specific behavior, considering factors such as past experiences and expectations for future difficulties. Factors underlying TPB and their relationship are demonstrated in Figure 5 in detail:

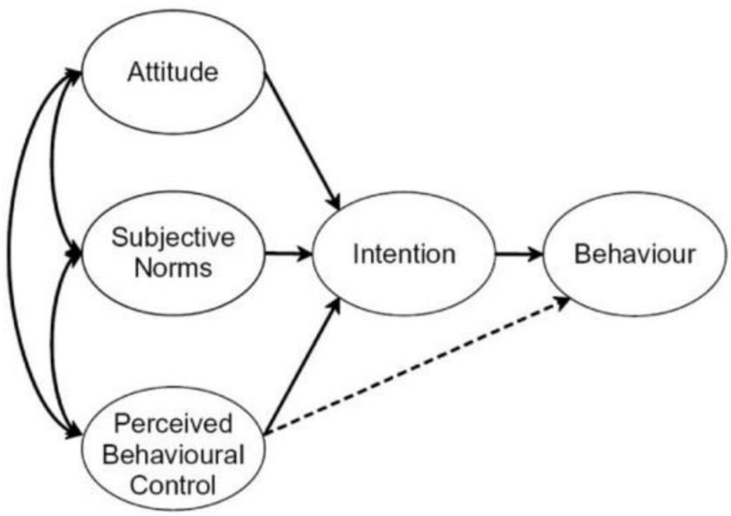

Figure 5. Theory of planned behavior
Source: [Ajzen, 1991]

The theory of reasoned behavior (Ajzen, 1991) has been applied to help understand intentions to engage in adoption behaviors in a variety of technology contexts, such as wearables (Sivathanu, 2018) and smart homes (Yang et al., 2017).

Attitude and intention from TRA were incorporated into the integrated research model as two main target variables. Subjective norms and behavioral control were not evaluated for inclusion in the set of innovation characteristics.

2.2.3 Technology acceptance model (TAM)

TAM was first established by Davis (1986) as a variation of the TRA, specifically designed to identify the factors influencing the acceptance of computers. According to TAM, the technology acceptance of a person is believed to be driven by their voluntary intention to use it. Following that, the intention to use technology is affected by a person's attitude towards using it and their perception of its usefulness and ease of use. Perceived usefulness implies to a person's belief that utilizing a specific technology improves job performance (Davis, 1989). Perceived ease of use refers to a person's belief that utilizing a specific technology requires little effort (Davis, 1989). TAM factors and their relationship are exhibited in Figure 6:

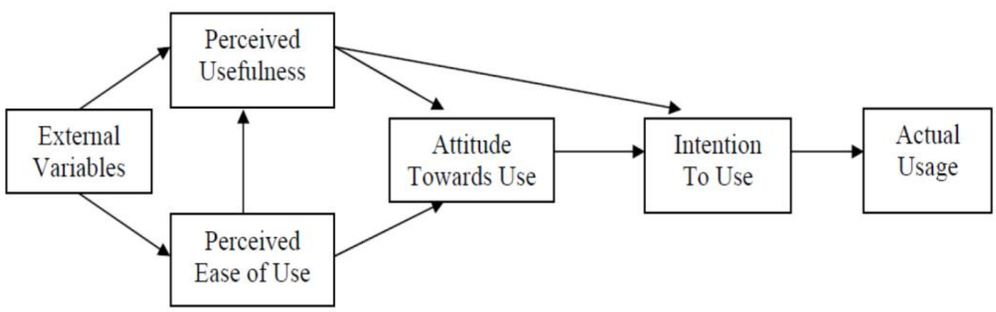

Figure 6. Technology acceptance model
Source: [Davis et al.,1989]

TAM has seen widespread application across a wide range of technologies and user groups, as well as in various contexts related to IoT technologies, including smart homes (Shin et al., 2018; Park, Kim et al., 2018; Shin et al., 2018; Kowalczuk, 2018; Shuhaiber & Mashal, 2019; de Boer et al., 2019) and wearables (Chuah et al., 2016).

In a study by Shin et al. (2018), the acceptance of smart home technologies was analyzed utilizing an extended TAM. The results showed that usefulness, ease of use, and compatibility all had a significant positive impact on the intention to use SHTs. They also pointed out that older consumers are more likely to quickly buy smart homes than younger consumers.

Park, Kim, et al. (2018) conducted a research on the acceptance of smart homes by expanding the original TAM. They found that factors such as compatibility, connectedness, control, system reliability, and enjoyment had a significant positive effect on the intention to use smart homes, alongside usefulness, ease of use, and attitude. The perceived cost, however, showed a negative effect on usage intention.

Kowalczuk’s (2018) finding of an extended TAM model was that ease of use, system's caliber and variety, and technology optimism positively affect usefulness. While usefulness and enjoyment positively and risk negatively impact the intention to adopt smart speakers.

Appling IoT skills as external variables to TAM, de Boer et al. (2019) revealed that numerous Internet skills (i.e., mobile, navigation, creative, and social) are essential antecedents for IoT adoption in smart homes.

Shuhaiber and Mashal (2019) applied an extended version of TAM to smart homes. They discovered that trust, awareness, enjoyment, perceived risks, usefulness and ease of use, all significantly influences attitudes towards smart homes in Jordan. As a result, these attitudes affect the intention to use smart homes.

Chuah et al. (2016) conducted an empirical study on wearable device adoption, using a theoretical model based on TAM. The results demonstrated that perceived usefulness and visibility were important factors that influenced the intention to adopt wearable devices.

Conversely, TAM has been criticized for being too focused on technology acceptance studies, and neglecting other theories, due to its domination in the literature (Benbasat & Barki, 2007).

Although the TAM and the DOI theory have different origins, there is some overlap between them. The idea of time and effort savings in DOI's relative advantage corresponds closely with the perceived usefulness concept in TAM. Meanwhile, the ease of use in TAM is the opposite of the complexity construct in DOI. In this context, all four main variables of TAM are involved in the initial set of innovation characteristics, without necessarily proposing the exact relationships as described in TAM.

2.2.4 Unified theory of acceptance and use of technology (UTAUT)

UTAUT, established by Venkatesh et al. (2003), proposes three direct factors that impact intention to use technology: performance expectancy, effort expectancy, and social influence. The theory also identifies two direct factors that impact usage behavior: intention and facilitating conditions, as well as up to four moderators of these relationships: gender, age, experience, and voluntariness of use. All those factors and their relationship are depicted in Figure 7. UTAUT studies the technology acceptance of individuals in organizational settings.

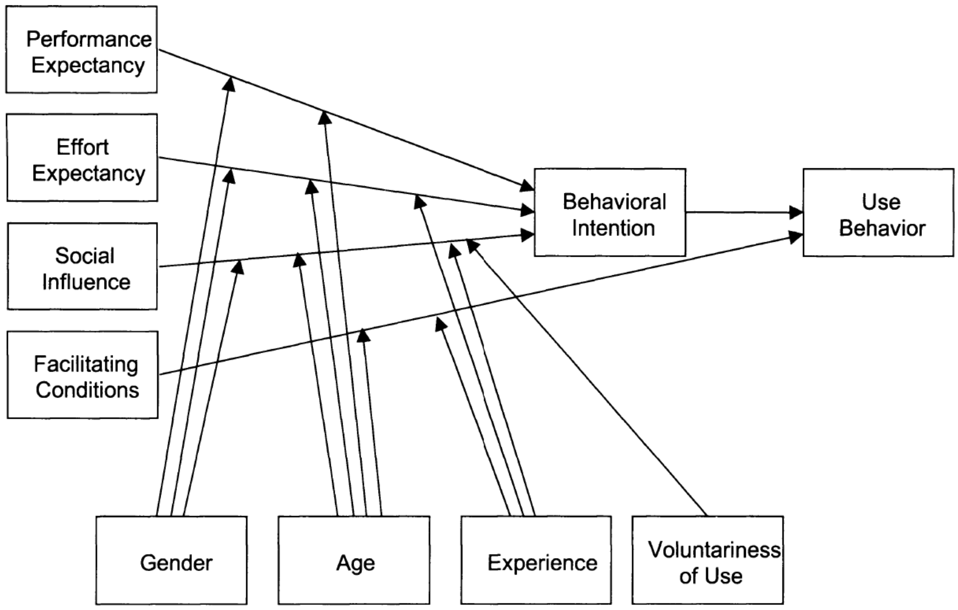

Figure 7. Unified theory of acceptance and use of technology
Source: [Venkatesh et al., 2003]

Performance expectancy refers to a person's belief in the ability of technology to improve job performance. It represents the degree to which a person thinks that using the technology will lead to a positive outcome (Venkatesh et al., 2003). This factor is similar to the relative advantage in Roger's (2003) DOI Theory and perceived usefulness in TAM by Davis et al. (1989).

Effort expectancy represents the perceived level of difficulty involved in using technology. It refers to how much effort the individual thinks they will need to put in to use the technology effectively (Venkatesh et al., 2003). This factor is like complexity in DOI and the opposite of the perceived ease of use of TAM.

Social influence indicates the perceived pressure or influence those important others, such as friends, family, or colleagues, have on a person to use a new technology (Venkatesh et al., 2003). This factor is related to the subjective norm in TRA and TRB.

Facilitating conditions refer to the perception of availability and accessibility of the necessary organizational and technical support for the usage of technology (Venkatesh et al., 2003). This factor is related to perceived behavioral control in TRB and compatibility in DOI. The compatibility concept in DOI encompasses elements that assess the match between a person's work approach and the utilization of the technology in the organization. In a consumer context, they indicate individuals’ resources and knowledge necessary to use technology, such as financial stability and self-efficacy related to this technology (Venkatesh et al., 2012).

Nysveen and Pedersen (2016) studied consumers’ adoption of IoT services by applying an extended UTAUT. They discovered that factors like performance expectancy, effort expectancy, social influence, technology anxiety, and privacy risk have a major effect on individuals' attitudes towards using IoT services. Additionally, facilitating conditions and attitude towards using IoT services both play a major role in determining the intention to use them.

Moreover, Ahn et al. (2016) proposed an extended UTAUT to explain predictors of intention to adopt sustainable household technologies. Their results demonstrated that performance, compatibility, and hedonic expectancy from sustainable household technologies, as well as sustainable innovativeness as a consumer characteristic, significantly predict intention to adopt. However, effort expectancy and social pressure are not significant predictors.

2.2.5 Unified theory of acceptance and use of technology2 (UTAUT2)

UTAUT, developed by Venkatesh et al. (2003), aims to examine the factors influencing technology adoption within organizations. UTAUT2 builds on the key elements of UTAUT and adds new constructs, making it more applicable to the consumer context (Venkatesh et al., 2012). Like UTAUT, it is believed that individual characteristics such as age, gender, and experience are performing a role in moderating the impact of these constructs on behavioral intention and technology usage. Figure 8 displays the proposed constructs and their relationships in UTAUT2.

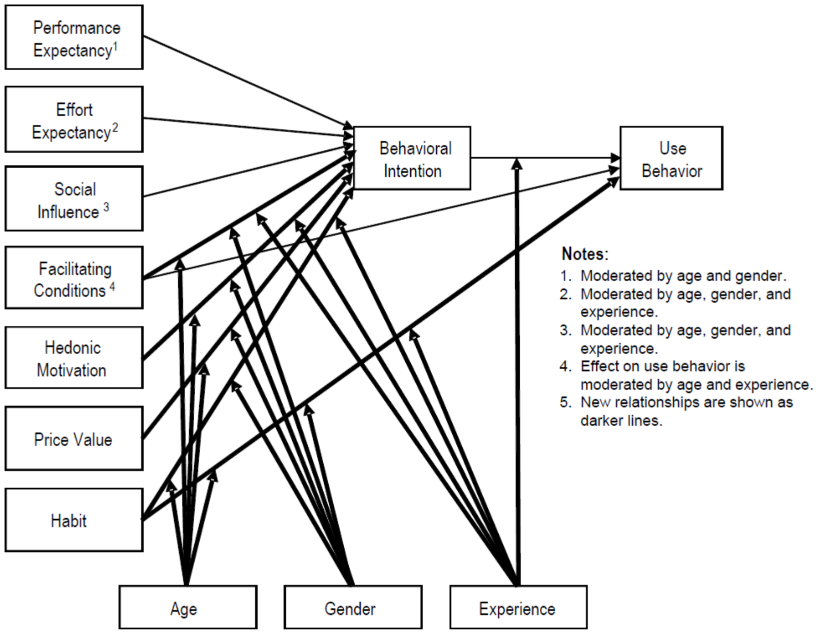

Figure 8. Unified theory of acceptance and use of technology2
Source: [Venkatesh et al., 2012]

UTAUT2 demonstrates the significant impact of hedonic motivation, price value, and habit in addition to performance expectancy, effort expectancy, social influence, and facilitating conditions on consumer technology acceptance and usage through empirical analysis. Hedonic motivation is understood as the enjoyment originated from utilizing technology in IS research, and it is defined as the pleasure or enjoyment that comes from technology usage (Venkatesh et al., 2012). Individuals typically pay the monetary cost of technology for personal use, while employees in organizations do not bear this cost. As a result, UTAUT2 includes price value, described as the rational evaluation of the perceived benefits of the technology versus its monetary cost, as a driving factor. Finally, UTAUT2 incorporates habit, which refers to the automatic performance of behaviors due to learning, as a factor (Venkatesh et al., 2012).

UTAUT2 and its derivatives have been used to uncover the technology innovation adoption in many different settings, such as e-commerce (Pascual-Miguel et al., 2015), mobile banking (Alalwan et al., 2017), and wearables (Gao et al., 2015).

Hedonic motivation in the form of enjoyment and price value constructs were incorporated into the initial set of innovation characteristics in this research.

2.2.6 Model of adoption of technology in households (MATH)

Brown and Venkatesh (2001) developed MATH in 2001 and enhanced it with life cycle characteristics in 2005. They stood up for the difference between individual vs. household technology acceptance. At the individual level, technology adoption is a rational process that can be made independently without involving others. In contrast, at the household level, adoption decisions are expected to be more complex due to the multifaceted interactions and negotiations among household members (Brown et al., 2015). A higher number of individuals engaged in an innovation decision results in a slower rate of adoption (Rogers, 2003, p. 221).

MATH is developed by combining TPB and DOI. It proposes that household life cycle stages (such as marital status, age, child's age, and income) moderate the relationship between attitudinal, normative, and control beliefs and the adoption intention of household technology (Venkatesh & Brown, 2001). Figure 9 shows the extended structure of MATH.

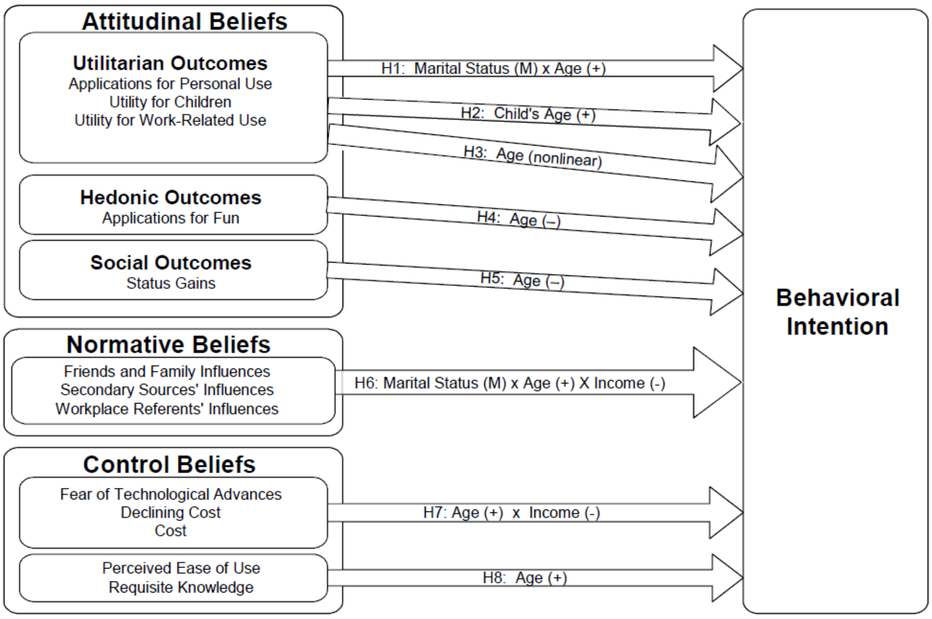

Figure 9. Model of adoption of technology in households
Source: [Brown & Venkatesh, 2005]

MATH categorizes five attitudinal beliefs into three outcomes: utilitarian, hedonic, and social. Utilitarian outcomes relate to the enhancement of household activities such as personal use, work, and children through technology innovation (Venkatesh & Brown, 2001). Hedonic outcomes encompass the joy and fun derived from using technology for its own sake (Brown & Venkatesh, 2005). Social outcomes refer to the status gains obtained through technology usage (Venkatesh & Brown, 2001).

MATH categorizes normative beliefs into three groups: influence from friends and family, influence from secondary sources, and workplace influence. Friends and family can influence one another’s behavior, whereas coworkers can influence them (Venkatesh & Brown, 2001). Rogers (2003) indicated that secondary sources are believed to perform a role throughout the technology acceptance process. In the case of MATH, secondary sources are information from television, newspaper, and other secondary sources.

At the final and third block of MATH, control beliefs are proposed to affect households' adoption intention by five factors: fear of technological innovations, decreasing price, price, ease of use, and required knowledge. While the first three are proposed as barriers to adoption, the last two are pictured as knowledge-related drivers.

Dwivedi et al. (2009) examined the drivers and barriers of broadband services adoption within households over a MATH-derived adoption model. They discovered that all beliefs are significant determinants of broadband adoption except hedonic outcomes, which might be limited because of content download restrictions.

2.2.7 Perceived risk theory (PRT)

PRT, introduced by Bauer (1960) to explain consumer behavior in marketing, refers to the uncertainty surrounding potential negative consequences. Many studies, exploring the adoption of various technologies, have adopted the notion of perceived risk and found that it is negatively linked with the intention to adopt technology (Hubert et al., 2018; Kowalczuk, 2018; Pavlou, 2001; Featherman & Pavlou, 2003; Park, Kim, & Jeong, 2018; Park, Kwak, et al., 2018, Hong et al., 2020).

In this research, security and privacy aspects of the risk theory were conceptualized with positive aspects and included in the initial set of innovation characteristics.

2.3 Diffusion of innovation theory (DOI)

DOI builds the theoretical base of this dissertation. All innovation characteristics (i.e., relative advantage, complexity, compatibility, trialability, and observability) proposed in DOI were incorporated in the initial set of innovation characteristics.

The DOI theory by Rogers (2003) suggests that innovation diffusion is a gradual process where an innovation is spread through communication channels among members of a social system. The innovation adoption process is illustrated in Figure 10 and is not an immediate decision. The process includes gaining initial knowledge, forming an attitude, making a decision, implementing the new idea, and confirming the decision (Rogers, 2003, p.168).

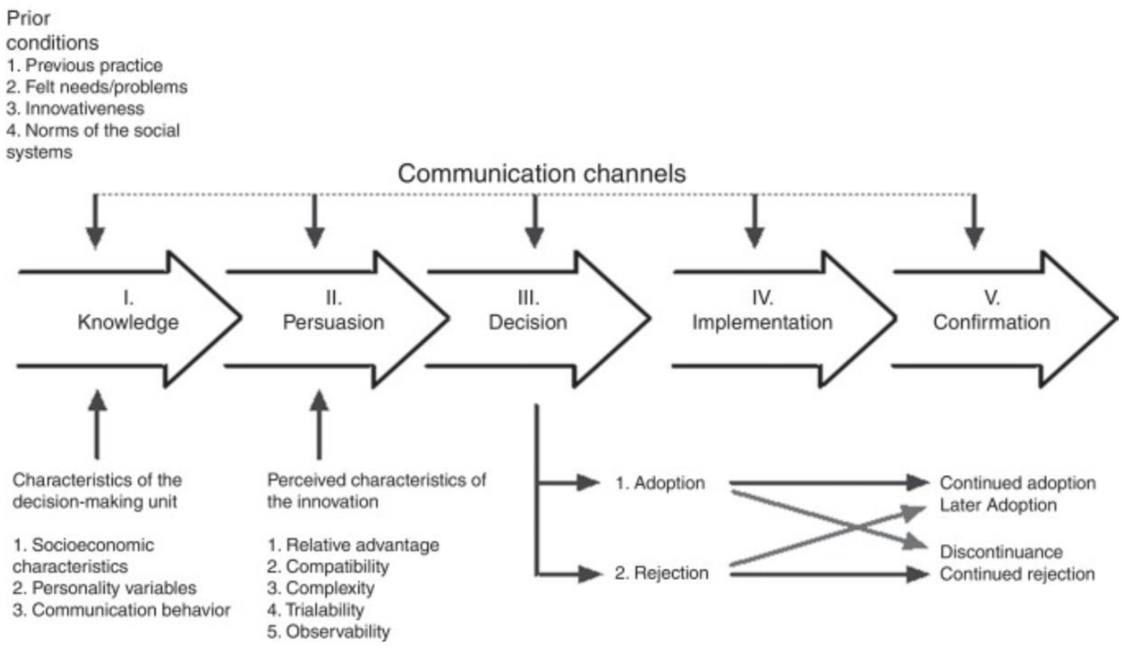

Figure 10. Innovation decision process
Source: [Rogers, 2003, p.170]

The flow of information about an innovation and its features occurs within the social system where adopters are located. Potential adopters search for information to learn about the potential outcomes of utilizing the innovation, and the assessment and evaluation of this information influence their adoption behavior. Five key characteristics of the innovation, namely relative advantage, compatibility, complexity, trialability, and observability, play a crucial role in determining adoption behavior. The following provides definitions for these innovation characteristics:

Relative advantage refers to how an innovation is perceived as an improvement compared to its predecessor (Rogers, 2003, p.15). The higher the perceived relative advantage of an innovation, the quicker it will be adopted.

Compatibility refers to how well an innovation aligns with the existing values, past experiences, and needs of potential adopters (Rogers, 2003, p.15). An idea that does not fit with the values and norms of a social system will not be adopted as rapidly as one that is compatible.

Complexity refers to how complicated an innovation is seen to be in terms of understanding and usage (Rogers, 2003, p.16). Innovations that are easier to understand are adopted faster than those that require new skills and comprehension.

Trialability refers to the ability to test an innovation on a limited scale (Rogers, 2003, p.16). Innovations that can be tried out incrementally are generally adopted faster than those that cannot be divided.

Observability implies the visibility of the outcomes of an innovation to others (Rogers, 2003, p.16). The more apparent the results of an innovation are, the more likely it will be adopted.

In DOI theory, a crucial result is a person's decision on the acceptance of the innovation. Some characteristics of people play an essential role in innovation adoption as well. Innovativeness is one of the most theorized personality characteristics for its influence on innovation adoption (e.g., Baudier et al., 2018; Touzani et al., 2018; Nikou, 2019). Innovativeness refers to how early an individual adopts new ideas compared to others in the system (Rogers, 2003, p. 22). Furthermore, there is a positive and linear relationship between socioeconomic status and the adoption of innovations. Being an early adopter of innovations is directly proportional to socioeconomic status-related variables, such as income, education, and profession.

Moore and Benbasat (1991) refined the attributes of innovations from the DOI theory and developed a set of factors for analyzing personal technology innovation adoption. They added two additional constructs as determinants of technology innovation adoption: image and voluntariness of use. Image refers to how using an innovation is seen as enhancing person's social status (Moore & Benbasat, 1991, p. 195). Voluntariness of use refers to how the use of the innovation is seen as being a voluntary choice (Moore & Benbasat, 1991, p. 195).

Additionally, Moore and Benbasat (1991) separated the observability factor in DOI theory into visibility and results demonstrability constructs. Visibility is the extent to which the innovation is noticeable in the adoption setting (Moore & Benbasat, 1991). Results demonstrability refers to how tangible the outcomes of using the innovation are perceived to be (Moore & Benbasat, 1991). They created scales for all eight constructs and found evidence for their predictive validity in the adoption of personal workstations.

Rogers (2003, pp. 267–299) categorizes members of a social system into five groups based on their relative time of adoption: innovators, early adopters, early majority, late majority, and laggards. This classification is made statistically by determining the standard deviations (sd) from the average time of adoption ($\bar{x}$), as illustrated in Figure 11.

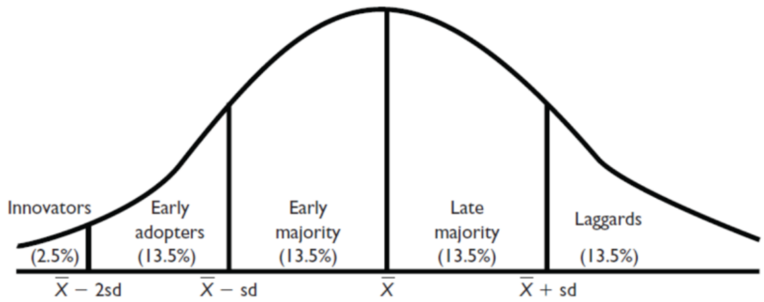

Figure 11. Adoption curve
Source: [Rogers, 2003, p. 281]

Each group is defined and detailed as follows:

Rogers (2003) identifies innovators as individuals who embrace new ideas and are willing to take risks. These individuals possess traits such as empathy, lower dogmatism, higher intelligence, a love of science, and higher aspirations for education, among others. To be an innovator, one must have the ability to handle uncertainty and a higher degree of abstract thinking (Rogers, 2003, pp. 289-290). According to Moore (1991), innovators are described as “technology enthusiasts who are easy to do business with.” They have a passion for new technology and are quick to try out new ideas, regardless of whether it generates significant profit. They are not seen as influential in determining buying decisions for others and have a limited market (p. 32).

Early adopters are often seen as leaders and trendsetters, as they are among the first to adopt new ideas and technologies. According to Rogers (2003), they are well respected by others in their social system and serve as role models for others to follow in their successful and discreet use of new innovations. Moore (1991) viewed them as change agents, influential in promoting new technologies and ideas to others in their social network.

The early majority is cautious in adopting new ideas, taking time before fully committing. They interact with others in their social network but are not typically seen as opinion leaders (Rogers, 2003). As per Moore (1991), they drive the formation of the initial market for innovation.

The late majority accepts new concepts after the regular member due to pressure from peers. Their adoption is driven by financial constraints, and they require a social environment that supports innovation and removes uncertainty about the idea (Rogers, 2003). According to Moore (1991), they are characterized as “conservatives” who value tradition more than progress (p. 46).

Laggards are the last individuals to adopt an innovation. They are generally isolated from the social networks and inclined to be skeptical of new ideas and change agents. Like the late majority, their resources are limited, and they require a high degree of certainty about the performance of the innovation before adopting it (Rogers, 2003). According to Moore (1991), laggards prefer to purchase ready-to-use packages at heavily discounted prices.

Additionally, previous studies have revealed significant variations in socioeconomic status, personality traits, and communication patterns between early and late adopters of innovations (Rogers, 2003). Hence, these characteristics of the five adopter categories are used for segmentation studies widely. In a study for determining factors driving personal computer adoption among American households, Venkatesh and Brown (2001) revealed that innovators and early adopters were motivated by hedonic and social outcomes from adoption. The early majority's adoption of innovation was primarily driven by utilitarian benefits and the impact of friends and family members. On the other hand, the late majority and laggards were held back by their fear of the rapid obsolescence of technological innovations.

Franceschinis et al. (2017) studied the acceptance of ambient heating systems with a research model based on DOI theory. They identified differences in beliefs and attitudes of individual consumers among three segments (early adopters, laggards, and early/late majority).

Some scholars preferred to incorporate DOI theory with other theories to study the drivers of adoption for different IoT contexts, namely smart homes (Hubert et al., 2018; Nikou, 2019) and wearables (Karahoca et al., 2018).

Hubert et al. (2018) created a comprehensive adoption model for smart homes, whose constructs are derived from TAM, DOI, and risk theory. The results emphasized that perceived risk is a significant construct hindering the intention to use, and it is mediated by perceived usefulness. Additionally, the most critical factor influencing the intention to use is the compatibility and usefulness of smart home applications.

Nikou (2019) revealed that compatibility, usefulness, and ease of use are essential factors affecting the adoption of SHTs; on the other hand, trialability showed no direct influence on the intention to use; its effect was done indirectly via usefulness and ease of use. Moreover, observability had no effect on the intention. In this study, TAM and DOI theory are integrated to examine smart home technology adoption.

Karahoca et al. (2018) built an integrated model based on TAM, DOI, protection motivation theory, and privacy calculus theory to investigate significant factors affecting intention to adopt healthcare IoT. Relative advantage, image, and ease of use factors have a significant impact, whereas compatibility and trialability are facilitators of adopting healthcare IoT.

After examining the related smart objects literature based on prevalent technology adoption models and theories, DOI was selected as the theoretical base of this dissertation and some relevant factors revealed from IoT-specific adoption literature were incorporated with DOI. This integrated model for SHT adoption builds the foundation of the qualitative study, where the aim is to confirm and enhance the research model with the findings of expert interviews in the upcoming chapters.

2.4 Technology readiness index (TRI) and TRI 2.0

TRI is a 36-item scale that measures a person's willingness to adopt new technologies to achieve their objectives in both personal and professional life (Parasuraman, 2000). TRI is a combination of positive (optimism and innovativeness) and negative (discomfort and insecurity) technology-related traits varying among individuals (Parasuraman, 2000; Parasuraman & Colby, 2015). Whereas optimism and innovativeness are conceptualized as contributors, discomfort and insecurity are theorized as inhibitors to technology readiness (Parasuraman & Colby, 2001). Parasuraman and Colby (2015) refined the original TRI by considering cutting-edge technologies and introduced TRI 2.0.

Lin et al. (2007) studied technology readiness in technology acceptance research. They integrated TRI with TAM to better understand consumers' adoption of innovations in personal usage. The link between technology readiness and attitude toward and intention to adopt technology is proven in various contexts such as self-service technologies (Lin & Hsieh, 2007), electronic services (Lin et al., 2007), mobile shopping (Celik & Kocaman, 2017), wellness mobile apps (Chen & Lin, 2018), wearables (Kim & Chiu, 2019), and smart meters (Hmielowski et al., 2019).

TRI is used in adoption studies either with a dominant side by weighting technology-related traits against each other or a multifaceted consumer profile. Some studies in the literature merged the dimensions of TRI into one score, indicating the dominant side of the overall technology readiness of an individual (e.g., Lin & Hsieh, 2007; Lin et al., 2007). It is calculated by aggregating four indicators through the averaging of measurement items in each dimension. Before applying the aggregation procedure, the inhibitors of technology readiness (discomfort and insecurity) are reverse scored. Walczuch et al. (2007) approached the TRI dimensions in a multifaceted format and directly linked them to the TAM factors in an organizational context. Thus, they found that optimism, innovativeness, discomfort, and insecurity directly mediate usefulness and ease of use. Godoe and Johansen (2012) posited again in the organizational context the multifaced profile of TRI. They discovered that optimism and innovativeness significantly affect usefulness and ease of use, which mediate the actual use of different technologies. Moreover, Kim and Chiu (2019) suggested TRI in the multi-dimensional form in the context of sports wearables. They empirically proved that drivers of TRI play a more vital role, compared to inhibitors, in mediators of usage intention. Hmielowski et al. (2019) found a strong effect of people's technology optimism and insecurity on their support levels of smart meter installation.

According to Parasuraman and Colby (2001), individuals with varying levels of technology readiness can be classified into five segments based on their scores. The segments are explorers, pioneers, skeptics, paranoids, and laggards as follows:

- Explorers are very motivated and have a low technological resistance.
- Pioneers have a mix of strong positive and negative views towards technology.

- Skeptics have low levels of both motivation and resistance.
- Paranoids have moderate motivation and high resistance towards technology.
- Laggards have low motivation and high resistance towards technology.

The segments extracted by TRI exhibit a resemblance to Rogers' (2003) adoption curve, which follows an S-shaped pattern and includes innovators, early adopters, early majority, late majority, and laggards. Borrero et al. (2014) implemented TRI for a segmentation study and found four segments, i.e., pioneers, explorers, skeptics, and laggards, but not paranoids. Parasuraman and Colby (2015) applied this classification of the scores on TRI 2.0 items and found that the characteristics of technology readiness segments have changed a little. TRI 2.0-based segments are listed below with distinct combinations of technology-related traits, whereas they have unique demographic characteristics as well:

- Skeptics are middle-aged and highly educated individuals who have a neutral attitude towards technology.
- Explorers are tech-savvy, young and highly educated people who have a strong motivation to adopt new technology, but low resistance to it. They own the largest number of tech gadgets.
- Avoiders are older and less educated individuals who are resistant to technology, with little motivation to adopt it. They have a low degree of ethnic diversity.
- Pioneers are highly diverse in terms of ethnicity and have a mix of favorable and unfavorable views about technology.
- Hesitators have low innovativeness and moderate resistance to technology, with limited involvement in tech-related professions.

These segments of Parasuraman and Colby (2015) are similar to Rogers' (2003) innovation adoption segments, where the explorers are parallel to the early adopter, and the avoiders are akin to the laggards. Ramírez-Correa et al. (2020) found the same five segments of original TRI 2.0 in a national study for a developing and less technologically mature country. However, Kim et al. (2018) extracted three segments for the sports wearables context by applying TRI 2.0 dimensions. This dissertation proposes TRI 2.0 dimensions to extract distinct consumer segments based on their positive and negative technology-related traits.

The methodology of this dissertation is outlined in the following chapter, which includes a justification for the chosen approach and a step-by-step guide for the entire research process.

CHAPTER 3

RESEARCH METHODOLOGY

In this chapter, the approach to finding answers for the research questions is presented. Initially, the rationale for selecting a specific research methodology is explained, after which the methods employed for conducting the qualitative and quantitative studies are described in detail.

This research aims to develop an integrated adoption model to explore the importance of innovation characteristics, technology-related traits, and lifestyles on consumers' attitude toward and intention to adopt smart home technologies. Considering the novelty of smart homes in the consumer world, a mixed-methods approach is preferred to uncover any contextual factors of SHT adoption and confirm their effects. Mixed-methods research brings quantitative and qualitative methodologies together in the same research inquiry (Creswell & Tashakkori, 2007; Venkatesh et al., 2013). In this dissertation, mixed-methods research allowed us to build a full-fledged set of SHT determinants by combining the results of qualitative semi-structured in-depth interviews with existing literature and by empirically analyzing their importance on SHT adoption based on the data collected in a quantitative study.

Compared with either quantitative or qualitative research methods alone, mixed-methods research has the following three strengths (Venkatesh et al., 2013; Alaiad & Zhou, 2017; Kowalczuk, 2018):

i. It has the ability to tackle both confirmatory and exploratory research inquiries at the same time. This allows contributions to theory and practice by validating existing theoretical findings and enhancing them with context-specific factors.

ii. It can offer stronger conclusions than a single approach. It can simultaneously deliver a holistic perspective and in-depth knowledge about the research topic. The depth of qualitative data is merged with the breadth of quantitative data collection.

iii. It can offer a collection of divergent and convergent views. Divergent findings can open new avenues for future research, while convergent findings enable the confirmation of existing theories.

The mixed-method approach is a valuable blueprint for academics to identify and test the technology adoption antecedents for specific contexts of the dynamic digital world. By analyzing data using both deductive and inductive approaches, the likelihood of discovering novel, technology-specific, and relevant factors is increased on the top of prior technology acceptance research. In the IoT context, a mixed method approach was utilized to understand patients' adoption of smart home healthcare solutions (Alaiad & Zhou, 2017), for exploring the antecedents of voice-activated smart speakers (Kowalczuk, 2018), for unearthing the adoption determinants of sustainable technologies (e.g., smart meters) in households (Wunderlich et al., 2019), and for exploring user acceptance of smart home technologies by understanding user demographics, preferences, and perceived risks (Sovacool et al., 2021).

Following a mixed-methods approach, this two-phase research began with a qualitative study through semi-structured in-depth expert interviews. Merging the theoretical determinants based on a literature review about innovation diffusion and technology acceptance in smart living context with new context-specific constructs uncovered in the qualitative study, the qualitative study reveals a comprehensive thematic map on drivers and barriers of SHT adoption. The details of the qualitative study are given in Chapter 4. The qualitative study findings are used to develop hypotheses and the integrative research model in Chapter 5. The analysis and results of the final empirical work are provided in Chapter 6, where a nationwide survey was employed to test the hypothesis in the proposed SHT adoption model. The overall methodological steps of this dissertation are represented in Figure 12 below.

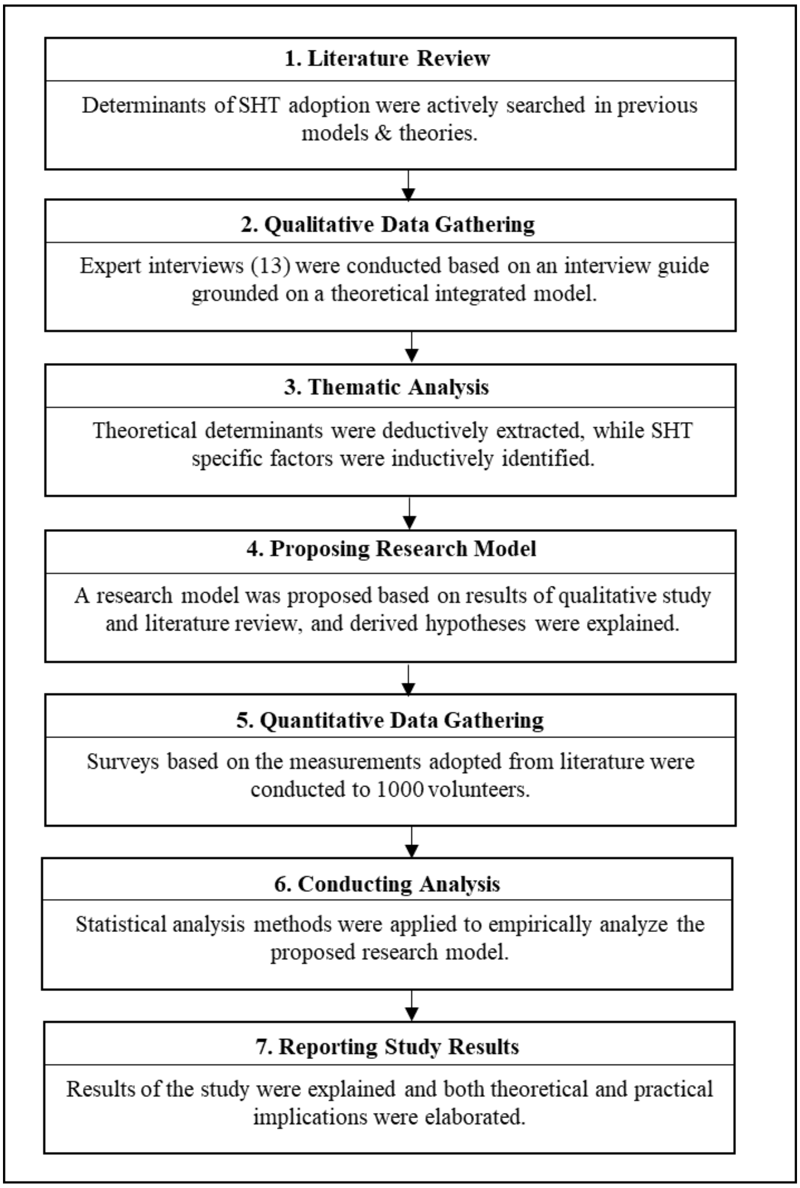

Figure 12. Methodological steps applied in this dissertation

3.1 Phase 1: Preview of the qualitative study

The initial phase in the development of the research model involved identifying significant factors for the acceptance of SHT. For this purpose, smart home studies and prevalent technology innovation adoption/acceptance literature were reviewed, and DOI was selected as a theoretical base. To extend DOI, five constructs (i.e., enjoyment, image, price value, security, and privacy) were incorporated from different technology adoption/diffusion models into proposed adoption determinants. This dissertation expands the understanding of the importance of incorporating adoption factors from multiple theories to enhance the comprehension of the acceptance of intricate technological systems such as smart home technologies.

Furthermore, technology-related characteristics and lifestyles of consumers are relatively less commonly used in technology adoption literature. However, individual difference variables can influence or moderate individuals' attitudes toward technology adoption (Agarwal & Prasad, 1998; Rogers, 2003; Venkatesh & Bala, 2008). Therefore, four technology-related traits of TRI 2.0 are incorporated into the research model along with three different lifestyle variables: environmental responsibility, health orientation, and home-as-extended-self.

The initial set of SHT determinants developed with insights from technology adoption and smart home literature was first qualitatively analyzed. 13 semi-structured in-depth interviews were conducted with smart home industry experts to validate and enhance the set of the antecedents of smart home adoption. Smart home research sought expert opinions for revealing consumer adoption insights (Sovacool & Del Rio, 2020; Del Rio et al., 2021; Balta-Ozkan et al., 2013; Kuebel et al., 2015), since their implementation is still in its nascent phase. The interview questions were formulated based on the preliminary factors extracted from existing literature on smart home adoption. The interviewees were meticulously selected to cover all subcategories of SHTs. Thematic analysis, which is one of the fundamental qualitative research methods (Braun & Clarke, 2006), was employed to scrutinize the qualitative data obtained from these interviews. A thematic map was generated as a result of the thematic analysis to visually represent the drivers and barriers to smart home adoption. Chapter 4 contains a thorough explanation of the methodological components of this qualitative study.

3.2 Phase 2: Preview of the quantitative study

In the quantitative part of this dissertation, a survey was developed as the data collection tool for testing the proposed hypotheses in the final integrative research model. The final research model, where the hypotheses were proposed, was built after the implementation of exploratory factor analysis on innovation characteristics and technology-related consumer traits individually. However, the initial research model was a combination of the contextual determinants identified in the qualitative study and the smart home determinants stemming from prior literature, which are listed below:

Relative advantage, complexity, compatibility, trialability, observability, image, enjoyment, price value, privacy, and security (from the literature review), and design and brand trust (from the qualitative study) are the characteristics of innovation, which are proposed to affect the attitude toward and intention to adopt smart home technologies.

Innovativeness, optimism, discomfort, and insecurity are the technology-related consumer traits from TRI 2.0, which are suggested as the consumer segmentation variables. The impact of innovation characteristics on attitude toward and intention to adopt SHTs are proposed as varying for technology-related consumer segments.

Environmental responsibility, health orientation, and home-as-extended-self are consumers’ lifestyles, which are also suggested as consumer segmentation variables. It is proposed that there is a difference between the clusters arising out of these lifestyle attributes in terms of their attitude toward and intention to adopt SHTs.

All measurement items of latent constructs in the final study were adapted from relevant academic literature with minor adjustments to the smart home context. Before conducting the survey, pre-tests and pilot tests were applied. Final study data was collected with the help of a grant taken from the Boğaziçi University Research Fund (Grant No: D-14801) via a professional research agency. The aimed population was volunteers between 25-65 years of age, from A, B, or C1 socioeconomic status (SES) and with average monthly income over the poverty level of a four-people-household (over 7,500 TL) as of January 2020. The aim was to collect data from 1,000 people who live in İstanbul, Ankara, or İzmir according to the population distribution in these cities with the target population. Surveys were conducted face-to-face. The details of methodological aspects of the quantitative study (i.e., final research model, research hypotheses, measurement instrument development, and sampling strategy) are provided in Chapter 5.

After the collection and compilation of the data, statistical analysis methods like linear regression, cluster, and difference analyses were employed to test proposed relations, and the findings were interpreted to explain the research model. The details of analyses and their findings are provided in Chapter 6. In this way, consumers’ attitudes toward and intention to adopt smart home technologies are analyzed, and the findings are obtained through the analysis of empirical data.

In the next chapter, the qualitative study is explained from the interviewee selection and the interview guide's preparation to the interviews' decoding and analysis, and the reporting of the results.

CHAPTER 4

PHASE 1: QUALITATIVE STUDY

Qualitative research was conducted with smart home industry experts through semi-structured, in-depth interviews and analyzed using a thorough iterative thematic analysis to understand antecedents of smart home technology adoption. The interviews provided valuable insights into current information on smart home technologies and key drivers and hindrances to market growth. The use of semi-structured interviews was deemed appropriate for exploring novel or cutting-edge technologies (Balta-Ozkan et al., 2013).

Collected information was analyzed with thematic analysis, a foundational method for qualitative analysis (Braun & Clarke, 2006). Through the use of thematic analysis method, researchers can extract comprehensive outcomes that encapsulate diverse aspects of the research theme by recognizing, scrutinizing, and communicating trends present in the primary dataset (Braun & Clarke, 2006). This data analysis method is widely used in technology adoption research for different contexts, such as wearables (e.g., Matt et al., 2019), mobile applications (e.g., Anderson et al., 2106) or social media marketing (e.g., Keegan and Rowley, 2017). After a constant review of codes, subthemes, and themes in literature, a full view of the main determinants of smart home technology adoption was driven and visualized as a thematic map. This map provides researchers with insights into smart home technology adoption and helps practitioners expand their markets.

4.1 Interview guide design

As applied extensively in previous smart home research (e.g., Shih, 2013; Hubert et al., 2018; Nikou, 2019), an integrative adoption model is proposed, where factors from several established models on technology acceptance, namely DOI theory, UTAUT2, and PRT are merged. The interview guide in Table 2 is originated on this multidimensional research model and serves as the structure for collecting the qualitative dataset.

Table 2. Interview Guide and Related Theoretical Constructs

Interview Questions	Theory, study or construct
How do you define the concept of the smart home?	Smart Home Definition
How do you group SHTs according to their usage?	Smart Home Categories
What is the demand for SHTs from Turkish consumers? What can be done to develop this market?	Smart Home Market in Turkey
What are the most important features and benefits of SHTs from the perspective of your customers?	DOI Relative Advantage
What are the points where Turkish consumers' home experience and SHT overlap?	DOI Compatibility
How and where can your consumers experience SHTs?	DOI Trialability
Where can your consumers get information on SHTs? Who are the leading opinion leaders? Or who can be? Why?	DOI Observability
Do your consumers perceive SHTs as easy to use?	DOI Complexity
Do your consumers enjoy using SHTs?	UTAUT2 Hedonic Motivation
What can you say about the price value perception of SHTs?	UTAUT2 Price Value
How does the social environment of consumers react to SHTs?	DOI Image
Is there any confidentiality agreement between you and your consumers about private data usage? How do you manage this process?	PRT Privacy
How do you ensure the security of SHTs?	PRT Security

Before delving into queries associated with the theoretical model, it is crucial to obtain current comprehension of smart homes. As a result, the interviews commenced with inquiries regarding the opinions of experts on the categorization and definition of smart homes.

After that, specific inquiries concerning the five innovation characteristics outlined in the DOI theory of Rogers (2003) were posed, namely relative advantage, complexity, compatibility, trialability, and observability. Their importance in the adoption of innovation has been empirically confirmed in numerous marketing and technology-related studies (e.g., Shih, 2013; Hubert et al., 2018). Additionally, the image was integrated into the initial set of innovation characteristics, taking into account that it was operationalized by Moore and Benbasat (1991) in conjunction with other DOI factors in the context of technology adoption.

Moreover, the interview guide incorporated hedonic motivation and price value from UTAUT2 as they are crucial factors leading to technology adoption in a voluntary consumer context (Venkatesh et al., 2012). Lastly, privacy and security concerns were included from PRT to represent uncertainties that may surface as a result of SHT adoption (Pavlou, 2001).

Through the integration of particular theoretical factors from established technology adoption models, an integrative model was established to qualitatively examine the determinants of smart home adoption. This model is tailored to the unique features of SHTs and encompasses various usage areas, thereby enhancing the relevance and validity of this work.

4.2 Sampling and data collection procedure for Phase 1

Semi-structured in-dept interviews were conducted with 13 experts, who work in marketing-related departments of different smart home domains. Experts serve as rich sources of information as they oversee marketing activities, including targeting and segmenting potential consumers. The sampling strategy was purposive and designed to include experts from eight domains related to smart homes:

- Home Appliance and Entertainment
- Home Automation
- Energy
- Telecommunication
- Building Products
- Security Services
- Technology
- Healthcare

Initially, known experts in smart home sector were contacted via LinkedIn Inbox, and further participants were identified using the snowball sampling method. Out of the 20 experts initially identified, 13 agreed to participate in the study, representing various domains such as telecommunications, energy, home appliances, and home automation. However, due to non-response, the study could not cover security services, building products, and technology domains. The sample size was determined based on achieving thematic saturation (Guest et al., 2006), meaning that ongoing data collection did not yield new themes. The interviews were conducted face-to-face in Turkey between May 2018 and July 2018, and each interview lasted between 60 to 90 minutes. The interview guide was used to direct the questions, and participants were given an opportunity to elaborate on their answers. The researcher

(PhD Candidate) who conducted the interviews was trained in interviewing techniques to ensure the collection of detailed and rich data. Participants provided signed informed consent for the interview.

The characteristics of the interviewees are depicted in Table 3. Eight out of 13 experts were working in the home appliances sector, whereas the sample has one representative for each home automation, telecommunication, and energy sector. Two interviewees represented the smart lighting sector in the sample. Moreover, ten experts hold a marketing-related position, two experts worked in IS and innovation domain, and one expert was leading the Turkish affiliate of a smart home automation company.

Table 3. Characteristics of Interview Participants

Pseudonyms of Experts	Sector	Position of Expert	Experience in SHT
R1	Home Appliances	IS and Innovation	+10 years
R2	Home Appliances	Strategic Marketing	+25 years
R3	Home Appliances	Business Development	+25 years
R4	Home Appliances	IS and Innovation	+20 years
R5	Home Appliances	Strategic Marketing	+15 years
R6	Home Appliances	Business Development	+5 years
R7	Home Appliances	Digital Marketing	+10 years
R8	Home Appliances	Strategic Marketing	+15 years
R9	Home Automation	Country Head	+30 years
R10	Smart Lighting	Strategic Marketing	+10 years
R11	Smart Lighting	Digital Marketing	+5 years
R12	Telecommunication	Strategic Marketing	+10 years
R13	Energy	Business Development	+20 years

4.3 Decoding and interpretation of interview findings

The recorded expert interviews were transcribed verbatim into Microsoft Word documents to ensure accuracy of the transcriptions. The thematic analysis method outlined by Braun and Clarke (2016) was employed to analyze the transcribed data and capture the experts' views on determinants of SHT adoption. Thematic analysis is a widely used qualitative approach that involves six phases of analysis: familiarization with the data, generation of initial codes, search for themes, review of themes, definition and naming of themes, and production of the report. In this study, a deductive coding framework (Venkatesh & Brown, 2001) was utilized, which was synthesized using the DOI, UTAUT2, and PRT, allowing to blend the previous findings from the literature on SHT adoption with the exploratory qualitative study findings. Additionally, the interview data was evaluated inductively to identify new context-specific and relevant factors on top of previous adoption factors in the literature.

To follow the data analysis steps suggested by Braun and Clarke (2016), the first step was to familiarize yourself with the transcribed interview data by repeatedly reading it. Next, recurring patterns were identified, and initial codes were assigned to them, resulting in 31 different codes in the data set. The third step involved grouping codes into subthemes based on logical patterns, which were then further organized into themes. A constant literature review was conducted throughout this process. The fourth step consisted of reducing subthemes to the most prevalent determinants in the adoption literature. In the fifth step, the themes were named, with similar names chosen from previous studies. Finally, the emergent themes were reported and visualized using a thematic map. The thematic map was used to visualize the interrelation between the subthemes and main themes, and to aid in the discussion of the results. This was a recursive process that involved moving back and forth as needed throughout the phases. The overview of themes and code frequencies can be found in Table 4.

Table 4. 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
		Non-compliant 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	After-sales concerns	9
		Lack of technology knowledge	6
		Wifi 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

Through an iterative analysis between the interview transcripts and relevant literature, the experts' perceptions of drivers and barriers to SHT adoption were identified, and they are discussed in the following section.

4.4 Findings of the qualitative study

To present the findings of the qualitative study, a thematic map (Figure 13) was created, consisting of two main themes, namely “Drivers” and “Barriers”, and their respective 13 subthemes. To ensure anonymity of the experts, pseudonyms in the form of “R” followed by a number were used instead of their real names.

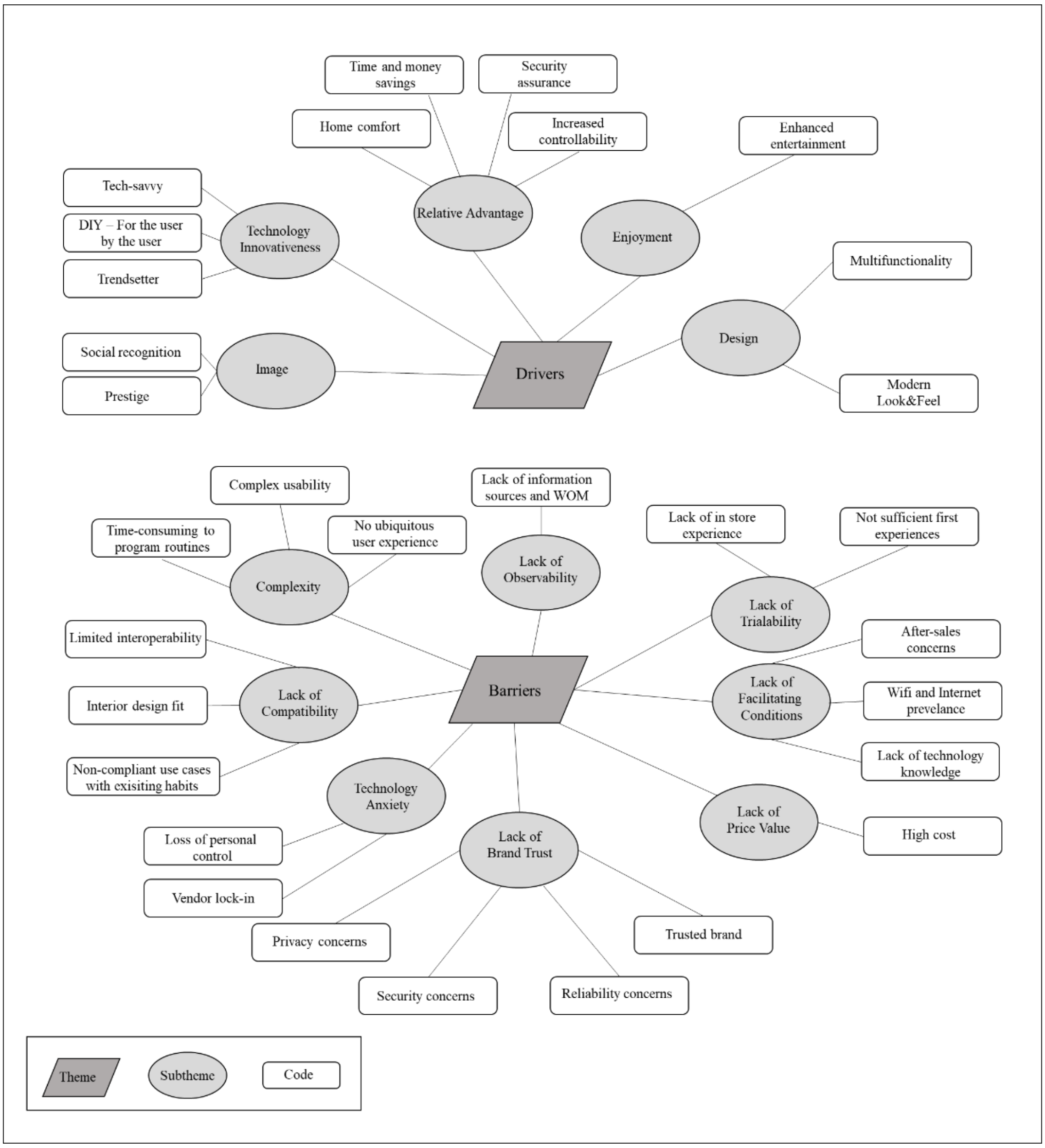

Figure 13. The thematic map on smart home technology adoption

4.4.1 Drivers of smart home adoption

The “Drivers” theme represents the perceived benefits of SHT adoption as identified by the experts, and includes the subthemes of “relative advantage”, “enjoyment”, and “image gains”, “modern and multifunctional design”, and “consumers' technology innovativeness”.

Relative advantage refers to the perceived functional benefits of SHTs compared to traditional substitutes. The most frequently mentioned advantages of SHT usage were increased home comfort and controllability, security assurance, and potential time and money savings. In Turkey, security was the most dominant benefit due to the high concern for securing households against break-ins. This finding is unique to Turkey, as no previous studies in other countries have emphasized this benefit to the same extent. As R12: *“The need for security perceived by Turkish people is much higher than the Europeans.”* Following security use cases, increasing home comfort is another frequently mentioned benefit of smart homes. R3 stated that *“People in an urban lifestyle have time as a scarce resource, so they seek to have comfort and peace of mind at their houses.”* Experts also recognized the energy efficiency benefits of SHT usage but argued that monetary gains were the primary motivator for consumers, rather than a decrease in their carbon footprint. Additionally, referents proposed increased controllability as a current value proposition of SHTs, as context-aware smart homes are not currently included in their solution portfolio. Only one interviewee mentioned the enhanced experiences that SHT usage can offer, as R1 *“Your washing machine can order the appropriate detergent based on the washing programs you used and your washing frequency.”*

Perceived enjoyment plays a vital role in promoting the adoption of smart homes. According to referents, consumers desire pleasure and excitement from using

SHTs, and many of them already enjoy the hedonic experiences that SHTs offer. R10's statement highlights the fact that smart lighting products can enhance consumers' enjoyment by providing adaptive ambiance lights that complement computer games or movie watching experiences, and even entertain babies with colorful lighting. This is because there is a strong connection between psychological moods and lighting. Additionally, R4 mentioned the collaboration between SHT providers and online streaming service providers, which contributes to an enhanced entertainment experience.

One of the key factors that promote the acceptance of SHTs is their image. Consumers associate the use of smart devices at home with modernity and view them as a source of social recognition and prestige. They take pride in showcasing their smart homes to their guests and neighbors and consider the use of advanced technologies as a status symbol. R9 supported this notion, stating that even construction companies base their marketing communication strategy on this motive, highlighting the social benefits of SHT adoption.

In terms of design, referents have indicated that consumers value SHTs as a means of expressing their modernity. Therefore, they place importance on the contemporary look and feel of SHTs. Additionally, they prefer the latest version of multifunctional appliances. Consumers perceive the combination of different features in a single appliance as a benefit of SHTs, even if they do not utilize all of them (R2).

Technology innovativeness is a sub-theme of SHT adoption drivers that encompasses tech-savviness, a preference for the do-it-yourself (DIY) concept, and a desire to be a trendsetter. According to R3, DIYers see no limit to the potential benefits and usage areas of SHTs. Tech-savviness is the motivation to own the latest technology products immediately after their launch, even if they require complex installation and usage processes, and may have some flaws. Experts have highlighted the significance of digital native millennials in the widespread adoption of SHTs in the coming years. As individuals who have been interacting with technology since childhood but may not yet make household technology adoption decisions independently, they are considered *"naturally tech-savvy"* (R12). Finally, being a trendsetter is characterized as a desire to follow attractive contemporary lifestyles (R11).

To summarize, SHTs enable consumers to achieve instrumental outcomes such as time and money savings, enhanced security, as well as hedonic outcomes like improved entertainment and social outcomes like increased prestige.

4.4.2 Barriers to smart home adoption

The theme of "Barriers" takes into account the insecurities and risks that consumers associate with adopting smart home technology. This theme is comprised of several subthemes, including "high cost", "complexity", "lack of technical and lifestyle compatibility", "limited opportunities for trial and observation", "challenges related to facilitating conditions", "absence of a trusted brand in the market", and "technology anxiety".

The primary hindrance to the widespread adoption of SHTs is the perceived lack of value in the monetary investment required for their purchase and use, including initial prices and subscription costs. All experts agreed that this unequal financial trade-off poses a significant barrier. According to R13, *"Even a simple smart home configuration costs more than 1,000 United States Dollars (USD). How could a consumer who earns a minimum wage (~350 USD) in Turkey afford it? They* *are only accessible to high-income consumers."* Some experts attribute this barrier to the economic conditions of the country and the short-term outlook of its people. R8 argued that *"In a country where people consider 12 months as the long term, it is highly unlikely for them to spend money on something that yields future value gains such as energy or monetary savings."* Consequently, some experts suggest a subscription-based model to address this issue. This would allow consumers to use SHTs without the need for an upfront investment and make them financially viable for users of all types (R6 and R12).

The concept of complexity encompasses the lack of ambient user experience, usability challenges, and time-consuming programming requirements. It is widely recognized as a major barrier to the adoption of SHTs, as noted by Balta-Ozkan et al. (2013) and Savocool & Del Rio (2020). According to R1, *"We need to strive for a state in which the machine continually learns from the data produced both inside and outside the home. Only then will we have an environment that is highly personalized and ambient, which is appealing to consumers."* SHTs do not offer an intuitive user experience, as consumers must handle the programming of complex routines for personalized usage. Usability issues arise when downloading multiple software applications to monitor and control different SHTs in the home, each with its own user interface and customer journey, further increasing complexity. The absence of a local language option in these applications and the usage of technical jargon also adds to the barriers of adoption. Experts emphasize that expanding the use of smart speakers as a control unit or hub for all SHTs would simplify personalization and usage (R3 and R12).

The lack of compatibility refers to the technical, aesthetic, and habitual alignment of SHTs with the current lifestyles of consumers. More than half of the respondents identified technical incompatibility issues among different SHTs. From a connectivity perspective, achieving interoperability between SHTs requires the adoption of universal standards for communication protocols, as suggested by R9. Experts emphasized the need to establish ecosystems by collaborating with a wide range of manufacturers and service providers to bridge the gap between customer preferences and smart home service offerings. However, current SHTs fall short of learning consumers' routines and adapting their services to changes. As R7 pointed out, *"Even if people purchase SHTs, they may stop using the smart features because current use cases do not trigger behavior change, which fails to establish new household habits."* Additionally, one respondent, R1, highlighted luxury segment consumers' complaints about the interior design fit of SHTs.

The lack of in-store experience centers and trial periods creates a significant gap that impedes consumers' adoption of SHTs, as it affects their perceptions of trialability. According to R3, *"The initial experiences of early adopters with SHTs were not satisfactory. As providers, it should be our top priority to continuously improve the product generation process to overcome the chasm to the mass market."* R12 expressed a similar concern about voice assistants, stating that *"Previous experiences with innovation significantly impact adoption, and we are facing this obstacle with voice assistants. After a few unsuccessful trials, people develop negative attitudes toward them."* Experts emphasized the importance of trialability in all SHT domains and the need for more opportunities to self-experience SHTs (R6).

The lack of observability was identified as a significant inhibitor by multiple experts. In 2021, the penetration rate of smart homes in Turkey was only 9.4% (Statista, 2021), indicating that SHT adoption was still in its early stages. This limited the opportunities for people to observe the usage and benefits of SHTs.

Experts referred to this phenomenon as limited *"Word of Mouth"* (R9, R12, R13). Additionally, experts pointed out that the information sources for SHTs, both online and offline, are limited and scarce. Social media influencers were identified as significant sources of observability, and R12 proposed the usage of big data to identify the relevant online channels and influencers for smart homes. R9 suggested organizing a smart home scenario contest on social media channels to encourage people to share their experiences with SHTs and increase their awareness.

The lack of facilitating conditions refers to concerns around the prevalence of wireless and broadband internet connections, after-sales support services, and knowledge gaps, including awareness of SHTs, where to purchase them, and how to install and set them up. While wireless technologies have made SHT implementations easier and more scalable, the lack of widespread and affordable broadband internet for existing housing stock is still a barrier to reaching a wider audience. According to TUIK (2019), 88% of Turkish households have internet access, while only 60% use a computer. The quality of after-sales services was seen as having a significant impact on SHT adoption. R6 pointed out that even internet modems are installed by service providers in consumers' homes, emphasizing the importance of installation services in Turkey. Therefore, experts suggested the need to distribute information about SHTs through their supply chain, from providers to wholesalers and technical services to consumers, and expand the wholesaler network. R11 also noted that consumers have limited knowledge of installing smart lighting products that they often think they need an electrician, even though their installation is the same as a standard bulb. R7 further indicated that most households do not even know their internet access password.

One of the biggest obstacles to the adoption of SHTs is the lack of a trusted brand, which encompasses concerns over security, device reliability, and privacy. Experts noted that Turkish consumers place a high degree of trust in SHT providers who have established household portfolios (R3). Eurostat (2019) showed that Turkish internet users have low awareness of privacy and personal identity protection (30%) in online environments, further highlighting the importance of a trusted brand. Dual responsibility for security was also emphasized, with providers and consumers both playing a role in ensuring safe usage. Educating consumers about securing their SHT usage is essential. R7 argued, *"An average Turkish consumer can only perceive what they see as a threat, not an abstract concept like cyber security. Therefore, they are only very uncomfortable with smart cameras considering the visual surveillance risk, but not afraid of cyber criminals."* Some experts suggest that addressing security concerns may be the easiest of the barriers to overcome. As an example, R9 mentioned: *"Smart home networks are protected with 128-bit encryption. It is easier to break the front door in an old-fashioned way than to solve this encryption key."* In terms of reliability, SHTs must be capable of providing accurate measurements and algorithms during power outages, as well as during critical tasks in scenarios involving assisted living or safety.

The technology anxiety barrier was identified as the sense of losing control and overreliance on technology vendors to manage the smart home environment. Experts noted that consumers expressed concerns about SHTs functioning autonomously and potentially disrupting their control over their own homes (R9).

To alleviate consumer uncertainties and increase their confidence in adopting SHTs, it is essential to provide them with easy-to-use, technically, and habitually compatible devices from trusted brands at affordable prices. Moreover, offering consumers the opportunity to try out smart homes at in-store experience centers and providing access to online and offline information sources can help raise their awareness of the benefits of SHTs.

The qualitative study provided more understanding of what may influence the attitude toward SHTs and their adoption intent. As a result of these interviews, design and brand trust constructs were included into the initial set of innovation characteristics. Furthermore, the theoretical concepts extracted from the literature review were verified by professionals in the industry. The information and knowledge imparted by the interviewees were also utilized during the development phase of the survey instrument. Based on the interviews, four categories of smart homes were recognized, which were then presented briefly in the survey to the participants. These categories are (1) smart appliances, (2) home entertainment, (3) home automation, and (4) security solutions.

The quantitative study is introduced and explained in the next chapter by providing details of the final research model, related hypotheses, measurement instrument development, and the sampling strategy.

CHAPTER 5

PHASE 2: QUANTITATIVE STUDY

This chapter provides the final research model and the methodological details of the quantitative part of this dissertation. It includes four subsections: Theoretical background, proposed research model and related hypotheses, measurement instrument development, and sampling and data collection procedure. The final research model incorporates the findings of two exploratory factor analyses. The first EFA was conducted on the initial set of innovation characteristics (DOI innovation characteristics, which are enhanced with contextual factors identified through a review of relevant literature and expert interviews). The second EFA examined TRI 2.0 technology-related traits. Additionally, the final research model considers three lifestyle attributes. The questionnaire utilized in the quantitative study serves as the data collection tool and is constructed from validated scales from previous literature, with slight adjustments made to suit the smart home context. The research population is representative of potential smart homes adopters in Turkey.

5.1 Theoretical background for Phase 2

The theoretical background of the research model elements is provided in detail in the following subsections:

5.1.1 Innovation characteristics

The DOI theory outlines five characteristics of innovations and demonstrates how an individual's perception of these characteristics can predict the rate of adoption of the innovation. All innovation characteristics from DOI theory are utilized in the initial set of innovation characteristics, which are relative advantage, compatibility, complexity, trialability, and observability. Remaining receptive to alternative innovation attributes that may be significant to a specific group of SHT adopters, extensive literature research and in-depth interviews with industry experts reveal the necessity to include price value, enjoyment, image, design, privacy, security, and brand trust as other context-specific innovation characteristics to the set of innovation characteristics. Those innovation characteristics in the initial set are explained in detail in the following:

Relative advantage refers to the extent to which an innovation is perceived to offer greater benefits than the existing idea it replaces (Rogers, 2003). Overall, the subdimensions of relative advantage usually encompass various benefits, such as economic advantages, low initial cost, reduction of discomfort, social benefits, time savings, and immediacy of rewards (Rogers, 2003). In the case of SHTs, greater consumer convenience, energy and time savings, improved health, and lower ecological footprint are proposed as the most important benefits (Balta-Ozkan et al., 2013; Paetz et al., 2012). According to Bae and Chang (2012), the multi-functionality of smart devices (in their case, smart TV) was an essential indicator of their adoption, which is like the findings of Stringer et al. (2006) for the case of domestic technologies. According to McKinsey&Company (2016), in addition to energy savings, users of smart thermostats value the devices' multi-functionalities, such as the ability to read temperatures in multiple rooms, automated energy usage reports, and the number of programmable periods. Moreover, Mennicken and Huan (2012) found that DIY homeowners demand smart homes to do things better than they do. Shih (2013) empirically proved the positive influence of relative advantage in smart home adoption. A faster adoption of technology innovation is expected when there is a greater perception of its relative advantage.

Compatibility refers to the extent to which an innovation is perceived to be in line with the current values, past experiences, and requirements of potential adopters (Rogers, 2003). Balta-Ozkan et al. (2013) suggested in their research that for SHTs to be adopted successfully, they need to be seamlessly integrated into the home's design, lifestyle, and overall sense of the home. Potential consumers are less likely to be attracted to technologies that do not align with their pre-existing norms or know-how and are not well integrated into their surroundings (Stringer et al., 2006). A technology that is compatible with the existing sociocultural values, beliefs, previous ideas, and/or needs of potential adopters is perceived as less uncertain, and therefore, it is more likely to diffuse more rapidly (Rogers, 2003). Therefore, Allameh et al. (2012) attempted to design a smart home to address future users' needs based on emerging lifestyles by implementing a user-centric design. Hubert et al. (2018) found that compatibility is a strong predictor of smart home acceptance, similar to the finding of Shih (2013). Park, Kim, et al. (2018) provided empirical evidence of the relationship between the compatibility and the usefulness of smart home technologies.

Compatibility in the IoT world has a technical aspect called interoperability. The key to a successful smart home lies in its ability to evolve and adapt to the changing preferences and needs of its inhabitants, allowing new devices to be easily integrated into the existing smart home system like adding a Lego piece (Balta-Ozkan et al., 2013; Marikyan et al., 2019). To act so, devices should communicate seamlessly and not interfere, meaning they work together reliably (Geraci et al., 1991; Marikyan et al., 2019). This phenomenon is called interoperability. It is an essential driver of smart home adoption (e.g., Yang et al., 2017).

Trialability refers to the extent to which an innovation can be tested or experimented with in a limited way before a full adoption decision is made (Rogers, 2003). Potential users can gain an understanding of the benefits and develop confidence in their abilities to use a smart home system by trying it out and observing how it operates (Meuter et al., 2005). Trialability positively affects technology innovation adoption. Rogers (2003) proposed that allowing a trial period can facilitate the adoption and implementation of an innovation. Moreover, he suggested that trialability is more critical for earlier adopters than later adopters, as they do not have any predecessors as an example to follow when they adopt an innovation. In general, innovations that offer the possibility to try them in small and incremental steps tend to be adopted more rapidly than those that require full and immediate commitment.

Observability refers to the degree to which the outcomes or benefits of an innovation are visible or easily demonstrable to others (Rogers, 2003). Meuter et al. (2005) suggested that observability can clarify the consumer's role, increase their confidence, and provide visible positive outcomes, which can boost motivation. Rogers (2003) argued that household innovations diffuse more slowly, as their observability is relatively low. An innovation that is more observable is more likely to be adopted by individuals as they can easily see the benefits of using it. Observability positively influences SHT adoption (e.g., Shih, 2013).

Complexity is the conceptual opposite of ease of use in TAM and refers to how difficult an innovation is perceived to be in terms of both understanding and use (Rogers, 2003). Complexity is a significant barrier to smart home adoption (e.g., Paetz et al., 2012; Bae & Chang, 2012). Venkatesh (2008) stated that smart homes need to be intuitive and not require technological expertise for faster adoption. To support this finding, Balta-Ozkan et al. (2013) suggested that SHT needs to be unobtrusive and transparent to the consumer due to its complexity. Simple, transparent digital smart home interfaces gain importance as the technology disappears into home surroundings until only the user interface remains visible to the users (Allameh et al., 2012). Technologies that are easy to understand and use tend to be adopted more quickly than those that require users to develop new skills and understandings. Technology must be simple and user-friendly. The complexity of smart homes leads to the refusal of their adoption.

Venkatesh and Brown (2005) proposed MATH for predicting households' technology adoption, which includes the control belief. One of the concepts in control belief is the perceived cost of adopting a technology (Venkatesh & Brown, 2001). The cost of SHTs has a significant negative impact on consumers' technology adoption in households (e.g., Paetz et al., 2012; Alaiad & Zhou, 2017; Park, Kim et al., 2018; Nikau, 2019; Tu et al., 2021; Al-Husamiyah & Al-Bashayreh, 2022). Moreover, in UTAUT2, price value was found to be one of the critical determinants of personal usage of technologies (Venkatesh et al., 2012). Price value refers to the mental calculation that consumers make when deciding whether to purchase and use technology, weighing the benefits they will receive against the monetary cost or sacrifice involved, such as the purchase price or subscription fees (Dodds et al., 1991; Venkatesh et al., 2012). Brush et al. (2011) mention the high cost of ownership as an important barrier to the broader diffusion of smart homes. Similarly, Balta-Ozkan et al. (2013) suggested the perceived cost of SHTs as a major adoption concern. Potential adopters perceive the price of SHT installation and maintenance as costly and complicated. In addition, they are hesitant to sign a smart contract, which could leave them vulnerable to rising prices. A positive price value is allocated when the perceived benefits of utilizing technology outweigh its monetary costs.

Research in the field of IS has indicated various constructs associated with hedonic value, such as fun, enjoyment, and pleasure, serve as motivators for the adoption of innovative technologies (e.g., Davis et al., 1992; Venkatesh, 2000; Brown & Venkatesh, 2005; Venkatesh et al., 2012). Davis et al. (1992) modeled the role of intrinsic motivation in TAM by introducing the concept of enjoyment. The concept of enjoyment refers to the degree to which the act of utilizing innovative technologies is perceived as enjoyable (Davis et al., 1992). Brown and Venkatesh (2005) included pleasure derived from household technology usage in MATH and found that hedonic benefits are significant determinants of adoption for some household segments. Furthermore, Venkatesh et al. (2012) described hedonic motivation in UTAUT2 as the joy and delight that people get from utilizing technology and determined that it is a crucial factor influencing consumers' intentions to adopt technology.

In technology adoption research, especially in the consumer context, enjoyment influences acceptance in many studies (e.g., Gao & Bai, 2014; Brown et al., 2015; Shuhaiber & Mashal, 2019). Household technology owners place a significant emphasis on hedonism when utilizing technology within their home environment. (Brown et al., 2015). Ahn et al. (2016) revealed the significance of hedonic experiences as a predictor of sustainable household technology adoption. Kowalczuk (2018) found that enjoyment had the strongest and most positive effect on intention to use voice-controlled smart speakers. Likewise, Shuhaiber and Mashal (2019) concluded that enjoyment had a significant influence on the intention to buy smart home devices and suggested adding smart homes fun and exciting elements through interactive functions. Moreover, Park et al. (2018) provided empirical evidence of the relationship between enjoyment and the ease of using smart home technologies.

The image represents the social outcomes of innovation adoption. It is defined as the extent to which the utilization of an innovation is perceived to elevate one's status or image within their social system (Moore & Benbasat, 1991). According to Rogers (2003), innovators are more strongly influenced by status outcomes than later adopters. Social outcomes are important for home settings where inhabitants welcome their beloved guests. According to Schill et al. (2019), SHTs are frequently adopted for reasons beyond utilitarian benefits, such as signaling affluence or a dedication to sustainability. SHTs are relatively the latest smart technologies with a considerably higher price range, so their users can be considered more innovative and prestigious than non-adopters. Sovacool and Del Rio (2020) found that assisted living technologies provide their adopters with social benefits such as networking, socializing, and inclusion.

Product design refers to exterior characteristics (aesthetics), interior design (ergonomics), and functional features of the product (Veryzer, 1995). These three aspects of product design create expectations of the product functions and affect consumers' decision-making (Moon et al., 2015). Product aesthetics is defined as the perspective of attractive appearance, which creates the initial impression of technological innovation and can be expressed as a product advantage (Bloch, 1995). Perceptions of product form as perceived aesthetics covered in previous research for wearables (Pfeiffer et al., 2016). Stringer et al. (2006) uncovered in a domestic technology adoption study that form and aesthetics are important factors for the selection and continuous usage of SHTs. Similarly, Park, Kwak, et al. (2018) found design as a significant factor in the perceived benefits of smart speakers at home. In the study of Sovacool and Del Rio (2020), the aesthetic look of SHTs adds a symbolic value to the house as a fashion item and increases SHT adoption.

Furthermore, ergonomics refers to product design characteristics that are perceived as improved ease of use, comfort, and safety (Moon et al., 2015). In the study of Wilson et al. (2014), ergonomics was argued under user-friendliness, which is closely related to the acceptability of smart homes.

Lastly, a strong gender divide was shown in design perceptions of domestic technologies. The aesthetics of smart homes and how well they integrate with the interior decor of their homes are of greater concern to women (Stringer et al., 2006). A cultural divide was also revealed in design perceptions of smart home solutions. Jeong et al. (2010) concluded in a comparison study between USA and Korea that different households and cultures demand different design solutions.

Privacy refers to the belief that technology providers' collection, access, use, and disclosure of an individual's personal information align with their expectations (Pavlou, 2001). Smart homes may collect information about their users to provide customized services (Balta-Ozkan et al., 2013). The quantity, specificity, and types of data collected by different smart home devices elicit privacy concerns among individuals. Four dimensions of information privacy concerns, namely collection, unauthorized secondary usage, errors, and illegal access, were identified by Smith et al. (1996). These dimensions have been considered reliable scales for assessing individuals' concerns regarding privacy practices and were utilized in this dissertation.

Privacy concerns are limiting enthusiasm for SHT adoption (Paetz et al., 2012). Especially assisted living use cases are subject to evaluation regarding their' privacy characteristics for adoption decisions (Courtney, 2008). Supporting this, Alaiad and Zhou (2017) found that privacy concerns have a negative effect on patients' intentions to use smart home healthcare systems.

Moreover, Nysveen and Pedersen (2016) studied consumers' adoption of IoT services and found that privacy risk harm has a significant negative effect on their attitude toward using them. This is in line with Balta-Ozkan et al. (2014) and Yang et al. (2017) were identified privacy and security concerns as potential barriers to STH adoption. Park, Kwak, et al. (2018) identified that privacy concerns positively influence the perceived risks of smart speakers. People are afraid of the risk of smart home technologies becoming too intrusive and attacking their own domestic privacy. Wunderlich et al. (2019) found that perceived privacy risk negatively influences consumers' intention to adopt smart meters. Lee (2020) and Pal et al. (2021) suggested that privacy concerns and vulnerabilities are the main reasons for home IoT resistance. Wei et al. (2019) found a direct positive impact of perceived privacy on the adoption intention of SHTs.

Security refers to the extent to which vendors are perceived to fulfill security needs, such as authentication, integrity, encryption, and non-repudiation (Cheung & Lee, 2000). Most IoT devices have limited capacity for computation, storage, and network; therefore, they are more vulnerable to attacks than other endpoint devices (Khan & Salah, 2018). Consequently, Porter and Heppelmann (2014) advocated the need for robust security management for smart products that should be provided by smart home vendors to ensure that consumers' personal data is adequately protected. The security management system should safeguard the data transmitted to, from, and between smart objects, prevent unauthorized usage of smart objects, and ensure secure access between the smart object and the vendor's central systems.

Security concerns are important barriers to smart home adoption (e.g., Brush et al., 2011; Balta-Ozkan et al., 2013; Yang et al., 2017; Kowalczuk, 2018). In the study of Gram-Hanssen and Darby (2018), potential SHT adopters expressed their concern about a possible hack into smart systems as some devices, such as remote controls, are more sensitive to security compromises. Moreover, they are concerned that data leaks from smart home providers' servers may possibly cause unauthorized third parties to gain information on themselves. Supporting this finding, Yang et al. (2017) found a significant negative effect of security and privacy risks on attitudes toward smart home services. According to Kowalczuk (2018), security and privacy risks exert a significant negative impact on the intent to adopt smart speakers. Correspondingly, Klobas et al. (2019) demonstrated that risks related to security negatively influence the intention to use smart home devices. Park, Kim, et al. (2018) defined security as the consumers' perspective toward the protection level against potential threats while using smart home services and proposed a positive effect on their adoption via usefulness. Wei et al. (2019) found a direct positive impact of security on the adoption intention of SHTs.

Trust is characterized as the willingness to accept vulnerability to a trustee due to favorable expectations of their actions (Colquitt et al., 2007). Trust is a proven determinant of technology acceptance, especially in e-commerce and digital banking contexts (Pavlou, 2001; Gefen et al., 2003; Pascual-Miguel et al., 2015; Alalwan et al., 2017). Security and privacy were indicated as antecedents of consumer trust in online transactions (Pavlou, 2001). Trust is especially important in the case of IoT.

In contrast to a single transaction in e-commerce, consumers continuously depend on the IoT vendor for interactions over IoT devices.

Brand trust refers to the confidence in a brand, specifically, the assured expectations regarding the brand's dependability and intentions in circumstances involving risk to the consumer (Delgado-Ballester, 2004). Brand was found to positively affect the perceived quality and value of products and, therefore, their buying intent (e.g., Dodds et al., 1991). According to our in-depth expert interviews from the smart home sector, brand trust is a major determinant of their adoption. This statement is supported by the literature as well. It has been widely stated that consumers are unaware of the benefits and potential value of smart homes supposing that an individual is not equipped with objective knowledge about the product. In that case, it is more likely to evaluate the product using extrinsic cues (e.g., packaging, brand name) (Marikyan et al., 2019b). Trust in a brand helps consumers overcome concerns about risks (e.g., privacy, security, the delegation of agency) and mitigate uncertainty.

No studies have been identified in the literature investigating brand trust in the SHT context. Previous studies are focused on trust in technology/service providers. Balta-Ozkan et al. (2013) elaborated on the importance of trust in smart home producers, taking the evidence from public opinions favoring the benefits of smart homes but suspecting that those benefits will not pass to consumers from producers. Similarly, Yang et al. (2017) tested the influence of trust in smart home service providers on their adoption and found that trust played a significant role in adopting smart home services. Adding to this finding, Yang et al. (2018) noted that trust in smart home service providers has emerged as a major concern due to the rapid growth of data-driven smart home companies, including Google. Shuhaiber and

Mashal (2019) tested user trust in smart homes through reliability and trustworthiness and found that perceiving trustworthiness contributes positively to the intention to buy SHTs. According to Sovacool and Del Rio (2020), consumers do not view smart home start-ups as sufficiently stable and trustworthy, given that their market dominance and brand recognition are not yet well-established. In certain markets, such as Italy, over 50% of smart home products are offered by such start-ups, which adds to the challenges of their adoption. Furthermore, Wilson et al. (2017) discovered that SHTs need to be supplied by trustworthy firms that can offer performance guarantees.

5.1.2 Technology-related consumer traits

The integrated research model in this dissertation attempts to combine innovation and consumer characteristics to identify determinants of smart home technology adoption for different consumer segments. Therefore, this dissertation proposes a segmentation study based on technology-related traits of consumers. The selected technology-related traits stem from TRI 2.0, where Parasuraman and Colby (2015) calculated the technology readiness score of consumers and related five distinct consumer segments. However, those technology-related traits were introduced to the research model after the implementation of EFA, which categorized them into technology motivators and technology inhibitors.

The first dimension of TRI 2.0 is optimism. It is defined as the inclination to hold “a favorable outlook towards technology and a belief that it provides individuals with greater control, flexibility, and efficiency in their daily lives” (Parasuraman & Colby, 2015, p. 60). In general, it reflects a positive sentiment towards technology and identifies individuals' distinct emotions that demonstrate technology as a beneficial advancement (Parasuraman & Colby, 2001). Those who hold an optimistic outlook towards technology are believed to readily adopt it and, in comparison to other consumers, are less likely to dwell on the unfavorable aspects of potential challenges and setbacks that may arise from new technologies (Walczuch et al., 2007). Thus, in the context of smart home technology, individuals who possess a greater degree of optimism towards technology are more likely to have a higher intention to adopt SHTs. Kowalczuk (2018) found the positive impact of optimism on the perceived usefulness of a smart home device, i.e., a voice-controlled smart speaker. Similarly, Hmielowski et al. (2019) revealed that technology optimism is associated with greater support of smart meter installation in one's home.

The second dimension and one of the most prevalent drivers of technology adoption is innovativeness. It is defined as the tendency "to be pioneer in the field of technology and thought leader" (Parasuraman & Colby, 2015, p. 60). This dimension assesses the extent to which individuals perceive themselves to be at the forefront of adopting new technology. This construct is also operationalized by Agarwal and Prasad (1998) as an influential personality characteristic, especially for technology adoption models. Innovative consumers are likely to perceive technology as easy since they have a vast understanding of technology and a genuine curiosity in exploring new technological advancements (Parasuraman & Colby, 2001). Innovativeness is proposed as a personal level determinant of innovation adoption in DOI. It is measured by how soon an individual adopts novel concepts compared to other members of its social system (Rogers, 2003). It is anticipated that people in the early adopter category are more innovative than those in the laggards category. Like Parasuraman and Colby (2001), Rogers (2003) also proposed that greater levels of personal innovativeness aid individuals in dealing with uncertainty and result in stronger intentions to adopt the innovation.

Ahn et al. (2016) identified that consumer innovativeness directly and positively impacts their intention to use a smart sustainable house. To complement this finding, Nikou (2019) concluded that innovativeness has a direct positive impact on the intention to use smart home technologies. Likewise, Wunderlich et al. (2019) unearthed the importance of innovativeness in consumers' intentions to adopt smart meters. Additionally, Baudier et al. (2018) found that personal innovativeness has a direct positive significant effect on the intention to use smart homes for females, not males, where gender moderates consumer innovativeness. Tu et al. (2021) also found the positive influence of consumer innovativeness on SHT adoption. Additionally, they mentioned that innovative people are more inclined to place value on the technical aspects of SHTs.

The third dimension of TRI 2.0, discomfort, is one of the inhibitors of technology adoption. Discomfort refers to the disposition of "perceiving a lack of control over technology and feeling overwhelmed by it" (Parasuraman & Colby, 2015, p. 60). Individuals who experience discomfort with new technology tend to feel anxious when using technology-based products and services. Such individuals often feel dominated by new technology and believe that some new technologies may not be appropriate for ordinary people (Parasuraman, 2000). Discomfort could be interpreted as computer anxiety - the level of an individual's uneasiness, or even dread, when presented with the prospect of utilizing computers (Venkatesh, 2000). This dimension typically gauges the fear and apprehension individuals feel when they are faced with technology. In the study of Sovacool and Del Rio (2020), fear of new technology stemming from an intrinsic motive of fear of the unknown was a potential barrier to smart home technology adoption. Individuals who feel greater levels of discomfort tend to perceive technology as more complex and less user-friendly (Walczuch et al., 2007). One of the most important barriers to adopt smart home technologies is considered the loss of control over household activities and delegating the agency and control to another agent, such as SHT providers or network operators (Balta-Ozkan et al., 2014; Gram-Hanssen & Darby, 2018). Thus, the technology discomfort of individuals negatively influences the adoption of smart home technologies.

The fourth and last dimension of TRI 2.0 is insecurity as an inhibitor of technology adoption. It refers to mistrust of technology and doubt regarding its capability to function appropriately, as well as concerns about its possible detrimental effects (Parasuraman & Colby, 2015). Insecurity construct concentrates on some specific features of technology-based interactions that differentiate insecurity from discomfort, which evaluates a general lack of comfort with technology. Individuals who encounter greater levels of insecurity hold doubts regarding the capacity of non-human processes to function properly (Parasuraman & Colby, 2001). According to Walczuch et al. (2007), security and privacy concerns can cause individuals to distrust new technology and be reluctant to adopt it. Hong et al. (2020) found that perceived risk, which stems from negative aspects of people, such as fear, stress, etc., is one of the barriers to smart home services adoption. Hmielowski et al. (2019) have empirically proven the negative association between technological insecurity and the support of smart meter installation. Balta-Ozkan et al. (2013) suggest that home automation can result in decreased social interaction and a lack of physical activity. Furthermore, participants in this study expressed apprehension about becoming excessively reliant on technology and being susceptible to power outages.

This dissertation proposes TRI 2.0 dimensions to extract distinct consumer segments based on their positive and negative technology-related traits. Thereafter, how the determinants of consumers' attitude toward and intention to adopt SHTs change among those segments was analyzed in this dissertation.

5.1.3 Lifestyle attributes

Different lifestyles could also differentiate the attitude toward and the intention to adopt SHTs, as different people perceive smart homes differently as a reflection of their values and cultural backgrounds. Therefore, the following three lifestyles are selected from the previous smart home literature to investigate consumer segments based on them and to analyze the difference between these consumer segments regarding their SHT adoption.

Health orientation impacts psychological tendencies on people's health (Snell et al., 1991). Snell et al. (2013) developed a scale to measure health orientation with ten dimensions, which are: (1) personal health consciousness, (2) health image concern, (3) health anxiety, (4) health esteem and confidence, (5) motivation to avoid unhealthiness, (6) motivation for healthiness, (7) health internal control, (8) health external control, (9) health expectations, and (10) health status. According to the literature review about smart homes, which was also supported by the qualitative study, health orientation, especially "motivation to avoid unhealthiness" and "motivation for healthiness", is an important lifestyle in adopting technologies in residential environments. "Motivation to avoid unhealthiness" is a subscale of health motivation, which pertains to the inclination to evade current or potential health problems. In contrast, “motivation for healthiness” implies a drive towards achieving optimal physical well-being.

Health-related benefits of SHTs are one of the most recognized dimensions of SHT adoption since their early use cases (e.g., Chan et al., 2009; Marikyan et al., 2019b). SHTs could support and assist people with potential health issues in executing their daily home tasks and providing consultancy for their overall well-being. Additionally, health consciousness reflected in a lifestyle that prioritizes wellness has a notable impact on preventive healthcare behaviors, including a tendency to choose healthier product alternatives (Jayanti & Burns, 1998). Health consciousness was found as a strong determinant of technology adoption in different contexts, such as dietary/fitness mobile applications (Chen & Lin, 2018), healthcare wearables (Zhang et al., 2017), or a moderator of innovation characteristics in health technology usage intentions (Çalışkan et al., 2018). On the contrary, another stream of research highlighted the potential health risks of smart home technologies. In the study of Sovacool and Del Rio (2020), potential health concerns of consumers were found as a barrier to SHT adoption, as long-term health implications of wireless technology are not yet disclosed. Supporting this finding, Balta-Ozkan et al. (2013) proposed that SHTs might cause unhealthy consequences such as lack of movement and laziness. On the contrary, Sovacool and Del Rio (2020) also found that adopting telemedicine and assisted living provides health benefits for people with potential health issues. Moreover, health threat considerations positively affect the intention to adopt wearable healthcare technologies (Gao et al., 2015). Baudier et al. (2018) concluded individuals belonging to the digital native generation anticipate receiving information from smart homes that would facilitate healthier lifestyles.

Environmentalism has matured into a significant social issue over the last decade, so it has become a factor influencing consumer purchase behavior (Follows & Jobber, 2000). Numerous consumer and marketing literature studies utilized consumers' environmental beliefs or attitudes to understand the adoption of eco-friendly products (e.g., Nasir & Karakaya, 2014; Ahn et al., 2016). Ecoscale was established by Stone et al. (1995) as a means of assessing an individual's degree of environmental responsibility. The instrument, which comprises 31 items, contains seven key dimensions: opinion and beliefs, awareness, willingness to act, attitude, actions taken, ability to act, and knowledge.

Ahn et al. (2016) suggested a favorable impact of environmentalism on the intention to adopt smart thermometers and concluded that consumers do not necessarily have to be environmentalists to adopt sustainable household technology. Though, Stringer et al. (2006) revealed that household technology choices are sometimes driven by the desire to live an ecologically responsible lifestyle. Supporting this, Franceschinis et al. (2017) found that private and public environmental concerns positively affect selecting a renewable heating system in the early adopter class, who is motivated by the idea that an innovation reduces environmental externalities. Furthermore, Schill et al. (2019) demonstrated that consumers' intention to acquire SHTs is strongly influenced by their environmental concern, indicating that SHTs are perceived as eco-friendly by consumers. Tu et al. (2021) discovered a strong positive impact of environmental identity on the willingness to adopt smart home features related to environmental sustainability. Finally, one of the perceived benefits of smart home technologies lies in energy efficiency and environmental sustainability (Balta-Ozkan et al., 2014; Wilson et al., 2015; Marikyan et al., 2019).

Houses can be emotionally charged for their residents. Haines et al. (2007) identified that people value memories, relationships, and places more than physical possessions and technology. This idea brought researchers to the evaluation of other theories like extended self. Extended-self construct examines the relationship between consumers' possessions and their sense of self (Belk, 1988 & 2013). There are four different levels of extended self: (1) individual (e.g., cars and clothing), (2) family (e.g., a house and its furnishings), (3) community (e.g., the neighborhood), and (4) group (e.g., a sports team) (Belk, 1988). Belk (2013) later suggested that the digital realm presents novel ways for self-extension, including (1) dematerialization (forming connections with digital content), (2) re-embodiment (constructing a digital-extended self), (3) sharing (engaging in social media interactions), (4) co-construction of self (permitting others to affect one's sense of self-extension), and (5) distributed memory (establishing collective memories through online communities). He also nominated IoT as a potential contributor to this digital self-extension. Deriving from Belk's research, possessions may contribute to how people articulate their social identity. By extension, smart home technologies are expected to contribute to how individuals formulate their social identity (Davidoff et al., 2006).

From a sociological consumption perspective, a home may be seen as a reflection of the life of its residents. As a home mirrors an individual's identity and displays the social status of its inhabitants, it follows that smart home technologies could be perceived as an expansion of one's self. According to the study of Mennicken and Huan (2012), people want to express their modernity through their homes. Being aware that SHTs support the idea of being modern is one of the main drivers of their SHT adoption. Moreover, DIY-smart-home owners perceive their smart homes as a hobby. By testing their programming concepts within their personal living space, this hobby can be regarded as a means of manifesting one's identity within the home (Gram-Hanssen & Darby, 2018). Moreover, Takayama et al. (2012) found that customizing the home environment with smart technologies transforms it into a reflection of one's individual sense of self.

5.1.4 Demographics, socioeconomics, prior experience, and housing structure

Rogers (2003) proposed that socioeconomic status and the adoption of innovations act in a positive and linear relationship. Being an early adopter of innovations is directly proportional to socioeconomic status-related variables, such as income, education, and profession. Kennedy & Holcombe-James (2022) investigated the smart technology experience in low-income households and found that they rarely imagine living in a smart home. Based on this approach, socioeconomic variables such as average monthly household income, education, and socioeconomic status were included in the research model alongside demographic variables (e.g., age, gender, and marital status). Shin et al. (2018) noted that older consumers are more inclined to promptly adopt smart homes compared to younger consumers. Pascual-Miguel et al. (2015) examined gender disparities in online consumer purchasing behavior and determined that gender plays a crucial role in moderating the relationship between purchase intention and determinants. Wunderlich et al. (2019) highlighted the importance of household demographics (i.e., age, education, income, and household size) in smart meter technology adoption.

Moreover, Brown and Venkatesh (2005) discovered in an empirical MATH research that the presence/age of children in the household significantly raised one aspect of utilitarian outcome related to children. Therefore, it is interesting to investigate parental status in this dissertation.

Finally, some previous smart home studies propose the housing structure and prior experience as moderator variables. Yang et al. (2018) discovered that the type of housing, along with gender, age, and previous experience, are significant moderator variables in the relationship between determinants of smart home adoption and adoption intention. Similarly, Chang and Nam (2021) the influence of gender, prior experience, and residential type on the preference for different smart home services. Sovacool et al. (2021) showed the positive impacts of previous experience on the positive perception of smart homes and their benefits.

The housing structure is measured in three dimensions, namely house ownership, location of house, and likeliness to move within the following year. In the study of Balta-Ozkan et al. (2014), it was revealed that smart homes are perceived as long-term investments and, therefore, viable only to homeowners. Renters are particularly concerned about how they can carry their smart home services to their next place of residence. Therefore, it is interesting to study this phenomenon in this dissertation.

5.1.5 Attitude toward and intention to adopt SHTs

Based on TRA (Fishbein & Ajzen, 1975), TRB (Ajzen, 1991), and the TAM (Davis, 1989), the integrated research model includes two important target variables, (1) the attitude toward SHTs and (2) the intention to adopt SHTs. All three theories/models emphasize the role of attitudes and intention in the determination of behavior. Actual behavior is not included in this integrated contextual adoption model of SHTs as this dissertation attempts to predict future behavior rather than measure the current behavior. Furthermore, this dissertation aims to investigate the attitude toward and intention to adopt SHTs individually, instead of proposing attitude as one of determinants of intention as suggested sequential relationship between them in the previous literature. The diffusion process of multi-faceted innovations such as smart homes may differ in terms of attitudes and intention to adopt. Therefore, both attitude toward SHTs and intention to adopt SHTs are treated as separate target variables in the quantitative part of this dissertation.

5.2 Research model and related hypotheses

After meticulously examining technology adoption literature such as DOI, TRA, TPB, TAM, UTAUT, UTAUT2, MATH, and PRT and conducting expert interviews, the initial set of innovation characteristics was proposed. Those innovation characteristics were explicitly tailored as determinants for studying consumers' attitudes toward and intentions to adopt smart home technologies. While each theory offers valuable insights and contributes uniquely to comprehending technology acceptance, it is frequently challenging to account for technology adoption through a singular theoretical framework (Benbasat & Barki, 2007) due to the intricate nature of new technological advancements and their impact on consumers. Smart homes comprise a variety of technologies such as sensors, communication platforms, appliances, hubs, among others. Due to their complexity, these technologies can be challenging for consumers to comprehend (Venkatesh, 2008; Park et al., 2003; Balta-Ozkan et al., 2013; Marikyan et al., 2019). To support this, Venkatesh et al. (2003) and Hubert et al. (2018) emphasized the need to combine different technology acceptance theories in more comprehensive frameworks to lead to novel insights. Therefore, selected constructs from different theories and the qualitative study were combined with the constructs from the theoretical base, DOI theory, in a larger framework of SHT adoption proposed in this dissertation.

In the first and main block of the research model, the characteristics of innovation are introduced. The initial set of innovation characteristics includes relative advantage, complexity, compatibility, trialability, observability, image, price value, enjoyment, design, privacy, security, and brand trust. However, after the implementation of EFA (explained in Section 6.3.1), a new set of determinants emerges, which are value superiority, consumer protection, design and reputation, enjoyment, complexity, and compatibility. These are proposed to have an impact on the attitude toward and the intention to adopt smart home technologies.

In the second block of the research model, two factors (technology motivators and technology inhibitors) proposed, which are found after the implementation of EFA on four technology-related traits from TRI 2.0 (explained in Section 6.3.2). TRI 2.0 is a consumer-specific theory (Parasuraman & Colby, 2015) that includes innovativeness and optimism as motivators, whereas discomfort and insecurity as inhibitors of individuals' technology readiness. The acceptance of technology by consumers is influenced by the interplay between the characteristics of the system and the users. Therefore, the impacts innovation characteristics on the attitude toward and the intention to adopt SHTs are investigated for different technology-related consumer segments.

In the third block, however, the differences of SHT adoption among the consumer segments, found after cluster analysis of each of the three lifestyle attributes are investigated. Based on previous studies, environmental responsibility, health orientation, and home-as-extended-self are the lifestyle attributes that are suggested as influential to the adoption of SHTs.

The combination of attitudinal beliefs on innovation and consumer characteristics is not widely used in technology adoption research. There are limited, but still, some models that proposed a combined effect of personality and technology characteristics in the IoT context (e.g., Ahn et al., 2016; Mani & Chouk, 2017; Touzani et al., 2018).

Figure 14 shows the proposed integrative adoption model for smart home technologies and depicts the hypothesized relationships between innovation characteristics, technology-related consumer traits, lifestyle attributes, demographics, socioeconomics, prior experience, housing structure and SHT adoption.

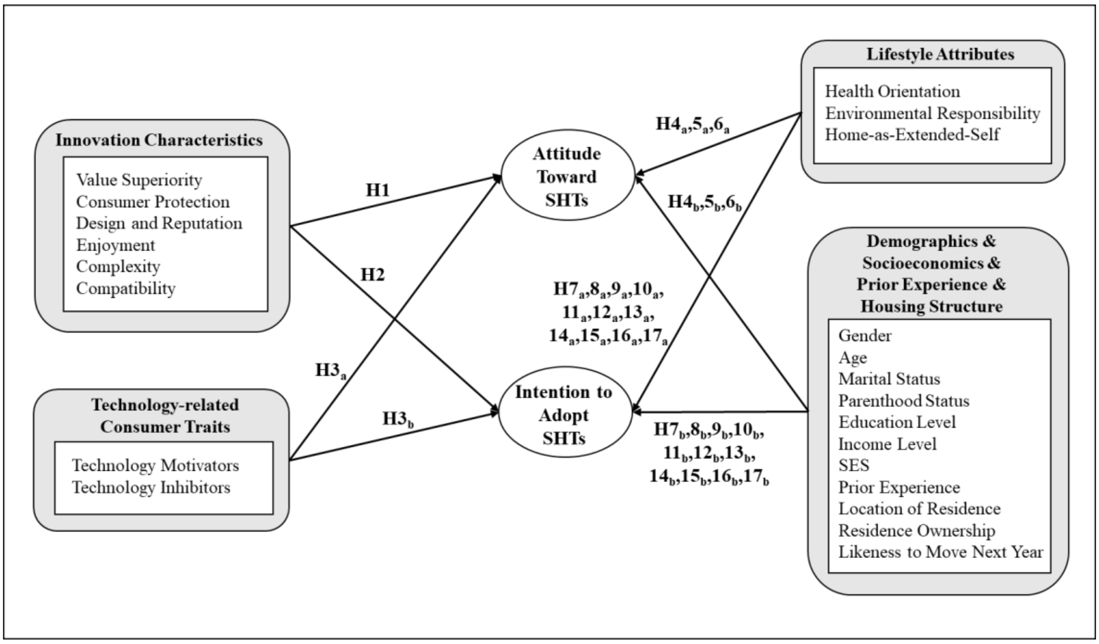

Figure 14. The proposed integrative adoption model for SHTs

The research hypotheses, which are depicted in Figure 14 are explained below:

H1. Innovation characteristics (Value Superiority, Consumer Protection, Design and Reputation, Enjoyment, Complexity, and Compatibility) affect attitude toward SHTs.

H2. Innovation characteristics (Value Superiority, Consumer Protection, Design and Reputation, Enjoyment, Complexity, and Compatibility) affect intention to adopt SHTs.

$H3_a$. The impact of innovation characteristics on attitude toward SHTs varies among technology-related consumer segments (Tech Savvies, Tech Yin-Yangers, and Tech Mediocres).

$H3_b$. The impact of innovation characteristics on intention to adopt SHTs varies among technology-related consumer segments (Tech Savvies, Tech Yin-Yangers, and Tech Mediocres).

$H4_a$. There is a difference between the consumer segments arising out of health orientation (Health-attentive and Health-lax) in terms of their attitude toward SHTs.

$H4_b$. There is a difference between the consumer segments arising out of health orientation (Health-attentive and Health-lax) in terms of their intention to adopt SHTs.

$H5_a$. There is a difference between the consumer segments arising out of environmental responsibility (Environment-conscious and Environment-indifferent) in terms of their attitude toward SHTs.

$H5_b$. There is a difference between the consumer segments arising out of environmental responsibility (Environment-conscious and Environment-indifferent) in terms of their intention to adopt SHTs.

$H6_a$. There is a difference between the consumer segments arising out of home-as-extended-self (Home-engaged and Home-detached) in terms of their attitude toward SHTs.

$H6_b$. There is a difference between the consumer segments arising out of home-as-extended-self (Home-engaged and Home-detached) in terms of their intention to adopt SHTs.

$H7_a$: There is a difference between males and females in terms of their attitude toward SHTs.

$H7_b$: There is a difference between males and females in terms of their intention to adopt SHTs.

$H8_a$: There is a difference among different age groups in terms of their attitude toward SHTs.

$H8_b$: There is a difference among different age groups in terms of their intention to adopt SHTs.

$H9_a$: There is a difference between singles and marrieds in terms of their attitude toward SHTs.

$H9_b$: There is a difference between singles and marrieds in terms of their intention to adopt SHTs.

$H10_a$: There is a difference between parents and non-parents in terms of their attitude toward SHTs.

$H10_b$: There is a difference between parents and non-parents in terms of their intention to adopt SHTs.

$H11_a$: There is a difference among different education level in terms of their attitude toward SHTs.

$H11_b$: There is a difference among different education level in terms of their intention to adopt SHTs.

$H12_a$: There is a difference among different income level in terms of their attitude toward SHTs.

$H12_b$: There is a difference among different income level in terms of their intention to adopt SHTs.

$H13_a$: There is a difference among different SES groups in terms of their attitude toward SHTs.

$H13_b$: There is a difference among different SES groups in terms of their intention to adopt SHTs.

$H14_a$: There is a difference between experienced and inexperienced customers in terms of their attitude toward SHTs.

$H14_b$: There is a difference between experienced and inexperienced customers in terms of their intention to adopt SHTs.

$H15_a$: There is a difference among different resident locations in terms of attitude toward SHTs.

$H15_b$: There is a difference among different resident locations in terms of intention to adopt SHTs.

$H16_a$: There is a difference between resident owners and renters in terms of their attitude toward SHTs.

$H16_b$: There is a difference between resident owners and renters in terms of their intention to adopt SHTs.

$H17_a$: There is a difference between movers and non-movers within the next year in terms of their attitude toward SHTs.

$H17_b$: There is a difference between movers and non-movers within the next year in terms of their intention to adopt SHTs.

5.3 Measurement instrument

This subsection explained how the survey has been developed, which serves as a data collection tool for testing the proposed hypotheses in the research model. All measurement items to measure latent constructs in the quantitative study were developed primarily based on previous studies with minor adaptations to smart home technologies.

Regarding innovation characteristics, the measurement of relative advantage was based on Sivathanu (2018) and Brown et al. (2015). The complexity, trialability, observability, and image items were adapted from Moore and Benbasat (1991), while the compatibility items were taken from Brown et al. (2015). The measurement of price value was adapted from Venkatesh et al. (2012), whereas enjoyment items were modified from Venkatesh (2000). Design items were based on Moon et al. (2015). Privacy and security items were taken from Pavlou (2011), while brand trust items were adapted from Yang et al. (2017).

The measurement items of technology-related traits, i.e., optimism, innovativeness, discomfort, and insecurity, were taken from TRI 2.0 by Parasuraman and Colby (2015).

As a lifestyle, the 31-item instrument of ECOSCALE was modified to a five-item version from the study of Stone et al. (1995) to measure environmental responsibility. Health orientation was measured with a modified four-item version of the health orientation scale (Snell et al., 2013; Nasır & Karakaya, 2014). Finally, for measuring home-as-extended-self, the scale developed by Sivadas and Machleit (1994) was customized for the home context, which measures the extent of possession incorporation in the extended self.

Several demographic, socioeconomic, prior experience, and housing structure related answers were also collected in the quantitative study. Finally, the measurement of target factors, namely attitude toward and intention to adapt SHTs, was adapted from Brown and Venkatesh (2005). Measurement item lists with the descriptions and the references from where those items were adopted are provided in Appendix A.

The original item scales were in English. In line with Schill et al. (2019), to ensure accuracy, three native speakers translated the item scales into the local language (Turkish) and then back translated them into English. In cases of discrepancies, the researchers chose the item that most closely resembled the original version. Appendix B includes the final version of the research survey. The questionnaire includes latent constructs, which are measured with literature-based scale items. These measurement items were evaluated by the sample on their agreement level with a seven-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

The questionnaire was structured to commence with a series of screening questions that facilitated the survey administrator in determining which individuals could be included as participants in the quantitative study. The screening questions pertained to the average monthly income of the household, age, and socioeconomic status (SES), which is determined by a combination of education, occupation, and employment status.

The initial section of the survey comprised of demographic inquiries relating to participants' age, gender, educational level, marital status, parental status, and average monthly net household income level. Moreover, three additional questions were asked to identify their housing structure.

In the second part of the survey, participants were asked for their agreement level with the expressions about TRI 2.0 dimensions and different lifestyle attributes.

Thirdly, participants' beliefs on smart home technologies were gathered. Before showing the expressions about SHT innovation characteristics, a definition of smart homes and examples from main SHT categories were provided in this part of the survey so that non-users get acquainted with SHTs via these examples. Experimental studies in IS literature frequently inquire about survey respondents' behavioral intentions after introducing them to a new technology via videos, booklets, or internet prototypes (Sheng et al., 2008; Hubert et al., 2018). In this part, participants are asked about their prior experience with SHTs.

In the fourth and final part of the survey, phrases about attitude toward and intention to adopt SHTs were shown to participants and asked for their agreement level.

The survey questionnaire was approved by Boğaziçi University Social Sciences and Humanities Ethics Committee for Research with Human Subjects (SBINAREK) on 08.07.2019, and their approval is provided in Appendix C.

Before conducting the survey, a pre-test was applied to test the survey instrument before the final data collection procedure. For pre-testing the instrument and its administration procedure, five testers were selected from SES A, B, or C1. Upon finding the testers, appointments were scheduled to obtain more in-depth and comfortable insights. During the survey completion process, they were instructed to verbalize their thoughts. After reading and responding to each question, they were prompted to share precisely what came to their mind. Feedback was solicited regarding the instrument's length, scale format, and question clarity.

The feedback obtained from the pretesting was collected and analyzed to revise the survey. The first feedback was about the examples provided for smart homes in the survey. These examples were sometimes confusing for respondents. Smart TVs are widespread in the Turkish market but having only a smart TV at home is not considered a smart home with a connected experience. Smart TVs are another type of monitor at home to connect to the Internet. In line with the study of Gram-Hanssen and Darby (2012), a high level of device connectedness enabling management of everyday home operations allows us to claim smart homes, excluding the cases of a smart TV or smartphone ownership. Therefore, smart TV was eliminated from the examples. Second, the arrangement of items was changed after the feedback received from pre-test participants. The items for technology-related traits and lifestyles were moved in the second part of the survey to implement the funnel method from general to specific. Finally, compatibility-related items were refined with changed wordings in Turkish. Participants got confused about lifestyle compatibility by assuming it was only technical interoperability.

After the pre-test, a pilot study was conducted to test the feasibility of the survey design and construct validity. The survey consisted of 84 items, except for demographics, socioeconomics, prior experience, and housing structure questions. Upon obtaining consent from the program chairs, the survey was disseminated to the department of management information systems' graduate program email list. It was posted online for the participants to access. The researcher shared the questionnaire link on social media channels, e.g., LinkedIn and Facebook. The researcher also invited her former colleagues in pharmaceutical and technology sectors to participate in the survey. The survey was administered online, and participation was voluntary as respondents answered the survey. A total of 167 responses were collected, but after excluding incomplete responses, only 103 remained for the analysis. The data from the pilot study was examined for completeness of responses, reliability, and construct validity. Subsequently, the final data collection started, which is described in the next section.

5.4 Sampling and data collection procedure for Phase 2

The research universe of observations was based on people with the following attributes:

i. People who live in three big cities of Turkey – İstanbul, Ankara, and İzmir
ii. People whose age is between 25 and 65
iii. People who are a member of SES A, B, and C1
iv. People whose average monthly household income is over 7,500 Turkish Lira (TL)

According to the Turkish Statistical Institute's (2020) address-based population registration system, this sample was represented by 14,572,496 people in 2019, in case SES groups and monthly household earnings were not considered. The concrete numbers are provided in detail in Table 5.

Table 5. Population per Gender, Age Group, and City

Gender	Female	Male		
	7,280,752	7,291,744		
Age Group	25-35	36-45	46-55	56-65
	4,691,478	4,301,895	3,306,566	2,272,557
City	İstanbul	Ankara	İzmir	
	8,867,670	3,179,949	2,524,877	

Source: [TUIK, 2020]

Households led by individuals under 25 years old typically have lower than average spending, as their incomes are often considerably lower than average as well. Furthermore, households led by individuals aged 65 and over tend to have spending levels significantly below the average (Martins et al., 2011). As smart home technologies are innovative products under the affluent commodity products category, the research data collection was restricted between the ages 25 to 65 considering their expenditure levels.

From another aspect, people tend to graduate from school around 20-25 years of age and retire around 60-65 years of age in many countries. A major shift in the consumption pattern is associated with graduation and retirement, reflecting a significant change in the life cycle (Martins et al., 2011). Therefore, the first constraint, which was applied to the sample, was the age group, which is defined as from 25 to 65.

The second constraint was the selection of cities to conduct a field study to gather research data. As İstanbul, Ankara, and İzmir are the three biggest and most representative metropoles of Turkey, data collection activities were conducted in these three cities.

The third constraint was the application of the SES filter to the selection of sample. Rogers (2003) proposed that socioeconomic status and the adoption of innovations act in a positive and linear relationship. Consumers adopt innovations in direct proportion to their socioeconomic status-related variables, such as income, education, and profession. Based on this approach, SES filter was implemented to the sample.

In the early stages of an innovation's diffusion, the expected uncertainty is high regarding that innovation's performance. It is proposed by Cancian (1976) that individuals from low-middle SES are more innovative than individuals from high-middle SES status, as people of higher rank will risk less than people from a lower rank. Therefore, SES Groups A and B, representing higher classes, and additionally C1 representing higher-middle class people for the population were selected. Based on the SES study of the Turkish Researchers' Association (2012), SES groups are identified based on individuals' occupations and education. More detailed mapping of SES groups of TUAD can be found in Figure 15.

		1	2	3	4	5	6	7	8	9
MAJOR INCOME-GENERATING PERSON		Primary School Dropout	Primary School Graduate	Middle School Graduate	High School Graduate Normal	High School Graduate Trade School	Foundation Degree	Open Education Faculty	Normal	Post Graduate
EMEKLİ ise:										
**	Retired – Working	(It will be coded below depending on the previous work and SES will be assigned.)								
**	Retired – Not Working	(SES will be taken 1 degree lower depending on the previous job, GRAHP 2 is not working, retired graph)								
SECTION A – DON'T HAVE A JOB WITH SALARY, UNEMPLOYED										
1a	Unemployed – Currently not working – don't have side income/receiving subvention	E	E	D	D	D	C2	C2	C2	C2
1b	Unemployed – Currently not working – have regular side income	D	D	C2	C2	C2	C1	C1	C1	C1
2a	Housewife– don't have side income/receiving subvention	E	E	D	D	D	C2	C2	C2	C2
2b	Housewife– have regular side income	D	D	C2	C2	C2	C1	C1	C1	C1
3	Student (without a job salary)			D	C2	C2	C2	C2	C2	C2
SECTION B – WORKING WITH SALARY OR PAYMENT										
4a	Labourer/Retainer – Working by piecework (Irregular, from time to time)	E	D	D	C2	C2	C2	C1	C1	B
4b	Labourer/Retainer – Working regularly (Doing the same job unless special conditions)	D	C2	C2	C1	C1	C1	B	B	B
5	Workmaster/Qualified workman – Has workers working under his command	D	C2	C2	C1	C1	B	B	B	B
6	Civil servant who doesn't direct / Craft / Expert etc.	D	C2	C2	C1	C1	B	B	B	B
7	Director (With 1-5 employees)	C2	C1	C1	C1	C1	B	B	A	A
8	Director (With 6-10 employees)	C2	C1	C1	C1	B	B	B	A	A
9	Director (With 11-20 employees)	C1	C1	C1	B	B	B	A	A	A
10	Director (With more than 20 employees)	C1	C1	B	B	B	A	A	A	A
11	Military Man (Military specialist,, sergeant, offier)		C2	C2	C1	C1	B	B	A	A
12	Expert with payment, seniority and qualifications (Lawyer, Doctor, Architect, Engineer, Academician etc.)							A	A	A
SECTION C – WORKING FOR THEIR OWN ACCOUNT – INDEPENDENT BUSINESS – QUALIFIED EXPERT										
13	Farmers (Working by themselves or with their families)	D	D	D	C2	C2	C2	C1	B	B
14	Street Hawker – Own Job (Including Free Lance), not giving service in a store	C2	C2	C2	C1	C1	C1	B	B	B
15	Working alone, store owner, tradesman (including taxi drivers)	C2	C1	C1	C1	C1	B	B	A	A
16	Business Owner with 1-5 employees (Trade, Agriculture, Manifacture, Service)	C2	C1	C1	B	B	B	B	A	A
17	Business Owner with 6 - 10 employees (Trade, Agriculture, Manifacture, Service)	C1	C1	C1	B	B	B	A	A	A
18	Business Owner with 11-20 employees (Trade, Agriculture, Manifacture, Service)	C1	C1	B	B	B	B	A	A	A
19	Business Owner with more than 20 employees (Trade, Agriculture, Manifacture, Service)	C1	C1	B	B	B	A	A	A	A
20	Freelance qualified expert (Lawyer, Engineer, Financial Advisor, Doctor, Pharmaceutist, etc.)							A	A	A

Figure 15. SES group mapping based on occupation and education
Source: [TUAD, 2012]

This mapping was used for the identification of individuals in the research sample. According to TUAD's (2012) research, A, B, and C1 individuals represented 5%, 10%, and 24% of people in cities. These ratios build the basis of the quota calculations for the sample.

Additionally, monthly average income was included in the sample screening questions. The minimum acceptable level of average monthly household income was identified as 7,500 TL, which was the official minimum level of the poverty level for a four-people-household in January 2020 from the Confederation of Turkish Trade Unions (2020).

Based on the above-explained filters, the questionnaire was directed to collect final search data. The aim was to reach 1,000 people representing this population. The field study was operated by a field research company face-to-face with the help of a grant from Boğaziçi University Research Fund (Grant No: D-14801). The following quotas in Table 6 were applied on the sample of 1,000 people for the field study.

Table 6. Sampling Quotas per Gender, Age Group, SES Group, and City

Gender	Female	Male		
	50%	50%		
Age Group	25-35	36-45	46-55	56-65
	32%	30%	23%	15%
SES	A	B	C1	
	15%	25%	60%	
City	İstanbul	Ankara	İzmir	
	609	218	173	

The survey data was collected through face-to-face interviews. The administrator of the survey from field research company read the questions to the participants and recorded their responses on an online form. The data collection process was carried out over a period of four weeks in March and April of 2020.

In the following chapter, a quantitative analysis was conducted to validate the proposed factors from the previous literature review, which are improved with in-depth expert interview results, and to test the relationships between the dependent and independent variables, which are proposed in this dissertation.

CHAPTER 6

FINDINGS OF THE QUANTITATIVE STUDY

The chapter provides the analysis steps and the findings of the quantitative part of this dissertation. The research population is representative of potential smart homes adopters in Turkey. The descriptive statistics section includes the demographic and socioeconomic details of the sample. Hypotheses proposed in the integrated research model in the previous chapter are analyzed for their validation in this chapter. To prove these hypotheses, reliability, cluster, multiple linear regression, one-way analysis of variance (ANOVA), Kruskal-Wallis, independent samples *t*-test, and Mann-Whitney U analyses were performed.

After the collection and compilation of the data, exploratory factor analysis was applied to each item block, namely, innovation characteristics and TRI 2.0. These exploratory factor analyses revealed factors of innovation characteristics, referred to SHT adoption determinants, and two main technology-related traits.

Furthermore, statistical analysis models like multiple linear regression, ANOVA, Kruskal-Wallis, independent samples *t*-test, or Mann-Whitney U analyses were utilized to test proposed relations/differences with these factors. The findings were interpreted to validate the hypotheses proposed in the research model.

Moreover, K-Means clustering analysis was applied to reveal different consumer segments regarding their technology-related traits. Differences between these indicated segments regarding their perceptions of innovation characteristics were explored. For this purpose, one-way ANOVA with Tukey post hoc tests was conducted using these three consumer segments as grouping variable and six factors of innovation characteristics as dependent variables.

While investigating the factors determining the attitude toward and intention to adopt SHTs, it aimed to consider the role of consumer segments, which were found regarding consumers' technology-related perceptions. To reveal it, three other regression analyses were run.

Lastly, differences between different lifestyles attribute based consumer segments, demographics, socioeconomics, prior experience, and housing structure were investigated regarding attitudes toward and intention to adopt SHTs with independent samples *t*-test, Mann-Whitney U, ANOVA, or Kruskal-Wallis tests.

6.1 Descriptive statistics

After receiving 1,099 questionnaires from the field research company, outliers and responses with missing values were removed, resulting in a sample of 995 respondents. From 995 valid complete responses of the quantitative study, 45.5% (453 observations) are female, 54.5% (542 observations) are male. 80.2% are married, and 73.4% have at least one child.

Information about respondents' demographic and socioeconomic characteristics is presented in Table 7.

6.2 Construct reliabilities

To check the reliability by internal consistency, Cronbach's Alpha (CA) statistics were calculated for all scales. Before calculating CA statistics, all items needed to be coded in the same direction to have all items in positive correlations. Therefore, three items in the attitude scale were reverse-coded (Hair et al., 2010). After these corrections, CA was found to be 0.935 for 84 items. The cut-off level of Cronbach's Alpha reliability measure is 0.70 (Nunnally, 1978).

Table 7. Demographic and Socioeconomic Characteristics of the Sample

n: 995					
Gender	Female	Male			
	453 (45.5%)	542 (54.5%)			
Age Group	25-35	36-45	46-55	56-65	
	339 (34.1%)	314 (31.6%)	205 (20.6%)	137 (13.8%)	
Education Level	Less than High School Degree	High School Degree	Foundational Degree	University Degree	Post Graduate Degree
	17 (1.7%)	465 (46.7%)	129 (13%)	314 (31.6%)	70 (7%)
Monthly Household Income (TL)*	7,500-9,999 (low)	10,000-19,999 (mid)	20,000-29,999 (mid-high)	Over 30,000 (high)	
	523 (52.6%)	370 (37.2%)	60 (6.0%)	42 (4.2%)	
SES	A	B	C1		
	165 (16.6%)	239 (24%)	591 (59.4%)		
City	İstanbul	Ankara	İzmir		
	604 (60.7%)	228 (22.9%)	163 (16.4%)		
Marital Status	Single	Married			
	197 (19.8%)	798 (80.2%)			
Parental Status	Yes	No			
	730 (73.4%)	265 (26.6%)			
Residence Ownership	Own House	Rental House	Family House	Lodgment	Others
	604(60.7%)	258 (25.9%)	102 (10.3%)	28 (2.8%)	3 (0.3%)
Likeliness to Move Next Year	Yes	No			
	505 (50.8%)	490 (49.2%)			

* The USD to TL exchange rate was 7.5 in March 2020.

Furthermore, all constructs were checked separately. For improvement in the reliability statistics of compatibility, the first item from its scale was discarded. After the omission of this item, the CA level of the compatibility construct was increased to 0.708 from 0.608. Two additional deletions were also executed for environmental responsibility and innovativeness constructs. By eliminating one item (ENVR4) from the environmental responsibility scale, its CA value went up from 0.808 to 0.826. By eliminating one item (INN4) from the innovation scale, its CA value increased from 0.737 to 0.744.

Insecurity and brand trust scales were also below the cutoff level (0.70). There is no improvement in CA value (0.62) for the brand trust construct, even in the case, one or more items would be deleted from its scale. For insecurity, CA was improved up to 0.60 after the deletion of INS1 and INS4 items. According to Janssens et al. (2008), a CA value between 0.60 and 0.80 permits the calculation of summated scale. Therefore, both constructs were kept in the next step of the analysis, namely exploratory factor analysis.

All other constructs demonstrated CA values that exceeded the minimum threshold values recommended in the literature (CA > 0.70), suggesting that they were all reliable. Likewise, the inter-item-correlation values of each construct's items were above 0.20, suggesting that the items represent the same content domain (Piedmont, 2014). Table 8 provides the reliability statistics for each construct.

Table 8. Initial Cronbach's Alpha Statistics of Constructs

Constructs	Number of Items Original	Cronbach's Alpha - Original	Number of Items After Item Deletion	Cronbach's Alpha - Final
Attitude Toward Adoption	7	0.914	7	0.914
Adoption Intention	5	0.910	5	0.910
Relative Advantage	4	0.883	4	0.883
Complexity	4	0.852	4	0.852
Compatibility	3	0.608	2	0.708
Trialability	3	0.869	3	0.869
Observability	4	0.852	4	0.852
Image	3	0.787	3	0.787
Price Value	4	0.742	4	0.742
Enjoyment	4	0.932	4	0.932
Design	4	0.871	4	0.871
Privacy	4	0.922	4	0.922
Security	3	0.724	3	0.724
Brand Trust	4	0.615	4	0.615
Innovativeness	4	0.737	3	0.744
Optimism	4	0.835	4	0.835
Discomfort	4	0.782	4	0.782
Insecurity	4	0.247	2	0.595
Environmental Responsibility	5	0.808	4	0.826
Health Orientation	4	0.725	4	0.725
Home-as-Extended-Self	3	0.717	3	0.717

6.3 Exploratory factor analysis

Two different exploratory factor analyses were conducted in SPSS Version 27 to see whether higher-order factors could be obtained. The first was applied to innovation characteristics (43 items), and the second was executed with TRI 2.0 (13 items). The sample size was 995.

6.3.1 Innovation characteristics

In the EFA process, loadings with a value greater than 0.4 were considered reliable (Guadagnoli & Velicer, 1988). The ratio of loadings between factors should not exceed 75% to ensure that items do not load across multiple factors. Trialability items (three items) did not significantly load on one factor. However, they loaded on multiple factors. Therefore, they were omitted from further analysis. Similarly, BRAND3, BRAND4, and VAL1 items loaded multiple dimensions without having a significant difference in loadings. Because of these cross-loadings, these three items were eliminated from the analysis. The final item count for further EFA was 37.

The extraction method for EFA was set to principal component analysis, with varimax as the rotation method and eigenvalue set to one. The Kaiser-Meyer-Olkin (KMO) measure which assesses the sample size adequacy for factor analysis, was 0.938, indicating a highly acceptable value well above the minimum threshold range of 0.50 - 0.60 (Hair et al., 2010). Bartlett's test of sphericity indicated that the data was suitable for factor analysis, with a strong indication of a potentially good factor solution at the 0.01 significance level. Intercorrelation test statistics are shown in Table 9.

Table 9. Intercorrelation Measures of Innovation Characteristics

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.938
Bartlett's Test of Sphericity	Approx. Chi-Square	24391.865
	df	666
	Sig.	0.000

All communalities were higher than 0.50, as depicted in Table 10, a sign of practical significance.

Table 10. Communalities for Innovation Characteristics

Item	Communality
ADV1	0.669
ADV2	0.628
ADV3	0.666
ADV4	0.634
COM1	0.657
COM2	0.690
COM3	0.729
COM4	0.692
COMPA3	0.585
COMPA2	0.553
OBS1	0.600
OBS2	0.547
OBS3	0.565
OBS4	0.664
IMG1	0.572
IMG2	0.578
IMG3	0.604
VAL4	0.636
ENJ1	0.830
ENJ2	0.782
ENJ3	0.811
ENJ4	0.805
DES1	0.583
DES2	0.730
DES3	0.757
DES4	0.718
PRIV1	0.744
PRIV2	0.769
PRIV3	0.769
PRIV4	0.749
SEC1	0.741
SEC2	0.573
SEC3	0.585
BRAND1	0.543
BRAND2	0.488
VAL2	0.705
VAL3	0.619

According to the results of EFA on innovation characteristics, a total of 37 items related to SHT characteristics were divided into six distinct factors, with a highly satisfactory total explained variance of 66.4 percent. The total variance explained statistics are exhibited in Table 11 below.

Table 11. The Statistics for Total Variance Explained of Innovation Characteristics

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Var	Cum %	Total	% of Var	Cum %	Total	% of Var	Cum %
1	9.943	26.873	26.873	6.096	16.476	16.476	9.943	26.873	26.873
2	6.552	17.707	44.58	5.89	15.919	32.396	6.552	17.707	44.58
3	3.658	9.886	54.467	3.875	10.473	42.869	3.658	9.886	54.467
4	1.959	5.294	59.761	3.802	10.276	53.145	1.959	5.294	59.761
5	1.351	3.652	63.413	3.112	8.411	61.555	1.351	3.652	63.413
6	1.108	2.995	66.409	1.796	4.853	66.409	1.108	2.995	66.409
Notes: Extraction Method: Principal Component Analysis.									

Satisfactory convergent validity is indicated when items exhibit high loadings on their corresponding constructs. Table 11 displays the extraction of six factors with an eigenvalue greater than 1.0 and indicates that all items had high loadings on their expected constructs, demonstrating satisfactory convergent validity. To determine the notable factor loadings, coefficients below 0.40 were disregarded when analyzing the rotated component matrix presented in Table 12. As per Hair et al. (2010), factor loadings above 0.50 are typically deemed essential for practical significance. Discriminant validity was assessed by verifying whether each item had higher loading on its designated construct or on any other constructs. The results, as given in Table 12 suggest that the measurement had reasonable discriminant validity.

Table 12. Rotated Component Matrix of Innovation Characteristics

	F1: Value Superiority	F2: Consumer Protection	F3: Design and Reputation	F4: Enjoyment	F5: Complexity	F6: Compatibility
ADV1	0.773					
ADV3	0.759					
ADV4	0.740					
ADV2	0.738					
OBS4	0.734					
IMG2	0.693					
OBS2	0.679					
OBS1	0.667					
IMG3	0.654					
IMG1	0.649					
OBS3	0.630					
PRIV4		0.858				
PRIV3		0.857				
PRIV2		0.853				
SEC1		0.844				
PRIV1		0.832				
SEC3		0.667				
SEC2		0.634				
VAL3		0.585				
VAL4		0.570				
BRAND2		0.532				
DES3			0.807			
DES2			0.779			
DES4			0.763			
DES1			0.665			
BRAND1			0.659			
ENJ1				0.844		
ENJ3				0.824		
ENJ4				0.816		
ENJ2				0.785		
COM4					0.817	
COM3					0.770	
COM2					0.761	
COM1					0.717	
VAL2						0.758
COMPA2						0.552
COMPA3						0.549

The first factor from this analysis was named "value superiority", referring to the perceived performance efficiency and social gains of adopting smart homes compared to other standard homes. This factor seems to have a significant importance level for the overall sample since smart home technologies provide many benefits to their consumers in the form of comfort, convenience, energy efficiency, as well as prestige, and social status. SHTs increase the attractiveness of residences and catch the attention of other people. This way, their superiority is visible to other individuals in that they could observe the benefits of using SHTs. Adopters could exercise greater control over various home activities thanks to SHTs, whereas the effort and time to complete routine home activities get shortened. Those superiorities are aggregated under the "value superiority" attribute of SHT innovation.

However, it is not only the value gains that play a role in SHTs adoption. The perception of "consumer protection" determined by perceived security, privacy, and price value of SHTs also appeared as a unique factor that plays a prominent role in smart home adoption. Along with the privacy of shared/created personal data stemming from the usage of SHTs, securing data for inappropriate access was summarized under the "consumer protection" factor with the proper value creation out of money spent on SHTs from a trustworthy brand. Consumers increased awareness of data privacy and information security areas led them to put increased importance on cybersecurity during their technology adoption process. Consumers turn to trusted brands in the SHT sector to mitigate these risks. Meanwhile, consumers generally want a reasonable price during smart home adoption evaluations.

Meanwhile, the third factor, "design and reputation", accommodates various design attributes such as style, user-friendliness, and ergonomics. Additionally, consumers' perception of how well-known the provider's brand also acts as an essential dynamic in the adoption decisions of some individuals. As for many personal technology products, the "enjoyment" that arises from adopting and using SHTs appears as another dominant factor of smart home adoption.

Another important aspect is the “complexity” of smart homes, where consumers may need more mental effort to set up, control, and maintain SHTs by themselves. Consumers avoid adopting technologies when they perceive their adoption will complicate their daily routines and become a cumbersome widget that is not easy to control. The final factor constituted from lifestyle and regular home activity fit of SHTs, is named as the importance given to “compatibility”. While consumers indicate their willingness to pay for the latest and advanced versions of SHTs, they want them to be compatible with the general sense of their homes.

Appendix D demonstrates 37 innovation characteristics’ items, which are grouped into six factors. An overview of the mean values for each factor indicates interesting findings. While value superiority ($\overline{x}_{VS}$: 5.19) and “design and reputation” ($\overline{x}_{DR}$: 5.44) were found as relatively higher rated innovation characteristics, enjoyment ($\overline{x}_{EJ}$: 4.63), consumer protection ($\overline{x}_{CP}$: 4.45), and compatibility ($\overline{x}_{CT}$: 4.42) followed them with slightly lower mean values, still on the positive side of the seven-point scale. On the contrary, complexity ($\overline{x}_{CM}$: 3.76) had the lowest mean value, slightly below the average level.

These moderate values suggest the importance of identifying groups or clusters of users who assign varying levels of importance to these innovation characteristics. This supports the need and value of the upcoming cluster analysis, which aims to achieve this objective.

6.3.2 Technology readiness index 2.0

The original TRI 2.0 has 16 items under four constructs. Four items were measured for each construct. However, during initial reliability checks with Cronbach’s Alpha, three items (INS1, INS4, INN4) were eliminated from insecurity and innovativeness constructs. So, EFA started with 13 items. During the analysis, one more item (INS2) was also omitted from the analysis because of its low communality below < 0.5 (0.293).

Principal component analysis with varimax rotation of the factor loadings was used to conduct a factor analysis on 12 statements from TRI 2.0. A scree plot of eigenvalues for different numbers of components indicated a two-factor solution. The resulting solution explained 57.6% of the variance across 12 items, which was satisfactory in terms of the total variance explained. As information is often less precise in the social sciences, it is not uncommon to accept a solution with around 60 percent of the total variance as satisfactory (Hair et al., 2010). The factor structure was distinct. The items were loaded cleanly on their respective dimensions (all cross-loadings are .30 or less), and all loadings are strong (.70 or higher). Furthermore, all dimensions met the minimum reliability threshold: technology motivators at 0.87 and technology inhibitors at 0.82.

The adequacy of sampling was evaluated using the KMO statistic, which yielded a value of 0.878, higher than the lowest acceptable level of 0.50. Individual measures of sampling adequacy values were checked by examining the main diagonal of the anti-image correlation matrix and were found to exceed the cutoff point of 0.50 (Janssens et al., 2008). Additionally, the null hypothesis of uncorrelated variables was rejected in Bartlett's test, indicating that the execution of factor analysis was meaningful.

According to the results of EFA on TRI 2.0, new two-factor constructs were built, such as:

Technology Motivators: The factor represents a blend of affirmative attitudes that affect consumer behavior toward technology and contributes to their technology readiness. Technology optimism corresponds to an enhanced quality of life through greater freedom, control, and mobility, while technology innovativeness is characterized by a tendency to be a technology pioneer and thought leader.

Technology Inhibitors: This factor was built upon negative beliefs about new technology adoption, which detract from the technology readiness of consumers. Lack of confidence in using technology, higher dependence on technology support, and diminished quality of personal relationships represented consumers' concerns about technology adoption and usage. Those beliefs were categorized under the technology inhibitors factor.

The factor names were in line with the theme categorization in the original work of Parasuraman and Colby (2015). Those factors correlated with consumers' receptiveness to new technologies are presented in Table 13.

Table 13. TRI 2.0 Factors

Factor Name	Variance Explained (%)	Eigenvalue	Item	Item Explanation	Item Loading
F1. Technology Motivators CR: 0.869 $\bar{x}_{TM}$: 5.14	34.75	4.17	OPT1	New technologies contribute to a better quality of life.	0.784
			OPT2	Technology gives me more freedom of mobility.	0.769
			OPT4	Technology makes me more productive in my personal life.	0.766
			OPT3	Technology gives people more control over their daily lives.	0.755
			INN1	Other people come to me for advice on new technologies.	0.749
			INN2	In general, I am among the first in my circle of friends to acquire new technology when it appears.	0.713
			INN3	I can usually figure out new high-tech products and services without help from others.	0.705
F2. Technology Inhibitors CR: 0.817 $\bar{x}_{TI}$: 4.17	22.80	2.74	DIS2	Technical support lines are not helpful because they do not explain things in terms I understand.	0.798
			DIS1	When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.	0.793
			INS3	Technology lowers the quality of relationships by reducing personal interaction.	0.752
			DIS4	There is no such thing as a manual for a high-tech product or service that is written in plain language.	0.737
			DIS3	Sometimes, I think that technology systems are not designed for use by ordinary people.	0.701
	57.6				

6.4 Cluster analysis on TRI 2.0

After conducting EFA to uncover technology-related traits of consumers, a K-means clustering analysis was applied. According to Kocak et al. (2020), hierarchical clustering was deemed unfavorable due to its inability to yield consistent outcomes for sample sizes exceeding 200. After conducting a clustering analysis ranging from two to five groups, the three-group solution was identified as the most effective at differentiating based on the two technology-related traits. Following ten iterations, the three-cluster solution was deemed the most fitting and significant solution based on the number of observations in each cluster and the notable variance in the mean centers for each item.

The cluster analysis ended up with three segments, which are named Tech Savvies (n: 356), Tech Yin-Yangers (n: 322), and Tech Mediocres (n: 317). Table 14 presents pertinent results, showcasing the ultimate cluster centers that signify the average value of each technology-related characteristic. The first segment was named "Tech Savvies". In comparison to the remaining two segments, the "Tech Savvies" segment displays the utmost degrees of motivational perceptions towards technology. The second segment, termed as "Tech Yin-Yangers", possesses the highest level of inhibitory perception towards technology, while their motivational perception level towards technology is also noteworthy. On the other hand, the third segment, named "Tech Mediocres", holds an average perception of both technology adoption motivators and inhibitors.

Tech Savvies are considered early adopters of technological innovations with high motivators and low inhibitors toward new technology adoption.

Table 14. Segments of Consumers Based on Their Technology-Related Perceptions

	Final Cluster Centers (over 7)			
	Cluster 1: Tech Savvies	Cluster 2: Tech Yin-Yangers	Cluster 3: Tech Mediocres	F Value
	n: 356 (35.8%)	n: 322 (32.4%)	n: 317 (31.9%)	
Technology Motivators	5.88	5.44	4.01	522.65*
Technology Inhibitors	2.95	5.57	4.13	845.11*

Note: * significant at the $p < .001$-level

Tech Yin-Yangers have both motivators and inhibitors highly scored. It means they desire the benefits of adopting new technologies but are more practical about difficulties and challenges. They tend to hold strong positive and negative views about technology.

Tech Mediocres rated both motivators and inhibitors as moderate. It shows that they are indifferent to adopting new tech-based products and services. They tend to have a detached view of technology.

One-way ANOVA was used to confirm the differences among groups, and the results showed significant differences among the three technology-related consumer segments in terms of their perceptions of innovation characteristics.

The general demographic profile of respondents under these three segments is presented in Table 15. All segments differ from each other in gender perspective. The segment with the highest technology motivation score, the Tech Savvies, is the most male-dominant cluster with a distribution of 60% male and 40% female consumers. In contrast, Tech Yin-Yangers are mostly women, with a 48% to 52% male-female composition. Most of the respondents in the total study sample exactly intensified in two age groups: 25–35 (34%) and 35–45 (32%), and the same trend can be observed in three segments as well. Another significant demographic distinction was raised out of the education level distribution of the sample. Among the different segments, Tech Savvies exhibit the highest concentration of individuals with higher education. While 41% of the Tech Savvies consumers have a university or postgraduate degree, the percentages are 37% and 38% for the other two segments. Conversely, the Tech Mediocres segment has the highest number of consumers with either a high school degree or less (53%). Most of the sample is composed of C1-class members (59%), and this trend is consistent across all segments. Tech Mediocres had a relatively higher proportion of C1-class members (63%), whereas Tech Savvies had a slightly lower proportion of C1-class members (57%). Conversely, SES B-class members are higher in Tech Savvies (27%) and lower in Tech-Mediocres (20%) segments in comparison to the total sample (24%). Finally, the analysis revealed that the Tech-Mediocres segment had a higher percentage of mid-high and high-income levels (13%) compared to the total sample means (10%), while Tech Savvies had the lowest percentage of high-income levels (2%).

Table 15. Demographic Profile of Segments

	Cluster 1: Tech Savvies n: 356 (35.8%)	Cluster 2: Tech Yin-Yangers n: 322 (32.4%)	Cluster 3: Tech Mediocres n: 317 (31.9%)	Total
Gender				
Female	142(40%)	168(52%)	143(45%)	453(45%)
Male	214(60%)	154(48%)	174(55%)	542(55%)
Age				
25-35	110(31%)	118(37%)	111(35%)	339(34%)
36-45	120(34%)	96(30%)	98(31%)	314(32%)
46-55	80(22%)	65(20%)	60(20%)	205(20%)
56-65	46(13%)	43(13%)	48(14%)	137(14%)
Education Level				
High School Degree or less	161(45%)	153(48%)	168(53%)	482(49%)
Foundational Degree	51(14%)	47(14%)	31(10%)	129(13%)
University Degree or more	144(41%)	122(38%)	118(37%)	384(38%)
SES				
A	57(16%)	55(17%)	53(17%)	165(17%)
B	96(27%)	79(24%)	64(20%)	239(24%)
C1	203(57%)	188(59%)	200(63%)	591(59%)
Monthly Household Income (TL)*				
7,500-9,999 (low)	188(53%)	174(54%)	161(51%)	523(53%)
10,000-19,999 (mid)	137(39%)	117(37%)	116(36%)	370(37%)
20,000-29,999 (mid-high)	22(6%)	17(5%)	21(7%)	60(6%)
> 30,000 (high)	9(2%)	14(4%)	19(6%)	42(4%)

* The USD to TL exchange rate was 7.5 in March 2020.

One of the objectives of this research was to examine the differences among the three segments in their perceptions of innovation characteristics. Therefore, the analysis continued with the analysis of innovation characteristics' perception differences with one-way ANOVA for identified three segments with post hoc tests. In Table 16, differences between three technology-related segments are reported. For complexity, compatibility, and "design and reputation" constructs, all segments significantly differ. Tech Mediocres rated all constructs except complexity lower than Tech Savvies, whereas they did not rate consumer protection significantly different from Tech Savvies. Tech Mediocres again did not rate enjoyment constructs significantly different from Tech Yin-Yangers.

Table 16. Differences in Innovation Characteristics' Perceptions Across Segments

	Cluster 1: Tech Savvies n: 356 (35.8%)	Cluster 2: Tech Yin-Yangers n: 322 (32.4%)	Cluster 3: Tech Mediocres n: 317 (31.9%)	F	Sig.	Tukey's Post Hoc Test*
Value Superiority	5.45	5.42	4.66	57.90	0.000	S-M; Y-M
Consumer Protection	4.42	4.71	4.21	12.27	0.000	S-Y; Y-M
Design and Reputation	5.98	5.28	5.01	64.48	0.000	S-Y; S-M; Y-M
Enjoyment	5.53	3.99	4.27	94.16	0.000	S-Y; S-M
Complexity	2.84	4.51	4.03	136.03	0.000	S-Y; S-M; Y-M
Compatibility	4.96	4.24	3.99	61.66	0.000	S-Y; S-M; Y-M

**Note:* For example, it should be read as "There is a significant difference between Cluster 1 (Tech Savvies - S) and Cluster 2 (Tech Yin-Yangers - Y)".

6.5 Multiple linear regression for innovation characteristics' impact on SHT adoption

Hypotheses 1 and 2 focus on the innovation characteristics that might explain consumers' attitudes toward and intention to adopt SHTs. Therefore, all innovation characteristics in the proposed research model were conceptualized as independent variables, and both the attitudes toward SHTs and intention to adopt as dependent variables. To test the Hypotheses 1 and 2 proposed in this dissertation, two different multiple linear regression analyses were conducted with the entire sample. Moreover, it aimed to consider the role of consumer segments, which were discovered regarding consumers' technology related perceptions in Hypotheses 3_a and 3_b. To test them, six other regression analyses were run. Before conducting regression analysis, the following nine assumptions were checked, which need to be satisfied for valid and reliable outcomes (Janssens et al., 2008):

i. A dependent variable is causally explained by one or more independent variables.

Based on an extensive literature review on innovation diffusion, technology adoption, and smart homes and the qualitative study results, the proposed factors lie at the basis of attitude toward and intention to adopt smart home technologies.

ii. In regression analysis, all relevant independent variables should be considered.

Although the results of previous research demonstrate that the proposed research model includes all relevant independent variables for smart home adoption, ZPRED and ZRESID graphs were also inspected for the presence of any possible pattern. As there were no patterns to conclude on ZPRED and ZRESID graphs, it was assumed that all relevant independent variables were included in analyses.

iii. For regression analysis, both the dependent and independent variables should be measured at least with an interval scale.

All independent and dependent variables were measured with a seven-point Likert scale, treated as an interval scale.

iv. There should be a linear relationship between the dependent and independent variables.

After examining the ZPRED and ZRESID plot, it was observed that a linear relationship would be appropriate as the plot did not show any patterns (such as a parabola) that suggest a non-linear relationship.

v. There should be an additive relationship.

vi. The residuals should meet the following criteria:

- Residuals should be independent of each other.

During the data collection field study, it was ensured that the respondents were not influenced by each other, and no questionnaire was filled in simultaneously. Therefore, each observation in the sample was independent of the others.

- They should be normally distributed with zero mean.

The error term distribution should be normal. Based on visual inspection of the histogram and normal quantile-quantile (Q-Q) plots, it was found that the residual distribution closely approximated a normal probability curve, with data points lying close to the 45-degree line in the Q-Q plot. This visual analysis supports the assumption of normality. Additionally, normality tests were conducted on the calculated residuals. Kolmogorov-Smirnov and Shapiro-Wilk tests were applied. For each model, one of these tests produced insignificant results, indicating that the residuals did follow a normal distribution.

- They should be homoscedastic (i.e., have constant variance across all levels of the independent variables).

Homoscedasticity indicates a constant variance of the error terms, which means the variance of the dependent variable is the same for any independent variable observation.

The scatter plot of standardized residuals versus standardized predicted value was visually examined. No pattern existed in the graphs of eight analyses. Therefore, no heteroscedasticity was concluded.

vii. A sufficient number of observations is required to ensure the model's adequacy in estimating the relationships between variables.

The minimum ratio of observations to variables is five to one. As six variables were included in eight regression analyses, the minimum number of observations should be 30. The total sample size was 995, the Tech Savvies 356, the Tech Yin-Yangers 322, and the Tech Mediocres 317. So, the number of observations was sufficient to hold the sample size assumption of multiple linear regression analysis.

viii. Multicollinearity, which is indicated by high degrees of correlation between independent variables, must be avoided.

Multicollinearity among independent variables is an undesirable situation in multiple regression analysis. It means a high correlation exists among two or more explanatory variables. It can contribute redundant information to the multiple regression.

Condition Index (CI), Variance Inflation Factor (VIF), and tolerance values of eight regression models were examined to check this assumption. A CI of 30 or more indicates the presence of multicollinearity. A tolerance of a value of .10 is recommended as the minimum level of tolerance (Tabachnick & Fidell, 2001). For VIF, the result should be more than 10 for the conclusion of multicollinearity (Hair et al., 2010). These three statistics were in strict ranges for all models, as demonstrated in Table 17. None of them exceeded the cut-off values.

Table 17. Collinearity Statistics for All Models

	Total Sample n: 995	Cluster 1: Tech Savvies n: 356 (35.8%)	Cluster 2: Tech Yin-Yangers n: 322 (32.4%)	Cluster 3: Tech Mediocres n: 317 (31.9%)
Collinearity Checks				
Max. CI	20.978	26.264	21.784	19.729
Max. VIF	1.810	2.366	1.998	1.701
Min. Tolerance	0.552	0.423	0.501	0.588

The mean factor scores from exploratory factor analysis in the previous section were used. So, these scores were uncorrelated.

ix. Although the existence of outliers may not necessarily violate the assumptions, it is still important to take them into consideration.

As all linear regression assumptions were satisfied for eight analyses, the analyses continued with SPSS Version 27 using enter method. The results of these eight regression analyses are summarized in Table 18.

All six regressions resulted in moderate overall R values, ranging between 0.628 and 0.694, with the exception of two regressions of the Tech Yin-Yangers segment. The R^2 value in linear regression is a measure of how well the predictor variables collectively explain the variance in the dependent variable, representing the proportion of the total variance in the dependent variable that is accounted for by the predictor variables. The R^2 values for the entire sample, the Tech Savvies segment, and the Tech Mediocres segment were at moderate levels, respectively 39.4%, 48.0%, and 44.3% of the variance in attitude toward SHTs, and respectively 39.6%, 48.1%, and 45.6% of the variance in intention to adopt SHTs were explained with independent variables.

Table 18. Determinants of Attitude Toward and Intention to Adopt SHTs Across Three Segments

	Total Sample n: 995		Cluster 1: Tech Savvies n: 356 (35.8%)		Cluster 2: Tech Yin-Yangers n: 322 (32.4%)		Cluster 3: Tech Mediocres n: 317 (31.9%)	
Dependent Variables	Attitude Toward SHTs	Intention to Adopt SHTs	Attitude Toward SHTs	Intention to Adopt SHTs	Attitude Toward SHTs	Intention to Adopt SHTs	Attitude Toward SHTs	Intention to Adopt SHTs
Independent Variables								
Value Superiority (β)	0.43***	0.46***	0.37***	0.44***	0.25***	0.24***	0.47***	0.46***
Consumer Protection (β)	0.13***	0.22***	0.09*	0.13***		0.18**	0.30***	0.38***
Design and Reputation (β)	0.10**		0.14**				0.12*	
Enjoyment (β)								
Complexity (β)	-0.20***	-0.09***	-0.13***		-0.18**		-0.23***	-0.10*
Compatibility (β)	0.07*	0.16***		0.21***		0.14**		
R	0.628	0.629	0.692	0.694	0.293	0.332	0.666	0.676
R-Squared	0.394	0.396	0.480	0.481	0.086	0.104	0.443	0.456

Notes: ***p < .001; **p < .01; *p < .05.

All F-tests are significant at the p < .001-level.

The beta coefficients were considered in order to assess the distinct impacts of the predictor variables. Table 18 only presents these coefficients for the predictor variables that were found to have significant effects on the dependent variables for each of the segments. As the Tech Yin-Yangers segment did not provide enough levels of R^2 to be interpreted, this segment was left aside for further interpretations.

When scrutinizing the influence of independent variables on the attitude toward SHTs of the entire sample (Hypothesis 1), it was discovered that value superiority has the most considerable impact, followed by complexity, consumer protection, “design and reputation”, and compatibility. All four factors influenced attitude toward SHTs for two segments except compatibility (Hypothesis 3_a). When the Tech Mediocres segment was considered solely, it was discovered that the effect of all four factors, especially consumer protection, increased. Additionally, it was observed that, for consumers belonging to the Tech Savvies segment, the impact of value superiority, consumer protection, and complexity declined, while the effect of “design and reputation” rose.

Furthermore, when assessing the influence of independent variables on the intention to adopt SHTs of the entire sample (Hypothesis 2), it was found that value superiority has the most significant effect, followed by consumer protection, compatibility, and complexity. It was found that compatibility is a predictor of the intention to adopt SHTs only for the Tech Savvies segment, while complexity is the predictor of the intention to adopt SHTs merely for the Tech Mediocres segment (Hypothesis 3_b). Both factors were also found to be effective for the entire sample. Besides, value superiority and consumer protection were two factors that contributed to estimation of intention to adopt among all segments. Finally, the impact of consumer protection in the Tech Mediocres segment was the highest compared to the Tech Savvies segment and the entire sample.

6.6 Difference analyses on lifestyle attributes

The differences among various lifestyle attribute-based segments were investigated regarding to their attitude toward and intention to adopt SHTs with independent samples *t*-tests or Mann-Whitney U tests.

6.6.1 Health orientation

After applying K-means clustering analysis on four items of health orientation construct with two groups demonstrated in Table 19, two distinct segments were revealed.

Table 19. Cluster Analysis Findings for Health Orientation

	Final Cluster Centers (over 7)		
	Cluster 1: Health-Attentive n: 538 (54.1%)	Cluster 2: Health-Lax n: 457 (45.9%)	F Value
I'm very self-conscious about my health.	5.88	3.90	554.81*
I'm constantly examining my health.	5.33	3.29	525.67*
I devote time and effort to my physical health. (e.g., Sleep, nutrition, exercise)	5.72	4.26	298.92*
I try to avoid engaging in behaviors that undermine my physical health.	5.83	3.40	917.63*

Note: * significant at the p < .001-level

As displayed in Table 20, the null hypothesis of equal variances may not be rejected (0.989 > 0.05) for two independent samples *t*-tests. Therefore, the *t*-test outputs for "Equal variances assumed" were checked. It showed that attitude toward SHTs scores for the health-attentive segment ($\bar{x}$: 5.73) and the health-lax segment ($\bar{x}$: 5.42) differ significantly (Hypothesis 4_a).

Table 20. Independent Samples *t*-Test for Segments Based on Health Orientation

	Levene Statistics						
	F	Sig.	*t*	df	Sig.	Mean for Health-Attentive Segment	Mean for Health-Lax Segment
Attitude Toward SHTs	0.000	0.989	-4.19	993	0.000	5.73	5.42
Intention to Adopt SHTs	2.827	0.093	-3.05	993	0.002	5.57	5.34

The test of Hypothesis 4_b revealed that there was a significant difference in mean intention to adopt SHTs between health-attentive and health-lax segments ($t_{993} = -3.05$, $p = .002$). The average intention to adopt SHTs score for the health-attentive segment ($\bar{x}$: 5.57) is relatively higher than the intention to adopt SHTs score for the health-lax segment ($\bar{x}$: 5.34).

6.6.2 Environmental responsibility

The application of K-means clustering analysis on four items of environmental responsibility construct with two groups, which is presented in Table 21, revealed two distinct consumer segments.

Table 21. Cluster Analysis Findings for Environmental Responsibility

	Final Cluster Centers (over 7)		
	Cluster 1: Environment-Conscious n: 570 (57.3%)	Cluster 2: Environment-Indifferent n: 425 (42.7%)	F Value
I generally prefer energy-efficient products.	6.08	3.40	1181.40*
I risk paying more for eco-friendly products (one-time or subscriptions).	5.51	3.67	454.42*
My involvement in environmental activities today will help save the environment for future generations.	5.94	3.60	848.78*
I would describe myself as environmentally responsible.	5.81	3.43	909.93*

Note: * significant at the $p < .001$-level

Table 22 demonstrates that the null hypothesis of equal variances may not be rejected (0.379 > 0.05) for two independent samples *t*-tests. Therefore, the *t*-test outputs for "Equal variances assumed" were checked. It showed that attitude toward SHTs scores for the environment-conscious segment ($\bar{x}$: 5.70) and the environment-indifferent segment ($\bar{x}$: 5.44) differ significantly (Hypothesis 5_a). However, the *t*-test showed no significant difference in intention to adopt SHTs between environment-conscious and environment-indifferent segments (Hypothesis 5_b).

Table 22. Independent Samples *t*-Test for Segments Based on Environmental Responsibility

	Levene Statistics						
	F	Sig.	*t*	df	Sig.	Mean for Environment-Conscious Segment	Mean for Environment-Indifferent Segment
Attitude Toward SHTs	0.776	0.379	-3.48	993	0.001	5.70	5.44
Intention to Adopt SHTs	1.11	0.292	-0.59	993	0.553	5.49	5.44

6.6.3 Home-as-extended-self

The application of K-means clustering analysis on three items of the home-as-extended-self construct with two groups presented in Table 23, revealed two distinct segments.

Table 23. Cluster Analysis Findings for Home-as-extended-self

	Final Cluster Centers (over 7)		
	Cluster 1: Home-Engaged n: 547 (55%)	Cluster 2: Home-Detached n: 448 (45%)	F Value
My home helps me achieve the identity I want to have.	5.85	3.43	1116.31*
I derive some of my identity from my home.	5.75	3.64	833.94*
My home is part of who I am.	6.05	4.55	344.06*

Note: * significant at the p < .001-level

As given in Table 24, the null hypothesis of equal variances may be rejected for attitude toward (0.004 < 0.05) and intention to adopt (0.002 < 0.05) SHTs. As the variances were not equal and parametric *t*-test could not be utilized instead nonparametric Mann-Whitney U test was executed.

Table 24. Independent Samples *t*-Test for Segments Based on Home-as-extended-self

	Levene Statistics						
	F	Sig.	*t*	df	Sig.	Mean for Home-Engaged Segment	Mean for Home-Detached Segment
Attitude Toward SHTs	8.443	0.004	-6.11	933.247	0.000	5.79	5.35
Intention to Adopt SHTs	9.922	0.002	-4.03	921.811	0.000	5.61	5.29

Table 25 showed a significant difference in attitude toward SHTs between home-engaged ($\bar{x}$: 5.79) and home-detached ($\bar{x}$: 5.35) segments (Hypothesis 6_a), as well as a significant difference in mean intention to adopt SHTs between home-engaged ($\bar{x}$: 5.61) and home-detached ($\bar{x}$: 5.29) consumers (Hypothesis 6_b).

Table 25. Mann-Whitney U Test for Segments Based on Home-as-extended-self

	Test Statistics			
	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Attitude Toward SHTs	93971	194547	-6.344	0.000
Intention to Adopt SHTs	104680	205256	-3.968	0.000

6.7 Difference analyses on demographics, socioeconomics, prior experience, and housing structure

In this section, the differences between demographics, socioeconomics, prior experience, and housing structure were investigated regarding attitude toward and intention to adopt

SHTs with independent samples *t*-tests, one-way ANOVA, Mann-Whitney U tests, or Kruskal-Wallis tests.

6.7.1 Gender

Table 26 revealed that the result of Levene's test for equality of variances was larger than 0.05, which indicated that the variances were equal for intention to adopt SHTs between genders, therefore the result of independent samples *t*-test could be interpreted. It showed no significant difference in intention to adopt SHTs between males and females (Hypothesis 7_b), as depicted in Table 26.

Table 26. Result of Independent Samples *t*-Test for Gender

	Levene Statistics						
	F	Sig.	*t*	df	Sig.	Mean for Males	Mean for Females
Attitude Toward SHTs	5.418	0.020	0.306	924.801	0.760	5.58	5.60
Intention to Adopt SHTs	1.435	0.231	-0.269	993	0.788	5.48	5.45

However, the null hypothesis of equal variances may be rejected (0.02 < 0.05) for attitude toward SHTs, therefore Mann-Whitney U test was executed. The result in Table 27 presented that there was no significant difference between males and females for attitude toward SHTs (Hypothesis 7_a).

Table 27. Result of Mann-Whitney U Test for Gender

	Test Statistics			
	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Attitude Toward SHTs	118517	265670	-0.942	0.346

6.7.2 Age

Following one-way ANOVA analysis among four age groups (25-35, 36-45, 46-55, and 56-65) and attitude toward SHTs (Hypothesis 8_a) and intention to adopt SHTs (Hypothesis 8_b), there was not a statistically significant difference among groups as demonstrated by one-way ANOVA ($F(3,991) = 0.612$, $p = .607$) for attitude toward SHTs (see Table 28), and for intention to adopt SHTs ($F(3,991) = 0.515$, $p = .672$) (see Table 29). The results of Levene's test for equality of variances were larger than 0.05, allowing for the interpretation of the ANOVA results.

Table 28. Result of ANOVA Among Age Groups for Attitude Toward SHTs

Age Groups	N	Mean	Levene's Test for Equality of Variances		ANOVA	
			Levene's Statistic	Sig.	F	Sig.
25-35	339	5.54	0.328	0.805	0.612	0.607
36-45	314	5.66				
46-55	205	5.56				
56-65	137	5.61				

Table 29. Result of ANOVA Among Age Groups for Intention to Adopt SHTs

Age Groups	N	Mean	Levene's Test for Equality of Variances		ANOVA	
			Levene's Statistic	Sig.	F	Sig.
25-35	339	5.52	0.802	0.493	0.515	0.672
36-45	314	5.47				
46-55	205	5.43				
56-65	137	5.38				

6.7.3 Marital status

The results of Levene's test for equality of variances, which were larger than 0.05, allowed to interpret the independent samples *t*-test results. There was no significant difference in attitude toward SHTs (Hypothesis 9_a) and intention to adopt SHTs (Hypothesis 9_b) between single and married respondents, as illustrated in Table 30.

Table 30. Result of Independent Samples *t*-Test for Marital Status

	Levene Statistics						
	F	Sig.	*t*	df	Sig.	Mean for Singles	Mean for Married
Attitude Toward SHTs	0.646	0.422	-1.441	993	0.150	5.48	5.62
Intention to Adopt SHTs	1.297	0.255	-1.129	993	0.259	5.38	5.49

6.7.4 Parenthood status

The results of Levene's test for equality of variances were larger than 0.05, allowing for the interpretation of the ANOVA results. Table 31 displayed no significant difference in attitude toward SHTs (Hypothesis 10_a) and intention to adopt SHTs (Hypothesis 10_b) between parents and non-parents.

Table 31. Result of Independent Samples *t*-Test for Parents/Non-Parents

	Levene Statistics						
	F	Sig.	*t*	df	Sig.	Mean for Parents	Mean for Non-Parents
Attitude Toward SHTs	0.828	0.363	1.211	993	0.226	5.62	5.52
Intention to Adopt SHTs	0.455	0.500	1.174	993	0.241	5.49	5.39

6.7.5 Education level

Following one-way ANOVA analysis among four education levels (High School Degree or Less, Foundational Degree, University Degree, and Post Graduate Degree) and attitude toward SHTs (Hypothesis 11_a) and intention to adopt SHTs (Hypothesis 11_b), there was not a statistically significant difference among groups as demonstrated by one-way ANOVA (F (3,991) = 0.062, p = .980) for attitude toward SHTs (see Table 32), and for intention to adopt SHTs (F (3,991) = 0.206, p = .892) (see Table 33). The results of Levene's test for equality of variances were larger than 0.05, allowing for the interpretation of the ANOVA results.

Table 32. Result of ANOVA Among Education Levels for Attitude Toward SHTs

Education Levels	N	Mean	Levene's Test for Equality of Variances		ANOVA	
			Levene's Statistic	Sig.	F	Sig.
High School Degree or Less	482	5.58	1.174	0.318	0.062	0.980
Foundational Degree	129	5.62				
University Degree	314	5.60				
Post Graduate Degree	70	5.60				

Table 33. Result of ANOVA Among Education Levels for Intention to Adopt SHTs

Education Levels	N	Mean	Levene's Test for Equality of Variances		ANOVA	
			Levene's Statistic	Sig.	F	Sig.
High School Degree or Less	482	5.45	0.123	0.947	0.206	0.892
Foundational Degree	129	5.44				
University Degree	314	5.51				
Post Graduate Degree	70	5.43				

6.7.6 Monthly household income level

Following one-way ANOVA analysis among four monthly household income levels (7,500 TL - 9,999 TL, 10,000 TL - 19,999 TL, 20,000 TL - 29,999 TL and over 30,000 TL) and intention to adopt SHTs (Hypothesis 12_b), there was not a statistically significant difference among groups as demonstrated by one-way ANOVA (F (3,991) =

2.529, p = .056) for intention to adopt SHTs as shown in Table 34. The Levene's test yielded a result of 0.123 for equality of variances, indicating a value larger than 0.05. This result enabled the interpretation of the ANOVA results.

Table 34. Result of ANOVA Among Income Levels for Intention to Adopt SHTs

Income Levels*	N	Mean	Levene's Test for Equality of Variances		ANOVA	
			Levene's Statistic	Sig.	F	Sig.
7,500 TL - 9,999 TL	553	5.53	1.933	0.123	2.529	0.056
10,000 TL - 19,999 TL	370	5.45				
20,000 TL - 29,999 TL	60	5.34				
over 30,000 TL	42	5.02				

* The USD to TL exchange rate was 7.5 in March 2020.

However, as presented in Table 35 the null hypothesis of equal variances may be rejected (0.002 < 0.05) for attitude toward SHTs. Due to the unequal variances, a parametric ANOVA test could not be employed. Instead, a nonparametric Kruskal-Wallis test was conducted.

Table 35. Result of ANOVA Among Income Levels for Attitude Toward SHTs

Income Levels*	N	Mean	Levene's Test for Equality of Variances		ANOVA	
			Levene's Statistic	Sig.	F	Sig.
7,500 TL - 9,999 TL	553	5.61	4.847	0.002	2.751	0.042
10,000 TL - 19,999 TL	370	5.64				
20,000 TL - 29,999 TL	60	5.41				
over 30,000 TL	42	5.15				

* The USD to TL exchange rate was 7.5 in March 2020.

The result of Kruskal-Wallis test in Table 36 displayed that there was no significant difference among different income levels regarding to their attitudes toward SHTs (Hypothesis 12_a).

Table 36. Result of Kruskal-Wallis Test Among Income Levels for Attitude Toward SHTs

	Test Statistics		
	Kruskal-Wallis H	df	Asymp. Sig.
Attitude Toward SHTs	7.723	3	0.052

6.7.7 SES

Following one-way ANOVA analysis among three SES groups (A, B, and C1) and attitude toward SHTs (Hypothesis 13_a) and intention to adopt SHTs (Hypothesis 13_b), there was not a statistically significant difference among groups as demonstrated by one-way ANOVA (F (2,992) = 1.609, p = .201) for attitude toward SHTs (see Table 37), and for intention to adopt SHTs (F (2,992) = 0.686, p = .504) (see Table 38). The results of Levene's test for equality of variances were larger than 0.05, allowing for the interpretation of the ANOVA results.

Table 37. Result of ANOVA Among SES Groups for Attitude Toward SHTs

SES Groups	N	Mean	Levene's Test for Equality of Variances		ANOVA	
			Levene's Statistic	Sig.	F	Sig.
A	165	5.49	1.571	0.208	1.609	0.201
B	239	5.69				
C1	591	5.58				

Table 38. Result of ANOVA Among SES Groups for Intention to Adopt SHTs

SES Groups	N	Mean	Levene's Test for Equality of Variances		ANOVA	
			Levene's Statistic	Sig.	F	Sig.
A	165	5.44	2.742	0.065	0.686	0.504
B	239	5.55				
C1	591	5.44				

6.7.8 Prior experience with SHTs

As depicted in Table 39, the null hypothesis of equal variances may not be rejected (0.428 > 0.05) for attitude toward SHTs. Therefore, the *t*-test result was interpreted. There was a significant difference in mean attitude toward SHTs between experienced and inexperienced consumers ($t_{993} = 4.629$, $p < .001$) (Hypothesis 14_a). It showed that attitude toward SHTs scores for experienced users ($\bar{x}$: 5.75) was relatively higher than the attitude toward SHTs score for inexperienced consumers ($\bar{x}$: 5.41).

Table 39. Result of Independent Samples *t*-Test for Experienced/Inexperienced Users

	Levene Statistics						
	F	Sig.	*t*	df	Sig.	Mean for Experienced Users	Mean for Inexperienced Users
Attitude Toward SHTs	0.629	0.428	4.629	993	0.000	5.75	5.41
Intention to Adopt SHTs	10.965	0.001	5.826	952.630	0.000	5.68	5.23

However, the null hypothesis of equal variances may be rejected (0.001 < 0.05) for intention to adopt SHTs, therefore Mann-Whitney U test was executed. The results in Table 40 displayed that there was a significant difference between experienced ($\bar{x}$: 5.68). and inexperienced consumers ($\bar{x}$: 5.23) (Hypothesis 14_b).

Table 40. Result of Mann-Whitney U Test for Experienced/Inexperienced Users

	Test Statistics			
	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Intention to Adopt SHTs	97426.500	210476.500	-5.774	0.000

6.7.9 Location of residence

Following one-way ANOVA analysis among three different residence locations of respondents (İstanbul, Ankara, and İzmir) and their attitudes toward SHTs (Hypothesis 15_a) and intention to adopt SHTs (Hypothesis 15_b), there was not a statistically significant difference among groups as demonstrated by one-way ANOVA ($F(2,992) = 0.210$, $p = .811$) for attitude toward SHTs (see Table 41), and for intention to adopt SHTs ($F(2,992) = 0.034$, $p = .967$) (see Table 42). The results of Levene's test for equality of variances were larger than 0.05, allowing for the interpretation of the ANOVA results.

Table 41. Result of ANOVA Among Cities for Attitude Toward SHTs

Cities	N	Mean	Levene's Test for Equality of Variances		ANOVA	
			Levene's Statistic	Sig.	F	Sig.
İstanbul	604	5.57	0.521	0.594	0.210	0.811
Ankara	228	5.61				
İzmir	163	5.64				

Table 42. Result of ANOVA Among Cities for Intention to Adopt SHTs

Cities	N	Mean	Levene's Test for Equality of Variances		ANOVA	
			Levene's Statistic	Sig.	F	Sig.
İstanbul	604	5.47	0.183	0.833	0.034	0.967
Ankara	228	5.47				
İzmir	163	5.44				

6.7.10 Residence ownership

As exhibited in Table 43, the null hypothesis of equal variances may not be rejected for attitude toward SHTs (0.018 < 0.05) and for intention to adopt SHTs (0.000 < 0.05). Hence, Mann-Whitney U tests were executed.

Table 43. Result of Independent Samples *t*-Test for Resident Owners/Renters

	Levene Statistics						
	F	Sig.	*t*	df	Sig.	Mean for Resident Owners	Mean for Resident Renters
Attitude Toward SHTs	5.628	0.018	2.052	785.312	0.040	5.65	5.50
Intention to Adopt SHTs	15.513	0.000	3.396	743.373	0.001	5.58	5.23

The results in Table 44 displayed that there was not a significant difference between resident owners ($\overline{x}$: 5.65) and resident renters ($\overline{x}$: 5.50) for attitude toward SHTs (Hypothesis 16_a). However, the difference is significant for intention to adopt SHTs Hypothesis 16_b). Resident renters ($\overline{x}$: 5.23) rated their intention to adopt SHTs significantly lower than the residence owners ($\overline{x}$: 5.58).

Table 44. Result of Mann-Whitney U Test for Resident Owners/Renters

	Test Statistics			
	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Attitude Toward SHTs	110434	187070	-1.731	0.083
Intention to Adopt SHTs	104996.500	181632.500	-2.964	0.003

6.7.11 Likeliness to move next year

The results of Levene's test for equality of variances were larger than 0.05, allowing for the interpretation of the ANOVA results. There was no significant difference in attitude toward SHTs (Hypothesis 17_a) and intention to adopt SHTs (Hypothesis 17_b) between those most likely to move from their residence next year and those not, as presented in Table 45.

Table 45. Result of Independent Samples *t*-Test for Likeliness to Move Next Year

	Levene Statistics						
	F	Sig.	*t*	df	Sig.	Mean for Movers	Mean for Non-Movers
Attitude Toward SHTs	1.851	0.174	0.323	993	0.747	5.60	5.58
Intention to Adopt SHTs	0.211	0.646	0.643	993	0.520	5.49	5.44

CHAPTER 7

CONCLUSION

The primary purpose of this dissertation is to understand the determinants of smart home adoption with a consumer segmentation approach. With this aim, the innovation characteristics attributed to the smart home adoption in the previous literature and context-specific constructs from the qualitative part of this dissertation are factor-analyzed to reveal the dimensions of innovation attributes. Furthermore, segments of consumers regarding their technology-related traits are explored, and differences among the three emerging consumer segments concerning their perception of innovation attributes are deeply investigated. The smart home adoption determinants are unveiled by testing the proposed integrated research model, and the variation of the effect of those determinants on SHT adoption are also tested across three technology-related consumer segments. Moreover, the differences among various lifestyle attribute-based consumer segment and SHT adoption are analyzed to understand the roles of lifestyles on the research object. Those findings are discussed in the upcoming three subsections of this chapter.

7.1 Innovation characteristics

One of the important research aims was to understand the antecedents of SHT adoption by combining constructs from several theories/models to grasp the adoption of complex multifaceted technologies better.

Digging deeper into the significant determinants of attitude toward and intention to adopt SHTs, value superiority was revealed to be the most influential driver. This factor combines items from relative advantage, observability, and image constructs. It indicates that the adoption of SHTs strongly depends on the positive assessment of their concrete benefits (comfort, efficiency, and social gains). This finding is parallel with previous literature findings that the most crucial determinant of SHT adoption is visible benefits along with social gains (e.g., Shih, 2013; Baudier et al., 2018). Incorporating smart home technologies into consumers' daily home routines requires a habitual change (Günlü, 2007) and it is not easy to observe and learn from others, as home life and family relations are considered as the private sphere (Bakardjieva, 2023).

The finding on consumer protection confirmed the previous research, which highlighted the significant importance of protecting consumers' best interests in terms of privacy, security, and price value in smart home adoption (e.g., Shuhaiber & Mashal, 2019; Wei et al., 2019). Privacy policies, which explicitly describe information collection, storage, usage, and security precautions, are not an industry standard for smart homes. Consumers get more cautious about their privacy and surveillance of their private routines when it comes to adopt SHTs, which might diminish the introvert and intimate character of their private sphere (Ziefle et al., 2011). This raises the intent on the consumer side to value SHT providers that promise consumer protection. Additionally, SHT providers should focus on the actual value of their smart home offerings instead of justifying the permanent price premium of smart products for just being smart (Aunkofer, 2018). Consumers put importance on trusted brands in SHT adoption. Thus, consumer protection is one of the primary antecedents of their adoption.

A significant barrier to SHT adoption was found as complexity. Critical aspects of this factor are user-friendliness, remote accessibility, and customizability, which do not require complicated knowledge acquisition. In the case of smart home services, easy-to-understand contracts and being able to cancel a contract at any time could also be counted as an adoption accelerator. Therefore, it is concluded that simplicity and convenience of SHTs drives their adoption (e.g., Aunkofer, 2018; Baudier et al., 2018), however their complexity is a significant barrier to the diffusion of smart homes.

Likewise, compatibility holds importance as a determinant of consumers' attitudes toward and intention to adopt SHTs. SHTs need to fit consumers' regular home activities. In addition, the availability of collaboration technologies enables the integration of various smart home ecosystems. Hoffman and Novak (2016) criticized SHT providers for not promising a connected life to their consumers. Instead of focusing on a single use-case-based benefit, they could have proposed many connected ecosystem solutions that integrate different complimentary services.

Finally, "design and reputation" positively affects the attitude toward SHTs, whereas it does not impact the intention to adopt. Style, ergonomics, and multi-functionality of SHTs are essential drivers of their positive perception along with a well-known brand (e.g., Stinger et al., 2006; Sovacool & Del Rio, 2020).

The enjoyment dimension of smart home characteristics was not indicated as a significant determinant of their adoption, in contrast to the previous literature findings, which emphasized the direct effect of enjoyment on IoT usage (e.g., Gao & Bai, 2014; Shuhaiber & Mashal, 2019) and revealed consumers' expectation of getting fun out of interaction with smart household objects (Brown et al., 2015). The respondents did not value the entertainment capabilities of smart homes in their adoption evaluations. Consumers respect the functionalities that can give them prestige and enable them to accomplish household tasks efficiently and comfortably. Smart homes' functional and social benefits determine their adoption rather than their hedonic blessings.

Trialability, from DOI theory, was excluded from the analysis in the EFA stage. One reason behind this could be that there is a limited number of smart home experience centers in Turkey where consumers could evaluate SHTs properly by practicing them by themselves. Additionally, the observability of SHTs is also limited as homes are private sphere of consumers, that is accessible only to limited people to try/observe their benefits.

7.2 Technology-related consumer traits

Another vital set of findings is the apparent clustering of consumers into three distinct technology-based segments: Tech Savvies, Tech Yin-Yangers, and Tech Mediocres. This segmentation study was executed with two factors (technology motivators and technology inhibitors), which were revealed after the implementation of EFA on original four dimensions of TRI 2.0. Parasuraman and Colby (2015) initially explored five segments out of TRI 2.0 dimensions (i.e., skeptics, explorers, avoiders, pioneers, and hesitators). However, some studies did not develop the original five-segment structure and revealed either four segments (Borrero et al., 2014) or three segments (Kim et al., 2018). The segmentation structure of Kim et al. (2018) was based on TRI 2.0 scale in the context of wearables and included explorers, laggards, and pioneers. However, Borrero et al. (2014) found four segments, i.e., pioneers, explorers, skeptics, and laggards, but not paranoids, in a TRI-based segmentation study. This three-segment classification was different from the segments of previous studies (Borrero et al., 2014; Parasuraman & Colby, 2015; Kim et al., 2018; Ramírez-Correa, 2020) and revealed those segments, which are also similar to some original TRI 2.0 segments: (1) Tech Savvies ~ Explorers, (2) Tech Yin-Yangers ~ Pioneers, and (3) Tech Mediocres ~ Skeptics.

The objective was to identify the factors determining the attitude toward and intention to adopt SHTs and to map technology-based segments with adoption antecedents. The results revealed a variation of the impact of SHT determinants on SHT adoption among the entire sample and three consumer segments, leading to the following findings:

Tech Savvies are considered early adopters of technological innovation with the highest motivators and lowest inhibitors toward their adoption. Tech Savvies rated all innovation dimensions higher than the other segments except complexity and consumer protection. Value superiority and consumer protection are common predictors of attitude toward and intention to adopt SHTs. Their attitude is also affected by "design and reputation" and complexity. Furthermore, compatibility is a determinant of intention to adopt SHTs merely for the Tech Savvies segment. In other words, people with a more optimistic view of technology are more likely to explore advanced versions of SHTs and harmonize them with their conventional home activities. Besides, the effects of value superiority, consumer protection, and complexity decrease for the consumers in this segment. However, the effect of "design and reputation" increases when their attitude toward SHTs is under examination. They value tech products' style and believe using tech brands increases their image and prestige. The Tech Savvies segment is the middle-aged male-dominant segment, with the highest concentration in the more educated population (41% has a university degree or more) and in the SES B-class members (27%). They have the least frequency of high-income levels (2%).

Tech Mediocres are indifferent to tech-based products and services by rating both motivators and inhibitors as moderate. Tech Mediocres evaluated all constructs except complexity lower than Tech Savvies. Tech Mediocres again do not assess the enjoyment dimension significantly different from Tech Yin-Yangers, while they evaluate all other factors significantly lower than Tech Yin-Yangers. These facts imply that they have the lowest mean ratings for all smart home characteristics except enjoyment and complexity. This segment consists of the most suspicious consumers on potential benefits, design distinctions, and compatibility of SHTs. Moreover, they have less faith in the benevolence of SHT providers. Value superiority, consumer protection, and complexity are the common antecedents of their SHT adoption when both their attitude toward and intention to adopt smart homes are considered. However, their attitude is positively affected by "design and reputation" on top of these three dimensions. Complexity is the predictor of intention to adopt SHTs solely for the Tech Mediocres segment. The effect of all four determinants of attitude, especially consumer protection, increases for Tech Mediocres compared to the total sample. This fact shows that individuals with indifferent views toward new technologies will be more reluctant to adopt complex gadgetry SHTs. Therefore, they tend to positively assess the smart home providers, which promise to manage any technological complications (e.g., security and privacy issues) for their consumers. The impact of consumer protection is the highest for the Tech Mediocres segment compared to other segments. However, they put the most importance on value superiority within the determinants of their SHT adoption. Tech Mediocres segment has the least educated members (53% has a high school degree or less), mainly SES C1-class members (63%), and the highest concentration of mid-high and high-income levels (13%).

Tech Yin-Yangers have highly scored motivators and inhibitors, indicating their ambivalence toward technology innovations. They give the highest mean value to value superiority, followed by "design and reputation", consumer protection, complexity, and compatibility. The members of this segment provide the highest mean ratings for consumer protection and complexity dimensions and the lowest mean rating for enjoyment dimensions. This is a clue that the members of this segment tend to perceive smart homes as so complicated that it reduces their pleasure in using them. They believe that new technologies simultaneously have both valuable and harmful outcomes, so they tend to trust well-known smart home providers to ensure their security and privacy. Mostly young women build this segment, and other demographic and socioeconomic characteristics reflect the sample. The smart home adoption determinants of Tech Yin-Yangers are not interpreted because of low R^2 values obtained from their corresponding regression analysis.

7.3 Lifestyle attributes

The impact of personal differences on attitudes toward and intention to adopt smart homes was also considered in this dissertation. Therefore, three different lifestyles identified through the literature review were examined for their effects on smart home adoption.

Difference analyses proved that there is a significant difference in attitude toward and intention to adopt SHTs between home-engaged (5.79 – 5.61) and home-detached (5.35 – 5.29) segments and health-attentive (5.73 – 5.57) and health-lax (5.42 – 5.34) lifestyles. However, having high environmental responsibility did not necessarily lead to a significant difference in smart home adoption intent. There is only significant difference in attitude toward SHTs between environment-conscious (5.70) and environment-indifferent (5.44) segments.

The effect of environmentalism was limited and only observed for the positive attitudes toward smart homes. This finding contradicts the empirical findings for energy-efficient technology adoption reported in the literature (e.g., Franceschinis et al., 2017; Schill et al., 2019; Tu et al., 2021). The reason behind this could be the perception of the research sample on the benefits of smart homes. They did not recognize smart home technologies as eco-friendly, akin to some previous research (e.g., Sovacool et al., 2021) concluded that there is a knowledge gap regarding the potential benefits of smart home adoption and even a consumer perception that SHTs are nonessential luxuries consuming more energy. Pohl et al. (2021) empirically revealed that environmental savings by using SHTs could only be achieved by adopting smart heating solutions, and there is a minimum 2.4-year usage period until the energy savings exceed the environmental effects caused by producing and using smart homes. Another reason validated in the qualitative part of this dissertation with the expert interviews is the consumer's unwillingness to pay green premiums for sustainable service/product alternatives and not prioritizing any long-term economic and sustainability benefits over the immediate investment required for SHT adoption.

Moreover, it is the first academic work where the home-as-extended-self lifestyle was investigated within the smart home context, even if the role of IoT was foreseen in extended-self literature by Belk (2013). Previous studies discussed the extended self phenomenon for mobile phones (Clayton, 2015), virtual assistants (Mirbabaie et al., 2021), and even for digital memory archives (Cushing, 2013). The results of this dissertation showed a meaningful positive effect of home self-expression on smart home adoption, which provides new aspects to the smart home domain. Homes are the safe cocoons where people live, work, study, relax, self-care, and entertain. This intimate and close bond with one's home increased the motivation to embellish and enhance homes with smart home technologies.

Besides, as previously suggested by Baudier (2018), health is one of the determinants of smart home performance expectations and habits, which drive to higher intention to use SHTs. The connection between leading a healthier lifestyle and positive beliefs about smart home adoption was again empirically proven in this research.

7.4 Demographics, socioeconomics, prior experience, and housing structure

This dissertation investigated the differences among different demographics, socioeconomics, prior experience, and housing structures in terms of their attitudes toward and intention to adopt smart homes. The study findings demonstrated that SHT adoption intent is significantly higher for experienced users and homeowners, whereas demographics and socioeconomics do not play a role.

People with prior experience with smart homes are more positive about smart home adoption than those without experience in line with the literature (e.g., Yang et al., 2018; Hong et al., 2020; Sovacool et al., 2021; Chang & Nam, 2021). Smart home adopters tend to rate smart homes more positively, maybe due to experiencing their benefits and learning how to mitigate their potential risks.

Moreover, resident owners tend to have higher levels of intent on smart home adoption than renters, similar to the findings of Balta-Ozkan et al. (2014) and Tu et al. (2021). The reason behind this could be the perception of smart homes as viable only to homeowners because of the high investment need for their installation (Balta-Ozkan et al., 2014) or renters do not have the habit of investing in home improvements (Sanguinetti et al., 2018). Renters could be concerned about the transferability of smart home technologies to the next property from the technical compatibility and installation/configuration perspectives and also be hesitant to solve the complexity of storing and reinstalling old equipment upon moving (Sanguinetti et al., 2018).

The findings of this dissertation did not reveal any difference in smart home adoption perceptions among age groups, gender, marital status, income levels, or education levels. Hmielowski et al. (2019), Hong et al. (2020), and Sovacool et al. (2021) did not find any impact of age on the perception of smart home adoption risks as Chang and Nam (2021) did reveal its effect on the intention to use. Similarly, Hmielowski et al. (2019), Hong et al. (2020), and Sovacool et al. (2021) did not find any impact of income on the perception of smart home adoption risks; however, Chang and Nam (2021) and Wunderlich et al. (2019) proved it empirically as a driver of SHT adoption.

CHAPTER 8

IMPLICATIONS

This dissertation seeks to understand the attitude toward and intention to adopt smart home technologies. Therefore, innovation characteristics from DOI theory were taken as the theoretical base and were enhanced with other factors from previous technology adoption literature in the context of smart homes. On top of that, personal differences were incorporated into the proposed research model in the form of technology-related traits and different lifestyles. By doing it, the purpose was to distill the differences in individuals' perceptions of smart home characteristics.

The following research questions were directed to understand the adoption of smart homes: (1) Which innovation characteristics are significant determinants of consumers' attitudes toward and intention to adopt SHTs? (2) What are the distinct segments of consumers about their technology-related traits? (3) How do determinants of consumers' attitudes toward and intention to adopt SHTs change among consumer segments based on their technology-related traits? (4) Do consumers' attitudes toward and intentions to adopt SHTs differ depending on their lifestyle attributes, demographics, socioeconomics, prior experience, and housing structure?

This dissertation differentiates from previous smart home adoption studies, firstly by proposing a full-fledged set of SHT determinants blended from many theories and the findings of the qualitative study, secondly by incorporating different technology-based consumer segments into analysis and lastly by searching the role of different lifestyle attributes and individual characteristics on smart home innovation adoption.

A mixed-method methodology, i.e., a qualitative study followed by a quantitative one, was utilized to address the research questions. In the initial part of this dissertation, semi-structured in-depth expert interviews were utilized to validate and enhance the individual elements of the proposed research model. For the quantitative part, a questionnaire was created to gather data from a representative sample of individuals in Turkey who are potential adopters of smart home technologies. Through face-to-face interviews, 995 observations were collected for further analysis. The hypotheses of the research model were tested by applying multiple linear regression, ANOVA, Kruskal-Wallis, independent samples *t*-test, and Mann-Whitney U tests on this dataset.

The first important finding of this research was the distinct set of innovation characteristics extracted via EFA. Value superiority represents smart home adoption's concrete benefits (i.e., comfort, efficiency, and social gains). In contrast, consumer protection is defined as protecting consumers' best interests regarding privacy, security, and pricing. Complexity is a barrier to SHT adoption by being not easy to use and operate. Compatibility symbolizes life-routines-fit and upgradability, while enjoyment signifies the fun and pleasure felt out of smart home usage. Finally, "design and reputation" stands for perceived style, ergonomics, and multi-functionality provided by a well-known smart home brand. Delving into the significant determinants of attitude toward and intention to adopt SHTs, it was found that value superiority is the most influential driver, followed by consumer protection, complexity, compatibility, and "design and reputation". The power and existence of their effects were different for attitudes toward and intention to adopt smart homes. Enjoyment, however, was found to be not influential on SHT adoption.

Another vital set of findings is the apparent clustering of consumers into three distinct technology-based segments: Tech Savvies, Tech Yin-Yangers, and Tech Mediocres. While investigating the factors that determine the attitude toward and intention to adopt SHTs, it is aimed to map technology-based consumer segments with antecedents of adoption. Notably, there is a variability of the impact of SHT determinants in the results obtained for the entire sample and the three distinct consumer segments.

Tech Savvies are considered early adopters of technological innovations with the highest motivators and lowest inhibitors toward their adoption. Tech Savvies segment is more likely to explore advanced versions of SHTs and harmonize them with their conventional home activities. Besides, they value tech products' style and believe using tech brands increases their image and prestige. The perceived value of smart home adoption is still the primary decision point for this segment.

Tech Mediocres are indifferent to tech-based products and services by rating both motivators and inhibitors as moderate. This segment consists of the most suspicious consumers on potential benefits, design distinctions, and compatibility of SHTs. Moreover, they have less faith in the benevolence of SHT providers. They are more reluctant to adopt complex and gadgetry SHTs. Therefore, they value the smart home providers, which promise to manage technological complications (e.g., security and privacy issues) for their consumers. They need to be still assured about the potential utilitarian and social benefits of smart homes for an increased adoption rate within this segment.

Tech Yin-Yangers have highly scored motivators and inhibitors, indicating their ambivalence toward technology innovations. The members of this segment tend to perceive smart homes as so complicated that it reduces their pleasure in using them. They tend to trust smart home providers to ensure security and privacy. Therefore, they rated consumer protection as the highest among other segments.

Moreover, leading some specific lifestyles also influences the level of positive attitudes toward or the intention to adopt smart homes. Striving for a healthier life and high self-expression over homes are the most influential lifestyles, where environmental responsibility is limited to influencing attitude, not intention. Similarly, experienced users and homeowners tend to evaluate higher intent on smart home adoption.

The results of this dissertation suggest essential insights into factors determining different technology-related consumer segments' attitudes toward and intention to adopt smart homes. Consequently, many theoretical and practical implications are provided in the following subsections by finishing this chapter with future research directions.

8.1 Implications from a theoretical perspective

Existing literature on innovation diffusion and technology adoption has provided limited knowledge regarding consumers' beliefs about innovation characteristics and individual differences in the smart home domain. To address this gap, current research was conducted, which can serve as a foundation for future studies to better understand the determinants of smart home adoption for different consumer segments. The diverse set of smart home adoption determinants is the first theoretical contribution of this research. Following that, the unprecedented power of the TRI 2.0 dimensions was validated for technology-related consumer segmentation. Moreover, the effect of each smart home determinant on each technology-related consumer segment and the whole research sample was unearthed.

Coming back to SHT adoption determinants, this research forms one of the initial efforts toward comprehending SHT adoption antecedents by combining constructs from several theories/models and contextual elements arising from a qualitative study to understand better the adoption of complex technologies such as smart homes. From a theoretical perspective, the DOI-based integrated research model is partially validated for predicting the adoption of innovative technologies such as smart homes. The strongest positive determinant of smart home adoption was revealed to be value superiority, while complexity was identified as the most significant barrier. The strong positive relationship between consumer protection and smart home adoption is proven and it is valid for all technology-related consumer segments. The positive effect of compatibility and "design and reputation" on smart home adoption is also confirmed.

One of the theoretical contributions is investigating technology-related consumer segments based on TRI 2.0 dimensions and validating the segmentation power of TRI 2.0 dimensions. In this research, three distinct segments are extracted instead of the five segments of the original TRI 2.0 study. However, these segments are similar to some segments extracted in the initial TRI 2.0 study (i.e., Tech Savvies ~ Explorers, Tech Yin-Yangers ~ Pioneers, Tech Mediocres ~ Skeptics) when individuals' perceptions of each TRI 2.0 dimension are considered.

Theoretically, the results of this dissertation suggest that a premise underlying some dominant technology acceptance models may need to be re-examined. Most models and theories on technology acceptance/innovation diffusion investigated behavioral intentions without considering the consumer characteristics of the target population. However, the perception of innovation attributes may differ based on the individual characteristics of consumers. The technology-related segmentation is included in the analysis and revealed that the impact, even the existence of smart home determinants, changes when specific consumer segments are considered. It implies that perceptions of innovation characteristics are not equally effective in developing adoption intentions for everyone.

8.2 Implications from a managerial perspective

The findings of this research suggest essential understandings into the factors determining different technology-related consumer segments' attitudes toward and intention to adopt smart homes. From a managerial perspective, these findings provide practitioners with workable suggestions for presenting smart home technologies to the new markets. Understanding what makes consumers resistant to or supportive of smart homes enables them to develop effective marketing strategies, allowing a broader community to benefit from smart home technologies and enabling vendors to gain a competitive advantage in this growing market. Moreover, smart home providers can take ideas from the findings of this dissertation to improve their current products/services.

The following three key aspects are recommended to smart home practitioners based on our research findings:

Firstly, the characteristics of marketable smart home technologies help companies to understand which barriers on the consumer side need to be overcome for the successful expansion of the smart home market. Smart home vendors should aim to provide intuitively managed stylish smart homes with cutting-edge functionalities that fit the lifestyle of consumers. While smart home technologies provide enhanced control and efficiency to their users at a fair price, they need to be equipped with the highest standards for security features to protect their users' privacy. Providing maximum value and protecting consumers from security, privacy, and pricing perspectives are the most critical determinants of SHT adoption intent. Regarding value superiority, product designers should consider maximizing the benefits of smart homes in terms of control, efficiency, and comfort. Besides these utilitarian benefits, consumers also expect social benefits from adopting smart homes. Practitioners are encouraged to strive for marketing communication campaigns stressing the prestige and visibility of smart home adopters. As domestic routines are considered as the private sphere of the potential adopters, they are not immediately visible to others. Therefore, SHT providers are recommended to consider the communication strategies to show consumers how to incorporate SHTs into their daily home routines. As suggested in one of the expert interviews, practitioners might organize competitions to collect and share different smart home scenarios and utilize social media influencers, who share their private sphere experiences on public sphere of social media.

Regarding consumer protection, the indicators of trustworthiness, security, and privacy are relevant. Whereas the product designers are recommended to focus on the security and reliability assurance of smart home technologies, vendors are urged to put the proper information governance in place to guarantee adopters' privacy. Price needs to be perceived as fair by potential adopters in exchange for the delivered value by the smart homes.

Secondly, the results of this dissertation suggest that perceptions of innovation characteristics can play a different role in adoption for different individuals. Technology-related traits of consumers affect the importance they attach to different SHT attributes and even their existence. Even if value superiority and consumer protection are adoption determinants of all consumer segments, their importance differs.

Tech Mediocres value customer protection more than the others, whereas Tech Yin-Yangers put importance on value superiority less than other segments. Being upgradeable and fitting to the existing lifestyles are significant for Tech Savvies and Tech Yin-Yangers, but Tech Mediocres do not extract their adoption intention from this attribute (compatibility). However, they prefer to have less complexity in usage and setup. Therefore, using standardized approaches to reach out to consumers is not suitable. Instead, companies should concentrate on creating distinct methods to engage with their potential customers. Designing distinct marketing programs to reach different segments of consumers would help companies accelerate the diffusion speed of their smart home products/services in the corresponding markets by resonating with various audiences. For people generally skeptical about technology, communication campaigns are suggested to focus on tangible benefits such as monetary savings rather than technological novelties. Moreover, manufacturers of smart home devices could tailor their products to cater to the diverse perspectives of individuals with different characteristics and expand their range of offerings.

Thirdly, aligned with the second recommendation, individuals' smart home adoption intentions significantly differ based on different lifestyles, housing structures, and prior experience. High health motivation and expression of self over homes positively affect smart home adoption. Smart home providers should highlight these themes in their advertisements and customer communications. Besides, they could select home and health-focused themed channels such as magazines, TV programs, or social media to promote their offerings. Moreover, resident owners tend to have higher levels of intent on smart home adoption than renters. It provides an opportunity for smart home providers to bundle their offerings in the moment of house sales in corporations with building companies. As a choice, they could build unique campaigns for homeowners to accelerate their offerings' diffusion. Another suggestion to smart home producers is to design renter-friendly solutions which do not require extensive infrastructure change and could be installed gradually. Besides, people with prior experience in smart homes are more positive about smart home adoption than people without experience. This finding provides a niche segment to smart home providers for up-selling or cross-selling to their existing customer base.

8.3 Limitations

The significance of combining theories in studies on the adoption of innovative technologies is supported by this research. Nevertheless, there are some limitations that could be addressed in future studies.

To begin with, data was solely collected in Turkey, where the smart home diffusion is in an early stage. Therefore, this research sample may limit the findings outside the countries at similar smart home diffusion levels.

Following that, this research was a cross-sectional study. Although this research examined an integrated model that incorporated elements of theories presented in earlier academic literature and supported by other empirical studies, it is important to recognize that a cross-sectional research design offers less insight than a longitudinal research design. Moreover, the individual's perceptions of innovation characteristics can vary significantly over time based on the progress of the adoption rate (Rogers, 2003).

Furthermore, smart home technologies were investigated in this dissertation from a general perspective by not only focusing on a specific SHT category or an adoption object. This generalization may cause some particular SHT category determinants to be left off the radar of the findings or to change their importance level.

Despite these limitations, this dissertation opens significant possibilities for future research, which are explained in the next section.

8.4 Future research directions

Smart home technologies offer new avenues for future research to academics. Researchers are encouraged to dedicate more effort to this research area to reach a deepened understanding of their adoption determinants.

To start with, it would be worthwhile to expand this dissertation to different global regions and investigate smart home adoption in a cross-cultural context, which would allow broader generalizability of the findings. In such a way, this research model could be tested against its' predictive power of SHT adoption across all cultures and all diffusion levels. This validation is even more critical for the smart home context, as homes are under heavy cultural dominance.

Furthermore, future research could concentrate on gathering data at multiple time points to confirm the findings and conduct a more in-depth analysis of the temporal sequence of relationships among variables.

Looking at it from another perspective, future research is encouraged to compare various SHT categories, considering that each category may fulfill distinct user requirements, such as home comfort versus energy efficiency needs (e.g., Aunkofer, 2018; Baudier et al., 2018; Chang & Nam, 2021) or test this model on one specific smart home service (e.g., Nikou, 2019). It can be assumed that the SHT category would moderate the relationships in the research model.

Another research topic for future studies on smart home adoption could be to examine the intention to adopt SHTs by combining lifestyle clusters with clusters based on technology-related traits, as this approach may reveal insightful findings. As a final recommendation, analyzing the influence of personality traits, such as those assessed in the Big Five Inventory, on potential adopters' perceptions of SHT characteristics and their intention to adopt smart homes would be worthwhile.

APPENDIX A

ORIGIN OF QUESTIONNAIRE ITEMS

Factor and Origin	ItemCode	Items of Factors
Intention (Brown & Venkatesh, 2005)	INT1	I intend to use smart home technologies.
	INT2	I predict that I would use smart home technologies.
	INT3	I expect to use smart home technologies in the near future.
	INT4	I intend to allocate more of my budget to smart home technologies in the near future
	INT5	If I have the opportunity, I'd use different smart home technologies.
Attitude (Brown & Venkatesh, 2005)	ATT1	Using smart home technologies is a good idea.
	ATT2	Using smart home technologies is a wise idea.
	ATT3	I like the idea of using smart home technologies.
	ATT4	Using smart home technologies is pleasant.
	ATT5	The idea of using smart home technologies seems distant from me.
	ATT6	I do not interest in using smart home technologies.
	ATT7	Using smart home technologies is boring.
Relative Advantage (Sivathanu, 2018; Brown et al., 2015)	ADV1	Using smart home technologies has more advantages as compared to other standard household tools.
	ADV2	Using smart home technologies takes less time and effort for home related activities.
	ADV3	Smart home technologies offer greater value to manage my home effectively.
	ADV4	Using smart home technologies gives me greater control over different activities at home.
Complexity (Moore & Benbasat, 1991)	COM1	I believe that using smart home technologies is cumbersome.
	COM2	I believe that I cannot control smart home technologies to do what I want it to do.
	COM3	I think that smart home technologies complicate my daily life.
	COM4	Using smart home technologies requires a lot of mental effort.
Compatibility (Brown et al., 2015)	COMPA1	Using smart home technologies is compatible with many aspects of my home.
	COMPA2	I think that using smart home technologies fits well with the way I do things at home.
	COMPA3	Using smart home technologies fits into style of activities at home.

Trialability (Moore & Benbasat,1991)	TRI1	I like to try various smart home technologies before purchase.
	TRI2	I know where I can go to satisfactorily try out various uses of smart home technologies (including virtual reality (VR) etc.)
	TRI3	I like to use smart home technologies on a trial basis at home long enough to see what they could do.
Observability (Moore & Benbasat, 1991)	OBS1	I like to learn the comments and reviews of those using smart home technologies.
	OBS2	I like to observe others using smart home technologies.
	OBS3	I like to see how others benefit using smart home technologies.
	OBS4	Houses equipped with smart home technologies are visible.
Image (Moore & Benbasat, 1991)	IMG1	People who use smart home technologies have more prestige than those who do not.
	IMG2	People who use smart home technologies have a high profile.
	IMG3	Using smart home technologies is a status symbol.
Price Value (Venkatesh et al., 2012)	VAL1	Smart home technologies are reasonably priced.
	VAL2	Smart home technologies are a good value for the money.
	VAL3	At the current price, smart home technologies provide a good value.
	VAL4	Invest to equip my home with smart home technologies is a good idea.
Enjoyment (Venkatesh, 2000)	ENJ1	I find using smart home technologies to be enjoyable.
	ENJ2	I find using smart home technologies not to be boring.
	ENJ3	The actual process of using smart home technologies is pleasant
Design (Moon et al., 2015)	DES1	The design of smart home technologies is very stylish.
	DES2	The design of smart home technologies provides cutting-edge functionality.
	DES3	The design of smart home technologies is user-friendly.
	DES4	The design of smart home technologies is ergonomic (intuitive and comfortable).
Privacy (Pavlou, 2001)	PRIV1	I am confident that smart home technology providers would not disclose consumer private information to unauthorized parties.

	PRIV2	I believe smart home technology providers will not share my private information without my consent in the future.
	PRIV3	I would have control over how the private information I provide will be subsequently used by smart home technology providers.
	PRIV4	Overall, I feel confident that my privacy will not be compromised during a transaction with smart home technology providers.
Security (Pavlou, 2001)	SEC1	I am confident that inappropriate parties will not reach to and deliberately observe my information from the databases of smart home technology providers.
	SEC2	I believe inappropriate parties cannot deliberately reach the user account that I provide for the usage of my smart home technologies.
	SEC3	I would feel secure operating my house through using smart home technologies.
Brand Trust (Yang et al., 2017)	BRAND1	It is important the brand of a smart home technology provider is well-known.
	BRAND2	I think smart home technology brands keep customers' best interests in mind.
	BRAND3	I think smart home technology brands have the expertise to keep their promises and commitments.
	BRAND4	It is important that I feel confidence in brand of smart home technology providers.
Optimism (Parasuraman & Colby, 2015)	OPT1	New technologies contribute to a better quality of life.
	OPT2	Technology gives me more freedom of mobility.
	OPT3	Technology gives people more control over their daily lives.
	OPT4	Technology makes me more productive in my personal life.
Innovativeness (Parasuraman & Colby, 2015)	INN1	Other people come to me for advice on new technologies.
	INN2	In general, I am among the first in my circle of friends to acquire new technology when it appears.
	INN3	I can usually figure out new high-tech products and services without help from others.
	INN4	I keep up with the latest technological developments in my areas of interest.
Discomfort (Parasuraman & Colby, 2015)	DIS1	When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.

	DIS2	Technical support lines are not helpful because they do not explain things in terms I understand.
	DIS3	Sometimes, I think that technology systems are not designed for use by ordinary people.
	DIS4	There is no such thing as a manual for a high-tech product or service that is written in plain language.
Insecurity (Parasuraman & Colby, 2015)	INS1	People are too dependent on technology to do things for them.
	INS2	Too much technology distracts people to a point that is harmful.
	INS3	Technology lowers the quality of relationships by reducing personal interaction.
	INS4	I do not feel confident doing business with a place that can only be reached online
Environmental Responsibility (Stone et al., 1995)	ENVR1	I generally prefer energy-efficient products.
	ENVR2	I risk paying more for eco-friendly products (one-time or subscriptions).
	ENVR3	My involvement in environmental activities today will help save the environment for future generations.
	ENVR4	I do not purchase products/services that are known to cause pollution.
	ENVR5	I would describe myself as environmentally responsible.
Health Orientation (Snell et al., 2013; Nasır & Karakaya, 2014)	HEAO1	I'm very self-conscious about my health.
	HEAO2	I'm constantly examining my health.
	HEAO3	I devote time and effort to my physical health. (e.g., sleep, nutrition, exercise)
	HEAO4	I try to avoid engaging in behaviors that undermine my physical health.
Home-as-Extended-Self (Sivadas & Machleit, 1994)	HOME1	My home helps me achieve the identity I want to have.
	HOME2	I derive some of my identity from my home.
	HOME3	My home is part of who I am.

APPENDIX B

FINAL QUESTIONNAIRE

Araştırmanın Adı: Tüketicilerin Akıllı Ev Teknolojilerine Yönelik Tutumları ve Benimseme Niyetleri

Değerli Katılımcı,

Boğaziçi Üniversitesi Yönetim Bilişim Sistemleri Bölümü doktora öğrencisi Birgül Başarır Özel, aynı bölümde öğretim üyesi Prof. Dr. V. Aslıhan Nasır ve Prof. Dr. Hande B. Türker'in eş danışmanlığında, tüketicilerin nesnelerin interneti tabanlı akıllı ev teknolojilerine yönelik tutum ve niyeti ile ilgili bir doktora tez araştırması yürütmektedir. Bu araştırma kapsamında düzenlenen ankette akıllı ev teknolojileri ile ilgili sizlerin görüş, düşünce ve tutumlarınıza yönelik sorular sorulmaktadır. Ankete katılımınız ve verdiğiniz bilgiler sayesinde akıllı ev teknolojileri ile ilgili tüketicilerin tutumlarını analiz edilebilecek ve analiz sonucu elde edilen bulgular bilimsel dergi ve konferanslarda yayınlayarak bu alandaki ilgili kurum/kuruluşlar, akademisyenler ve genel olarak toplum bilgilendirilecektir.

Katılımınız gönüllülük esasına dayanmaktadır ve verdiğiniz cevaplar gizli kalacaktır. Araştırmada kimliğinizi açıkça sorgulayan bir soru bulunmamaktadır. Yanıtlarınız bireysel olarak belirlenmeyecek, tüm cevaplar birlikte derlenecek ve toplu olarak analiz edilecektir. Soruları yanıtlarken rahatsızlık duyarsanız anketi tamamlamaktan vazgeçebilirsiniz. Katılmaktan vazgeçtiğiniz durumda sizden o ana kadar alınan veriler de kayıt edilmeyecektir. Anketi yanıtlamanız yaklaşık 15 dakika sürmektedir.

Araştırmaya yönelik bir sorunuzun olması halinde araştırmacı Birgül Başarır Özel (birgul.ozel@boun.edu.tr) ya da proje yürütücüsü Prof. Dr. V. Aslıhan Nasır (aslihan.nasir@boun.edu.tr) ile iletişime geçebilirsiniz. Araştırma çerçevesiyle ilgili Boğaziçi Üniversitesi Sosyal ve Beşerî Bilimler İnsan Araştırmaları Etik Kurulu'na (SBİNAREK, sbinarek@boun.edu.tr) danışabilirsiniz.

Araştırmaya katılımınız için teşekkür ederiz.

Yukarıdaki açıklamayı okudum, bu çerçevede araştırmaya katılmayı kabul ediyorum. *

- Evet, kabul ediyorum.
- Hayır, kabul etmiyorum.

Size okuyacağım ifadeleri teknolojiye yönelik düşüncelerinizi yansıtacak şekilde 1'den (Kesinlikle Katılmıyorum) 7'ye (Kesinlikle Katılıyorum) kadar olan bir ölçek üzerinde değerlendirir misiniz? Aradaki puanları da kullanabilirsiniz.

1. Yeni teknolojiler yaşam kalitemi artırır.
2. Teknoloji bana erişim esnekliği (mobilite) verir.
3. Teknoloji günlük hayatım üzerinde daha fazla kontrol sahibi olmamı sağlar.
4. Teknoloji beni özel hayatımda daha verimli kılar.
5. Yeni teknolojiler hakkında çevremdekiler benden tavsiye alır.
6. Genellikle arkadaş grubum içinde yeni teknolojileri ilk satın alan kişilerden birisiyim.
7. Yüksek teknoloji ürün ve hizmetlerini çoğunlukla başkalarının yardımı olmadan kullanabilirim.
8. İlgilendiğim alanlardaki teknolojik gelişmeleri yakından takip ederim.

9. Bir teknoloji firmasından teknik yardım aldığımda karşımdaki kişinin benim bilgi eksikliğimi kötüye kullandığı hissine kapılırım.
10. Teknik destek çalışanlarından benim anlayacağım düzeyde basit bir dille yardım alamıyorum.
11. Bazen teknolojinin sıradan insanların kullanabilmesi için tasarlanmadığını düşünüyorum.
12. Teknoloji kullanım kılavuzlarının benim anlayacağım düzeyde basit bir dille yazılmadığını düşünüyorum.
13. İşlerimi yapmak için teknolojiye çok bağımlıyım.
14. Teknolojiyi çok fazla kullanmak dikkatimi aşırı derecede dağıtır.
15. Teknoloji, yakınımdaki insanlar ile etkileşimimi azalttığı için ilişki kalitemi düşürür.
16. Sadece sanal ortamda faaliyet gösteren işletmelerle iş yapmak konusunda emin değilim.
17. Genel olarak enerji tasarrufu sağlayan ürünleri tercih ederim.
18. Çevre dostu ürünlere daha fazla ödemeyi (tek seferlik veya aboneliklerde) göze alırım.
19. Gelecek nesilleri düşünerek çevreyi koruma faaliyetlerine bugünden katılırım.
20. Çevre kirliliğine sebep olan ürün ve hizmetleri satın almam.
21. Kendimi çevreci olarak tanımlarım.
22. Sağlığım konusunda bilinçliyim.
23. Sağlık kontrollerimi düzenli olarak yaptırırım.
24. Sağlıklı olmak için ekstra çaba sarf ederim. (uyku, beslenme, egzersiz vb.)
25. Sağlığımı bozabilecek fiziksel etkenlerden kaçınırım.

26. Evim kişiliğimi yansıtmama yardım eder.

27. Evime gelenler kişiliğim ve nasıl biri olduğum hakkında bilgi sahibi olur.

28. Evim yaşam tarzım hakkında fikir verir.

Akıllı Evler Tanımı

Akıllı evler, yüksek teknoloji iletişim ağı ile donatılmış birbirine bağlı sensörleri ve ev aletlerini içeren bir sisteme sahip konutlara verilen isimdir. Akıllı evlerin sunduğu özelliklerden bazıları; evdeki donanımlara uzaktan erişilebilir, yönetilebilir ve kontrol edilebilir olmalarıdır. Akıllı evler, ev sahiplerinin ihtiyaçlarına uygun hizmetler sunar.

Akıllı evlerde kullanılan teknolojiler aşağıdaki gibi gruplanabilir:

- Akıllı Ev Aletleri (Akıllı Buzdolabı, Akıllı Çamaşır Makinası, Akıllı Bulaşık Makinası, Akıllı Kahve Makinası, Akıllı Elektrik Süpürgesi vb.)
- Eğlence Sistemleri (Sesle Kumanda Edilen Asistanlar, Programlanabilir Aydınlatmalar vb.)
- Ev Otomasyonu Sistemleri (Akıllı Termostat, Akıllı Pencere, Perde ve Sulama Sistemleri, Akıllı Sayaçlar vb.)
- Güvenlik Sistemleri (Akıllı Kilitler, Hareket Sensörlü Kameralar, Duman Detektörleri, vb.)

Evinizde yukarıdakilere benzer bir akıllı ev teknolojisini kullanıyor musunuz veya daha evvel kullandınız mı?

- Evet
- Hayır

(Evet İse) Akıllı Ev Teknolojilerini kullanıyorsanız veya daha evvel kullandıysanız genel olarak memnuniyet düzeyinizi belirtir misiniz? 1 çok düşük, 7 çok yüksek anlamına gelmektedir. Aradaki puanları da verebilirsiniz.

Şimdi size okuyacağım ifadeleri değerlendirirken lütfen az önce bahsettiğimiz akıllı ev teknolojilerini göz önünde bulundurunuz ve ifadelere katılım derecenizi 1'den (Kesinlikle Katılmıyorum) 7'ye (Kesinlikle Katılıyorum) kadar olan bir ölçek üzerinde değerlendiriniz. Aradaki puanları da verebilirsiniz.

1. Akıllı ev teknolojilerini kullanmak, evlerdeki mevcut geleneksel eşya ve araçları kullanmaya kıyasla daha avantajlıdır.

2. Akıllı ev teknolojileri kullanılarak ev işleri daha az zaman ve çaba ile tamamlanır.
3. Akıllı ev teknolojileri, evdeki yaşantımı daha verimli bir şekilde yönetmemi sağlar.
4. Akıllı ev teknolojilerini kullanmak evdeki çeşitli işlerimi daha iyi kontrol etmemi sağlar.
5. Akıllı ev teknolojilerini kullanmanın zor olacağını düşünüyorum.
6. Akıllı ev teknolojilerini istediğim gibi kontrol edemeyeceğimi düşünüyorum.
7. Akıllı ev teknolojilerinin günlük yaşantımı karmaşıklaştıracağını düşünüyorum.
8. Akıllı ev teknolojilerini kullanmayı öğrenmek için çok uğraşmam gerekebilir.
9. Akıllı ev teknolojileri, evimde kullandığım mevcut eşya ve araçlar ile uyumludur.
10. Akıllı ev teknolojileri günlük yaşantımdaki alışkanlıklarım ile örtüşmektedir.
11. Akıllı ev teknolojileri genel olarak yaşam tarzımla uyumludur.
12. Akıllı ev teknolojilerini satın almadan önce deneyebilmeyi isterim.
13. Akıllı ev teknolojilerinin satın almadan önce faydalarını gözümde canlandırabileceğim şekilde (sanal gerçeklik vb. yöntemler ile) tanıtılmasını isterim.
14. Akıllı ev teknolojilerinin mağazada veya alternatif yöntemler ile tanıtılmasının yanı sıra, bu teknolojileri kendi evimde de deneme olanağının sunulmasını isterim.
15. Akıllı ev teknolojilerini kullananların yorum ve değerlendirmelerini öğrenmek isterim.
16. Çevremdeki insanları akıllı ev teknolojilerini kullanırken gözlemlemek isterim.

17. Çevremdeki insanların akıllı ev teknolojilerinden nasıl faydalandıklarını görmek isterim.
18. Akıllı ev teknolojileri ile donatılmış konutlar dikkat çekerek fark yaratır.
19. Akıllı ev teknolojilerini kullanan kişiler daha prestijlidir.
20. Akıllı ev teknolojilerinin refah düzeyi daha yüksek kişiler tarafından tercih edileceğini düşünüyorum.
21. Akıllı ev teknolojileri kullanmak bir statü sembolüdür.
22. Akıllı ev teknolojilerine bütçemden düzenli olarak belli bir pay (Aidat ve üyelik ücretleri gibi) ayırabilirim.
23. Akıllı ev teknolojilerinin en yeni ve gelişmiş versiyonunu kullanmak için bütçemden ekstra ödeme yapabilirim.
24. Akıllı ev teknolojilerine ödeyeceğim fiyat yüksek olsa da sağlayacağı faydaya değer.
25. Evimi akıllı ev teknolojileri ile donatmak için gerekli yatırımı yapmayı göze alırım.
26. Akıllı ev teknolojilerini kullanmanın eğlenceli olacağını düşünüyorum.
27. Akıllı ev teknolojilerini kullanmanın sıkıcı olmaması gerekir.
28. Akıllı ev teknolojilerini kullandıkça daha çok keyif alınır.
29. Akıllı ev teknolojilerini kullanmanın hayatıma renk katacağını düşünüyorum.
30. Akıllı ev teknolojilerinin tasarımı şık olmalıdır.
31. Akıllı ev teknolojilerinin tasarımı işlevsel olmalıdır.
32. Akıllı ev teknolojilerinin tasarımı kullanıcı dostu olmalıdır.
33. Akıllı ev teknolojilerinin tasarımı ergonomik (rahat ve konforlu) olmalıdır.

34. Akıllı ev teknolojisi üreticilerinin, kişisel verilerimi başka kurum ve kişiler ile paylaşmayacağına güveniyorum.
35. Akıllı ev teknolojisi üreticilerinin, kişisel verilerimi istek ve iznim dışında kullanmayacağına inanıyorum.
36. Akıllı ev teknolojisi üreticilerinin, kişisel verilerimi kayıt ederken belirttikleri amaç dışında kullanmayacağına güveniyorum.
37. Genel olarak, akıllı ev teknolojilerinin kullanımı sırasında/sonrasında kişisel verilerimin gizliliğinin sağlanacağına eminim.
38. Akıllı ev teknolojileri üreticilerinin kişisel verilerimi tuttukları veritabanlarına yetkisiz kurum ve kişilerin ulaşıp kişisel verilerimi çalmayacağına inanıyorum.
39. Akıllı ev teknolojilerini kullanırken oluşturacağım kullanıcı hesabını korumak için gerekli önlemleri alabileceğimi düşünüyorum.
40. Akıllı ev teknolojilerini kullanarak evimi yönetmek konusunda güvenlik endişem (sızma, yetkisiz erişim vb.) olmaz.
41. Akıllı ev teknolojilerini satın alacağım markanın bilinir olması önemlidir.
42. Akıllı ev teknolojisi markalarının müşterilerinin çıkarları doğrultusunda hareket edeceklerini düşünüyorum.
43. Akıllı ev teknolojisi markalarının taahhütlerini yerine getirecek şekilde işinin uzmanı olduğuna inanıyorum.
44. Akıllı ev teknolojilerini satın alacağım markaya güven duymam önemlidir.

Değerlendirdiğiniz tüm ifadeleri düşündüğünüzde size okuyacaklarıma ne derece katıldığınızı 1’den (Kesinlikle Katılmıyorum) 7’ye (Kesinlikle Katılıyorum) kadar olan bir ölçek üzerinde değerlendirir misiniz? Aradaki puanları da kullanabilirsiniz.

1. Akıllı ev teknolojilerini kullanmak iyi bir fikirdir.

2. Akıllı ev teknolojilerini kullanmak akıllıcadır.
3. Akıllı ev teknolojilerini kullanmak bana cazip geliyor.
4. Akıllı ev teknolojilerini kullanmak keyifli olacaktır.
5. Akıllı ev teknolojilerini kullanma fikri bana çok uzak geliyor.
6. Akıllı ev teknolojilerini kullanmak hiç ilgimi çekmiyor.
7. Akıllı ev teknolojilerini kullanmak sıkıcı olacaktır.
8. Akıllı ev teknolojilerini kullanmaya niyetim var.
9. İleride daha çeşitli işleri de yapmak için akıllı ev teknolojilerini kullanabilirim.
10. Yakın gelecekte akıllı ev teknolojilerini daha çok kullanacağım.
11. İleride akıllı ev teknolojilerine daha çok bütçe ayıracağım.
12. İmkânım olsa farklı akıllı ev teknolojilerini kullanırım.

Size okuyacağım Akıllı Ev Teknolojilerinden her birini kullanma konusundaki istekliliğinizi (1 çok düşük, 7 çok yüksek) olmak üzere değerlendirir misiniz? Aradaki puanları da verebilirsiniz.

- Akıllı Ev Aletleri (Akıllı Buzdolabı, Akıllı Çamaşır Makinası, Akıllı Bulaşık Makinası, Akıllı Kahve Makinası, Akıllı Elektrik Süpürgesi vb.)
- Eğlence Sistemleri (Sesle Kumanda Edilen Asistanlar, Programlanabilir Aydınlatmalar vb.)
- Ev Otomasyonu Sistemleri (Akıllı Termostat, Akıllı Pencere, Perde ve Sulama Sistemleri, Akıllı Sayaçlar vb.)
- Güvenlik Sistemleri (Akıllı Kilitler, Hareket Sensörlü Kameralar, Duman Detektörleri, vb.)

Lütfen Cinsiyetinizi Belirtiniz:

- Kadın
- Erkek
- Belirtmek İstemiyorum

Lütfen Yaşınızı Belirtiniz:

- 25 altı
- 25-35
- 36-45
- 46-55
- 56-65
- 65 üstü

Lütfen Medeni Durumunuzu Seçiniz:

- Bekâr
- Evli

Çocuğunuz Var mı?

- Evet
- Hayır

(Evet İse) Çocuk Sayınızı Seçiniz:

- 1
- 2
- 3
- 3'ten fazla

Lütfen Eğitim Durumunuzu Seçiniz: (SES: ABC1)

- Okula gitmedi/İlkokul terk
- İlkokul (5 yıl)
- İlköğretim/Ortaokul ve dengi (8 yıl)
- Normal lise
- Meslek Lisesi
- Yüksekokul (2 yıllık)
- Açık öğretim
- Üniversite (4 yıllık)
- Lisansüstü

Lütfen Çalışma Durumunuzu Seçiniz:

- Emekli, şu an çalışıyor
- Emekli, şu an çalışmıyor
- Gelir getiren bir işi yok, çalışmıyor
- Maaş ya da ücret karşılığı çalışıyor
- Kendi hesabına çalışıyor

Lütfen Ne İşle Uğraştığınızı/Mesleğinizi Belirtiniz:

- Gelir getiren bir işi yok, çalışmıyor
    - İşsiz - şu an çalışmıyor - ek gelir yok, yardım alıyor
    - İşsiz - şu an çalışmıyor - düzenli ek gelir var
    - Ev kadını - ek gelir yok, yardım alıyor
    - Ev kadını - düzenli ek gelir var
    - Öğrenci

- Maaş ya da ücret karşılığı çalışanlar
  - İşçi/hizmetli - parça başı işi olan (yevmiye)
  - İşçi/hizmetli - düzenli işi olan (maaş)
  - Ustabaşı/kalfa - kendine bağlı işçi çalışan
  - Yönetici olmayan memur / teknik eleman/uzman vs.
  - Yönetici (1–5 çalışanı olan)
  - Yönetici (6–10 çalışanı olan)
  - Yönetici (11–20 çalışanı olan)
  - Yönetici (20'den fazla çalışanı olan)
  - Ordu mensubu (uzman er, astsubay, subay)
  - Ücretli nitelikli uzman (avukat, doktor, mimar, mühendis vs.)
- Kendi hesabına çalışanlar – serbest meslek – nitelikli uzman
  - Çiftçi (kendi başına/ailesiyle çalışan)
  - Seyyar - Kendi işi (free lance dahil), dükkanda hizmet vermiyor
  - Tek başına çalışan, dükkan sahibi, esnaf (taksi şoförü dahil)
  - İşyeri sahibi- 1–5 çalışanlı (Tic, Tarım, İmalat)
  - İşyeri sahibi- 6–10 çalışanlı (Tic, Tarım, İmalat)
  - İşyeri sahibi -11–20 çalışanlı (Tic, Tarım, İmalat)
  - İşyeri sahibi - 20'den dazla çalışanlı (Tic, Tarım, İmalat)
  - Serbest nitelikli uzman (avukat, mühendis, mali müşavir, bilgisayar yazılımcısı vs.)

Ortalama aylık hane halkı geliriniz nedir?

- 5,000 TL Altı
- 5,000 TL- 7,500 TL Arası
- 7,500 TL - 9,999 TL Arası
- 10,000 TL - 19,999 TL Arası
- 20,000 TL - 29,999 TL Arası
- 30,000 TL ve Üstü

Şu anda oturduğunuz ev:

- Kendi Evim
- Kiralık
- Lojman
- Aileme Ait Ev
- Diğer

Daimi İkamet Ettiğiniz Evin Yaklaşık Yaşını Seçiniz:

- 0-3
- 4-10
- 11-20
- 20’den fazla

Gelecek 1 Sene İçinde İkamet Ettiğiniz Evden Taşınma Olasılığınızı Seçiniz:

- Taşınma Olasılığım Yüksek
- Taşınma Olasılığım Düşük

DEĞERLİ ZAMANINIZI AYIRDIĞINIZ İÇİN TEŞEKKÜR EDERİZ!

APPENDIX C

ETHICS COMMITTEE APPROVAL

T.C. BOĞAZİÇİ ÜNİVERSİTESİ
Sosyal ve Beşeri Bilimler İnsan Araştırmaları Etik Kurulu (SBİNAREK)

08.07.2019

Prof. Dr. Aslıhan Nasır
Boğaziçi Üniversitesi,
Uygulamalı Bilimler Yüksekokulu,
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Sayın Araştırmacı,

"Tüketicilerin IoT Tabanlı Akıllı Ev Teknolojilerine Yönelik Tutum ve Niyeti Consumers' Attitude and Intention Towards Smart Home Technologies based on the IoT (Internet of Things)" başlıklı projeniz ile Boğaziçi Üniversitesi Sosyal ve Beşeri Bilimler İnsan Araştırmaları Etik Kurulu (SBİNAREK)'e yaptığınız 2019-29 kayıt numaralı başvuru 08.07.2019 tarihli ve 2019/06 sayılı kurul toplantısında incelenmiş ve projenize etik onay verilmesi uygun bulunmuştur.

Saygılarımızla, bilgilerinizi rica ederiz.

Doç. Dr. Osman Sabri Kıratlı (Başkan)
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APPENDIX D

FACTORS OF SHT CHARACTERISTICS

Factor Name	Variance Explained (%)	Eigenvalue	Item	Item Explanation	Item Loading
F1. Value Superiority CR: 0.910 $\bar{x}_{VS}$: 5.19	26.87	9.94	ADV1	Using smart home technologies has more advantages as compared to other standard household tools.	0.773
			ADV3	Smart home technologies offer greater value in managing my home effectively.	0.759
			ADV2	Using smart home technologies takes less time and effort for home-related activities.	0.740
			ADV4	Using smart home technologies gives me greater control over different activities at home.	0.738
			OBS4	Houses equipped with smart home technologies are visible.	0.734
			IMG3	Using smart home technologies is a status symbol.	0.693
			IMG1	People who use smart home technologies have more prestige than those who do not.	0.679
			IMG2	People who use smart home technologies have a high profile.	0.667
			OBS2	I like to observe others using smart home technologies.	0.654
			OBS1	I like to learn the comments and reviews of those using smart home technologies.	0.649
			OBS3	I like to see how others benefit using smart home technologies.	0.630
F2. Consumer Protection CR: 0.918 $\bar{x}_{CP}$: 4.45	17.71	6.55	PRIV4	Overall, I feel confident that my privacy will not be compromised during a transaction with smart home technology providers.	0.858
			PRIV3	I would have control over how the private information I provide will be subsequently used by smart home technology providers.	0.857
			PRIV2	I believe smart home technology providers will not share my private information without my consent in the future.	0.853
			SEC1	I am confident that inappropriate parties will not reach to and deliberately observe my information from the databases of smart home technology providers.	0.844
			PRIV1	I am confident that smart home technology providers would not disclose private consumer information to unauthorized parties.	0.832
			SEC3	I would feel secure operating my house through using smart home technologies.	0.667
			SEC2	I believe inappropriate parties cannot deliberately reach the user account that I provide for the usage of my smart home technologies.	0.634
			VAL3	At the current price, smart home technologies provide a good value.	0.585
			VAL4	Invest to equip my home with smart home technologies is a good idea.	0.570
			BRAND2	I think smart home technology brands keep customers' best interests in mind.	0.532

Factor Name	Variance Explained (%)	Eigenvalue	Item	Item Explanation	Item Loading
F3. Design and Reputation CR: 0.875 $\bar{x}_{DR}$: 5.44	9.89	3.66	DES3	The design of smart home technologies is user-friendly.	0.807
			DES2	The design of smart home technologies provides cutting-edge functionality.	0.779
			DES4	The design of smart home technologies is ergonomic (intuitive and comfortable).	0.763
			DES1	The design of smart home technologies is very stylish.	0.665
			BRAND1	It is important the brand of a smart home technology provider is well-known.	0.659
F4. Enjoyment CR: 0.932 $\bar{x}_{EJ}$: 4.63	5.29	1.96	ENJ1	I find using smart home technologies to be enjoyable.	0.844
			ENJ3	The actual process of using smart home technologies is pleasant	0.824
			ENJ4	I have fun smart home technologies.	0.816
			ENJ2	I find using smart home technologies not to be boring.	0.785
F5. Complexity CR: 0.852 $\bar{x}_{CM}$: 3.76	3.65	1.35	COM4	Using smart home technologies requires a lot of mental effort.	0.817
			COM2	I believe that I can not control smart home technologies to do what I want it to do.	0.770
			COM3	I think that smart home technologies complicate my daily life.	0.761
			COM1	I believe that using smart home technologies is cumbersome.	0.717
F6. Compatibility CR: 0.681 $\bar{x}_{CT}$: 4.42	3.00	1.11	VAL2	I'm willing to pay more for the latest and advanced version of smart home technologies.	0.758
			COMPA3	Using smart home technologies fits into style of activities at home.	0.552
			COMPA2	I think that using smart home technologies fits well with the way I do things at home.	0.549
	66.41				

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