Kristiania University College

Master of Information Systems (Digital Business Systems)

Exploring the Use and Adoption of Smart Home Technology: Findings from Norway

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Abstract

Due to the continuously increasing socio-technical interconnectedness of the world, the massive increase in connected devices, networks, and systems creates new opportunities for automation and advanced digitalization like never before. With the perennial presence of smartphones, mobile technologies are also applied to and combined with new operations, including automation of domestic lives. Thus, smart and intelligent technologies is a hot topic in the smart home industry. Researchers have studied motivating and blocking factors for smart home technology adoptions among consumers. As Norway is a technologically developed country with generally skilled citizens, the Norwegian smart home market comprises a potential market for mass adoption of smart home technologies.
To the researcher's knowledge, there is little new literature on smart home technology adoption in Norway. Hence, this thesis will study drivers and barriers affecting Norwegian consumers' intentions to adopt smart home technologies, and the diffusion of smart home adoption in the Norwegian market. Through a mixed-methods research design, this study provides insights from both a consumer and a professional perspective obtained from interviews, in addition to consumer insights from a survey.

The data collection was based on a research model adapted from the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) by Venkatesh et al. (2012). The research model used in this thesis consists of eight constructs which were measured by their effect on behavioral intention towards adoption smart home technology. The eight constructs include performance expectancy, effort expectancy, social influence, hedonic motivation, price value, facilitating conditions, energy management, and security and privacy. Through quantitative and qualitative data analysis, the findings showed that the strongest drivers that was identified for smart home technology adoption was hedonic motivation, price value, and social influence. The lack of awareness and familiarity of smart home technology was identified to be a central potential barrier to adoption, whereas enhanced market communication and education regarding smart home technology might contribute to get closer to mass adoption of smart home technology in Norway. The implications for practice entailed that smart home vendors should ensure a better communication of smart home technology's benefits and usefulness towards consumer and assist in educating the mass market about smart home technology to raise awareness and familiarity. The implications for research pointed out that there is need for additional research on smart home technology adoption in Norway is needed in the future to see the development in the market.

This thesis consists of six sections: (1) introduction to the research topic, objectives, and the research questions, (2) a literature review on existing relevant literature within the field of study, (3) research method, (4) reporting on empirical findings from the data collection and analysis, (5) discussion and implications of the respective findings in relation to the literature, and finally (6) conclusion, limitations, and suggested directions for future research.

Keywords: *IoT, Smart Home Technology, Adoption, Behavioral Intention, UTAUT2*

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List of Abbreviations:

SHT – Smart Home Technology

IoT – Internet of Things

ICT – Information and Communications Technology

AI – Artificial Intelligence

RQ – Research Question

UTAUT2 – The Unified Theory of Acceptance and Use of Technology 2

PLS – Partial Least Square

SEM – Structural Equation Modelling

CFA – Confirmatory Factor Analysis

AVE – Average Variance Extracted

CR – Composite Reliability

HTMT – Hetero-Monotrait

VIF – Variance Inflation Factor

CMB – Common Method Bias

SRMR – Standardized Root Mean Squared Residual

r^2 – Coefficient of determination

f^2 – Effect size

q^2 – Predictive relevance

NSD – Norsk Senter for Forskningsdata (Norwegian Centre for Research Data)

PE – Performance Expectancy

EE – Effort Expectancy

HM – Hedonic Motivation

PV – Price value

SI – Social Influence

FC – Facilitating Conditions

SP – Security and Privacy

EM – Energy Management

BI – Behavioral Intention

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1. Introduction

The perennial growth in the world population has increased by more than one billion people since 2007 (United Nations, 2019b, p. 5). By the year 2050, United Nations (the UN) has predicted the world's population to reach 9.7 billion people and the urban population to reach 6.7 billion (United Nations, 2019b, p. 5; United Nations, 2019a, p. 11). In addition to that, the world is becoming more and more interconnected, and the development of smart technologies is taking an increasing presence in business, manufacturing, education, and our daily lives (Næringslivets Hovedorganisasjon, 2018). It is now produced more data every week than in the previous century in total, and the increased data capacity has enabled more widespread use of technologies such as artificial intelligence, machine learning, and the Internet of Things (IoT) (Næringslivets Hovedorganisasjon, 2018). In addition, the development of smart technologies for households is also changing the way people live their everyday lives at home. "Smart" technologies involve devices and sensors that are connected via the Internet, often referred to as the Internet of Things, and are often used for automation, control, and monitoring of household-related tasks, routines, and applications (Dimensional Research, 2020). Yet the definition of smart homes is debated among researchers and professionals and will be elaborated on later in this study.

Certain smart home applications have, during the past years, become relatively common in modern households (Teknologirådet, 2020). Based on data collected by Norstat, Slettemeås (2019) reported that the most common smart application among the survey respondents in Norway were smart meters, followed by digital TV and smart multimedia. As the author notes, the Norwegian government decided that all households should have smart meters implemented in early 2019. Hence, the 56 percent that state to have a smart meter in their home reveal unawareness and ignorance of certain technologies they use in their daily lives (Slettemeås, 2019, p. 7). From a survey on smart home applications, Dimensional Research (2020, p. 10) found that IoT manufacturing stakeholders had experienced a 57 percent growth in market opportunities for Smart Home solutions from 2018 to 2020. More people are implementing smart technologies in their homes and digitizing various parts of traditional living. After two years of a global pandemic, multiple lockdowns, and people spending significantly more time at home, investigating people's attitudes, intentions, and behaviors regarding the use of smart devices in their everyday lives are relevant like never before.

Norway has a well-developed digital infrastructure that supports both private and public operations. Regarding device accessibility and Internet connectedness, Norway is at the global forefront (Slettemeås, 2019). Compared to the other countries in Europe, Norway is also ranked well above average in digital skills, expansion of bandwidth, and Internet use. Norwegian citizens are, in general, well-educated and advanced users who adopt new technologies and innovations relatively early (Næringslivets Hovedorganisasjon, 2018). In 2021, 98 percent of Norwegians had access to the Internet, and 96 percent of Norwegians owned a smartphone (Schiro, 2022, p. 57). Although Norway is a wealthy and technologically developed country with generally digitally skilled citizens, automated smart homes are still not a standard for most Norwegian households. In a survey for electrical home-system installation companies in Norway, the majority answered that smart home installations were not part of their standard offer but that they could install it if the customer specifically asked for it. Among the companies that answered that smart home installations were a standard offer, this mainly concerned heating systems for new cabins (Ingebrigtsen & Taxt, 2019). However, as Ingebrigtsen and Taxt (2019) also reported, contractors want the new constructions to be smart home ready, such that the houses and buildings can be transformed into smart entities at a later point. As technology is such a critical part of modern societies, the Norwegian government also needs to follow the new technological developments being implemented and utilized in other countries and other parts of the world. Hence, expanding and advancing digitally- and technologically based systems and infrastructures for cities, municipalities, and communities is important (Teknologirådet, 2020).

IoT development has enabled a new paradigm of techno-physical networks and applications that can potentially improve life quality (Shuhaiber & Mashal, 2019). It is estimated that the worth of the global IoT market will be approximately $3.9-$11.1 trillion by 2025 (Manyika et al. 2015, p. 2). A study by Furszyfer Del Rio et al. (2021) reported that the global market share for different applications of smart home technologies in 2018 was clearly dominated by home entertainment applications. Many studies have been conducted on the research topic. However, as smart technologies continuously advance and markets change, new studies will be required. Common topics found in the existing literature include the security and privacy of smart home technologies, costs, cost-savings, social influence, home energy management, usefulness, enjoyment, and ease of use, among others (Aldossari & Sidorova, 2020; Li et al., 2021).

Consumption Research Norway (SIFO) leads the ReLink project, which involves mapping current and future experiences and vulnerabilities of connected homes in a societal context. The ReLink project is focused on risks related to Smart/connected homes and published its most recent report back in 2019 (Slettemeås, 2019). The report was based on a survey by Norstat regarding Norwegian consumers' relation to smart applications based on IoT and the Internet. This research further built on the ReLink project's basic aim to enhance understanding of the Norwegian smart home market. However, whereas the ReLink project focuses more on the vulnerabilities and risks related to smart homes from a city and national perspective, this study focused more on peoples' attitudes, use, perceptions, concerns, motivations, and intentions to adopt smart home technologies.

Despite the contributions of existing studies on smart home technology (SHT) and user adoption, there is to the researcher's knowledge still a gap in the literature regarding the Norwegian IoT-based smart home technology market, drivers and barriers, and the diffusion of smart homes. In addition, smart home technologies are continuously developing and advancing, maintaining the importance to study the market conditions and their developments progressively. By gaining insight into people's awareness, attitudes, and behaviors related to IoT and SHT, stakeholders can improve their understanding of the market, including its tendencies, trends, variations, and changes. Such insights might provide practical importance for future product- and service development of IoT-based SHT, the diffusion of consumer adoption of SHT, and possibly national opportunities and incentives for energy management. Furthermore, researchers studying this topic or related research topics can gain updated insights into the current market conditions and compare to previous studies of other locations or times. Additionally, the findings of this thesis can be compared and analyzed in relation to other markets' smart home technology adoption during the pre-, during-, or post-pandemic. Based on the aforementioned considerations, the research questions for this study were defined as follows:

- ***RQ1:*** *What drivers and barriers affect the Smart Home Technology adoption in Norway?*
- ***RQ2:*** *How can the diffusion of smart home technology use in Norway be expanded?*

The objectives of this thesis were to develop an enhanced understanding of the drivers and barriers of smart home technology adoption in Norway and explore the diffusion of adoption and market conditions. The objectives were studied through the application of the Unified

Theory of Use and Acceptance of Technology 2 (UTAUT2) by Venkatesh et al. (2012) which will be elaborated on in Section 3.1. Furthermore, this study aimed to provide recent insight into the Norwegian smart home market, both from the consumer's and the vendor's perspectives. Therefore, the units of analysis were divided into two groups. To get insights into the market's attitudes, intentions, and behaviors of different consumers, the first unit of analysis contains data collected from a diverse group of people, including all ages, occupations, locations, and income rates, conducted through a survey. Another unit of analysis involved industry professionals from SHT-related professions to obtain insights into the market outlooks, observations, and experiences from the vendors' perspectives. Finally, a unit of consumers with various demographical backgrounds was also interviewed to elaborate on consumer perspectives.

This study consists of 6 sections. The following section elaborates on the research topic through a systematic literature review. Section 3 presents the method and research design of this study. Section 4 contains the study's findings, while Section 5 comprises a discussion of the respective findings and the study's implications. Finally, Section 6 presents the conclusion, including the study's limitations and proposed directions for future research.

2. Literature Review

This section contains a review of existing relevant literature within the respective field of study. The literature review intends to compose an acumen for essential topics in the SHT research field, providing a theoretical foundation for the impending analysis. The literature review is divided into six sub-sections: 2.1. Smart Cities and Smart Homes, 2.2. Home Energy Management, 2.3. Usefulness of Smart Home Technology, 2.4. Ease of Use and Technological Literacy, 2.5. Facilitating Conditions of Smart Home Technology, 2.6. Hedonic Motivation and Enjoyment of Use, 2.7. Costs and Cost-savings, 2.8. Security and Privacy Risk, and 2.9. Social Influence.

2.1. Smart Cities and Smart Homes

Technological development has contributed to a paradigm shift in the 21st century, in which the increased access to products and services has contributed to an increased quality of life

(Shuhaiber & Mashal, 2019). However, the massive urbanization and industrialization of cities also come with challenges of population density, city planning, and administration (Eremia et al., 2017). Resultingly, the cities also consume considerably more recourses and contribute to higher emissions, waste volumes, and a compromised natural environment (Zeinab & Elmustafa, 2017). As Eremia et al. (2017) argued, the cities of the future need to be equipped to face the challenges coming with an aging population, population growth, population mobility, social inequalities, climate change, and globalization, among a long list of other factors.

Smart cities are often characterized by infrastructures that support economic, sustainable, and social development in a city (Eremia et al., 2017). Energy conservation is a central part of smart city concept, in which smart homes constitute an essential element. Smart homes can be described as residences with networks that can digitally sense, access, connect, control, and share information and data between electro-physical domestic devices, machines, sensors, and systems (Shuhaiber & Mashal, 2019; Ghosh, 2018). Balta-Ozkan et al. (2013) pointed out that the smart home is distinguished from the high tech-home through the high-tech networks that connect the devices and sensors. Similarly, another common definition of smart homes used by several researchers is the description of smart homes as residences tooled with connected high-tech networks of domestic devices, sensors, and systems that can be accessed, monitored, and controlled remotely via sensor interfaces (Balta-Ozkan et al., 2013). However, literature has also pointed out incoherence, confusion, or slippage in the delimitation and definition of smart homes (Sovacool & Furszyfer Del Rio, 2020). Since there is no clear and unitedly agreed on definition of smart homes, these terms are often used interchangeably, describing the same concept (Li et al., 2021). Kim et al. (2017) argued that smart homes cannot be defined as an independent concept, as smart homes follow the rapid development of IoT technology that is applied to residences. Marikyan et al. (2019) pointed out similarities and overlaps in smart home definitions found in literature and highlight three key aspects that many researchers appear to agree on. These include hardware and software, the benefits or services the technology provides, and the change in the users' behavior (Marikyan et al., 2019).

Smart grids can facilitate distributed energy systems that can generate electricity independently within a city, providing flexibility and balance for energy demand and supply (Kim et al., 2021). On a smaller scale, microgrids can potentially improve energy efficiency in, for example, a home by providing real-time information about energy consumption. Such technologies enable the utilization of the consumption and supply of energy and allow the trading of energy surpluses (Kim et al., 2021). The literature has argued that the smart home is a fundamental component that is important in the interrelations between urban life and smart technologies and in smart cities (Zhang & He, 2020). Ghosh (2018) pointed out the critical role smart homes have for smart cities' sustainability, as smart homes contribute effectively to the consumption and sustainability society. This entails water consumption and supply, energy consumption and supply, smart healthcare solutions, safety, and various other features (Ghosh, 2018).

2.2. Home Energy Management

Home energy management is oftentimes associated with smart homes (Wilson et al., 2017). Nevertheless, literature is somewhat divided on the perspective of SHT generating a more sustainable living or not. While the many have agreed that smart homes are a crucial part of the sustainability of smart cities and a sustainable urban environment (Zhang & He, 2020; Zeinab & Elmustafa, 2017), others have argued that smart technologies do not automatically improve sustainability (Sovacool et al., 2021; Furszyfer Del Rio et al., 2021). Such arguments suggest that SHT can be conflicting regarding sustainability aspects, as some technologies save, monitor, and reduce energy consumption while others waste it (Sovacool et al., 2021). Hence, studies have implicated that despite being depicted as improving life quality, smart home technologies do not automatically generate more sustainable living (Sovacool & Furszyfer Del Rio, 2020). Comparably, Balta-Ozkan et al. (2013) questioned whether the co-evolvement of technology and society rocking with routines and practices will lead to unintentional effects that counter energy efficiency. In addition, the authors highlighted the risk of potentially increasing energy consumption due to new energy-consuming habits and lifestyles. Moreover, Furszyfer Del Rio et al. (2021) found that smart homes were generally not significantly associated with sustainability across the various countries that were studied, revealing dualistic tensions in the perception and association of smart homes and sustainability. Despite SHT potential to enhance sustainability consciousness and awareness, wasteful energy consumption might still remain an issue (Furszyfer Del Rio et al., 2021). A possible explanation might be that many smart home technologies are not concentrated on energy-saving but rather on serving comfort and convenience for a more luxurious lifestyle (Furszyfer Del Rio et al., 2021).

Nevertheless, researchers have also argued for how SHT support and enables enhanced sustainability. SHT can potentially provide users with data and information about their household's energy- and water consumption regarding energy- and resource efficiency and reducing domestic over-consumption and carbon emissions (Oliveira et al., 2015). Wilson et al. (2017) found that the functionality of energy management in smart homes positively affected consumers' perspectives on SHT. Additionally, their findings showed that most of their respondents saw possibilities for energy-saving as one of the top benefits of SHT (Wilson et al., 2017). Likewise, Li et al. (2021) argued for the motivational effect of efficient energy management with SHT, through the enablement of energy consumption transparency and management in a home through smart devices and monitoring. This can enable efficient energy management without compromising comfort and convenience for the consumers (Li et al., 2021).

Smart grids can provide two-way communication between the household and the energy supplier, enabling real-time monitoring and management of the energy consumption (Zeinab & Elmustafa, 2017). With technologies such as timers, smart sensors, AI-driven control- and monitoring systems, smart meters, and other IoT-based technologies, smart homes can reduce overall energy and water consumption, reduce costs, and improve household sustainability (Guo et al., 2019). In addition, the use of green energy, waste recycling, and energy- and water consumption management systems are facilitating elements affecting the sustainability of a household (Ghosh, 2018; Park et al., 2018a). In a study by Bhati et al. (2017), findings showed that using SHT for energy-saving had a positive effect on the adoption of SHT, and that it can often reveal intentions for long-term energy-savings. The study also showed that energy-savings were among the strongest motivators for adopting SHT among the survey respondents and whereas the majority would invest to save energy (Bhati et al., 2017). Bhati et al. (2017) suggested that the consumers' willingness to save energy was high, as long as it did not compromise their comfort of living. Similarly, Kim et al. (2021) suggested that there is a tradeoff between comfort and energy-savings, whereas it can be challenging for them to be equally satisfied. However, SHT can enable the consumers to achieve energy efficiency while maintaining comfort through transparency of energy consumption and forecasting (Li et al., 2021; Kim et al., 2021).

2.3. Usefulness of Smart Home Technology

Smart home research has gained increasing interest from researchers in the past decade, alongside the technological developments that have advanced and enhanced IoT-enabled smart home solutions (Barbosa et al., 2020). Whether there is a cloud-based or local sensing device, the intent of smart solutions is to streamline domestic chores and processes, provide valuable insights, improve cost and energy efficiency, and provide long-term convenience and advantages to users (Furszyfer Del Rio et al., 2021). Some of the most common applications of Smart Home solutions today include smart Heating, Ventilation, and Air Conditioning (HVAC) systems, smart lights, smart meters, smart security systems, smart TV, and smart speakers (Al-Fuqaha et al., 2015; Sovacool et al., 2021). Additionally, advancing technologies solutions such as home robots, smart wearables, smart vehicles and drones, and smart healthcare solution are becoming increasingly common. The more smart devices implemented in the household, the more intelligent tasks and interactions can be performed (Guo et al., 2019). Smart entertainment and multimedia are also among the most adopted smart home technologies (Park et al., 2018b). Smart speakers and voice recognition devices have become more prevalent in recent years, with products such as Amazon's Alexa, Apple's Siri, and Google Home. Implementing AI in voice recognition technologies enables people to have conversational interactions with devices (Guo et al., 2019). The user can give commands to each connected device or directly to the AI that controls the devices. Guo et al. (2019) suggested that the former user pattern is usually beneficial to smart healthcare, security, and energy management, while the latter is beneficial for intelligent interactions and smart home automation.

Some researchers point out that smart home providers need to pay more attention to and study the consumer needs of smart home products and services more thoroughly (Luor et al., 2015). Nevertheless, for consumers to understand the usefulness of the smart home product or service, the benefits of the respective product or service must be clearly and elaborately communicated and demonstrated to the consumers and should not require significant changes or reshaping of their daily routines (Balta-Ozkan et al., 2013). As previous studies have shown, perceived usefulness has had a strong effect on the intention to use and attitude towards smart home technologies (Park et al., 2018b). Furthermore, consumers' awareness of the use of SHT can be essential to whether the products and services are successfully adopted and utilized (Hong et al., 2020). Research has implied that awareness is more critical for SHT adoption among adults and the elderly than among young people (Cannizzaro et al., 2020). Sovacool et al. (2021) pointed out that smart home technologies cover needs ranging from energy management to entertainment services, but question whether the technologies and applications are utilized to fulfill their potential. Moreover, unawareness and lack of technological understanding might restrict clear evaluations of the potential benefits and opportunities of smart home technologies among consumers, which in turn can negatively affect their perception of usefulness and ease of use of SHT (Nikou, 2019; Hong et al., 2020). A lack of experience and trust might also hinder consumers from seeing the potential usefulness of SHT (Marikyan et al., 2019). In contrast, if consumers are familiar with or aware of the ease of use, opportunities, and applicability of different smart home products or services, attitudes and intentions to adopt have been shown in research to increase as it can reduce uncertainty (Shuhaiber & Mashal, 2019). Shuhaiber & Mashal (2019) argued that consumers' awareness of smart home technologies and their ease of use has a considerable impact on their attitudes towards them. Hence, the importance of SHT providers to be aware of the socio-technical aspects of smart home technologies is a highly important factor in order to generate trust among consumers (Cannizzaro et al., 2020). This increases the importance of proper market commination and consumer education.

2.4. Ease of Use and Technological Literacy

The perceived ease of use of SHT is commonly discussed in literature and is often found to have a positive effect on SHT adoption (Aldossari & Sidorova, 2020; Gao & Bai, 2014). Despite the various opportunities posed by IoT and SHT, research also shows that SHT might not be beneficial to everyone. Findings from Furszyfer Del Rio et al. (2021) study suggested that smart home technologies might exclude those who struggle to adapt and learn new technologies and that they might not perceive the benefits of smart home technologies like those who have a better technological understanding. In Li et al. (2021) study on the motivations and barriers of smart home adoption, the findings showed that technological anxiety was one of the potential barriers to adoption. The authors especially pointed this out to apply to the elderly and other people with low technical literacy, with less experience and familiarity with the respective technology (Li et al., 2021). Hence, because of the complex technology behind the smart home solutions, researchers have emphasized the importance of seamless, automated, interoperative, well-implemented, and user-friendly smart home applications (Balta-Ozkan et al., 2013). Balta-

Ozkan et al. (2013) suggested implementing more intelligent and self-learning technologies that make the core technologies invisible to the end-users to reduce the perceived complexity of SHT. For instance, researchers have investigated how AI can be implemented into Smart Home systems to automate the management of several devices. Centralized intelligent control and management can be realized by analyzing the data of the user's behavior and patterns (Guo et al., 2019). However, despite the appearance of the SHT, some consumers still worry about errors or too complex applications that they are not equipped or skilled to resolve or use themselves (Oliveira et al., 2015).

2.5. Facilitating Conditions of Smart Home Technology

Literature on SHT adoption has also discussed the importance of infrastructure and support related to the respective SHT, facilitated by the technology itself or by the vendor. Furthermore, the facilitation of information exchange between the SHT vendor and the consumer has been identified in the literature as part of the infrastructure related to the implementation and use of SHT (Balta-Ozkan et al., 2013). Kim et al. (2017) found that these facilitating conditions of technical- and vendor support related to SHT had great importance in the adoption of SHT. The trust in smart home vendors has proved to also strengthen the effects of advice and support from friends, superiors, and peers on the intentions to use SHT (Yang et al., 2017). Aldossari and Sidorova (2020) suggested that lack of experience with SHT might cause the consumers to not perceive the need for supporting resources as a critical aspect of SHT adoption. Findings from Sovacool et al. (2021) suggested that people from lower-income groups perceive smart home technologies as non-essential household attributes that will increase reliance on external experts.

Interconnectedness and compatibility between different technologies are often described as part of the facilitating circumstances of SHT adoption (Nikou, 2019). The compatibility of technologies has also been identified to be an influential factor in adoption (Park et al., 2018b). This might involve the interconnectivity and compatibility of different software and hardware, for example, by different SHT vendors (Kim et al., 2021). The findings from Yang et al. (2018) and Barbosa et al. (2020) showed that interoperability is one of the main motivating factors for consumers to adopt smart home technologies. As defined by Peine (2008), smart homes are based on the interoperability of information and communications technology (ICT) in the household. Hence, as automated control and management of different smart devices and systems is an important part of smart homes, a lack of interoperability might cause significant drawbacks to usefulness and convenience for consumers (Balta-Ozkan et al., 2013; Peine, 2008). Nikou (2019) found that the level of compatibility of SHT also affected the consumers' perception of ease of use and the usefulness of the technology. Incompatibility might catalyze increased stress and frustration related to SHT, especially for those with less technical understanding. With frustration and stress surrounding SHT, perceived difficulty and complexity might increase and negatively affect the perceived usefulness and intention to adopt (Oliveira et al., 2015). Consumers with lower technological literacy and struggle to adapt to new technologies might experience an increased dependency on others to function the SHT (Sovacool et al., 2021).

2.6. Hedonic Motivation and Enjoyment of Use

According to previous studies, the perceived usefulness of smart technologies and smart home solutions depends on several factors. The consumers' enjoyment of using SHT has been pointed out to be an important intrinsic driver for adoption (Hsu & Lin, 2018). This factor has been described in the literature as perceived enjoyment of use, technological enthusiasm, or hedonic motivation regarding SHT. The hedonic motivation or enjoyment of SHT is considered the perceived fun and joy of using SHT beyond the mere convenience of the products or service (Mashal & Shuhaiber, 2018). Furthermore, technological enthusiasm, fascination, and enjoyment of SHT have been shown to be factors also impacting the perceived ease of use, relating to the consumer's technological literacy (Furszyfer Del Rio et al., 2021; Park et al., 2018b). Technological enthusiasm and the enjoyment of use are often recognized as factors positively affecting peoples' perceived value of smart home technologies and their intention to adopt them (Mashal & Shuhaiber, 2018). The more enjoyable the consumer experience the applications to be, the higher the perceived usefulness of the SHT (Park et al., 2018b). Aldossari and Sidorova (2020) found that the consumer's hedonic motivation is a central aspect of SHT adoption and highlighted the importance of considering user experience when designing smart home solutions. Paetz et al. (2012) also concluded in their study that technological enthusiasm for new technologies had a positive effect on motivations for SHT adoption. Venkatesh et al. (2012) identified hedonic motivation has having stronger impact on behavioral intention than performance expectancy for technology acceptance in a consumer-oriented context.

Furthermore, previous literature has suggested that one of the possible determinants of technological enthusiasm was income and personal economy (Furszyfer Del Rio et al., 2021).

2.7. Costs and Cost-savings

The considerations regarding costs related to SHT investments have been somewhat dualistic in the literature. Nonetheless, research suggested that cost is one of the determining factors of smart home adoption for consumers. The familiarity with SHT might affect how costs related to SHT are perceived. Uncertainty can potentially lead to cost-related concerns, while those familiar with the potential of SHT may more easily perceive its value (Hong et al., 2020; Sanguinetti et al., 2018). The perceived financial risk related to investing in SHT involves the risk of the investment not proving financially profitable (Hong et al., 2020). Despite positive attitudes toward smart products or services, cost concerns can become a delayer or barrier to adoption (Mashal & Shuhaiber, 2018). Research have implied that the costs related to purchasing, implementation, maintenance, repairs, energy consumption, and investment feasibility are common barriers to smart home adoption (Balta-Ozkan et al., 2013). Another consideration that can affect cost concerns in becoming a barrier to adoption is whether the user is a homeowner or a tenant, as tenants might be more restrained due to difficulties in easily bringing the systems and devices to new properties (Furszyfer Del Rio et al., 2021).

However, another side of the literature has suggested that the perceived value of SHT investments can be one of the leading drivers for adoption (Aldossari & Sidorova, 2020). When the investment in the SHT is considered to provide more benefits of use than the monetary cost, the technology might have a positive influence on the consumers' intentions to adopt (Venkatesh et al., 2012). Venkatesh et al. (2012) discussed this as a tradeoff between the monetary costs and perceived benefits of the respective technology, referred to as price value. Barbosa et al. (2020) found that price and cost-savings were among the top motivating factors that impacted the consumers to adopt SHT. However, the price was also among the top barriers to adopting SHT. With price being both a driver and a barrier to SHT adoption, the consumers' perceived benefits of the technology determine whether price functions as a driver or barrier. In cases of the price being the motivator, the monetary value is justified by the benefits of the technology (Aldossari & Sidorova, 2020). Moreover, the opportunities for energy-saving from SHT can reduce energy costs in the residence, and smart home healthcare can enable the elderly to live at home longer and reduce other expenses of institutional healthcare expenses (Li et al., 2021). Findings from a study by Aldossari & Sidorova (2020) showed that the respondents considered the benefits of SHT as more important than the price. Hence, the price value had a positive effect on the respondents' intention to adopt SHT. A study by Paetz et al. (2012) showed that monetary savings turned out to be the most important benefit to the focus group participants in regard to investing in SHT. Their findings also showed that the shorter the payback time and the higher the benefit of the SHT investment, the more positive the participants' evaluations became (Paetz et al., 2012).

2.8. Security and Privacy Risk

With the growing adoption of smart home technologies, trust issues regarding security and privacy remain among of the barriers related to IoT-based SHT adoption (Cannizzaro et al., 2020). Concerns related to the security and privacy of smart home technologies have been among the consumers' top concerns due to the fear of surveillance capitalism, privacy invasion, data protection, and vulnerability to hacking (Furszyfer Del Rio et al., 2021). Several studies still implied a divide in peoples' perspectives on security, privacy, and safety-related to SHT (Sovacool et al., 2021). Whereas security concerns and risks related to privacy are often suggested to be among the top barriers to SHT adoption, it can also provide an increased sense of safety and security at home (Cannizzaro et al., 2020), and smart home technologies can also provide improved home safety and security and health security (Sovacool et al., 2021). Literature highlighted such attributes as smart alarm systems and locks that can improve home security, smart health applications that can enhance home safety, and other smart technologies that can enable the detection of fire, gas leakages, earthquakes, and other incidents (Sovacool et al., 2021).

Since smart homes collect significant volumes of data from the daily life of the residents, security and privacy, and trust in the smart home vendors have become a central topic (Chen et al., 2020; Aldossari & Sidorova, 2020). Findings from Geeng & Roesner (2019) showed that the privacy concerns of the participants were clearly more centered around the risk of companies collecting and using the data than on interpersonal privacy concerns. Barbosa et al. (2020) found that only a total of only 11% of their respondents perceived security and privacy as a motivating factor for SHT adoption, while 50% believed that security and privacy concerns could prevent them from adopting. Moreover, Yang et al. (2017) stressed the importance of a sense of security and privacy among consumers. As the home is a safe space for people, they are particularly protective and sensitive if they experience a lack of trust, risk, uncertainty, or lack of control. Therefore, consumers might not desire automated control and management of security systems in their homes, as being able to control the systems themselves would provide them with more trust and a sense of control (Yang et al. 2017). Findings from Shuhaiber & Mashal (2019) and Aldossari and Sidorova (2020) showed that perceived risk related to security and privacy concerns has a significant negative effect on the respondents' trust in SHT, affecting the intentions to use SHT. Relatedly, the findings from Bhati et al. (2017) also highlighted security and privacy risks as a central concern among the respondents, explained by the sensitivity of data and stability for SHT solutions like smart healthcare.

2.9. Social Influence

Commonly discussed in the SHT adoption literature is the effect of social influence on intentions to use and adopt. The social influence has shown to have a positive effect on adoption and can involve the effects that people who are close to or important to the consumer have on the consumer's perceptions and decisions regarding SHT (Aldossari & Sidorova, 2020). Besides social influence coming from family and friends, peers, social networks, or mass media are also sources of social influence (Gao & Bai, 2014). The findings from a study by Aldossari and Sidorova (2020) showed that social influence from people close to one had a positive effect on attitudes and intentions to use SHT. The authors also pointed out that positive experiences with SHT that are shared with people within the same social circle also had a positive effect on attitudes towards SHT (Aldossari & Sidorova, 2020). Furthermore, as pointed out by Li et al. (2021), social influence is especially relevant in the initial stages of the decision-making process due to the lack of experience and familiarity with the technology. Other studies have also found significant positive effects of social influence on SHT adoption (Mayer et al., 2011; Chen et al., 2020). Additionally, Mayer et al. (2011) found that gender had a moderating effect on social influence, as women were more prone to social influence than men. Gao and Bai (2014) identified social influence to have the second strongest effect on behavioral intention. Sharing experiences and following consumer trends are central aspects of social influence that can impact adoption (Gao & Bai, 2014).

Contrarily, researchers have also studied the impact of the effects of negative social influence on the adoption of technology. Li et al. (2021) identified negative social influence as one of the barriers to SHT adoption n, as consumers can be socially influenced, affecting their judgments of new innovations or products. As Vrain and Wilson (2021) discussed in their study, non-users of SHT were found to get information about SHT from social sources. Howbeit, their access to experience with the technologies were limited due to a limited number of adopters in their social networks (Vrain & Wilson, 2021). Nevertheless, Li et al. (2021) stated that the dimension of social influence on the adoption of SHT is a field that needs more research.

3. Method

Based on the previously defined research questions and hypotheses, this section proposes a theoretical background and research design adequate for obtaining the necessary data to make sufficient analyses. The research design for this study was described, explained, and justified based on the purpose of the study and the availability of data. Prior to the primary data collection, a systematic literature review was conducted to provide an overview of the most relevant research on the research topic, associated sub-topics, and pertinent theories and models (Snyder, 2019; Haddara & Zach, 2011). The literature review is concept-centric, organized by concepts and topics. This way, key findings from the research could be compared and substantiated (Webster & Watson, 2002). The articles included in the literature review were mainly retrieved from MISQ, JSTOR, IEEE Xplore, EBSCOhost, and Google Scholar. To narrow the search, a selection of keywords was used, including smart home, smart technologies, IoT, smart home adoption, technology acceptance, UTAUT2, barriers and drivers of technology adoption, Norway, and intelligent home technologies. The selected articles were published in the years between 2008 and 2022. In addition, a backward search was used to gain a deeper understanding of the research topic and sub-topics. The secondary findings from the literature review provided insights and an understanding of the research topic. Hence, a research model was selected based on this foundation of literature, which is presented in Section 3.1.

3.1. Theoretical Background

Using a theoretical framework helps to understand the users' perspectives and attitudes on the use and adoption of smart homes and to ensure relevant data collection. For this purpose, the research model for this study was based on the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) with some modifications and extensions for the context of this study (Venkatesh et al., 2012). The Unified Theory of Acceptance and Use of Technology was originally introduced in 2003 by Venkatesh et al. (2003). The model intended to combine the elements from existing adoption models within information systems literature (Kavandi & Jaana, 2020). The original model consists of the factors "Performance Expectancy", "Effort Expectancy", "Social Influence", and "Facilitating Conditions", which affect the "Behavioral Intention" of using the respective technology (Venkatesh et al., 2003). The UTAUT2 was presented in 2012 as a newer version of the original UTAUT with a focus on consumer adoption and use of technology, with three additional factors "Hedonic Motivation", "Price Value", and "Habit" (Venkatesh et al. 2012). The UTAUT2 was chosen as an appropriate fundament for this study's research model due to its coverage of critical topics or constructs that were disclosed in the literature review and its ability to measure consumers' acceptance, attitudes, use, and adoption of technology. As this study targeted a population that includes both consumers who have experience or habits related to the use of SHT and those who do not, the "Habit" construct was excluded from the research model for this study. Furthermore, due to the findings in previous literature on SHT, "Security/Privacy" and "Energy Management" were included as two additional constructs (Figure 1). The Behavioral Intention construct entailed the intention to use and adopt smart home technology for the non-users, and to continue to use and adopt more smart home technologies in the future for those who were already users of SHT.

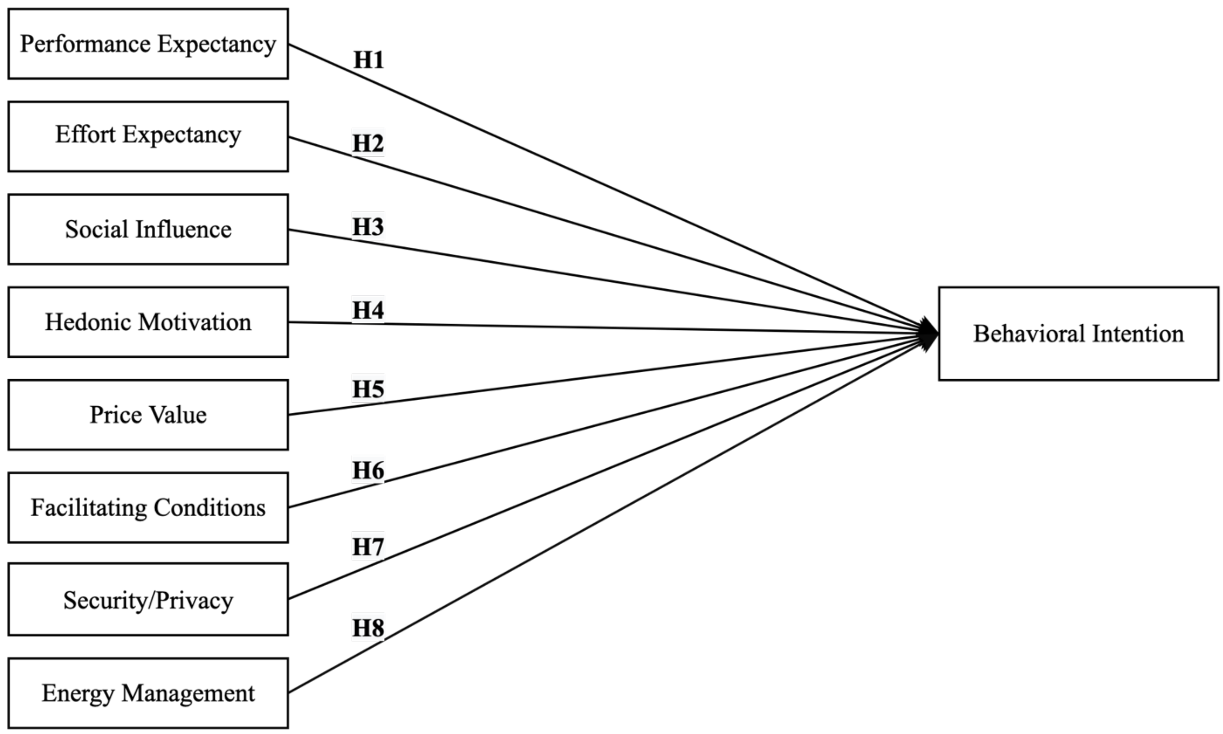

Figure 1*: Research model: A version of the UTAUT2 (Venkatesh et al., 2012), modified to the context of this study.*

Performance Expectancy (PE): The performance expectancy construct entails how useful and helpful the consumer considers smart home technology to be, and whether it is beneficial for solving certain tasks (Venkatesh et al., 2012).

Effort Expectancy (EE): Effort expectancy concerns the consumer's use of smart home technology, and to which extent the consumer experiences ease of use or difficulties related to the use of smart home technology (Venkatesh et al., 2012).

Social Influence (SI): Social influence construct concerns the influence others have on the consumer's intention and use of smart home technologies. This entails influence by family or friends, or by other peers (Venkatesh et al., 2012).

Hedonic Motivation (HM): The hedonic motivation concerns the perceived enjoyment of using smart home technology. This construct has been shown to influence the acceptance and use of technologies (Venkatesh et al., 2012).

Price Value (PV): The price value construct refers to a cognitive tradeoff that consumers face between the advantages and the monetary cost of acquiring and using the smart home technology (Venkatesh et al., 2012).

Facilitating Conditions (FC): The facilitating conditions construct represents the consumer's perception of the availability of support and resources related to smart home technology (Venkatesh et al., 2012).

Security/Privacy (SP): The privacy and security construct is an additional factor for the context of this study. Based on findings from previous relevant literature regarding the use and adoption of smart home technology, privacy and security have shown to be of importance for consumers' attitudes and intentions of using technology (Furszyfer Del Rio et al., 2021).

Energy Management (EM): The energy management construct is another additional construct included as a result of the literature review findings. Energy management is a highly central part of smart technology in general, and a fundamental part of smart homes (Wilson et al., 2017).

Based on the literature review, the research model, and previous studies using the UTAUT2, these hypotheses were defined:

H1: Performance Expectancy significantly affects behavioral intention toward smart home technology adoption.

H2: Effort Expectancy significantly affects behavioral intention toward smart home technology adoption.

H3: Social Influence significantly affects behavioral intention toward smart home technology adoption.

H4: Hedonic Motivation significantly affects behavioral intention toward smart home technology adoption.

H5: Price Value significantly affects behavioral intention toward smart home technology adoption.

H6: Facilitating Conditions significantly affect behavioral intention toward smart home technology adoption.

H7: Security and Privacy significantly affect behavioral intention toward smart home technology adoption.

H8: Energy Management significantly affects behavioral intention toward smart home technology adoption.

3.2. Research Design and Approach

The research design of this study consists of a mix of quantitative and qualitative methods. This research design is often referred to in the literature as a "sequential quantitative-qualitative mixed-method research design" (Figure 2). It provides a broad foundation of data to facilitate an insightful understanding of the respective research field (Venkatesh et al., 2016). By combining of quantitative and qualitative data collection, it was possible to gather comprehensive data from the respective market and more detailed and elaborative data from both consumers and industry professionals and obtain insights about tendencies in the market. Hence, perspectives from both the consumer- and the provider side of the market enabled a broader understanding of attitudes, perspectives, and behavior and provided a more solid foundation of data for analysis and discussion. Furthermore, the interviews enabled elaboration on topics and trends from the survey. Hence, the methods were complementary, covering different aspects of data collection.

The validity of the research entails that the data collection was conducted in an appropriate way, that the findings were generated by the data, and that the findings answered the research questions. To enhance the validity of the research, more than one data generation method was used to provide several channels for insights into the research topic. This is referred to as method triangulation (Oates, 2006). The validity of the methods is further elaborated on within the following sections.

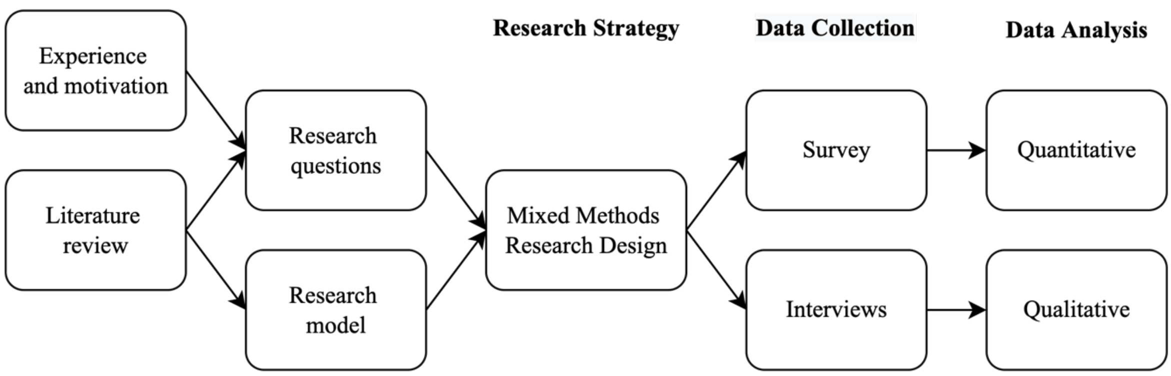

Figure 2*: Research process (Oates, 2006).*

3.2.1. Quantitative Method

By using a survey as a quantitative research method for this study, the goal was to obtain insights and knowledge about how consumers in Norway perceive and use smart technologies and get indications of the main barriers and drivers of SHT adoption in this market. By identifying patterns, trends, and tendencies in the collected data, quantitative research methods could, through different data analyses, provide insights into a population based on a representative sample of respondents that can be generalized for the population. Quantitative research usually consists of numeric data that is obtained through data collection methods such as surveys (Gripstud et al., 2016; Oates, 2006). Whereas quantitative data analyses require standardized and systematic data collection from a relatively large number of respondents, the target group for this study included Norwegian citizens with different occupations, ages, income levels, and locations (Oates, 2006).

3.2.2. Quantitative Data Collection

In order to compose a well-designed questionnaire that was suitable for this study, the questions or items were adapted from or inspired by relevant literature on SHT adoption (Table 1). Hence, the question phrasings were based on inspiration from questionnaires that have been tested in previous studies. The survey contained closed-ended questions to generate pre-coded data that could more easily be analyzed (Oates, 2006). The survey was carefully constructed and presented in a structured order that would be logical for the respondents. Besides questions regarding the constructs in the research model, questions regarding demographics were also included to give insights the respondents' general demographical backgrounds and the sample's representativeness for the population. The response choices for the demographical questions were categorized as brief answers that could group the respondents into generalized pre-determined demographical clusters. This enabled descriptive statistics about the survey respondents and whether there was any critically disproportionate representation of respondents from certain demographical groups. Questions about demographics were constructed as multiple-choice, allowing only one answer. The questions related to the research model were constructed as statements with a 5-point Likert-scale ranging from "strongly disagree" to "strongly agree". This provided numerical values that were later analyzed. One rank-order question regarding the importance of attributes of SHT was included at the end of the survey to provide additional insights into the respondents' priorities. The alternatives were defined based on literature (Appendix A).

The survey was constructed in Qualtrics, as it did not collect any personal information or other data that could identify the respondents. Before publishing the survey, the responses were also anonymized in Qualtrics' settings to make sure no IP-addresses could be collected. This ensured that all responses were completely anonymous and aligned with Kristiania University College's regulations. The distribution of the survey entailed sharing on social media platforms such as Facebook, Instagram, LinkedIn, Snapchat, and Mattermost. In addition, email and direct messages were used for distribution. The survey was also published on Amazon's MTurk limited to Norway. Howbeit, this did not generate any responses.

The internal validity was measured by content validity and construct validity. Content validity measures how well the survey generates relevant and valuable insights for the research topic. Therefore, questions covering all constructs of the research model and other relevant questions were included in the survey to make sure the questions covered all the important aspects needed to answer the research questions. Construct validity involves how accurately the questions measure the desired metrics (Oates, 2006). To ensure construct validity, every construct from the research model was represented by three questions.

For the findings to represent the targeted population, external validity was checked. Therefore, a pilot study was done to check that the questions measured the respective constructs that they were intended to measure and to ensure mutual understanding of the questions and relevance for the research project. This was done by distributing the survey to 20 representative respondents and uploading the data into the software to test whether the measurements aligned with the intentions. However, it was discovered that the execution of the pilot study was too weak to discover the survey's insufficiencies. Despite that the survey had already been distributed, it was therefore concluded that the survey should be stopped and a new survey should be conducted. Hence, a new pilot study of 35 respondents was conducted and analyzed for the new survey, which was then accepted for further analysis. The questionnaire was also shown to an experienced researcher and to an expert in the topic for validation of questions and structure (Oates, 2006). The feedback was then reviewed, and necessary changes to the survey were made before distributing it further.

The respondents and sample size were determined by the reach of the researcher's network and the ability to distribute the survey widely. These observations should be considered when evaluating the generalizability of the findings. The sample consisted of 104 respondents who answered the survey, of which 100 respondents were left after the data cleaning, including 52 men and 48 women. Ideally, the total number of respondents would be higher in order to better represent the respective population. Still, the number of respondents achieved in this study is viable to provide insights into the population.

Item	Question	Reference
Performance Expectancy		
PE1	“Smart home technology is useful”	(Venkatesh et al., 2012; Shuhaiber & Mashal, 2019; Nikou, 2019)
PE2	“Smart home technology will simplify tasks at home”	
PE3	"Smart home technology will increase convenience at home"	
Effort Expectancy		
EE1	"Learning how to use smart home technology is easy for me"	(Venkatesh et al., 2012; Shuhaiber & Mashal, 2019; Slettemeås, 2019)
EE2	"Using smart home technology is easy for me"	
EE3	“I (would) master the use and control of smart home technology”	
Hedonic Motivation		
HM1	“Using smart home technology is/would be entertaining”	(Venkatesh et al., 2012; Hsu & Lin, 2018)
HM2	“I (would) enjoy using smart home technology”	
HM3	"I (would) have fun using smart home technology"	
Social Influence		
SI1	“People who influence my behavior think I should use smart home technology”	(Venkatesh et al., 2012)
SI2	“People whose opinions I value think I should use smart home technology”	
SI3	"People who are important to me think I should use smart home technology"	
Price Value		
PV1	“Smart home technology is reasonably priced”	(Venkatesh et al., 2012; Hsu & Lin, 2018)
PV2	“Smart home technology provides good value for the price”	
PV3	"Smart home technology is worth the price"	
Facilitating Conditions		
FC1	“I have access to the necessary resources to use smart home technology”	(Venkatesh et al., 2012; Gao & Bai, 2014)
FC2	“I have the necessary knowledge to use smart home technology"	
FC3	“I can get the necessary help if I have difficulties related to smart home technology”	
Energy Management		
EM1	"Energy management is important to me for using smart home technology"	(Based on literature findings for the context of this study)
EM2	"It is important for me to control and monitor the energy consumption in my home"	
EM3	"Smart home technology is effective in managing energy consumption"	
Security and Privacy		
SP1	“Smart home technology is safe to use (safe from unwanted surveillance, hacking, viruses, etc.)”	(Based on literature findings for the context of this study)
SP2	“Smart home technology will not make me digitally vulnerable”	
SP3	"Smart home technology maintains my security and privacy"	
Behavioral Intention		
BI1	“I intend to use smart home technologies within near future”	(Venkatesh et al., 2012; Chen et al., 2020; Nikou, 2019)
BI2	“I will adopt smart home technologies within the next few years”	
BI3	"I will use smart home technology in my daily life"	

***Table 1**: Overview of items and references.*

3.2.3. Quantitative Data Analysis

First and foremost, the data was imported as an SPSS file from Qualtrics and uploaded into SPSS. In order to ensure a good quality of the data, the dataset was checked for incomplete responses and unnecessary fields. The headers and labels were abbreviated and adjusted to tidy the dataset. Then, descriptive statistics were conducted to obtain insights about the survey's respondents using tests including independent-samples t-test, compare means, descriptive statistics, and frequency. Additionally, SPSS was used for testing Common Method Bias (CMB).

The dataset was then saved as a comma-separated .csv-file to do a Partial Leas Square Structural Equation Modelling (PLS-SEM) confirmatory factor analysis (CFA) in SmartPLS version 3.3.9 to test the hypothesized relationships between constructs and evaluate the model (Ringle et al., 2015). PLS-SEM consists of predefined relationships between constructs and the items that measure them (Levallet & Chan, 2016). PLS-SEM also works well for small sample sizes and does not assume normality in the dataset (Hair et al., 2021). Since this study aimed at examining the use and adoption of SHT in Norway through an extended and modified version of the UTAUT2, PLS-SEM was an appropriate approach as it is effective for theory building or development and prediction of the constructs (Hair et al., 2021). This was done in a two-stage process where the first stage assessed the measurement model while the second stage assessed the structural model. The measurement model concerned testing the reliability and validity of the constructs, while the structural model tested the hypothesized relationships between the constructs and the effects of the structural model (Hair et al., 2021). The procedure for assessing the structural model included assessing collinearity issues, the significance, and relevance of relationships, explanatory power, and predictive power (Hair et al., 2021).

3.2.4. Qualitative Method

Qualitative research usually consists of non-numeric data that can be extracted from data collection methods such as case studies, in-depth interviews, focus groups, document analyses, and experiments (Oates, 2006). With the exploratory character of qualitative research methods, this data collection methods could be suitable for obtaining deeper insights and understanding of the participants' thoughts, behaviors, attitudes, and restraints regarding the research topic, and to look for themes, phenomena, or categories in the data (Oates, 2006; Gripstud et al., 2016). Withal, for qualitative research methods, the researchers' skills to analyze the data for themes and categories are more determining for the research's quality. By using interviews as a qualitative research method in this study, in-depth insights could provide a valuable supplement to the survey as it provided a deeper understanding of the topics that were not revealed through the survey. Moreover, the interviews could also reveal or elaborate on key sub-topics that the survey did not cover or did not provide detailed information on.

3.2.5. Qualitative Data Collection

The qualitative data collection consisted of ten interviews with five experts and five consumers, conducted in the period between November 2021 and May 2022. The participants included smart home experts with relevant industry experience within IoT, SHT, and Smart City-related industries in Norway with years of insight and experience in their field. The experts were interviewed to provide insights into the suppliers' side of the Norwegian SHT market and provide perspectives on current and expected smart home-related consumer trends.
Interviews with consumers were conducted to provide a deeper understanding of their attitudes, perspectives, behavior, and intentions related to SHT. Since surveys provide limited details in the respondents' answers, interviews enabled consumers to elaborate (Oates, 2006). The aim of collecting qualitative data from both consumers and vendors was to obtain a thorough understanding and knowledge of the Norwegian SHT market based on consumers' attitudes and behaviors to SHT and the vendors' perspectives of the market and customers. Hence, through analysis of this data, insights about potential variations in perspectives among consumers and vendors could be revealed, and critical insights about the research topic could be discovered and help answer the research questions.

In order to find relevant and interesting participants from the vendor side, the snowball sampling technique was used. This technique is effective in locating interview objects of populations by asking participants for further recommendations of acquaintances who are relevant and interesting to the study (Oates, 2006). The sampling size was initially decided to be between five and ten industry professionals based on the capacity of the researcher and the responses from those who were approached. Due to difficulties in getting responses from potential interview objects that were contacted, the snowball sampling technique was crucial for achieving a sufficient number of interviews with relevant participants, resulting in five experts. Ideally, a higher number of participants would have been interviewed in the study to create an even better understanding of the smart home and IoT industry in Norway. The consumer-participants were found through stratified sampling, where the participants were chosen to represent different demographics within the population (Oates, 2006). Five consumers were interviewed, which all ensured that they had responded to the survey as well. Hence, the interviews could elaborate on the respective topics beyond the data collected through the survey.

The interviews were semi-structured, allowing additional questions to be asked and answered besides a set of pre-defined questions. The order of questions could thus be changed depending on the progress of the interviews. Before the interviews, an interview guide was outlined to ensure that essential topics were covered and that the questions were formulated to be relevant and open-ended (Oates, 2006). Additionally, follow-up questions and relevant questions of explanations or elaborations were included along with the interviews. Resultingly, sub-topics, details, and challenges could be discovered while still having some interview guidelines through defined questions and topics to reduce the risk of missing out on essential information (Oates, 2006).

All participants were provided with a consent form prior to the interviews that they signed, with information regarding the research project, the data handling, the research project process, and their rights. The interviews were conducted via Microsoft Teams or Zoom due to the social regulations caused by the COVID-19 pandemic and the availability of the participants. The duration of the interviews was between 30-60 minutes. The interviews were recorded using the Diktafon application, transcribed and translated for further data analysis, and all the participants were anonymized. Hence, the participants will be referred to as "EXP1, EXP2, …" for the Experts and "CON1, CON2, …" for the Consumers instead of their personal name or company name to preserve their anonymity (Table 2). The quotes that were relevant to include in the study were then checked with the participants in a citation check to ensure an aligned and correct understanding of the discussed topics. Furthermore, the qualitative data were also checked against other sources to ensure that the stated facts were correct (Oates, 2006).

#Nr.	Role	Affiliation/Knowledge	Date of interview	Code
1	CEO	Smart home technology vendor	26.11.2021	EXP1
2	Head of Smart Cities	Smart technology organization, smart homes in a smart city context	01.03.2022	EXP2
3	Head of Sales	Smart home technology vendor	16.03.2022	EXP3
4	Head of Business Development	Smart home technology vendor	16.03.2022	EXP4
5	Product Manager	Smart home technology vendor	03.05.2022	EXP5
6	Consumer	Extensive knowledge about smart home technology and home automation, uses many automated solutions.	24.03.2022	CON1
7	Consumer	Good knowledge about smart home technology, uses some solutions.	02.04.2022	CON2
8	Consumer	Some knowledge about smart home technology, uses a few solutions.	04.04.2022	CON3
9	Consumer	Limited knowledge about smart home technology, do not use.	09.04.2022	CON4
10	Consumer	Some knowledge about smart home technology, uses a few solutions.	23.04.2022	CON5

***Table 2**: Overview of participants.*

3.2.6. Qualitative Data Analysis

In order to identify underlying patterns, connections, themes, and sub-themes in the qualitative data beyond the topics in the research model, a thematic analysis was used (Braun & Clarke, 2006). The thematic analysis is a useful method for finding and analyzing variations, differences, and similarities in the participants' perspectives regarding the respective topics (Nowell et al., 2017). A deductive approach was used to do the qualitative data analysis, whereas the questions were mainly centered around the research model's topics. Additionally, the thematic analysis focused on discovering and capturing themes and sub-topics beyond what was covered by the pre-defined questions in the interview guide (Oates, 2006).

According to Braun and Clarke (2006), there are six phases of a thematic analysis, including familiarizing with the interviews, coding the data, searching for themes in the data, reviewing the themes, defining the themes, and reporting. The qualitative raw data collected from the semi-structured interviews was unorganized and chaotic. Therefore, it was necessary to familiarize with, code and categorize the data to enable insight and contextualization of the data. Hence, after transcribing the interviews, the data was coded by identifying and labeling essential themes and topics of data that were talked about in the interviews. This involved topics that were brought up in the pre-defined questions or other relevant topics that the participants' brought up themselves. The overreaching topics corresponded with the construct from the research model, but the thematic analysis enabled additional themes and sub-topics to be explored. The themes were then reviewed and defined. Since there is a risk of overlooking themes and patterns with a deductive approach, the researcher needed to be extra attentive.

Measuring the validity of the interviews can be somewhat tricky due to a lack of objectivity and consistency (Oates, 2006). However, some elements can be evaluated to check if the interviews are appropriate for the research, including the participants' experience in and relevance to the research topic, the context in which they were held, and the information the participants were provided about the project in advance. Howbeit, these evaluations do still rely on the subjective interpretation of the researcher (Oates, 2006). In consideration of this, the interview guide was designed to correspond to the study's objectives with clearly defined questions (Appendix B).

3.3. Research Philosophy

The underlying research paradigm explains a shared way of thinking about the world and about specific aspects of it. The paradigms also tell something about how the world is perceived, how to acquire knowledge about it, and which strategies are appropriate to use in to acquire this knowledge (Oates, 2006). The most common underlying philosophical paradigm in research is positivism, which also applies to large parts of this study. The scientific method assumes that the world exists independently and can be studied objectively. Further, positivism seeks patterns, regularities, and generalization to explain and describe the world through hypotheses, testing, findings, and conclusions (Oates, 2006). With the mixed methods research design of this study, a part of the research might not be applicable to this view. Due to some degree of interaction and personal interpretation of semi-structured interviews in the qualitative method, total objectivity might be compromised. As an alternative, interpretivism is another research paradigm that is suitable for this type of research, whereas the view of the word depends on the person who sees, affected by social and contextual factors. In this view, the researcher is not neutral and objective due to the bias caused by experiences, interactions, and theoretical frameworks (Oates, 2006). Despite the social and contextual factors that can affect the qualitative method, this study aimed at keeping an objective perspective that can facilitate generalizations for SHT adoption and use. By providing detailed research, other researchers can evaluate whether the research applies to their context.

3.4. Ethics in Research

In research, it is important for the researcher to work and behave in accordance with ethical considerations (Oates, 2006). The data collection for this project is approved by Norwegian Centre for Research Data (NSD). This application was to ensure the accuracy and correctness of the qualitative analysis, as the capacity of a single researcher is limited in an interview setting. With NSD's approval of the project and the participants' consent, the interviews could be recorded. Hence, the researcher was able to moderate the interviews properly while transcribing the interviews from the recordings afterward. This way, the participants' privacy and data protection was assured while also ensuring the correctness and accuracy of analyses and quotes. As previously mentioned, Qualtrics was used since no personal information or other data specific enough to identify the respondents was gathered in the survey. The settings were adjusted to anonymize the survey responses in order to stop the software from collecting any of the respondents' IP-addresses. Based on these considerations, NSD concluded it was not necessary to apply for approval for the survey.

In order to make sure the interview participants were aware and adequately informed about what their participation and rights entailed, a consent form was provided to them in advance of the interviews (Appendix C). The consent form informed the participants about their rights regarding their participation in the study, to withdraw from participating, to be anonymous, rights to confidentiality, and their rights to give consent. All participants signed the consent form prior to the interviews. The quotations included in the findings section were sent to the participants to ensure alignment in the participants' and the researcher's understandings of the quotes. The respondents in the survey were also introduced to an information page before starting on the actual questions of the survey. This page contained information about the research, how the data would be handled, their anonymity, the purpose of the data collection, and contact information to the researcher and to NSD.

The ethical responsibilities of the researcher were assured by considering Oates' (2006, p. 60) list of a researcher's duties, including "no unnecessary intrusion" of the researcher, whereas the researcher only asked questions that were of interest to the research topic. Further, the researcher should "behave with integrity", involving true handling and presentation of the study's findings. The researcher should also avoid any form of plagiarism at all costs, and proper referencing should be practiced.

4. Study Findings

In this section, the quantitative and qualitative findings are presented separately. The quantitative findings are presented in sub-section 4.1., while qualitative findings are presented in sub-section 4.2.

4.1. Quantitative Findings

This section presents the findings from the quantitative data collection and analysis. The interpretations and discussion of the findings are further discussed in section 5. This section consists of descriptive statistics presented in sub-section 4.1.1., and model assessment presented in sub-section 4.1.2.

4.1.1. Descriptive Statistics

The descriptive statistics provided insights and an overview of the distribution of respondents in the survey based on socio-demographical characteristics. The descriptive statistics also gave an overview of tendencies in behavior, attitudes, and use of SHT among the respondents.

Respondents' profiles

The demographical factors of the respondents are shown in Table 3 and gives an overview of the distribution of the respondents' age, gender, location (part of Norway), highest completed education, occupation, income (before taxes), homeownership, and residence type. The overview in Table 3 clearly shows that some demographical factors contained a disproportionate distribution. Resultingly, respondents of 66 years of age or older (2%) and people who are retired (4%) were not highly represented. Furthermore, people living in Northern Norway (1%) were also underrepresented.

Demographics		n	%
Age	18-25	22	22%
	26-35	19	19%
	36-45	11	11%
	46-55	26	26%
	56-65	20	20%
	66 or older	2	2%
Gender	Male	52	52%
	Female	48	48%
Income	100.000NOK or less	9	9%
	101.000-300.000NOK	15	15%
	301.000-500.000NOK	16	16%
	501.000-700-000NOK	22	22%
	701.000NOK or more	38	38%
Occupation	Student	21	21%
	Working	75	75%
	Retired	4	4%
Education	Upper secondary school	26	26%
	Bachelor's degree	49	49%
	Master's degree	15	15%
	PhD	2	2%
	Other	8	8%
Ownership	Owner	71	71%
	Tenant	25	25%
	Live at the residence for free	4	4%
Recidencial type	House	56	56%
	Appartment	41	41%
	Other	3	3%
Location	Eastern Norway	65	65%
	Western Norway	10	10%
	Southern Norway	14	14%
	Northern Norway	1	1%
	Central Norway	10	10%
Use	Yes	79	79%
	No	21	21%

***Table 3**: Descriptive statistics of age, gender, location, education, occupation, income, homeownership, residence type, and use.*

Respondents' behaviors

The respondents were asked whether they currently use SHT and which technologies they use. Out of the total 100 respondents, 79 respondents answered that they used SHT, while 21 did not use any. Through a frequency calculation in descriptive statistics, the findings showed that smart entertainment/multimedia was clearly the most commonly used by 71% of the respondents, followed by smart security systems (38%) and connected car (36%). The least common smart home technologies used by the respondents were smart healthcare technologies, integrated smart home system, and other types of SHT that were not listed in the question. Furthermore, only 17% answered that they used smart energy management (Table 4).

	Smart home technology	% of respondents
Which smart home technologies do you currently use?	Smart entertainment/multimedia	71%
	Smart security system	38%
	Connected car	36%
	Smart lights	29%
	Smart heating, ventilation, or air conditioning (HVAC)	29%
	Smart speaker	24%
	Home robots	21%
	Smart energy management	17%
	Integrated smart home system	11%
	Smart healthcare technology	7%
	Other	5%
	None of the above	14%

Table 4: *Use of smart home technologies among respondents.*

Respondents' attitudes

Comparing means was used to gain more insight into the distribution of SHT use between the different demographical groups, looking at N and mean for each technology distributed across groups. The mean and the standard deviation for the questions were based on a 5-point Likert-scale, whereas 1 equals "strongly disagree" and 5 equals "strongly agree" relative to the statements presented in the questions. The standard deviation shows the dispersion relative to the mean. The findings showed that the young- and middle-aged adults are more focused on energy management than the youngest and the oldest age groups (Table 5). Another observation showed that the respondents in the higher-income groups had a higher mean price value perception than the respondents in the lower-income groups (Table 6).

Age		EM1	EM2	EM3
18-25	Mean	3.36	3.36	3.32
	N	22	22	22
	Std.Dev.	0.79	0.953	0.78
26-35	Mean	3.89	3.89	3.47
	N	19	19	19
	Std.Dev.	0.994	1.1	0.905
36-45	Mean	4.09	3.91	3.82
	N	11	11	11
	Std.Dev.	0.539	0.701	0.874
46-55	Mean	3.81	3.88	3.96
	N	26	26	26
	Std.Dev.	0.895	0.864	0.774
56-65	Mean	3.80	3.90	4.00
	N	20	20	20
	Std.Dev.	1.152	0.852	0.725
66 or older	Mean	2.50	2.00	2.50
	N	2	2	2
	Std.Dev.	0.707	1.414	0.707
Total	Mean	3.73	3.74	3.69
	N	100	100	100
	Std.Dev.	0.941	0.96	0.849

***Table 5**: Focus on EM compared among age groups.*

Income		PV1	PV2	PV3
100.000NOK or less	Mean	2.33	2.78	2.67
	N	9	9	9
	Std.Dev.	1	0.972	1
101.000-300.000NOK	Mean	2.67	2.87	2.87
	N	15	15	15
	Std.Dev.	0.976	0.834	0.99
301.000-500.000NOK	Mean	2.69	2.88	3.13
	N	16	16	16
	Std.Dev.	0.873	0.806	0.806
501.000-700.000NOK	Mean	3.00	3.14	3.18
	N	22	22	22
	Std.Dev.	0.926	0.834	0.733
701.000NOK or more	Mean	3.00	3.26	3.29
	N	38	38	38
	Std.Dev.	0.838	0.685	0.611
Total	Mean	2.84	3.07	3.12
	N	100	100	100
	Std.Dev.	0.907	0.795	0.782

***Table 6**: Perceived PV compared among income groups.*

Furthermore, respondents who were homeowners perceived SHT for energy management as more important and effective than the tenant respondents. Additionally, the means for price value was also measured higher among the respondents who own their residence, and the behavioral intention was also somewhat higher among homeowners (Table 7).

Home ownership		PV1	PV2	PV3
Owner	Mean	2.92	3.13	3.20
	N	71	71	71
	Std.Dev.	0.89	0.792	0.71
Tenant	Mean	2.68	2.88	2.92
	N	25	25	25
	Std.Dev.	0.988	0.833	0.954
I live at my current residence for free	Mean	2.50	3.25	3.00
	N	4	4	4
	Std.Dev.	0.577	0.5	0.816
Total	Mean	2.84	3.07	3.12
	N	100	100	100
	Std.Dev.	0.907	0.795	0.782

Home ownership		EM1	EM2	EM3
Owner	Mean	3.82	3.80	3.83
	N	71	71	71
	Std.Dev.	0.976	0.95	0.845
Tenant	Mean	3.56	3.60	3.36
	N	25	25	25
	Std.Dev.	0.821	0.957	0.81
I live at my current residence for free	Mean	3.25	3.50	3.25
	N	4	4	4
	Std.Dev.	0.957	1.291	0.5
Total	Mean	3.73	3.74	3.69
	N	100	100	100
	Std.Dev.	0.941	0.96	0.849

Table 7*: PV and EM compared to homeownership.*

An independent-sample t-test and compare means were used to test the means between two groups (Landau et al., 2004). This test was intended to compare the means between users and non-users of smart home technology. Observation showed that despite non-users not having high behavioral intentions to start using SHT, they did still consider the ease of use of SHT relatively high in comparison (Table 8). A question with the statement "I am familiar with SHT and its usability" (represented by "Familiarity" in Table 8) revealed that the awareness of and familiarity with SHT among the non-users were considerably lower than for the users. Additionally, the mean for SI among non-users was shown to be considerably lower among the users (Table 8).

Use		BI1	BI2	BI3	PE1	PE2	PE3	EE3	EE2	EE1	SI1	SI2	SI3	Familiarity
Yes	Mean	4.09	4.01	4.10	4.23	4.13	4.03	4.03	4.14	4.10	3.04	3.22	3.11	4.04
	N	79	79	79	79	79	79	79	79	79	79	79	79	79
	Std.Dev.	0.963	0.993	0.969	0.847	0.868	0.847	0.891	0.763	0.727	0.967	0.943	0.92	0.953
No	Mean	2.71	3.00	2.57	3.38	3.52	3.33	3.76	3.33	3.76	2.52	2.24	2.29	2.90
	N	21	21	21	21	21	21	21	21	21	21	21	21	21
	Std.Dev.	1.102	0.894	0.811	0.865	0.928	0.856	0.889	0.966	0.944	1.03	1.091	0.902	1.179
Total	Mean	3.80	3.80	3.78	4.05	4.00	3.88	3.97	3.97	4.03	2.93	1.01	2.94	3.80
	N	100	100	100	100	100	100	100	100	100	100	100	100	100
	Std.Dev.	1.137	1.054	1.124	0.914	0.91	0.891	0.893	0.87	0.784	0.998	1.049	0.973	1.101

Table 8*: Users vs. Non-users: BI, PE, EE, SI, and familiarity to SHT.*

The rank-order question provided a brief insight into the respondents' priorities of SHT attributes based on the alternatives that were available to them, through descriptive statistics. The means represent the average prioritization in an ascending order. The findings showed that for users of SHT, they considered usefulness as the most important attribute in order for them to invest in SHT. Importance of energy management was ranked relatively low. For the non-users, lack of usefulness was considered the main reason for not using SHT, followed by cost. Lack of technical skills and social influence did not appear to be particularly central barriers (Table 9). It should be noted that this question did not have a forced answer function, enabling the respondents to refrain from changing the rank-order. Hence, the initial order presented to them would remain their answer to the question.

Question	Mean	n	Std.Dev.
What is most important to you for investing in or using smart home technology?			
Usefulness	2.47	79	1.42
Ease of use	3.08	79	1.61
Cost	3.32	79	1.45
Security and privacy	3.36	79	1.56
Energy management	4.13	79	1.72
Interoperability between vendors	4.85	79	1.47
Other	6.79	79	0.85
What is the main reason you do not own or use any smart home technology?			
Lack of usefulness	2.43	21	1.4
Cost	2.86	21	1.6
Lack of interoperability between vendors	3.57	21	1.12
Privacy/security reasons	3.79	21	1.82
Lack of technical skills	4.93	21	1.91
Other	5.14	21	2.45
Social influence	5.29	21	1.22

***Table 9**: Priorities regarding smart home technology.*

4.1.2. Model Assessment PLS-SEM

To conduct the necessary tests for assessing the model, SmartPLS 3.3.9 and SPSS were used. To assess the study's model, two stages were conducted: the assessment of the measurement model involving testing the reliability and validity, and the assessment of the structural model, testing the hypotheses. These two stages help the researcher check that the data is reliable and valid before making interpretations and conclusions about the constructs in the research model (Hulland, 1999).

PLS-SEM is a popular method within information systems research as it can handle complexity, is suitable for small sample sizes, and does not assume a normal distribution of data (Ringle et al., 2012). The minimum sample size of PLS-SEM should be at least ten times the number of independent variables in the model, which in this study involved eight independent variables hence a minimum sample size of eighty respondents (Gefen et al., 2000). The dataset used in SmartPLS for this study had a sample size of 100 respondents, which fulfilled this rule. However, it is important to note that a larger sample size could increase the precision of the SEM; hence some researchers argue that more complex calculations are needed to determine the minimum sample size.

Measurements for Skewness and Kurtosis were done to check the univariate and multivariate normality of the data. The latent variables were exported into an excel sheet and put into webpower.psychstat.org, which then processed and calculated the measures for skewness and kurtosis. Most latent variables had an acceptable degree of normality with skewness and kurtosis within the interval of -1 to +1, except PE, which had kurtosis at 1.460 (Appendix D) (Hair et al., 2010). This signified that PE had a peaked distribution. However, in this case, this was not a critical issue, and SmartPLS is effective in handling nonnormal data.

Assessment of measurement model

The data were saved as a .csv file and uploaded into Smart PLS. The path model was constructed by marking each question and dragging them into the canvas to create the respective constructs. Then the constructs were placed to align with the research model, being PE, EE, HM, SI, PV, FC, EM, and SP connecting to BI as the dependent variable. When the constructs turned blue, the PLS algorithm could be run. The output showed the inner and the outer loadings of the model, whereas the outer loadings represented the item loadings and the inner loadings represented the path coefficient showing the weight of impact each construct had on BI (Hair et al., 2010).

Assessing validity and reliability of the model, indicator reliability, internal consistency, convergent validity, and discriminant validity were checked (Hair et al., 2021). Indicator reliability measures how accurate the items measure the latent construct and can be assessed by factor loadings for each of the items. The loadings should be at least 0.5 (Hulland, 1999) but preferably above 0.7 for the items to be good measures for the latent constructs (Hair et al., 2021). By running the PLS algorithm, findings showed that most loadings satisfied the criteria and could be kept for further tests. However, SP2 had a loading of 0.617 and did not satisfy the criteria of 0.7 (Table 10). FC3 had a loading of 0.699, and it was decided that FC was kept while SP was removed before proceeding further (Figure 3).

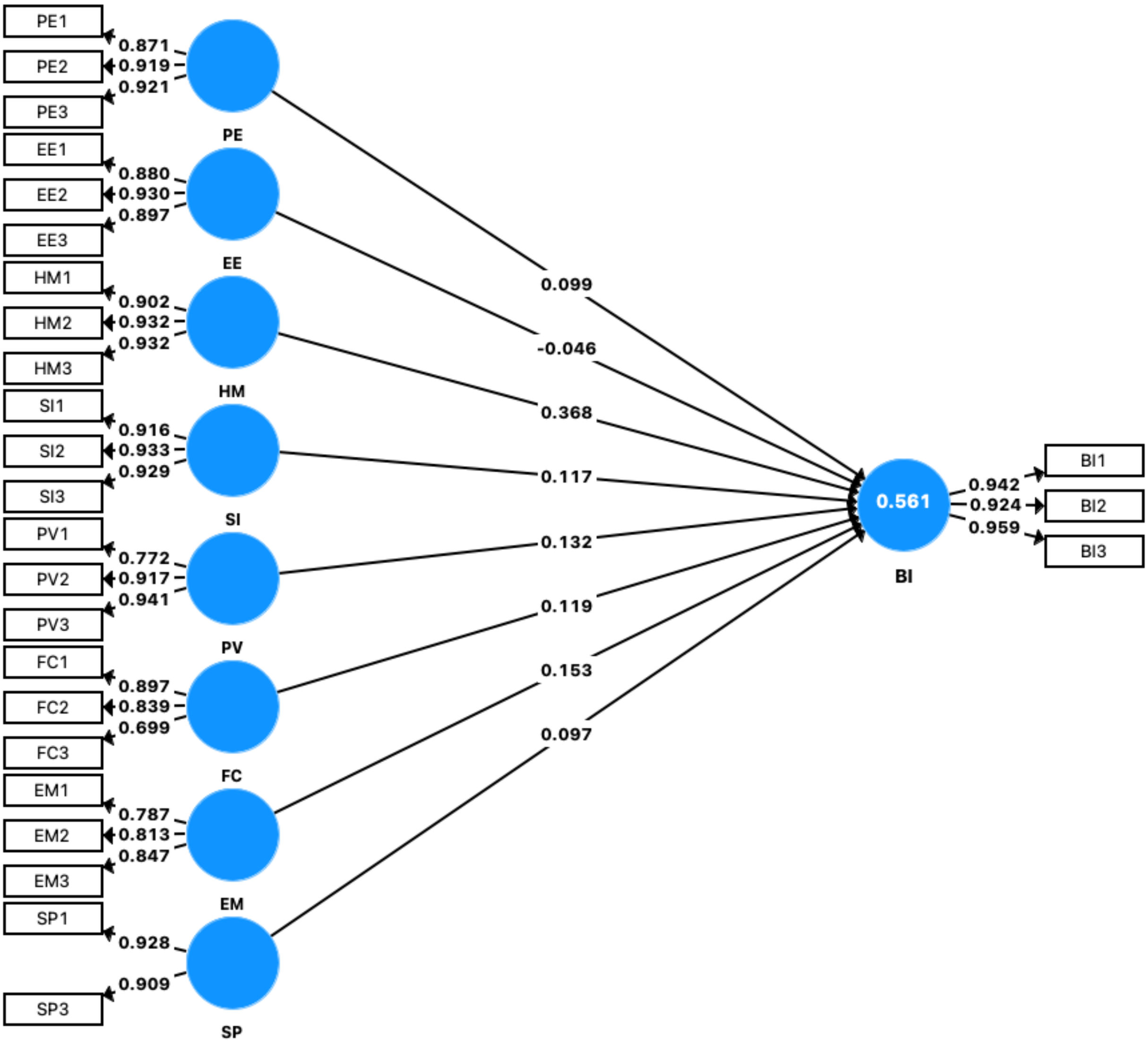

***Figure 3**: Outer loadings and path coefficient.*

The Internal consistency was tested with Composite Reliability (CR), entailing how well the items measured the latent construct they were meant to measure through values between 0 and 1 (Hair et al., 2021). The CR should be above 0.7, and the findings showed acceptable CR values (Table 10) (Nunnally, 1978). Another measure for assessing the internal consistency is the rho_A or Cronbach's alpha. Hair et al. (2021) suggested that Cronbach's Alpha might be too conservative; hence rho_A provided an acceptable intermediary measure for internal consistency. Since both rho_A and Cronbach's alpha were also measured above 0.7 (Table 10), the values were satisfactory and suggested that the items were positively related.

Convergent validity explains the convergence of the constructs for explaining the variance of their items. To measure convergent validity for the constructs, Average Variance Extracted (AVE) for each item should be above 0.5. Findings showed that AVE for all items was above 0.5, implying that 50% or more of the items' variance was explained by the constructs (Hair et al., 2021).

Construct	Items	Loadings	AVE	CR	rho_A	Cronbach's alpha
Performance Expectancy	PE1	0.871	0.818	0.931	0.896	0.888
	PE2	0.919				
	PE3	0.921				
Effort Expectancy	EE1	0.880	0.814	0.929	0.913	0.887
	EE2	0.930				
	EE3	0.897				
Social Influence	SI1	0.916	0.858	0.948	0.929	0.917
	SI2	0.933				
	SI3	0.929				
Hedonic Motivation	HM1	0.902	0.850	0.945	0.929	0.913
	HM2	0.932				
	HM3	0.932				
Price Value	PV1	0.772	0.774	0.911	0.969	0.862
	PV2	0.917				
	PV3	0.941				
Facilitating Conditions	FC1	0.897	0.666	0.856	0.831	0.756
	FC2	0.839				
	FC3	0.699				
Security and Privacy	SP1	0.908	0.675	0.858	0.878	0.769
	SP2	0.617				
	SP3	0.905				
Energy Management	EM1	0.787	0.666	0.856	0.759	0.750
	EM2	0.813				
	EM3	0.847				
Behavioral Intention	BI1	0.942	0.887	0.959	0.943	0.936
	BI2	0.924				
	BI3	0.959				

* AVE ≥ 0.5
* CR, rho_A, Cronbach's alpha ≥ 0.7

Table 10: *Reliability and validity: Loadings, AVE, CR, rho_A, Cronbach's alpha.*

Discriminant validity was assessed to check the subjective independence of the items on their latent construct. The discriminant validity can be measured through Cross Loadings, Fornell-Larcker, and Hetero-Monotrait (HTMT). Cross loadings were checked to ensure that the items only loaded at 0.7 or above under one single construct (Table 11) (Gefen et al., 2000). Furthermore, Fornell-Larcker was assessed by checking that the constructs shared the highest variance with its items (Table 12) (Hair et al., 2014). HTMT has often been argued by researchers to be a better measurement for discriminant validity (Hair et al., 2021). HTMT is the mean of the item correlations for the constructs, whereas high HTMT values might indicate problematic discriminant validity (Sarstedt et al., 2017). The findings showed that the HTMT values were satisfactory as they were below the threshold of 0.85 and hence had discriminant validity (Table 13) (Hair et al., 2021). Based on these assessments, the findings suggested that the questions measured the latent constructs they were indented to measure.

	PE	EE	EM	SI	HM	PV	FC	SP	BI
BI1	**0.942**	0.356	0.432	0.375	0.594	0.498	0.476	0.386	0.266
BI2	**0.924**	0.241	0.480	0.326	0.559	0.575	0.461	0.426	0.356
BI3	**0.959**	0.347	0.581	0.401	0.651	0.608	0.535	0.456	0.310
EE1	0.234	**0.880**	0.233	0.443	0.458	0.400	0.232	0.101	0.078
EE2	0.339	**0.930**	0.355	0.427	0.450	0.434	0.231	0.058	0.003
EE3	0.316	**0.897**	0.364	0.481	0.415	0.382	0.204	0.041	-0.003
EM1	0.431	0.245	**0.787**	0.253	0.470	0.458	0.314	0.326	0.113
EM2	0.373	0.317	**0.813**	0.414	0.291	0.434	0.191	0.207	0.005
EM3	0.486	0.322	**0.847**	0.494	0.342	0.556	0.405	0.428	0.228
FC1	0.399	0.349	0.526	**0.897**	0.282	0.372	0.373	0.163	0.026
FC2	0.316	0.535	0.268	**0.839**	0.317	0.233	0.326	0.078	0.003
FC3	0.195	0.358	0.349	**0.699**	0.130	0.286	0.081	0.152	0.154
HM1	0.506	0.438	0.361	0.282	**0.902**	0.591	0.355	0.193	0.121
HM2	0.666	0.429	0.497	0.318	**0.932**	0.698	0.495	0.314	0.237
HM3	0.582	0.482	0.378	0.263	**0.932**	0.586	0.456	0.351	0.209
PE1	0.513	0.355	0.571	0.314	0.559	**0.871**	0.333	0.283	0.216
PE2	0.507	0.465	0.514	0.420	0.631	**0.919**	0.449	0.428	0.283
PE3	0.593	0.401	0.536	0.269	0.655	**0.921**	0.431	0.371	0.256
PV1	0.226	0.137	0.174	0.177	0.239	0.224	**0.772**	0.362	0.335
PV2	0.471	0.249	0.382	0.380	0.429	0.437	**0.917**	0.385	0.302
PV3	0.570	0.232	0.382	0.323	0.510	0.448	**0.941**	0.372	0.287
SI1	0.374	0.132	0.340	0.152	0.346	0.389	0.391	**0.916**	0.449
SI2	0.466	0.011	0.391	0.111	0.228	0.344	0.400	**0.933**	0.426
SI3	0.402	0.065	0.388	0.179	0.318	0.381	0.364	**0.929**	0.431
SP1	0.319	0.038	0.140	0.085	0.227	0.239	0.330	0.494	**0.928**
SP2	0.286	0.001	0.142	0.011	0.156	0.275	0.282	0.360	**0.909**

Table 11*: Discriminant validity: Cross Loadings*

	BI	EE	EM	FC	HM	PE	PV	SI	SP
BI	0.942								
EE	0.335	0.902							
EM	0.532	0.361	0.816						
FC	0.391	0.498	0.478	0.816					
HM	0.641	0.486	0.453	0.313	0.922				
PE	0.597	0.449	0.597	0.366	0.682	0.904			
PV	0.523	0.245	0.383	0.352	0.479	0.448	0.880		
SI	0.450	0.070	0.404	0.157	0.316	0.399	0.416	0.926	
SP	0.330	0.023	0.153	0.055	0.211	0.278	0.334	0.469	0.918

***Table 12**: Discriminant validity: Fornell-Larcker*

	BI	EE	EM	FC	HM	PE	PV	SI	SP
BI									
EE	0.359								
EM	0.624	0.430							
FC	0.439	0.617	0.612						
HM	0.683	0.545	0.537	0.354					
PE	0.650	0.506	0.725	0.448	0.750				
PV	0.529	0.268	0.425	0.382	0.493	0.476			
SI	0.480	0.091	0.471	0.194	0.345	0.444	0.474		
SP	0.376	0.045	0.203	0.112	0.235	0.328	0.414	0.538	

***Table 13**: Discriminant validity: HTMT*

Assessment of structural model

To assess the structural model, collinearity issues, the significance and relevance of relationships, explanatory power, and predictive power were calculated in SmartPLS (Hair et al., 2021). For assessing collinearity issues, variance inflation factor (VIF) values above 5 might indicate collinearity, meaning that the construct had a correlation with the other variables (Sarstedt et al., 2017). The findings showed that the inner VIF values for all the constructs were all below 2.5 and showed no strong signs of collinearity (Table 14).

Inner VIF Values	
	BI
EE	1.663
EM	1.897
FC	1.614
HM	2.188
PE	2.479
PV	1.586
SI	1.612
SP	1.360

***Table 14**: Inner VIF values.*

For testing the hypotheses, bootstrapping was conducted. Bootstrapping is a method to evaluate the direct effects of the relationships that are hypothesized in the research model. The significance level was set to 0.1 for a two-tailed test type; hence the t-value should be above 1.645 for the path coefficients to be statistically significant (Hair et al., 2021). The t-values showed that only two of the relationships had significance while the others did not. This resulted in only H4, H5, and H6 being supported (Table 15). The path coefficients are often referred to as standardized beta coefficient in the structural model, which is labeled as "Std. Beta" in Table 14 (Hair et al., 2011).

Findings from the bootstrapping also produced measures for the coefficient of determination (r^2) and effect size (f^2). The r^2 measured the predictive accuracy of the model and the explanatory power of the endogenous constructs, which here was BI. The r^2 ranges between 0 and 1, whereas a higher value would imply higher explanatory power or the predictive power of the construct. The bootstrapping resulted in an r^2 of 0.561 and a r^2 adjusted of 0.523, which was considered a moderate explanatory power (Hair et al., 2021). To assess how big an effect each construct or path had on the endogenous construct, the f^2 was measured. (Sarstedt et al., 2017). An f^2 value of 0.02 is considered as a small effect size, 0.15 as a moderate effect size, and 0.35 as a large effect size (Cohen, 1988; Sarstedt et al., 2017). The findings showed that EM, SI, HM, PV, and FC had f^2 of 0.02 or above, implying a small effect size, while PE, EE, and SP had f^2 below 0.02, implying no effect (Table 15).

Additionally, a blindfolding procedure was conducted to calculate and assess the predictive relevance (q^2) of the path model, also known as cross-validated redundancy. A smaller difference between the original values and the estimated values gives a higher q^2 indicating a greater predictive accuracy (Hair et al., 2014). The omission distance (D) for the blindfolding procedure was set to the default of 7 (Hair et al., 2014). The findings from the blindfolding showed a q^2 of 0.460, which was an acceptable value for proving predictive relevance (Hair et al., 2011).

Hypothesis	Relationship	Std Beta	Stdev	T statistics	Decision	f^2	95%CI LL	95%CI UL
H1	PE -> BI	0.099	0.119	0.829	Not supported	0.009	-0.077	0.306
H2	EE -> BI	-0.046	0.114	0.401	Not supported	0.003	-0.210	0.170
H3	SI -> BI	0.117	0.069	1.689*	Supported	0.019	0.007	0.230
H4	HM -> BI	0.368	0.111	3.317**	Supported	0.141	0.166	0.530
H5	PV -> BI	0.132	0.076	1.746*	Supported	0.025	0.023	0.267
H6	FC -> BI	0.119	0.114	1.041	Not supported	0.020	-0.093	0.292
H7	SP -> BI	0.097	0.072	1.349	Not supported	0.016	-0.013	0.216
H8	EM -> BI	0.153	0.107	1.431	Not supported	0.028	-0.026	0.324

- CI = confidence interval, LL = lower limit, UL = upper limit
- *p<0.1, **p<0.01
- Effect size: 0.02 small, 0.15 medium, 0.35 large (Cohen, 1988)
- r^2 BI = 0.561
- q^2 BI = 0.460

***Table 15**: Direct relationships for hypothesis testing.*

To avoid biased interpretations of the data analyses, CMB was tested using SPSS. A lack of consideration of potential common method effect in the data may cause biased estimations of the reliability and validity of the data analyses and might ultimately affect the findings of the analyses (MacKenzie & Podsakoff, 2012). Therefore, Harman's single factor test was conducted to see if there was common method bias in the data. By doing a Dimension Reduction for Factors in SPSS with a principal axis factoring, no rotation, and a fixed number of factors 1, the single factor that was extracted from the analysis was 34.29% (Appendix D). It was thus concluded that there was no sign of common method bias in the data as this measure was considerably lower than 50 (Harman, 1976).

Researchers have argued that a general measurement of model fit is not applicable for PLS-SEM as it often proves to be unsuccessful or insufficient. However, there are still some measures of model fit that can be assessed in PLS-SEM, such as SRMR, yet it is important to note this is often considered to be somewhat ineffective (Hair et al., 2021). SRMR values below 0.08 are considered good fit (Hu & Bentler, 1999), which the findings fulfilled with an SRMR of 0.072 (Table 16).

SRMR	Original sample	Sample mean	95%CI LL	95%CI UL
Saturated Model	0.072	0.05	0.059	0.062
Estimated Model	0.072	0.05	0.061	0.067

***Table 16**: SRMR.*

4.2. Qualitative Findings

In the analysis of the qualitative data collected from the interviews, some key topics were emphasized and repeated throughout several interviews. Hence, these themes and sub-themes were identified and extracted through a theme analysis to put the qualitative data into context to elucidate and explicate the research questions. In the following sub-sections, insights and findings from the interviews are presented by the key themes that were identified and discussed. Onwards, the experts interviewed are referred to as "EXP" (singular) or "Experts" (plural), while the consumers interviewed are referred to as "CON" (singular) or "Consumers" (plural).

4.2.1. Usefulness

When asked about their perception of the usefulness of SHT, most Consumers said that the usefulness of SHT was important for them to buy it. However, the Consumers, except CON1, did only have knowledge and familiarity with a few types of SHT and were not aware of the variety of SHT. There was a clear consensus among the participants that it is important to clearly communicate and show what benefits and convenience the SHT can add to consumers' everyday lives. EXP5 said that one of their methods for communicating the applicability of SHT was through articles that address certain problems or challenges and how SHT can help solve this, rather than writing merely about the products.

Furthermore, three out of five Experts pointed out that all SHT vendors today have their own apps for managing their smart home products or services. EXP2 suggested that, ultimately, consumers will want only one button, which is the "optimize button". As quoted by CON1:

> "*A big problem today is that everything is smart, but everything also has its own app. If you are interested in smart home technology and gadgets, your phone will fill with apps for each solution. That is the opposite of the smart home "utopia". I want only one app, not ten.*"

However, not all of the Consumers were concerned about the number of smart home apps on their phone. Theoretically, the Consumers agreed that many apps would become confusing and less efficient, yet most did not use many smart home technologies resulting in a variety of different smart home apps. Another aspect that became clear throughout the Consumer-interviews was that the knowledge and awareness about what SHT can be used for, beyond multimedia and lights, were relatively limited for the majority of the Consumers.

4.2.2. Ease of Use

When talking about the ease of use and levels of complexity, the Experts mentioned that SHT might seem complex and overwhelming for those who are not particularly familiar with SHT or those who have a lower technological literacy. EXP1 and EXP5 stated that the smart home market has used to be a very tech-savvy market with few solutions that most consumers are skilled enough to implement themselves. As EXP5 stated:

> *"I think that in the past 30 years of smart home technology, consumers with a particular interest in smart home technology and consumers with a high purchasing power have dominated the market. This has also been part of the challenges of achieving mass adoption as it has determined much of the product development."*

However, as addressed by most of the Experts, more smart home technologies entering the market today require less knowledge and experience and are easier to implement for those without technical understanding. Experts noted that if the consumer journey of acquiring, implementing, and using the SHT is too complicated, it will become a barrier to adoption. EXP1 also emphasized that in order for consumers to use the technology, the bar for starting to use the products or services has to be low. When discussing smart home automation and integrated systems, CON1 pointed out:

> "*Unfortunately, I think that a lot of the smart homes – or let us say smarter than remote-controlled homes – today require some know-how. Not necessarily that one has it in advance but has the time and will to acquire it. I think that is the biggest barrier for many to adopt smart home technology.*"

The Consumers were asked about to what extent they perceived the ease of use of the SHT they were familiar with. The answers suggested that the perspectives related to ease of use were somewhat divided. While most of the consumers that were interviewed in this study stated that they were relatively confident that they would master the implementation and use of basic SHT, CON5 was not equally confident that they would master the implementation and use of basic solutions without help from others. However, CON5 explained that this did not hinder the adoption of SHT, due to the availability of assistance from their spouse.

4.2.3. Social Influence

There was a general consistency among the Experts' answers that social influence is an important part of SHT adoption. The Experts all agreed that social influence from friends and family, demonstrations, and showcasing of the technology are important in spreading awareness, knowledge, and attention among consumers. As EXP1 stated:

> "*The strongest and most powerful and efficient marketing channel is the one where consumers have experiences of quality, security, and reliability with a product or service and its vendor and then shares these experiences with their friends and family.*"

Besides the effect of social influence, EXP4 stressed the importance of communicating the benefits of the SHT and that without sufficient understanding of the benefits of SHT, social influence will not gain its full effect.

Initially, CON1 and CON2 put more emphasis on the functions and benefits of SHT in influencing their choices of adoption. However, they also admitted that social influence will always have some impact. CON3 and CON5 stated that social influence was a large part of their decision-making process for buying new technological products and valued the opinions and experiences shared by trusted people. CON4 explained that social influence would probably somewhat influence decision-making and awareness of SHT, yet did not think this standalone would lead to investing in and adopting SHT. CON5 expressed social influence as one of the most important drivers for adoption, whereas this was especially central for adopting new SHT beyond what they already used. Furthermore, social influence was also mentioned to be an important channel for discovering and exploring new products. Most Consumers mentioned that by being shown and demonstrated the actual smart home product, they were more likely to be influenced to buy it themselves if they considered it beneficial. Moreover, mass media and social media were brought up as influencing factors for use and adoption, especially among the younger part of the Consumers.

4.2.4. Enjoyment and Enthusiasm

As suggested by EXP2 and EXP3, a generalization of Norwegians is that they love gadgets, the majority own a smartphone, and many also have the latest and fanciest smartphones. CON1, CON2, and CON3 stated that they enjoy gadgets and like to test out new products and stay informed. Generally, curiosity was explained as a central source of motivation and interest in SHT. When asked about what they enjoyed with SHT, CON3 and CON5 expressed that the opportunities to choose and switch the color of the lights remotely in a seamless way were among the main reasons. Additionally, controlling everything through one's smartphone was highlighted by three of four Consumers who used SHT, while CON1 preferred everything to be automated.

Two of the Experts mentioned that some of the consumers who are very enthusiastic about SHT also program solutions themselves which they post on social media for others to use. This was supported by CON1, who had respectively created such solutions and made them available for others. EXP1 estimated that the volume of consumers who are motivated by having the latest and fanciest technologies constitute around ten to fifteen percent of the consumers and do not represent the masses. Similarly, EXP2 estimated that around ten to twenty percent of consumers in Norway have a special interest in technology, while the rest will not experiment with SHT as they care for the solutions working for their purpose from the start. As CON1 highlighted, the will to obtain the necessary knowledge is a central factor for adopting SHT and that new solutions require less prior know-how to succeed. Furthermore, CON1 also suggested comfort and luxury as important drivers for SHT interest. EXP1 pointed out comfiness and coziness as central characteristics of the Norwegian market, whereas Norwegians, in general, will not compromise on coziness at home. Relatedly, CON2 and CON5 both expressed that they have timed outdoor lights and leave some lights on in the house at night and when they are away because it looks cozier to the neighbors and that the technology enables them to control it remotely. Furthermore, CON3 and CON5 expressed that their use of SHT today has increased their interest in and wish to try out other SHT in the future.

4.2.5. Costs and Cost-savings

Regarding the prices and costs related to SHT, the participants were somewhat split in their perspectives. Most of the Experts argued that many smart home technologies being offered today have reduced their price levels as more solutions are based on "do-it-yourself" solutions that do not require implementation by electricians or installers. As stated by EXP3: "*there is a consolidation in the Norwegian smart home market whereas sensor and device prices are being reduced.*" However, as EXP4 emphasized, there are still some challenges getting mass adoption of SHT:

> "*We see that some of those who start using smart home technology also start seeing the various benefits it provides and care for which solutions are supported by the different vendors. We need to get to the point where consumers are excited about the technology and see the benefits, without the technology being too expensive.*"

With extensive experience with the implementation and use of SHT and automation, CON1 pointed out costs as one of the big barriers for many to adopt more advanced SHT. CON1:

> "*I think the price is definitely a large barrier to many, and it has two related downsides: The first is that many dismiss the concept relatively quickly due to the pricing; The second is that many just want to test it out and do not really invest enough for them to properly benefit from it.*"

However, for most Consumers, the price was not a big issue regarding investing in SHT since they did not use complex interconnected SHT that required large investments. Still, CON2 emphasized that in the end, the spreadsheet will have the final word in any decision-making process; hence it all comes down to costs and savings. Other Consumers considered the functionality of the SHT to be more important than the price in the decision-making process, up to a certain cost level. Additionally, the opportunity to save costs, for example, by energy management, was emphasized by the majority of the Consumers as a motivator for using SHT. CON3 and CON4 stated that they would prefer to achieve a return of investments within a year of purchase, while CON2 and CON5 was willing to wait up to 3 years. CON1, however, stated that they would never be able to save in the costs used on creating a fully automated home.
Homeownership was also identified as a factor influencing the decision-making regarding SHT. When asked about willingness to invest in SHT, CON3 and CON4 declared that as long as they do not own the residence, the willingness to invest in SHT was low. This determinant was also mentioned by EXP5.

4.2.6. Facilitating Conditions

When asked about the facilitation of SHT today, a commonly mentioned topic by the Experts was the need for a general standard on which to build all SHT solutions. Arguably, this will enable a much higher level of interoperability and compatibility between vendors and technologies and increase the overall functionality of a smart home. As EXP2 pointed out, there have been several attempts to create other standards previously, yet no one has succeeded in creating one universal standard that everyone will use. Another challenge pointed out by the Experts was the limited training and knowledge of the salespersons at the distributors' stores, causing them not being able to provide the knowledge and guidance necessary for the customers to match the right products to their needs can become a barrier for some consumers in using SHT. EXP3 expressed the concern like this:

> *"There are a lot of different solutions available, and the staff working at the large distributor warehouses are ultimately not experienced enough with smart home technology to help the consumers understand what they need and why.*"

CON1 also addressed this issue by sharing personal experiences with staff with limited relevant knowledge. However, EXP5 stated that this used to be a central issue for the SHT market, yet it has improved somewhat in the past few years.

The Experts agreed that having properly functioning customer support is a critical element as there will always be some consumers who will never be able to implement the solutions themselves. The Consumers also considered available customer support important and expected the vendor to assist them if problems should occur, yet they had a more nuanced perspective. Three of the Consumers stated that they would rather ask friends or family for support or assistance regarding SHT. This was explained that they knew one or more people who could usually provide them with the necessary help quickly. Based on experience as a smart home enthusiast, CON1 pointed out that "*unless you know someone who can provide the necessary help, good customer support is crucial as it can be challenging to figure out how to solve problems by oneself since it requires a certain level of understanding to be able to solve the issues via 'Googling'*." CON5 clearly stated that they would not be able to adopt SHT independently and rely on help from either family or customer support.

4.2.7. Security and Privacy of Smart Home Technology

Regarding the security and privacy of SHT, the Consumers were also somewhat divided in their perspectives. CON4 stated that this factor was the main reason they did not use any SHT today and especially pointed out that smart speakers were problematic due to the possibility of them listening to personal conversations and accessing sensitive information. It was stipulated as a matter of what technology the consumer was comfortable with having at home. Some concerns regarding the security and privacy of SHT were also expressed by CON1:

> "*I totally understand the concerns around the security and privacy of smart homes. That is the reason why my smart home runs on a local server in my house, and not on an external server. Hence, my home is still smart if the internet was to shut down, and my data is not accessible in a public cloud that can be hacked.*"

On the other hand, the other Consumers did not have any severe security or privacy concerns regarding the use of SHT and trusted the vendors and their software and hardware.
EXP1 pointed out that the SHT for home security is getting mature and have already been used for quite a while by alarm companies. Their experience of increasing interest from their customers regarding smart home security solutions was partly explained by the widespread use of technology in our lives and how used we are to it. As highlighted by EXP4, the SHT should not be possible to hack, but if they are, the smart home vendors should not posit any private information. Whereas more devices and systems are becoming interconnected, EXP4 stressed the increasing importance of good security and privacy. Furthermore, EXP5 emphasized that privacy and security related concerns should, by principle, mainly apply to the vendors and not so much to the consumer, as the vendors should grant the security and privacy of using the technology.

4.2.8. Home Energy Management

The Experts all agreed that energy management is a critical factor in the adoption of smart homes today due to rising energy prices. However, there were some divided perceptions on the importance of energy management regarding SHT among the Consumers. The Consumers that owned their residences cared more about energy management and getting a better overview and control of consumption and costs. In contrast, the Consumers who were tenants or who had the energy costs were included in their rent did not acknowledge energy management as a particular focus or motivation for adopting SHT. Moreover, some Consumers were not aware of the possibilities of energy and cost-saving enabled by SHT.

Nevertheless, the Experts seemed to agree that in a larger perspective, widespread adoption of SHT can also have a great impact on energy management nationally. As pointed out by EXP2 and EXP3, this can not only reduce overall energy consumption but flatten out the major peaks where energy demand is highest, and the supply is most pressured. As EXP2 described:

> *"By flattening out the peaks in energy consumption in Norwegian homes and cabins during the 24 hours, we can reduce the total need for energy nationally. Consumers' energy consumption has a massive effect on infrastructure and investments nationally and can prevent the need for a buildup of massive power masts in the nature.*"

Furthermore, when asked about the Norwegian SHT market, EXP2 pointed out various interesting characteristics of Norwegians' way of living, behavior, and usage of resources. EXP1 and EXP2 emphasized that Norwegians have a very low energy awareness compared to the rest of Europe, much of which can be explained by the generally good and stable personal economies and a big focus on comfort while reducing the focus on thrift. It was also pointed out by all the Experts that the recent all-time-high energy prices have shown an effect on consumers' awareness, interest, and attention to managing their energy consumption with SHT. However, EXP2 emphasized that the mass adoption of SHT will not happen without an increase in knowledge and competence regarding energy consumption and management, compatible and reliable smart home systems, and successfully communicated benefits regarding use, economy, and climate. EXP1 and EXP3 also added that they have experienced an increase in the focus on energy management, consumption, and costs from their customers recently, yet that this is not an exclusive motivation for adoption.

5. Discussion

The research model for examining the use and adoption of SHT in Norway in this study extends the UTAUT2 by Venkatesh et al. (2012) by including energy management and security and privacy as suggested by the literature. The quantitative findings showed that in this study, hedonic motivation had the strongest effect on behavioral intention towards using and adopting SHT, followed by social influence and price value. Surprisingly, these three constructs were the only ones that were significantly different from 0 and thus had a considerable effect on BI. Therefore, H3, H4, and H5 were supported, while H1, H2, H6, H7, and H8 were not supported (Table 17). To the researcher's knowledge, there is no existing literature comprehending the approach of this study on the use and adoption of SHT in Norway. Hence, the findings from this study are interesting for further discussion.

	Hypothesis	Decision
H1	Performance Expectancy significantly affects behavioral intention toward smart home technology adoption.	Not supported
H2	Effort Expectancy significantly affects behavioral intention toward smart home technology adoption.	Not supported
H3	Social Influence significantly affects behavioral intention toward smart home technology adoption.	Supported
H4	Hedonic Motivation significantly affects behavioral intention toward smart home technology adoption.	Supported
H5	Price Value significantly affects behavioral intention toward smart home technology adoption.	Supported
H6	Facilitating Conditions significantly affect behavioral intention toward smart home technology adoption.	Not supported
H7	Security and Privacy significantly affect behavioral intention toward smart home technology adoption.	Not supported
H8	Energy Management significantly affects behavioral intention toward smart home technology adoption.	Not supported

Table 17*: Overview of hypotheses.*

Performance Expectancy

PE has often been discussed as a strong driver for SHT adoption, involving the perceived usefulness and benefits of the SHT (Park et al., 2018b). Nonetheless, the quantitative findings showed that PE did not have significant effect on BI in this study. A possible explanation for the insignificant relationship between PE and BI might be that the usefulness of SHT is not perceived by the respondents. As Balta-Ozkan (2013) and Expert-interviews suggested, clear communication and demonstration of SHT are crucial for educating consumers about the functions and features that SHT can bring to simplify daily life. A somewhat conflicting finding was that the users ranked usefulness as the top priority for investing in SHT in the rank-order question. Despite the insignificant effect of PE in the quantitative findings, most consumer-interviews specified benefits, usefulness, and functionality as important requirements for SHT adoption. Yet, other aspects of SHT adoption were also critical for the decision-making.

Furthermore, the interviews also revealed that the awareness of SHT applicability was relatively low among most of the Consumers. The potential lack of awareness, familiarity, or experience with SHT might strongly affect consumers' capability to perceive the usefulness of SHT (Nikou, 2019). Furthermore, as literature argued, consumer needs should be in focus when developing and selling SHT for the consumers to see the usefulness of the solutions (Luor et al., 2015). Two Experts and a Consumer pointed out a related issue, whereas the distributors who sell SHT often do not have sufficient competence about the products to provide expertise to find and cover the consumers' needs or preferences. This might also contribute to explaining the lack of perceived usefulness. In essence, PE appears to be a central aspect of SHT adoption, yet not a guaranteed or exclusive driver for consumers in Norway to adopt SHT.

Effort Expectancy

A somewhat counter-intuitive finding in the quantitative findings was the slightly negative relationship between EE and BI. Findings suggested that effort expectancy or ease of use had a negative effect on adoption, differently from the findings of some similar studies (Gao & Bai, 2014). EE relates to the user-friendliness of SHT and to what degree consumers perceive the technology as easy or difficult to use. Like literature emphasized the importance of creating seamless and user-friendly solutions to avoid complexity becoming a barrier to adoption (Balta-Ozkan et al., 2013), the Experts also pointed out that more smart home vendors are now starting offer technology that is more user-friendly that consumers can adopt without assistance from electricians or installers. Hence, EE might be less prone to be a potential barrier in the process of acquiring, implementing, and using the SHT. Yet, the slightly negative value was an unexpected result. This might be explained by that even though the respondents who answered that they do not use and do not intend to start using SHT, they still considered themselves equipped to handle SHT relatively easily. As descriptive statistics showed, the mean for EE for those who did not use any SHT was relatively high, even though the mean for their behavioral intentions was low (Table 8). Additionally, the rank-order findings also suggested that lack of technical skills were not considered a barrier by the non-users themselves (Table 9). Furthermore, for the Consumer-interviews, the perceptions of ease of use did not seem to be a barrier to the Consumers, regardless of use or intentions to use SHT or not. As literature has suggested, perceived difficulty of use being a barrier to adoption apply particularly to people with less technical literacy and the elderly (Li et al., 2021), which might suggest that the respondents have a relatively high technological literacy, despite whether they are using SHT or not.

Social Influence

Consistent with the reviewed literature regarding the effect of social influence on SHT adoption (Aldossari & Sidorova, 2020), the quantitative findings showed that SI had a significantly positive effect on behavioral intention to use and adopt SHT among the respondents, confirming the findings by Mayer et al. (2011) and Chen et al. (2020), among others. As the qualitative findings also showed, influence from friends, family, mass media, and social media was generally considered an important source of information for the decision to use and adopt SHT by the majority of the participants (Chen et al., 2020; Gao & Bai, 2014). The Experts especially highlighted the importance of word-of-mouth and the sharing of experiences as crucial to spreading knowledge, awareness, and potentially adoption of SHT. As literature has also previously suggested (Li et al., 2021), this study's findings suggest that social influence is a central part of consumers' decision-making process for SHT adoption, whereas influence from people close to them or form people with integrity was highlighted. As a non-user, CON4's statement that they would not adopt SHT based on the influence of others and the low mean for SI among the respondents could be explained by Vrain and Wilson's (2021) argument concerning that a limited number of adopters in the non-users' social network might restrain them from exposure to and experiences with the respective technologies.

Hedonic Motivation

Another construct that showed a significantly positive effect on BI in the quantitative data analysis was HM. The relationship between HM and BI was the strongest relationship out of all the constructs, which might suggest that HM was the strongest driver for SHT adoption among the respondents. As suggested by Venkatesh et al. (2012), hedonic motivation had a stronger effect than performance expectancy on the consumers' intentions to use smart home technology. As literature also suggested, the more enjoyable, entertaining, or fun experiences with SHT are, consumers' perceptions of usefulness and relevance will increase and affect intentions to use and adopt the technology (Park et al., 2018b; Shuhaiber & Mashal, 2019). As expressed by CON4 and CON5, the enthusiasm regarding adopting new SHT can be strengthened by having had positive experiences with SHT. This might imply that hedonic motivation works as an accelerator for adoption for those who already are familiar with and have experience with SHT.

The Consumers interviewed in this study who expressed the most enthusiasm and enjoyment regarding SHT were homeowners and were also those with a higher and more stable income. Moreover, descriptive statistics showed that the income distribution among the respondents descended from “701.000NOK or more”, suggesting that the respondents have a generally good purchasing power. These observations corresponded to the literature’s suggestion that income and personal economy might have an impact on the level of HM (Furszyfer Del Rio et al., 2021). Furthermore, as more smart home technologies are becoming more user-friendly and require less prior knowledge about the solutions, a more widespread interest in and curiosity about SHT might be demonstrated. This view was pointed out by Experts and related to the literature discussing technological literacy as a relevant aspect relating to technological enthusiasm (Furszyfer Del Rio et al., 2021).

Price Value

There was consistency between the literature pointing out the positive effect of investments in SHT (Aldossari & Sidorova, 2020), and the quantitative findings showing a significantly positive effect of price value on behavioral intention. Additionally, the qualitative findings also suggested that cost-savings and the perceived value of using SHT can have a motivating effect on intentions to adopt SHT, like suggested by Barbosa et al. (2020). As the price value involves the consumers’ perceived tradeoff between price and benefits of the SHT (Venkatesh et al., 2012), the interviews revealed that for most of the Consumers price might only become a barrier for large investments. Aligning with findings by Furszyfer Del Rio et al. (2021), homeownership was found to have an impact on the consumer’s motivation for investing in SHT, whereas homeowners had a higher willingness than tenants. Due to rising energy prices in Norway, smart home vendors have noticed an escalation in consumer interest for SHT to manage the costs of their energy consumption. Resultingly, the cost-saving aspect of smart homes was perceived as a driving factor for adopting SHT, whereas consumers can save energy and costs as well as possibly have a return of investment over time (Paetz et al. 2012).

Facilitating Conditions

The facilitating conditions of SHT entail the surrounding infrastructures that enable the SHT to function as intended, whether it be interoperability between different solutions, available customer support, and the consumer's ability to acquire the necessary knowledge and skills to utilize the SHT (Kim et al., 2017; Venkatesh et al., 2012). The qualitative findings suggested that both the Experts and the Consumers considered FC as important in SHT adoption. Due to convenience and access, almost half of the interviewed Consumers would ask friends and family for assistance rather than contacting customer support. Hence, the support from friends and family appeared to be important in facilitating SHT adoption besides support from the vendor (Yang et al., 2017). However, the quantitative findings showed that FC had a slightly positive relationship with BI, yet there was no significant effect. This might be explained by a limited experience with SHT among the respondents, leading to an underestimation of the importance or value of the facilitating conditions (Aldossari & Sidorova, 2020).

Security and Privacy

In literature, concerns regarding security and privacy risks have often been discussed as a central potential barrier to SHT adoption (Furszyfer Del Rio et al., 2021). However, as the qualitative findings revealed, the Consumers' attitudes towards security and privacy varied. Those who used some SHT solutions did not have particular security and privacy concerns, and some also felt that SHT enabled better home security (Sovacool et al., 2021). On the other hand, the Consumer who did not use SHT and the Consumer who used the most complex SHT did, however, have some security and privacy concerns. These diverging attitudes might explain the insignificant slightly positive relationship between SP and BI in the quantitative findings. However, this relationship was not significant. Another explanation might be, as suggested by EXP5, that SP concerns mainly apply to the vendors and should therefore not be a concern to the consumers. This explanation requires that the consumers have trust in the smart home vendor (Chen et al., 2020). Either way, SP did not appear to be a critical factor in the adoption of SHT among the respondents.

Energy Management

Consistent with the literature (Li et al., 2021), the Experts emphasized how SHT has the potential to help consumers obtain an overview of their energy consumption at home and can help reduce overall consumption. Literature has suggested the motivational effect of energy-saving to be a driver for SHT adoption, provided it does not compromise comfort and convenience (Bhati et al., 2017). However, as EXP2 pointed out, awareness of household energy consumption has been a central challenge to SHT adoption. The findings from the rank-order question also suggested that energy management was not prioritized as an important attribute for investing in SHT among the users. Moreover, the descriptive statistics also showed that the respondents were not aware of having a smart meter (AMS) even though this was installed in most residences in Norway in 2019 (Slettemeås, 2019). This might stipulate an example of a relatively low awareness regarding smart home energy management solutions, which was also supported by EXP2 statement about Norwegians' ignorance regarding energy consumption and the importance of comfort. This, in turn, corresponded with the literature's findings regarding the tradeoff between comfort and energy-saving (Kim et al., 2021).

The quantitative findings of this study did not generate a significant relationship between EM and BI. Despite this, both Expert- and Consumer interviews proposed EM as a critical aspect of sparking interest in SHT among consumers in Norway, now more than ever before. The Expert-interviews suggested that due to the increase and instability in the energy prices in Norway over the past year, consumers have shown more interest in SHT for obtaining an overview of their residential energy consumption and costs. The somewhat diverging findings might be explained by factors such as unawareness, energy costs being included in the rent, or perceived difficulty (Furszyfer Del Rio et al., 2021). As also reported in the findings, most of the Consumers were not aware of the different ways SHT can help manage and save energy and costs.

5.1. Implications for Research

Despite much research on SHT adoption existing in general, there is to the knowledge of the researcher limited new research on SHT adoption in Norway. Hence, this study contributes to the research field by providing an overview and insights into the SHT market in Norway from both a consumer and a vendor perspective. This study provides empirical support to the importance of hedonic motivation, the perceived price value, and the social influence regarding the use and adoption of SHT in Norway.

Most of the reviewed research on SHT adoption have addressed central topics concerning benefits and usefulness of SHT, ease- and difficulty of use, the dependence on help and support, opportunities for energy-saving and energy management, and costs and cost-saving. Through a mixed-methods research design, the findings of this study suggested that HM, PV, and SI were the strongest drivers to SHT adoption among the respondents. However, other factors, like PE and EE, that were often identified as the drivers in literature (Gao & Bai, 2014; Shuhaiber & Mashal, 2019), did not prove to have a significant effect on behavioral intention in this study. Even though the quantitative findings did not fully align with the expected outcomes of the proposed research model, the findings provide insights into Norwegian respondents' perceptions, attitudes, and intentions towards the use and adoption of SHT. Minding that Norway is a wealthy country with a functioning welfare system, these identified drivers suggested that mere usefulness, energy-saving, or ease of use of SHT are not sufficient motivators for adoption. The strong impact of HM on intentions to use and adopt SHT and the high income of the respondents support a generalized understanding that Norwegians have good purchasing power and often have an interest in gadgets. Interestingly, the study's quantitative findings might imply that the respondents did not perceive SHT as particularly useful in improving or assisting current daily life tasks, but rather perceived SHT as an enjoyable and fun attribute to their daily lives. Nevertheless, this thesis calls for further research on smart home technology adoption in Norway.

5.2. Implications for Practice

Through the analysis of quantitative and qualitative findings, the main identified barriers to SHT adoption in Norway involved the lack of awareness and familiarity with SHT and its applicability to daily life tasks, especially among the non-users. Hence, to increase the diffusion of SHT adoption in Norway, the awareness of the variety of SHT solutions needs to increase in the mass market. Additionally, improving consumers awareness regarding energy consumption and home energy management might lead to an increased interest in SHT, which can contribute to the national energy consumption management towards enhanced sustainability.

Furthermore, as social influence was also identified as a driver of adoption, positive word-of-mouth and focus on mass- and social media might contribute to a higher awareness regarding SHT and possibly generate increased SHT adoption. Since non-users did not consider SI to impact their intentions to use SHT to a large degree, achieving increased exposure to SHT within their social network might contribute to make them more familiar with the concept (Vrain & Wilson, 2021).

Practical implications of the study also suggest that smart home vendors in Norway might want to focus on persistent and clear market communication regarding the benefits and convenience SHT can add to consumers' lives, beyond mere entertainment. For instance, raising the awareness of the household's energy consumption through real-time monitoring based on gamification principles might appeal to consumers' hedonic motivation to adopt SHT for energy management. By raising the awareness and consumers' familiarity to SHT, the perceived usefulness might also improve (Mashal & Shuhaiber, 2018). Furthermore, increasing Norwegian consumers' awareness of their own energy consumption and the opportunities for energy management and potential energy and cost-savings might also increase the initiative among consumers to adopt SHT. As Experts expressed, they had already experienced an increased initiative from consumers due to rising energy prices in the past months. Such incentives for home energy management can have considerable impact on total energy consumption in a national context if a widespread diffusion of smart home technology adoption is achieved.

6. Conclusion and Future Research

Much research has been conducted regarding the adoption of SHT. However, there was not much new research to be found on the respective topic in the context of the Norwegian SHT market. Norway is a wealthy country with a developed digital infrastructure and with a functioning welfare state that ensures economic safety, healthcare, and education for the citizens of Norway (Slettemeås, 2019). Furthermore, assumptions that Norwegians have good technical skills and a strong purchasing power make it interesting to investigate the role of SHT among Norwegian consumers. Hence, the objectives of this study were to gain insights and understanding regarding the SHT market in Norway and to identify potential drivers and barriers to SHT adoption among Norwegian consumers. Based on these aims, the research questions were defined:

- ***RQ1:*** *What drivers and barriers affect the Smart Home Technology adoption in Norway?*
- ***RQ2:*** *How can the diffusion of smart home technology use in Norway be expanded?*

Based on a systematic literature review, a research model was adopted and adapted from the UTAUT2 by Venkatesh et al. (2012) to the context of this study. Through a mixed-methods

research design, this study examined perceptions, attitudes, intentions, and use of SHT in Norway from both a smart home vendor's perspective and a consumer perspective to answer the respective research questions.
Resultingly, the findings from the structural model showed that HM, PV, and SI had significant effects on behavioral intention among the survey's respondents, whereas hedonic motivation and enthusiasm regarding SHT were identified as the strongest driver of adoption. Furthermore, descriptive statistics and the analysis of the consumer interviews revealed that the awareness and knowledge of SHT's applicability to daily life tasks were relatively low beyond the technologies the participants currently used. Consequently, lack of awareness and familiarity to SHT and its usefulness was identified as the main potential barrier to adoption.
To increase the diffusion of SHT adoption in Norway, the awareness of the variety of SHT solutions needs to increase in the mass market along with the benefits and usefulness of the respective technologies. Hence, a suggestion was to ensure clear and broad communication of SHT's applicability and advantages to the consumers. Moreover, the consumers need to be better educated by vendors and other stakeholders about how SHT might be useful in reducing or monitoring their energy consumption and how it can potentially improve daily life convenience and comfort. Additionally, increased awareness of energy consumption might generate an initiative from consumers to adopt SHT in combination with the rising energy prices. Nonetheless, the SHT market in Norway remains interesting for future studies, as this study contributes to providing insights that other researchers may use to compare findings from other studies for gaining insights into the Norwegian SHT market.

6.1. Study Limitations and Directions for Future Research

There are some relevant limitations that should be pointed out to ensure a proper and true interpretation of the study. A general limitation is the researcher's limited experience conducting this type of research. Nevertheless, the respective limitations regarding the research methods are described in the following sub-sections and directions for future research are proposed.

6.1.1. Limitations of the survey

While surveys are an effective way of collecting data from a large population, the answers will be categorical and less detailed. As it is a way of collecting many responses, surveys provide limited details about the respondents' understandings of the topic and the questions. With multiple-choice questions the researcher cannot correct potential misunderstandings of questions or answer options nor evaluate the truthfulness of the respondents' answers (Oates, 2006). The descriptive statistics showed that the elderly (66 years old or older) and consumers living in Northern Norway were underrepresented in the sample. Hence, the external validity and the generalizability of the quantitative analysis might be reduced. Another limitation that should be mentioned is the construction of the rank-order questions for user- and non-user respondents, as the response choices should have been defined more carefully based on the topics identified by the literature, corresponding with the research model.

Although PLS-SEM works well with small sample sizes, a larger sample size might have generated a more precise quantitative analysis with possibly larger effect sizes and possibly a more generalizable representation of the population. Due to insufficiencies in the first survey that was distributed, a new one had to be tested and distributed. This might explain a lower response rate for the latter survey. Nonetheless, the sample size of 100 respondents was evaluated as acceptable. Comparing the sample size to the size of the population, generalizing a sample size of 100 respondents might not be able to represent the entire population. Future research may conduct a similar study, ensuring a large sample size and checking whether the findings are replicated. If so, and if the distribution is representative of the population in terms of demographics, the findings from this study's survey might also be more generalizable.

6.1.2. Limitations of the interviews

Limitations related to the subjectiveness of participants can make it hard to achieve consistency in the data generated by the interviews. Variations in personal perspectives, interpretations, experiences, and beliefs affect the way the interview is conducted. Additionally, the researcher's interpretations will affect the way the qualitative data is later analyzed, potentially reducing the reliability to which the interviews might be interpreted somewhat differently by another researcher (Oates, 2006). Furthermore, the consumers that were interviewed in this study have various experiences and knowledge regarding SHT, resulting in some participants having difficulties in elaborating their answers. However, these participants are still valuable to include to gain insight into the perspectives of those without extensive knowledge or who do not use SHT.

As this study was conducted by one researcher within a predetermined period, there was a limited capacity in terms of time and workload. Several smart home vendors, an energy supplier supporting smart energy management, and telecom companies were contacted for potential interviews, yet the response rate was low. Therefore, five Expert interviews were conducted with smart home vendors or companies working towards SHT through a smart city perspective were conducted in total. In addition, the Consumer interviews were conducted to cover different demographical groups. Future research may conduct more interviews, including both experts and consumers, generating even more insights into the market and into the different demographical groups. Hence, researchers might gain additional in-depth insights into the elaborated perceptions and attitudes of the consumers regarding SHT adoption.

Another potential direction for future research entails the study of more in-depth understanding of SHT users versus non-users. Researchers may look more in detail at the differences and similarities of users' and non-users' perspectives on SHT, and further study the differences between different demographical groups. Additionally, researchers may further study the role of SHT in a national context, the use of SHT in Norwegian households, and the potential sustainability effect this have for Norwegian communities, cities, and for the country.

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Appendices:

Appendix A) Questionnaire

Information about the research:

This survey is a part of the primary research for a Master's thesis in Information Systems to get a general understanding of the drivers, barriers, attitudes, and behavior related to IoT and smart home technology adoption in Norway. This survey is voluntary, and all participants are anonymous. All collected data will be deleted after the project end, and no data will be shared during the analyses.

By completing this survey, the participant agrees to:

- The data will be confidential and electronically and anonymously stored.

- The data will never be shared with competitors or in any other commercial form.

- The data will be analyzed in a greater context to discover patterns and tendencies in a larger group of respondents to give insights into the smart technology adoptions among Norwegian consumers.

For more questions regarding the project, please contact researcher *ANONYMIZED* (researcher) at [*ANONYMIZED*] (email address), if you have questions for NSD's evaluation of this project, please contact NSD – Norsk Senter for Forskningsdata AS – Email: [personverntjenester@nsd.no] or phone: [55 58 21 17].

In which part of Norway do you live?

- Eastern Norway
- Western Norway
- Central Norway
- Southern Norway
- Northern Norway

Gender

- Male
- Female
- Other

Age

- 18-25
- 26-35
- 36-45
- 46-55
- 56-65
- 66 or older

Are you the owner or a tenant (leietaker) of your current residence?

- Owner
- Tenant
- I live at my current residence for free

What type of residence do you currently live in?

- House
- Appartment
- Other

What is your highest completed education?

- Upper secondary school
- Bachelor's dergree
- Master's degree
- PhD
- Other

What is your current occupation?

- Student
- Working
- Retired
- Unemployed
- Other

What approximately is your annual income (before taxes)?

- 100.000NOK or less
- 101.000-300.000NOK
- 301.000-500.000NOK
- 501.000-700.000NOK
- 701.000NOK or more

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"I am familiar with Smart Home technology and its usability"	○	○	○	○	○

Do you use any smart home technology?

- Yes
- No

Which smart technologies do you use in your home?

- Smart security system (e.g. video surveillance, alarm, locks, etc.)
- Smart lights
- Smart heating, ventilation, or air conditioning (HVAC)
- Smart energy management (e.g. smart meter, etc.)
- Smart speaker (e.g. Alexa)
- Smart entertainment/multimedia (e.g. AppleTV, Chrome Cast, etc.)
- Home robots (e.g. robot lawn mower. robot vacuum cleaner, etc.)
- Integrated smart home system
- Connected car
- Smart healthcare technology
- Other
- None of the above

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
“Smart home technology is useful”	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
“Smart home technology will simplify tasks at home”	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"Smart home technology will increase convenience at home"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"Learning how to use smart home technology is easy for me"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"Using smart home technology is easy for me"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"I (would) master the use and control of smart home technology"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"Energy management is important to me for using smart home technology"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"It is important for me to control and monitor the energy consumption in my home"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"Smart home technology is effective in managing energy consumption"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"People who influence my behavior think I should use smart home technology"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"People whose opinions I value think I should use smart home technology"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"People who are important to me think I should use smart home technology"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"Using smart home technology is/would be entertaining"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"I (would) enjoy using smart home technology"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"I (would) have fun using smart home technology"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"Smart home technology is reasonably priced"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"Smart home technology provides good value for the price"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"Smart home technology is worth the price"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"I have access to the necessary resources to use smart home technology"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"I have the necessary knowledge to use smart home technology"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"I can get the necessary help if I have difficulties related to smart home technology"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"Smart home technology is safe to use (safe from unwanted surveillance, hacking, viruses, etc.)"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"Smart home technology will not make me digitally vulnerable"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"Smart home technology maintains my security and privacy"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"I intend to use smart home technologies within near future"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"I will adopt smart home technologies within the next few years"	○	○	○	○	○

Evaluate whether you agree or not to the statement:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
"I will use smart home technology in my daily life"	○	○	○	○	○

Display this question

If Which smart technologies do you use in your home? Smart security system (e.g. video surveillance, alarm, locks, etc.) Is Selected

Or Which smart technologies do you use in your home? Smart lights Is Selected

Or Which smart technologies do you use in your home? Smart energy management (e.g. smart meter, etc.) Is Selected

Or Which smart technologies do you use in your home? Smart speaker (e.g. Alexa) Is Selected

Or Which smart technologies do you use in your home? Smart entertainment/multimedia (e.g. AppleTV, Chrome Cast, etc.) Is Selected

Or Which smart technologies do you use in your home? Home robots (e.g. robot lawn mower. robot vacuum cleaner, etc.) Is Selected

Or Which smart technologies do you use in your home? Integrated smart home system Is Selected

Or Which smart technologies do you use in your home? Connected car Is Selected

Or Which smart technologies do you use in your home? Smart heating, ventilation, or air conditioning (HVAC) Is Selected

Or Which smart technologies do you use in your home? Smart healthcare technology Is Selected

Or Which smart technologies do you use in your home? Other Is Selected

What is most important to you in regard to investing in or using in Smart Home technology? (Drag and drop - Rank the most important on top, and the least important on bottom)

Cost	1
Ease of use	2
Security and privacy	3
Usefulness	4
Interoperability between vendors	5
Energy management	6
Other	7

Display this question

If Which smart technologies do you use in your home? None of the above Is Selected

What is the main reasons you do not own or use any smart home technologies? (Drag and drop - Rank the most important on top, and the least important on bottom)

Cost	1
Lack of interoperability between vendors	2
Lack of usefulness	3
Lack of technical skills	4
Privacy/security reasons	5
Social influence	6
Other	7

Appendix B) Interview guides

Interview guide 1 – Experts:

How would you describe the current state of the Norwegian smart home technology market?
How is the current smart home technology market in Norway today, compared to 3, 5, and 10 years back?

>How has the development been?

What do you think/experience are the main drivers for smart home technology adoption among your customers today?
What do you think might be the barriers to smart home technology adoption for Norwegian consumers today?
In what ways are smart home technologies beneficial to consumers?
Are there some consumers that will not benefit from smart home technology?

>If yes, who and why not?

Do you have a typical customer profile/segment, if so, who is a typical smart home technology adopter?
How important is enjoyment and entertainment of use for a successful smart home technology adoption?
How do you communicate smart home technology related messages to the Norwegian consumer market?

>Do you think there are more effective ways to communicate clearly?

From your perspective, how important is social influence for smart home technology adoption?
Have you experienced changes in consumer initiative for smart home technology adoption after the energy prices started to increase significantly?

>If yes, please elaborate.

Can smart home technology be beneficial in a national perspective?

>If yes, how?

How is security and privacy of smart home technology today?
How important do you consider vendor support to be for consumers to adopt smart home technology?
From your experiences, who are more dependent on support regarding smart home technology adoption?

How will you describe the pricing of smart home technologies today?

>Have the prices changed over the past years?

>How do you experience the consumers acceptance of the prices?

Would you say that the smart home technology market is mainly driven by consumer needs or by innovations?

What is needed for increasing the diffusion of smart home technology adoption in Norway?

How does the future of smart home technology look like from your perspective?

>What does the diffusion of smart home technology adoption in Norway look like within near future from your perspective?

Interview guide 2 – Consumers:

How is your familiarity to the concept of Internet of Things?

How is your familiarity to smart home technology?

Do you currently use any smart home technologies in your home?

>If yes: Which? How is your experience with using smart home technology?

>If no: Is there a particular reason for that, if so, what is it?

Do you think smart home technology is/would be beneficial or useful to your daily life?

>If yes: In what ways?

>If no: Why not?

What is your relationship to energy management at home?

Which incentives for saving energy do you use or have at home?

How good of an overview do you have of your total energy consumption at home?

How important is it to have an overview of your total energy consumption at home and/or to save energy?

To which extent do you care about security and privacy of smart home technology?

To which extent do you feel confident that smart home technology will/would ensure your security and privacy at home?

>If low: What are your concerns?

How do you evaluate your technical skills?

Do you feel confident that you can independently master the control and use of smart home technology?

>If no: What are your largest barriers? What are your concerns?

How important is the availability of help from others for you to adopt smart home technology?

How important is the interoperability between different technologies to you regarding adoption of smart home technology?

What is your opinion on pricing of smart home technology compared to its usefulness to you?

If you are to adopt (a new) smart home technology, for how long are you willing to wait for the investment to become break even or profitable?

Where do you hear about smart home technologies or stay updated on the products?

How important is others opinions regarding the use of smart home technology to you?

To which extent do you feel that you are influenced by others regarding adopting smart home technologies, and who have the most impact on your attitude towards smart home technology?

To what extent are you interested in and enthusiastic about new technology?

To what extent do/would you enjoy using smart home technology?

If user: Do you plan to adopt more smart home technologies within near future?

>If yes, what are your main drivers?

>If no: What are the main barriers?

If non-user: Do you plan to adopt more smart home technologies within near future?

>If yes, what are your main drivers?

>If no: What are the main barriers?

Appendix C) Consent form

Information About the Research

This document provides a brief overview of the research project regarding smart technology adoption in Norway, and a consent form for the interviewee to agree to share and discuss relevant topics.

Purpose

This research project aims at investigating the factors affecting smart technology adoption in Norway and the drivers and barriers of smart home adoptions. Moreover, the project explores the consumer oriented IoT and smart technology market in Norway and the current and expected future role and potentials of such technologies. The purpose of this interview is to gain a thorough understanding of the smart technology market in Norway and get insights into the providers' experiences, perspectives, attitudes, operations, and expectations regarding the respective market.

Participation

- If you agree to participate as an interviewee in this project, you will be asked a set of questions and expected to elaborate on the topics discussed. The interview is expected to last approximately 30-60 minutes.
- For the purpose of data analysis, the interview will be recorded and later transcribed. By signing this document for participation, you also agree to recording of the interview. The recording and transcript will only be available for the researcher and deleted once the analysis is done.
- The interviewee will be anonymous throughout the thesis and analyses.
- To participate in this research project is voluntarily. You can at any time choose to resign from participating in the project. All personal information will be deleted immediately.

Privacy

Information gathered from the interview will be handled confidentially and in line with privacy regulation. The only person with access to the data are the researcher/interviewer. In analyses, company name and interviewees name will be replaced with codes (e.g. Company 1 and Professional 1). Information used in analyses will be related to the smart home and smart technology industry, and the company and interviewee will not be detected based on this information. The personal information will be deleted when the project is over, May 2022.

Your rights

As long as you can be identified in the data materials, you have the rights to:

- Insights into the information about you, and to get a copy of these
- Correct faulty information if that occurs
- Have your information deleted
- Send a complaint to the Data Inspectorate regarding the handling of your information

If you have questions for NSD's evaluation of this project, please contact

- NSD – Norsk Senter for Forskningsdata AS – Email: [personverntjenester@nsd.no] or phone: [55 58 21 17]

If you have any questions regarding the research or want elaborations on the project, please contact Kristiania University College through *ANONYMIZED* (supervisor) – *ANONYMIZED EMAIL ADDRESS* - or *ANONYMIZED* (researcher) – *ANONYMIZED EMAIL ADDRESS*

Best regards,

ANONYMIZED

ANONYMIZED

Data Use & Confidentiality Agreement

I have received and understood the information regarding this research project and had the opportunity to ask questions.

I hereby declare that:

1. *All the interviews will be recorded, transcribed, and translated to English.*

2. *The interview data will be confidential.*
3. *The interview data will not be shared with anyone within or across organizations.*
4. *The data will be electronically and anonymously stored, without the interviewees' names or affiliations.*
5. *Names and affiliations will not be published within the research publications (unless the interviewees/companies state otherwise).*
6. *The interview data will form bases for academic research articles, and there is a possibility of anonymously quoting some statements.*
7. *The data will never be shared with competitors or in any other commercial form.*
8. *All the articles will be sent to relevant interviewees before publishing, in order to confirm that the researcher(s) interpreted their views correctly if requested.*

Signature   Date

______________________   ____________________

Appendix D) Quantitative data findings – Tables

Descriptive statistics:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
PE1	100	1	5	4.05	0.914	-1.233	0.241	2.130	0.478
PE2	100	1	5	4.00	0.910	-1.149	0.241	1.569	0.478
PE3	100	1	5	3.88	0.891	-0.635	0.241	0.252	0.478
EE1	100	2	5	3.97	0.893	-0.549	0.241	-0.424	0.478
EE2	100	2	5	3.97	0.870	-0.693	0.241	0.005	0.478
EE3	100	2	5	4.03	0.784	-0.566	0.241	0.078	0.478
EM1	100	1	5	3.73	0.941	-0.766	0.241	0.696	0.478
EM2	100	1	5	3.74	0.960	-0.781	0.241	0.581	0.478
EM3	100	1	5	3.69	0.849	-0.465	0.241	0.223	0.478
SI1	100	1	5	2.93	0.998	-0.294	0.241	-0.446	0.478
SI2	100	1	5	3.01	1.049	-0.288	0.241	-0.311	0.478
SI3	100	1	5	2.94	0.973	-0.214	0.241	-0.173	0.478
HM1	100	1	5	3.72	0.889	-0.825	0.241	0.794	0.478
HM2	100	1	5	3.96	0.909	-0.990	0.241	0.828	0.478
HM3	100	1	5	3.59	0.965	-0.536	0.241	0.132	0.478
PV1	100	1	4	2.84	0.907	-0.504	0.241	-0.428	0.478
PV2	100	1	4	3.07	0.795	-0.743	0.241	0.441	0.478
PV3	100	1	4	3.12	0.782	-0.732	0.241	0.379	0.478
FC1	100	1	5	3.64	0.938	-0.792	0.241	0.231	0.478
FC2	100	2	5	3.76	0.955	-0.564	0.241	-0.526	0.478
FC3	100	1	5	3.90	0.927	-0.731	0.241	0.202	0.478
SP1	100	1	5	3.05	1.038	-0.212	0.241	-0.527	0.478
SP3	100	1	5	3.10	0.927	-0.435	0.241	-0.147	0.478
BI1	100	1	5	3.80	1.137	-0.774	0.241	-0.237	0.478
BI2	100	1	5	3.80	1.054	-0.486	0.241	-0.526	0.478
BI3	100	1	5	3.78	1.124	-0.640	0.241	-0.490	0.478
Valid N	100								

(Descriptive statistics calculated in SPSS, Table visualized in Excel.)

Skewness and Kurtosis:

Output of skewness and kurtosis calculation

```
Sample size:  100
Number of variables:  9

Univariate skewness and kurtosis
   Skewness SE_skew Z_skew Kurtosis SE_kurt Z_kurt
BI   -0.624   0.241 -2.585   -0.304   0.478 -0.635
EE   -0.446   0.241 -1.849   -0.326   0.478 -0.681
EM   -0.593   0.241 -2.458    0.261   0.478  0.546
FC   -0.714   0.241 -2.959   -0.174   0.478 -0.363
HM   -0.818   0.241 -3.390    0.780   0.478  1.630
PE   -0.960   0.241 -3.975    1.460   0.478  3.052
PV   -0.777   0.241 -3.219    0.670   0.478  1.401
SI   -0.293   0.241 -1.212   -0.280   0.478 -0.586
SP   -0.544   0.241 -2.253   -0.221   0.478 -0.463

Mardia's multivariate skewness and kurtosis
                b          z     p-value
Skewness  18.38699 306.449783 1.45664e-10
Kurtosis 110.62115   4.129398 3.63715e-05
```

(Skewness and kurtosis calculated in webpower.psychstat.org.)

Common Method Bias:

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.831	36.410	36.410	9.258	34.287	34.287
2	3.216	11.912	48.321			
3	1.842	6.822	55.143			
4	1.761	6.522	61.665			
5	1.519	5.627	67.292			
6	1.297	4.805	72.097			
7	1.117	4.135	76.232			
8	.834	3.090	79.323			
9	.807	2.989	82.312			
10	.592	2.192	84.504			
11	.541	2.002	86.506			
12	.501	1.854	88.360			
13	.423	1.568	89.928			
14	.391	1.447	91.375			
15	.333	1.232	92.607			
16	.302	1.119	93.726			
17	.249	.923	94.649			
18	.234	.867	95.516			
19	.198	.735	96.250			
20	.183	.679	96.930			
21	.177	.654	97.584			
22	.160	.594	98.178			
23	.138	.509	98.687			
24	.110	.409	99.096			
25	.096	.355	99.451			
26	.085	.313	99.764			
27	.064	.236	100.000			

Extraction Method: Principal Axis Factoring.

(Harman's single-factor test for common method bias, calculated in SPSS)

R square and r square adjusted:

R Square

Matrix | R Square | R Square Adjusted

	R Square	R Square Adjusted
BI	0.561	0.523

R Square Adjusted

Mean, STDEV, T-Values, P-... | Confidence Intervals | Confidence Intervals Bias ... | Samples

	Original Sample (C	Sample Mean (M)	Standard Deviatior	T Statistics (|O/STI	P Values
BI	0.523	0.574	0.072	7.253	0.000

(r square and r square adjusted calculated by SmartPLS version 3.3.9)

Bootstrapping:

Total Effects

Mean, STDEV, T-Values, P-Values | Confidence Intervals | Confidence Intervals Bias Corrected

	Original Sample (C	Sample Mean (M)	Standard Deviatior	T Statistics (|O/STI	P Values
EE -> BI	-0.046	-0.027	0.114	0.401	0.688
EM -> BI	0.153	0.152	0.107	1.431	0.153
FC -> BI	0.119	0.107	0.114	1.041	0.298
HM -> BI	0.368	0.349	0.111	3.317	0.001
PE -> BI	0.099	0.111	0.119	0.829	0.407
PV -> BI	0.132	0.142	0.076	1.746	0.081
SI -> BI	0.117	0.114	0.069	1.689	0.092
SP -> BI	0.097	0.105	0.072	1.349	0.178

(Bootstrapping done in SmartPLS version 3.3.9)

Blindfolding:

Construct Crossvalidated Communality

Total | Case1 | Case2 | Case3 | Case4 | Case

	SSO	SSE	Q² (=1-SSE/SSO)
BI	300.000	83.615	0.721
EE	300.000	123.892	0.587
EM	300.000	202.512	0.325
FC	200.000	133.757	0.331
HM	300.000	105.667	0.648
PE	300.000	121.758	0.594
PV	300.000	138.444	0.539
SI	300.000	99.248	0.669
SP	200.000	111.024	0.445

Construct Crossvalidated Redundancy

Total | Case1 | Case2 | Case3 | Case4 | Case

	SSO	SSE	Q² (=1-SSE/SSO)
BI	300.000	161.341	0.462
EE	300.000	300.000	
EM	300.000	300.000	
FC	200.000	200.000	
HM	300.000	300.000	
PE	300.000	300.000	
PV	300.000	300.000	
SI	300.000	300.000	
SP	200.000	200.000	

(Blindfolding sone in SmartPLS version 3.3.9)