

# Business Potential for Smart Homes

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<p>Abstract</p> <p>Smart homes are a part of the currently increasing technology called the Internet of Things, which has roused interest in consumers and researchers. Smart homes aim at improving the quality of life at home while reducing the energy demand of households but despite the promising benefits, the consumer adoption of smart homes is low. The purpose of the study was to examine the business potential of smart homes through the perceptions of students studying at JAMK University of Applied Sciences. The knowledge base defined what smart homes are and presented the development of the smart home market.</p> <p>The research was based on a qualitative method using focus group interviews. In addition, a questionnaire, distributed to the interviewees, was used as a quantitative method.</p> <p>According to the interviews, the participants were interested in smart technology in homes, and they saw advantages the technology could bring into their daily lives and how it could improve the lives of the elderly and disabled. The participants were interested in improving energy efficiency, safety &amp; security, and comfort in their homes with smart technologies. The participants also expressed concerns for smart homes. These were related to the technology and data security of smart homes. Smart homes were seen as an amenity for the wealthy and the usefulness and actual need for smart homes was questioned.</p> <p>The research revealed the price being the key barrier to adopting smart homes, and more affordable smart devices and appliances would appeal to a larger market.</p>		
Keywords/tags Smart homes, IoT, interview, focus group		
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Tiivistelmä <p>Älykodit ovat osa tällä hetkellä kasvamassa olevaa Internet of Things -teknologiaa joka on herättänyt kuluttajien ja tutkijoiden mielenkiinnon. Älykodit tähtäävät elämänlaadun parantamiseen kotona vähentäen samalla kotitalouksien energian kulutusta. Lupaavista hyödyistä huolimatta älykotien määrä on vähäinen. Tutkimuksen tavoite oli tutustua älykotien kaupallisiin mahdollisuuksiin Jyväskylän ammattikorkeakoulun opiskelijoiden näkökulmasta. Teoriaosuudessa määriteltiin älykodit ja niiden markkinoiden kehitys.</p> <p>Tutkimus perustui kvalitatiiviseen tutkimusmenetelmään, ja se toteutettiin kohderyhmän haastatteluilla. Lisäksi toteutettiin kysely haastatteluun osallistuneille, joka toimi kvantitatiivisena menetelmänä.</p> <p>Haastatteluiden mukaan tutkimukseen osallistuneet olivat kiinnostuneita älykotitekniikasta. He tunnistivat hyötyjä, joita älykotitekniikka voisi tuoda heidän jokapäiväiseen elämäänsä sekä miten älykodit voisivat parantaa vanhusten ja toimintakyvyttömiä elämää. Osallistujat olivat kiinnostuneita parantamaan kotonaan energiatehokkuutta, turvallisuutta ja mukavuutta älykotitekniikalla. Osallistujat toivat esille myös huolen aiheita älykodeista. Ne liittyvät älykotien teknologiaan ja tietoturvaan. Älykotien nähtiin olevan mukavuustuote rikkaille, ja osallistujat kyseenalaistivat älykotien käytännöllisyyden ja todellisen tarpeen.</p> <p>Tutkimus osoittaa älykotien hinnan olevan suurin este niiden hankintaan sekä edullisemmat älylaitteet olisivat houkuttelevampia suuremmalle määrälle kuluttajia.</p>		
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Muut tiedot		

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# 1 Introduction

Television shows and movies have given us a glimpse of life in the future, but these visions of high tech living are still quite far from coming to reality. Smart homes are part of this futuristic vision, which envisions an automated and intelligent living environment, which adapts to the lifestyle and preferences of its occupant. So far, smart homes or sometimes called connected homes have mostly been an interest of early adopters and enthusiasts, but today the technology is growing. Major companies have been investing in smart homes in recent years, and consumers are offered an increasing variety of connected appliances and devices.

Smart homes hold an immense potential to change the way we live. They aim at improving comfort, convenience and safety at home while reducing the energy demand of households (Balta-Ozkan et al. 2013a, 363-365). In addition, smart homes could help with the issue of aging population in Europe by improving elderly home care. (Chan et al. 2009, 90-96). However, despite the hype and growth forecasts by industry proponents, the actual deployment of smart homes remains low. In 2017, only about one percentage of Finnish dwellings were equipped with a smart home network and connected smart devices (Karilahti 2017).

This thesis aims to explore the business potential of smart homes through consumer focus group interviews. The research results summarize the key findings of the focus group interviews. The target group for this study were adult education students who studied at JAMK University of Applied Sciences. The adult education students were asked to participate in the study during their lessons and three interview groups were formed from them. A questionnaire was used to gather quantitative data of the perceptions of the focus group participants. The focus of the research was to answer if the consumers were ready to adopt the technology in their homes, what their concerns of smart homes were and in which kind of smart home technologies they were interested. The concept of 'smart home' is defined in the 3<sup>rd</sup> chapter and a look into the state of the smart home market is presented. The initiative for this research came from BAse Foundation, which is a non-profit organization located in Jyväskylä.

## 2 Research Problem and methods

### 2.1 Research Problem

The purpose of the thesis was to explore the business potential of smart homes through the perceptions of students studying at JAMK University of Applied Sciences. The students were proposed as a target group for this study by the assigning Organization Base Foundation. Adult education students were chosen as the study target group as they are a diverse group of different ages and life stages and offer different viewpoints to the topic. The adult education students are, based on their age, likely to include home-owners as the average age for first time home buyers in Finland is 27,5 (Tilastokeskus, n.d.). Three student focus groups interviews were conducted to explore the topic. A questionnaire was used as a quantitative method of data collection in order to get a clear understanding of the answers by the interview participants.

The aim was to find an answer to the research questions:

#### **Are the focus groups receptive or interested in smart technology in the home?**

The aim was to find out the student' feelings and perceptions about smart homes and if they were currently ready to adopt smart home technology.

#### **Which smart home technologies hold potential in the groups?**

This question aimed to find out examples of smart home products' the students find useful and would buy for their homes.

#### **What are the concerns and barriers to adopting smart home technologies?**

The aim was to understand the underlining reasons that were holding back the students from buying smart home technologies.

### 2.2 Collection of Data

Research data collection methods are generally divided into qualitative and quantitative methods (Kananen 2010, 36). The quantitative method involves a large number

of respondents and produces data which is measurable in numbers and allows for generalization whereas the qualitative method produces data that is descriptive and aims at a deeper understanding of a phenomenon (Kananen 2008, 24).

This thesis aimed to explore students' perceptions of smart homes. Therefore, to answer the research questions, the qualitative method was chosen as the most suitable way of data collection. Consumers might not be familiar with the concept of smart homes or do not have a thorough understanding of the subject, collecting data by a quantitative method from a more substantial number of respondents, would not have produced detailed and accurate enough information on the opinions, ideas, and perceptions the students have on smart homes.

Focus group is a method of collecting qualitative data. It "involves engaging a small number of people in an informal group discussion (or discussions), 'focused' around a specific topic or set of issues" (Wilkinson 2004, 177). Krueger and Casey (2015, 2) describe that "the purpose of conducting a focus group is to better understand how people feel or think about an issue, idea product or service."

Focus groups are semi-structured interviews as they do not follow a rigid structure and execution of conventional interviews. Instead, the focus is on an open discussion among the participants. This interaction between the participants is what allows the possibility to gather rich data from a large number of respondents relatively quickly. (Wilkinson 2004, 177-180.) "Focus groups are moderated by a group leader whose purpose is to facilitate the discussion using carefully planned and sequenced open-ended questions pertaining to the topic" (Krueger and Casey 2015, 7). Carey (1994, 225) notes how "data regarding perceptions and opinions are enriched through group interaction because individual participation can be enhanced in a group setting.

According to Wilkinson (2014, 178), a focus group can involve as low as two participants to as high as twelve. Nonetheless, Krueger and Casey (2015, 82) state 5-12 participants as optimal. The size of a group can significantly influence the amount and quality of information received from the participants for the reason that a group which is too large will hinder participants interaction and a group too small will limit the diversity of different ideas (ibid, 6).

Krueger and Casey (2015, 23) recommend planning three to four focus groups and conducting more interviews if a saturation point has not been reached. Saturation is reached when the answers of the participants do not give any new information, and the scope of the responses have been heard.

### 2.3 Preparation and Implementation

The first step in conducting the focus groups was designing the guideline questions for the sessions. The first questions were chosen to ask the participants about their general interest in new technologies and opinions on technology becoming a part of their everyday lives. The purpose of these opening questions was to get the participant's talking and thinking about the subject of technology and its role in the participant's lives. They were designed to be easy questions that everyone in the groups would be able to answer. The questions then moved on to more specific topics asking about the participant's familiarity and experiences with smart homes. The ending questions were the most challenging asking about the participant's thoughts on consumer target groups of smart homes and the technological development of smart homes.

Before the group interviews were conducted, the prepared interview questions were evaluated in a test session with one student. The purpose was first to get familiar with the interview situation and secondly, to see how well the participants would understand the questions and how much time they would spend answering them.

The focus group interviews were held at JAMK University of Applied Sciences in the city of Jyväskylä. Jyväskylä is a city in Central Finland and has a population of 150 000. The adult education students were asked during their lessons if they would be willing to participate in a focus group interview. In total nine people agreed, which formed three groups consisting of two, three and four participants in each group. The groups were formed based on the participants' availability during the day. The focus group interviews were held in the Lounge area of the campus as it offered a relaxing and comfortable environment with sofas around a table. The age of the students ranged from 22 to 49 and eight of them were female and one male. Three of

the participants lived in an owner-occupied dwelling, and six lived in rental apartments.

At the start of the interview, a paper (*Appendix 1*) containing information about the interview and a short explanation about smart homes was given to the participants. In addition, the participants were given a preliminary questionnaire (*Appendix 2*) with questions about their age, sex, residence and their interest in new technologies and smart homes. The participants were asked if they agreed to have the interview session audio recorded for later transcription and analysis, which they all agreed. They were encouraged to share their views and opinions during the interview. The interviews took around 10-15 minutes. The prepared questions can be found in *Appendix 3*.

## 2.4 Analysis and interpretation

A distinctive difference between the analysis of quantitative data and focus group data is when the analysis starts. Quantitative data is analyzed after all, or most of the data has been gathered, by contrast, focus group data is already analyzed during the data collection process. Data analysis during the collection phase improves the quality of data as questions and topics that were not answered in previous group sessions can be identified and focused on in the next focus group sessions. (Krueger and Casey 2015, 141.) Furthermore, a great deal of importance is put on the analysis of group dynamics and other psychosocial factors brought by the social context of focus groups. Factors like participants censoring or conforming their behavior to their perceptions of the group, certain individuals dominating the discussion, or individual's socioeconomic status affecting perceptions from others can have a negative influence on the data which the researchers should be aware of. (Carey 1994, 234-239.)

For this research, the small number of people in the groups limited the participant interaction. Therefore, the analysis of these issues and their implications on the data was not emphasized. The questionnaire given to the participants served as a second point of view, which proved to be beneficial as the length of the participant's answers varied, and not all participants gave a clear answer to some of the interview questions.

The interviews were fully transcribed using the audio recordings of the sessions. Each of the groups had 2-4 participants, and each member's answers were marked under "participant" in the transcript. Identifiers were not used during the sessions. Once the interviews were transcribed, the transcripts were re-read to familiarize with the data. The answers were categorized into themes: interest, knowledge, and opinions of smart homes, concerns, and barriers to adopting smart homes, potential smart home technologies, consumer target group for smart homes. Summary of the answers based on these themes is presented in the results section in chapter 4.

## 2.5 Reliability and validity

Reliability and validity are terms used to measure the trustworthiness of research. They are both factors that should be taken into consideration from the beginning of the study as increasing them in a later part of the research is not possible. Conducting reliability and validity assessment on qualitative research is noticeably more difficult than on quantitative research. The nature of qualitative research deals with observing people who are unpredictable in behavior and the observations are susceptible to the researcher's interpretation. The basis for increasing trustworthiness is thorough documentation of the research process. (Kananen 2008, 124-125.)

Reliability is used to assess the extent the research results are replicable. The research is reliable if it is repeated on to the same population, in similar conditions and produces similar results. Perfect reliability cannot be achieved in qualitative research as situational factors affecting people are not constant, small differences outside of the control of the researcher may affect the answers given by the respondents. (Kumar 1996, 140-141.).

Validity is assessing whether the research measures what it was set out to measure. In other words, it measures the quality of the research instrument. (Kumar 1996, 137-138.)

Triangulation is a method of increasing reliability of qualitative research using combining different research methods to get a different point of view to the phenomena (Kananen 2010, 71-72). The questionnaire in this study was used as a quantitative

point of view to the students' perceptions of smart homes and allowed the participants to answer honestly without influence from the group.

### 3 Smart Homes

#### 3.1 Definition of a smart home

King (2003, 2) defines smart homes as:

“A dwelling incorporating a communications network that connects the key electrical appliances and services, and allows them to be remotely controlled, monitored or accessed.”

The concept of smart homes is a part of the so-called Internet of Things, where devices transmit data and communicate with each other through a closed internet connection (Alaa et al. 2017). This device linking network is a crucial concept in smart homes and which differentiates a smart home from home installed with high-tech, non-connected standalone devices (Balta-Ozkan et al. 2013a). In addition, a smart home incorporates an intelligent control system which gathers information and imparts instructions and home automation devices which are controlled by the communication network (Carner 2009).

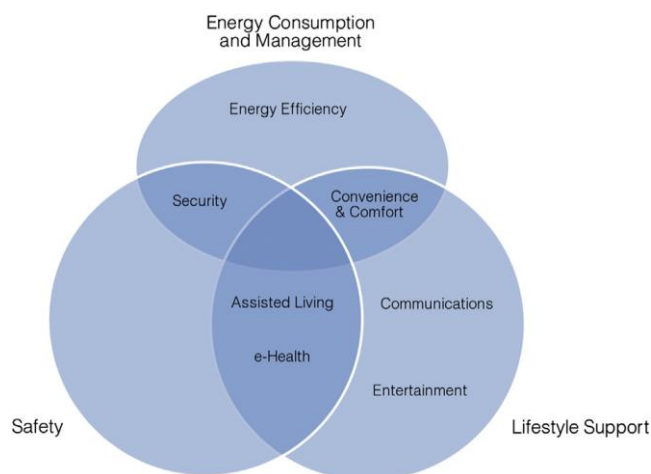


Figure 1. Smart home services (Balta-Ozkan et al. 2013b).

Balta-Ozkan et al. (2013b) categorize the types of services smart homes provide to the resident based on the user's needs they target (Figure 1). These are energy efficiency, security, convenience & comfort, assisted living, e-health, communications, and entertainment. On a broader scale, they are divided into energy consumption and management, safety and lifestyle support.

According to King (2013), there are three ways of implementing smart home technologies into a building:

- Installation into existing homes
- Purpose-built smart homes,
- Conversion of other properties (e.g. Barns, warehouses) customized to buyers' needs.

Smart homes in this thesis refer to both homes with a built-in hardwired communication network and connected devices, and homes which have been installed with one or more off-the-shelf smart home devices or appliances. A full installation of a smart home device network during building construction is much more expensive, costing from around 2000 euros to upwards of tens of thousands of euros (Pelttari 2017).

Smart homes use multiple different communication standards. Wi-fi is an internet network often used at home, which means it is compatible with many devices consumers have in their homes. Its downside is a high power consumption requiring devices to be connected to a power source or needing a long-lasting battery. Bluetooth is used mostly by mobile devices, and it is built into laptops and mobile phones. It was developed initially for close connections between devices but has been picked for home automation for its extremely low power consumption Z-wave and ZigBee are low power consuming networks used by many smart home devices. Z-wave and ZigBee's advantages include greater signal coverage and high bandwidth, but their disadvantage is that they are not compatible with most mainstream home devices. (Pullen 2015.)

Smart homes aim at energy use reductions through optimized energy management (Balta-Ozkan et al. 2013a, 364). Based on an earlier study (Louis, 2014) referenced by Louis (2015, 885) home automation could achieve a 12 % reduction in energy consumption in an average Finnish household. However, Hargreaves, et al.( 2017) argues

that smart homes might not be able to achieve the optimistic prospects of energy demand reduction. From a nine-month study on ten households in the UK Hargreaves, et al. (2017) concluded that

*“there is little evidence that smart home technologies will generate substantial energy savings and, indeed, there is a risk that they may generate forms of energy intensification.”*

Herrero et al. (2018) came to the similar findings, saying:

“Smart home technologies may reinforce unsustainable energy consumption patterns in the residential sector, are not easily accessible by vulnerable consumers, and do little to help the ‘energy poor’ secure adequate and affordable access to energy at home.”

The population in Europe is aging adding to concerns over increasing healthcare costs and the wellbeing of older adults. There is vast research literature on assisted living for the elderly and a large part of these support that smart homes provide remote home-health monitoring of daily activities, cognitive decline, mental health, and heart conditions of elderly, as well as assessing and reducing loneliness, and allowing older people to live longer independently at home. (Liu et al. 2016; Austin, et al. 2016; Maheshwaree, et al.; Majumder et al. 2017.)

### 3.2 Development of the smart home market

The first home automation machine ECHO IV was created in 1966, and the first home automation network technology X10 was developed in 1975 (Evolution of Smart Home and IoT Through History 2015). Wireless connections Z-wave and Zigbee later succeeded the x10, and the first smart home products for consumers emerged in the 1980s which were followed by integrated media systems in the 1990s. It was not until the 2000s when home appliance manufacturers began introducing connected appliances to the market. (Levy et al. 2012, 3.)

In recent years several major companies have made their entry into the smart home market with consumer smart home products and appliances. Amazon, Apple, Google and Samsung have introduced voice-controlled smart hubs (Figure 1) which use virtual assistants, found earlier on iOS and Android smartphones. These smart hubs are

used to connect and control smart home appliances and devices allowing devices with different control messages to communicate with a central unit. (Ion, 2018.) Other manufacturers have released a variety of smart home products from smart beds and fridges (Figure 2) to smart robots (Song, 2017). The industry analysts are expecting significant growth with Gartner estimating homes containing up to 500 smart devices in 2022 (Gartner Says a Typical Family Home Could Contain More Than 500 Smart Devices by 2022,2015).



Figure 2. Amazon Alexa smart hub

taken from Amazon.com



Figure 3. Samsung Family Hub smart fridge

taken from Samsung.com

## 4 Research results

The questionnaire was answered by the focus group participants before the group interviews were conducted at JAMK University of Applied Sciences. The participants consisted of eight females, and one male and their age ranged from 22-49. The results showed that the participants had some interest in smart homes and home improvement.

## 4.1 Questionnaire

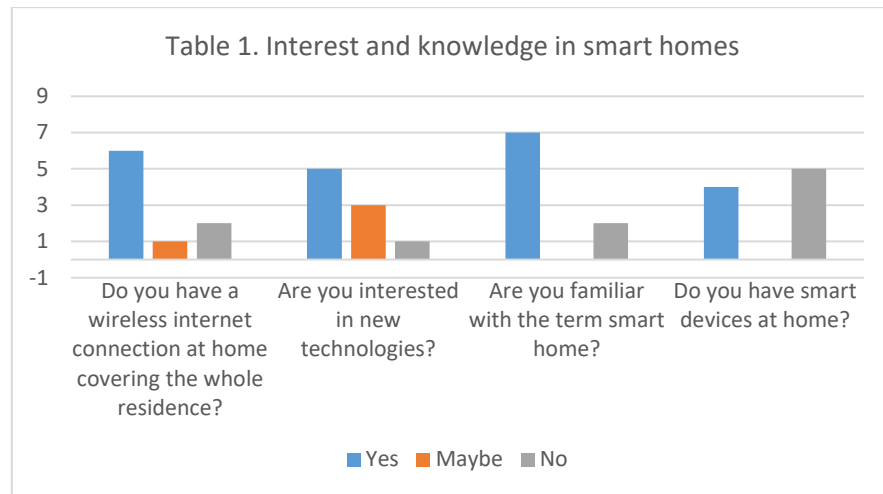


Table 1. Interest and knowledge in smart homes

Almost all participants had a wireless internet connection at home, and most were familiar with the term 'smart home'. Five of the participants were interested in new technologies, and four already had smart devices at home.

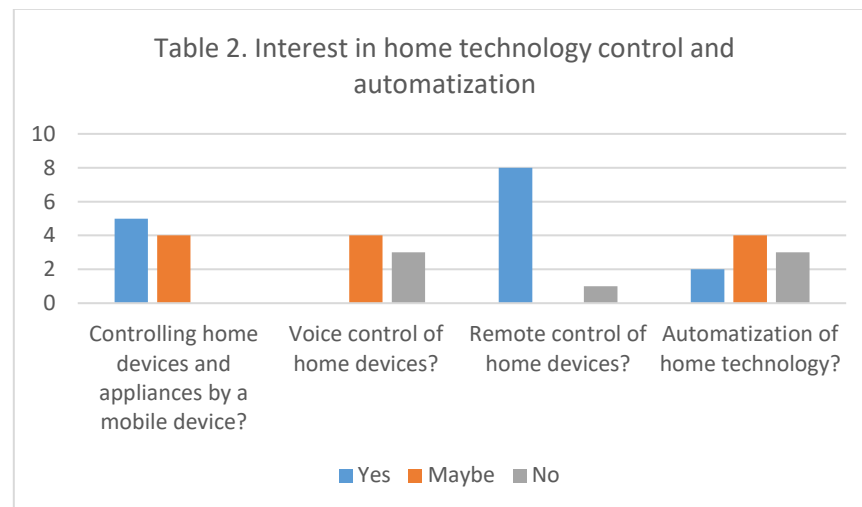


Table 2. Interest in home technology control and automatization

The participants were interested in remote control of their home devices but voice control, control by mobile devices and automatization of home technology gathered much less interest.

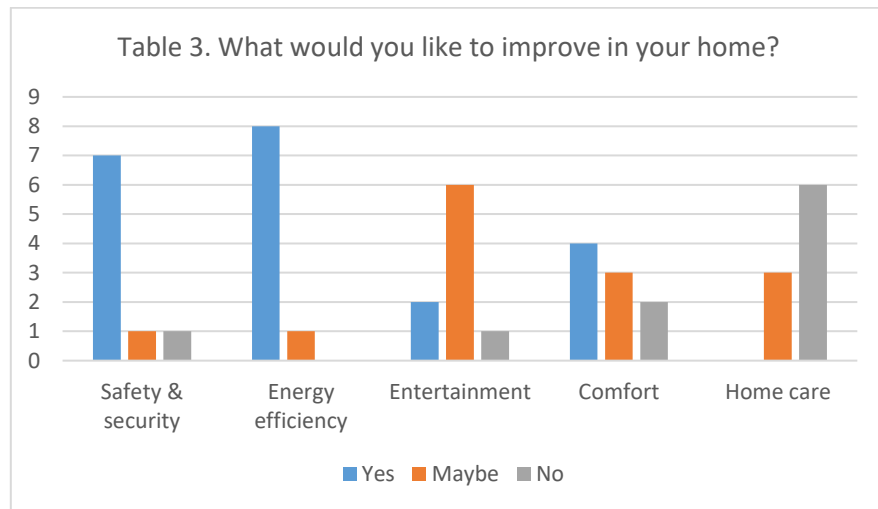


Table 3. What would you like to improve in your home?

Eight out of the nine respondents were interested in improving energy efficiency in their home, followed by safety & security chosen by seven respondents. Six were interested in enhancing entertainment at home. Home care gathered the least interest with six respondents not being interested, but three answered as “maybe” being interested.

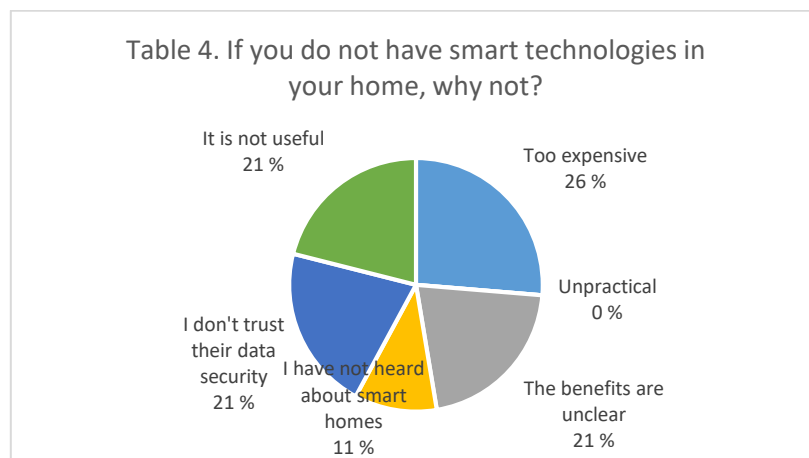


Table 4. If you do not have smart technologies in your home, why not?

The reasons for not acquired smart home technologies were very equally divided between options: it is not useful, I don't trust their data security, I have not heard about smart homes, the benefits are unclear and too expensive. None of the respondents answered unpractical.

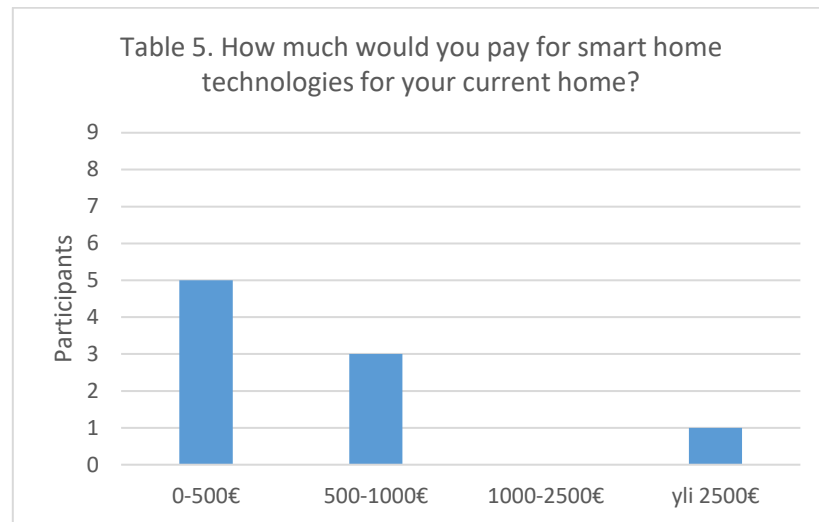


Table 5. How much would you pay for smart home technologies for your current home?

Five out of nine respondents were willing to pay 0-500€ for smart home technologies for their current home. Three were willing to pay 500-1000, and one was willing to pay over 2500€.

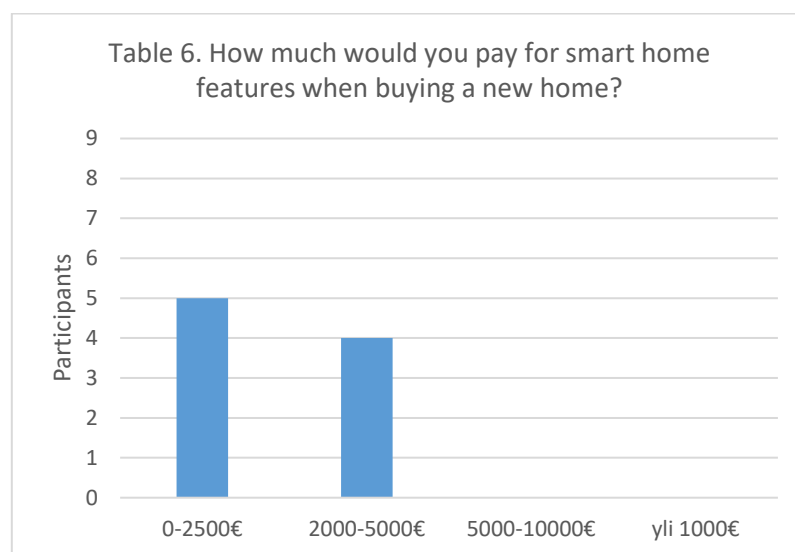


Table 6. How much would you pay for smart home features when buying a new home?

The five of the respondents were willing to pay 0-2500€ and four were willing to pay 2500-5000€. None of the respondents were willing to pay over 5000€ for smart technologies when buying a new home.

## 4.2 Focus Group interview

### 4.2.1 Interest, Knowledge, and Opinions of Smart Homes

The respondents were interested in new technologies and had heard about smart homes before. They told about seeing advertisements of smart home appliances on the television, or having read news about them, but also said they didn't know well what a smart home was or what it was encompassed of.:

*“well I'm interested in new innovations, yes, but I'm not interested in developing new innovations, but the technological development is interesting to me personally” participant*

*“Well I've also heard about them, but I don't have any deeper knowledge, only on the surface level” - participant*

*“I'm interested in, based on my occupational therapy studies, how my customers could benefit from it, like from different solutions. So, of course, I can do everything myself, but some smart solutions could be useful- - participant*

*“I'm interested but at this moment it feels like it's very expensive and sometimes it feels like that they are a bit silly.” - participant*

*-for me anything that helps in daily life, paying the bills on the phone and everything can be done on the phone. I can pay with my phone in many places and of course everything related to sports, measure the heartbeat, and time and speed and you can compare the results, so those things are interesting- - participant*

A few of them already had some smart home devices in their homes like a TV, washing machine, camera and an alarm, which they were somewhat satisfied with and found them useful. The participants expressed interest in buying smart home devices in the future

### 4.2.2 Which smart home technologies hold potential in the groups?

The groups were welcoming to the thought of smart technologies making their daily life at home easier. They hoped smart technologies could offer solutions on simple household chores and tasks like watering their flowers, remotely turning on a sauna, folding their clothes into the closet, remotely turning on heating at a summer cottage or opening their home door with a code instead of keys:

*-for myself, the first thing I would get is a lock so that it would use some kind of code so that a normal key wouldn't be needed. And then when you come (home) with grocery bags, I could just type (the code), so I*

*wouldn't need to take out a key from the bottom of my bag- - participant*

*-we have at our summer cottage, where it's cold (no heating) during the winter. So, we are thinking if we should buy something to be able to remotely put the electricity and heating on because it's very cold there then- - participant*

*-for me it would be some kind of flower watering device- - participant*

*-I have to say that I spent very little time at home. I had to take a moment to think what I would need at home because I'm such a little time at home, but a washing machine came to my mind which would be easy to put on remotely or that it would do things for me- – participant*

Safety and security application gathered interest as well as moisture detectors:

*“well, the first thing that comes to my mind is security, all those alarm systems and what else are there... video surveillance and so on. And there is a lot of talk about mold and moisture problems if we could prevent those because I don't want to be exposed to those, but the safety would be the first for me.” Participant*

They also recognized the energy management possibilities of smart homes:

*-I'm also interested in the energy savings and the eco-friendliness. For that, it (a smart home) is going to help a lot- - participant*

### 4.2.3 Concerns and Barriers to Adopting Smart Homes

Despite the interest shown in smart homes the participants also expressed concerns about smart homes. The participants said that the reason for not having acquired smart home technologies was the cost of the devices. They expressed smart homes as inessential and not offering enough actual benefits to warrant the costs. The technology was seen to be in an early stage of development and not having enough user experiences from other consumers to make a purchase decision. The usefulness of controlling home devices and appliances by mobile devices was questioned:

*-For me, it's strange if you can turn on your washing machine with a phone and stuff, I don't feel it's indispensable, so I have some doubts about it- participant*

Concern over the life-cycle of technology was raised, questioning how long smart home technologies will last and how much maintenance they require:

*-well it can make life easier a lot, but then again, I'm very skeptical if you can trust it and how well it works and how it works and how much you have to do maintenance on them and all of this because technology doesn't last forever or none of the devices last forever- - Participant*

Concern was also raised over smart home technologies changing the occupants' life-style and making them lazy:

*-I think people should be able to manage their daily lives. At least people our age, well of course, our education in nursing, it (smart homes) can be made into a tool to help, then it's a different situation, but if you are a fully functional person, then will it turn into kind of laziness in the daily life, that's my opinion- - participant*

Furthermore, the participants voiced distrust in technology and expressed concern of over-reliance on technology and what would happen when these technologies didn't work:

*-yes, for me it's familiar as well. I've been to a smart home that's designed for the elderly people or disabled and in that it worries me that if we trust technology and it doesn't work and then no one will go to check up on the elderly. If he is all right when all the meters and monitors show that everything is all right, what if the floor that's supposed to give an alarm doesn't do it? And because of that, I think you can't replace a human completely- - participant*

Concern over privacy was made from the use of voice control data for advertisements:

*-you are speaking with a friend and then after you get an advertisement about the topic..." continued "Then you can't speak about anything at home- - Participant*

#### 4.2.4 Consumer target group for Smart Homes

The participants recognized the possibilities smart homes could offer for elderly home care and life improvement of disabled people but at the same time thought smart homes were an amenity for the wealthy.

*-well firstly that it's kind of ... a thing for people with higher income- - Participant*

*-people with disabilities is one, or those already mentioned like the elderly people like if you fall at home, it will give an alarm or this kind of things- - Participant*

*-well then also those people who are well off and who want the best technologies so those would be one group who could be interested because they don't have any problems getting through their daily lives, they just want everything to be the best- - Participant*

*-yes, I think these people who need assisted living, it might give them possibilities to live at home longer because of this technology, it is a good idea-*

They felt that smart homes would fit the lifestyles of families who live busy lives:

*-for people who work and have a family and who have a lot of household chores and have a lot of laundries and very hectic daily lives, so not necessarily... well for people living alone, of course, yes...but they don't necessarily need that much- - Participant*

As students, they did not think they were a consumer target group for smart homes:

*- well as a student I don't belong in the groups that's well off and I think I'm still quite young and I'm still very able to move- -participant*

## 5 Conclusion

The purpose of this study was to find out the business potential of smart homes through the perceptions of adult education students studying at JAMK University of Applied Sciences. The findings indicate that the focus group participants were interested in having smart home technologies in their homes and had positive perceptions about them. The participants were welcoming to having devices and appliances in their home, which would increase convenience and ease their life at home. They mentioned specific needs that smart homes could offer benefits. These were related to safety & security applications, energy management, comfort, and entertainment. The questionnaire revealed that most of the study participants had an interest in improving energy efficiency in their home, which they did not emphasize in the group discussions.

The participants also expressed notable concerns for smart homes. These were related to the distrust in technology and data security of smart devices. During the focus group interviews, the participants questioned the actual usefulness and the need for smart homes. In the questionnaire, none of the participants answered smart homes being unpractical as a barrier to buying smart homes.

The participants saw the elderly and disabled as being a group that would most benefit from smart homes. As students, they did not think they would be a consumer target group for smart homes and due to the costs, saw smart homes being an amenity for the wealthy.

This study reveals some of the barriers to smart home deployment and why smart home adoption has not caught on the hype yet. Gaining trust for data security and privacy among consumers is a challenge that manufacturers are facing. Consumers have substantial concerns over the data gathered by smart technologies. Smart home manufacturers should be transparent in how they use voice-control data and other data gathered by sensors in smart homes and how do they prevent unwanted third-party access to the data.

The results indicate that marketers should focus on communicating the benefits of smart homes to the consumers to realize the added value the new “smart” devices have over the non-connected devices. There is a lot of doubt about the usefulness of smart technologies and consumers are looking to hear user experiences from smart homeowners before making purchase decisions. It is expected that consumers are not looking to introduce complicated devices which disturb their daily routines in their homes. Smart homes should be as non-intrusive as possible for the residents to use and adopt into their daily lives.

Environmental awareness and eco-friendliness are factors that increasingly play a role in consumer purchase decisions. The reduction of carbon footprint and cost savings on electricity bills by energy management of smart homes might be a selling point which is the most useful for consumers. Smart home manufacturers should ensure that the energy saving promises are attainable by consumers.

The participants overwhelmingly told that the cost of smart homes was the most prominent obstacle in acquiring smart products. It could be concluded that more affordable devices and appliances would appeal to a larger market than at present.

An in-depth study of a different target group such as home-owners could provide a better understanding of the smart home market. A focus on the user experiences of smart homeowners would provide information on how consumers use smart home technologies enabling manufacturers to design better user-based products.

## 6 Discussion

The purpose of this study was to find out the business potential of smart homes through the perceptions of adult education students studying at JAMK University of Applied Sciences. The study succeeded in finding answers to the research questions and presenting an overview of the business potential of smart homes based on the focus groups.

There were some shortcomings in the research that may have influenced the quality of the data. Firstly, the focus groups were very small to incite discussion in the participants and the rather short length of the sessions, 15 minutes or less, is a short duration to explore a subject in depth. This time limit was brought by the fact that the interview sessions were conducted during the participants' lessons at the school. The author's inexperience in conducting group interviews limited the facilitation of group discussion and formation of follow-up questions to answers given by the participants. The goal for this study would have been to have an open discussion between the participants, but this was not successfully achieved. While there were similarities and recurrence in the answers of the groups, due to the mentioned limitations, it cannot be concluded that saturation point was reached with this study.

Moreover, during the group sessions, several of the participants mentioned their studies in nursing or in ICT. Because of their study fields, they might have had some experiences and foreknowledge of smart homes, and this could be a factor in how they perceived smart homes overall. Therefore, it would have been relevant to have a question about their studies in the questionnaire that was handed out at the beginning of the group sessions. A diverse group of students from different study fields would have been desirable for this research. Furthermore, the gender distribution of the participants was not even. Only one of the nine participants were a male. Therefore, any comparison between men and women cannot be made off the data as the focus groups were not a representative sample of the whole target group of this study.

The questionnaire also had some issues which should have been avoided. After the data collection, the author realized that some of the questionnaire questions should

have used the Likert- scale for the answering options. A broader range would have produced a more thorough understanding of the opinions of the participants.

The subject of smart homes was completely new to the author when starting this process and it took a lot of time to understand the subject. The knowledge base of concerning smart homes could more longer and more thorough in presenting their definition and market development. Even though smart homes have been around for a while and there is already a vast amount of research on them, finding information and understanding was quite challenging. Many journals and research papers were also behind a paywall, which the author could not access until very late in the thesis writing process.

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## Appendices

Appendix. 1 Information paper given to the participants

### Potentiaalisten älykoti ostajien haastattelu

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Jyväskylän Ammattikorkeakoulu

Haastattelu kuuluu opinnäytetyöni ”Business Potential for Smart Homes” aineiston keräämiseen. Opinnäytetyön tavoitteena on selvittää kuluttajien kiinnostusta älykoti teknologiaan kohderyhmähaastatteluilla. Pienissä ryhmissä tehtävä haastattelu kestää noin 15 minuuttia. Haastattelut tehdään anonymisti ja nauhoitetaan analyysiä varten.

#### Mikä on älykoti?

Älykoti tarkoittaa uusia laitteita ja kodinkoneita jotka ovat kytkettynä kotiverkkoon ja mahdollistavat uusia toimintoja asumisessa. Kodin sähköjärjestelmän kautta yhtenäiseen verkkoon kytketyt talon laitteet ja kodinkoneet, voidaan ohjelmoida tekemään haluttuja toimintoja automaattisesti tai etäohjattuna sekä oppimaan asukkaan valinnoista ja mukautumaan niiden mukaan. Yksittäisiä älykkäitä kodin laitteita voi ostaa noin 200 eurosta alkaen. Koko kodin kattava älykotilaitteiden verkosto maksaa noin 1500 eurosta kymmeneen tuhansiin euroihin.

#### Esimerkkejä älykotiteknologiasta:

**Viihde:** televisiot, äänentoisto

**Turvallisuus:** varashälyttimet, kamerat, lukot

**Kodintekniikka:** lämmityksen säätö, valaistuksen säätö, ilmastointi, home/kosteusvauriovaroitin, Energiansäästö

**Kodinkoneet:** jääkaapit, pesukoneet, kahvinkeitin

**Terveys/hyvinvointi:** Kodinhoiva, telelääketiede

## Appendix. 2 Questionnaire

## Älykodit kyselylomake

Sukupuoli Mies  Nainen

Ikä \_\_\_\_\_

Asinpaikkakunta \_\_\_\_\_

Asumismuoto

Vuokra  Omistusasunto  Osaomistusasunto  Asumisoikeusasunto

Kyllä Ehkä Ei/En

Onko kotonanne koko kodin kattava

langatonverkkoyhteys?

Oletko kiinnostunut uusista teknologioista?

Onko termi "älykoti" sinulle tuttu?

Onko kodissanne älykotilaitteita?

Jos vastasit kyllä tai ehkä, mitä älykotilaitteita kotonasi on?

---

Oletko kiinnostunut

- Kodintekniikan ohjaamisesta

- |   |                          |                          |                          |
|---|--------------------------|--------------------------|--------------------------|
| • mobiillisovelluksella?                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • Kodintekniikan ohjaamisesta<br>ääniohjauksella? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • Kodintekniikan etäohjauksesta?                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • Kodintekniikan automatisaatiosta?               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Mitä seuraavasti haluaisit parantaa kotonasi?

- |                   |                          |                          |                          |
|-------------------|--------------------------|--------------------------|--------------------------|
| • Turvallisuus    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • Energian säästö | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • Viihde          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • Asumismukavuus  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • Kotihoiva       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Jos kotonasi ei ole älykotitekniikkaa, miksi ei? (rastita ruutu, jos olet samaa mieltä)

- |                                   |                          |
|-----------------------------------|--------------------------|
| • Liian kallista                  | <input type="checkbox"/> |
| • Epäkäytännöllistä               | <input type="checkbox"/> |
| • Hyödyt epäselviä                | <input type="checkbox"/> |
| • En ole kuullut älykodeista      | <input type="checkbox"/> |
| • En luota älykotien tietoturvaan | <input type="checkbox"/> |
| • Ei ole tarpeellista             | <input type="checkbox"/> |

Paljonko maksaisit tämän hetkisen kodin "älykkyyden" lisäämisestä älylaitteilla?

- |              |                          |
|--------------|--------------------------|
| • 0-500€     | <input type="checkbox"/> |
| • 500-1000€  | <input type="checkbox"/> |
| • 1000-2500€ | <input type="checkbox"/> |
| • Yli 2500€  | <input type="checkbox"/> |

Paljonko maksaisit älykoti ominaisuuksista, jos ostat kodin? (arvio)

- |                |                          |
|----------------|--------------------------|
| • 0-2000€      | <input type="checkbox"/> |
| • 2000-5000€   | <input type="checkbox"/> |
| • 5000-10 000e | <input type="checkbox"/> |
| • Yli 10 000€  | <input type="checkbox"/> |

## Appendix. 3 Interview questions

### Aloitus

Opinnäytetyön aiheen esittely ja haastattelun ohjeiden kertominen

### aloituskysymykset:

1. oletteko kiinnostuneita uudesta teknologiasta, innovaatioista tai tuotteista?
2. Mitä mieltä olette teknologian kehityksestä osaksi jokapäiväistä elämää?

### varsinaiset kysymykset

1. Oletteko tietoisia älykodeista? Onko termi tuttu?
2. onko kodissanne älykotituotteita tai teknologiaa? Oletko tyytyväinen älykotitekno-  
logiaan?
3. Mitkä ovat teidän ensivaikutelmat älykodeista? Mikä on ensimmäinen asia mikä tu-  
lee mieleen?
4. Miksi et ole vielä ostanut älykotiteknoologiaa?
5. Oletko suunnitellut ostavasi älykotiteknoologiaa?
6. Mistä älyteknologiasta kotiin olisitte kiinnostuneita?
7. Minkälaisista älykotiratkaisuista olisi teille itsellenne hyötyä? Mistä ette ole kiinnos-  
tuneita?
8. Minkälaisia ominaisuuksia haluaisit kotiisi, jos saisit itse suunnitella älykodin?
9. Minkälaisille kuluttajille älykoti teknologia on mielestänne suunnattu?
10. Missä vaihetta teknologian kehitys älykodit ovat?